STANDARDS FOR SUSTAINABLE BUILDINGS IN THE UNITED STATES OF AMERICA

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SUMMARY

There are no national building codes in the United States that mandate sustainable buildings. Several organizations have developed rating systems that classify buildings for sustainability, primarily for material savings, energy savings and environmental impact. Three of these groups are in the process of transforming their rating systems into separate consensus-based standards. This paper provides a background on the organization, their rating systems and the content of the developing standards. Finally, it looks at how masonry will apply to those proposed standards.

INTRODUCTION

This paper does not cover the need for green building standards. The "why build green" issues have been well documented and do not have to be repeated here. The awareness and use of building green has been accepted by governmental jurisdictions and by the public. Rather, this paper addresses how the development of a green building standard has been addressed in the United States of America.

As may be expected, the building industry specifically, and the population in general, in the United States are paying considerable attention to "green" issues. Building materials, construction practices, homes, and other buildings are identified as green. Virtually every newspaper, magazine and television station has run at least one story, if not a featured series, on the movement toward green products and practices.

To understand the development of a green building standard, it is important to remember that the United States does not have a national building code mandated by the government. Rather, state, county and city officials adopt and modify one of the model building codes for use in their jurisdiction. Furthermore, model building codes organizations do not write the entire content of their document. They frequently adopt a standard or practice that has been developed by a special interest group. Such standards could be self-serving. In order for the standards to be accepted by national code groups the standard must be consensus-based. Current green building rating systems were not developed in a consensus-based fashion.

Consensus-based standards are written under a process established by the American National Standards Institute. Important factors in the consensus process are:

1. Open and balance membership such that those members who represent "producers" of materials or concepts in the standard have fewer votes than members who are "users" of the standard or have a "general interest" in it;
2. More than a simple majority of the voters must agree on the content;
3. Every negative vote cast in the development of the standard must be answered;
4. The standard must be submitted to a public review for comments prior to its completion.

SUSTAINABLE DESIGN

Limitations of Rating Systems

The focus of current green building rating systems is energy use and the impact on the environment. All contain numerous requirements and credits intended to reduce building operational energy use, promote the use of building products with lower environmental impacts, and provide a healthy indoor environment. However, what is often lacking in all of these rating systems is a means by which to promote and measure the avoidance of negative impacts. All measure the diversion of waste from landfills, but only the National Association of Home Builders (NAHB) effort recognizes materials that have little or no on-site waste to begin with. Similarly, efficient use of materials is not well-recognized. Materials such as masonry that perform multiple functions avoid the use of other materials, such as paints, sound insulation, etc. At present, efficiencies such as these are included only in the NAHB rating system. Life cycle assessment of the building is not included. Only a whole-building, holistic approach can capture the true intent of sustainable design.

Sustainable Design Components

While there is general agreement on many of the elements of sustainable building design, defining and measuring it poses a challenge. The first step is to define sustainable design for buildings. To be sustainable a design must consider more than just energy and environmental impacts. A holistic approach is necessary. The Whole Building Design Guide [NIBS 2007] developed by the National Institute of Building Sciences discusses sustainable design in terms of "whole building design". In their words,

> *"Whole Building design in practice requires an integrated team process in which the design team and all affected stakeholders work together throughout the project phases and to evaluate the design for cost, quality-of-life, future flexibility, efficiency; overall environmental impact; productivity, creativity; and how the occupants will be enlivened. The 'Whole Buildings' process draws from the knowledge pool of all the stakeholders across the life cycle of the project, from defining the need for a building, through planning, design, construction, building occupancy, and operations"* .

Every sustainable building is unique, designed specifically for its site and the programming requirements of the user. All high performance, sustainable buildings should consider the following components of design [SBIC 2004]:

- Environmentally responsive site planning
- Energy efficient building shell
- Thermal comfort
- Energy analysis
- Renewable energy

- Water efficiency
- Safety and security
- Daylighting
- Commissioning
- Environmentally preferable materials and products
- Durability
- Efficient use of materials
- High performance HVAC
- High performance electric lighting
- Life cycle cost analysis
- Acoustic comfort
- Superior indoor air quality
- Visual comfort

However, it is not enough to design the project in a holistic manner. It is also important to determine the effectiveness and outcome of the integrated design solution. Following the commissioning of the building it is important to ensure that the high-performance goals have been met and will continue to be met over the life of the project. Retro-commissioning can help ensure that the building will continue to optimally perform through continual adjustments.

GREEN BUILDING STANDARDS DEVELOPMENT

The following sections describe the background of the development process and the current status of the standards from the three organizations which are promulgating a consensus-based green building standard. Each of them has recently adopted a consensus process or is partnered with another group that has one. Each uses their existing rating system as the basis for the green building standard. It is not too much of a surprise that the chase for a consensus-based green building standard is underway. It is somewhat disappointing that one benefit of the sought after prize may be the income accrued to the winner rather than a definitive green building standard. The three organizations are the U. S. Green Building Council (USGBC), www.usgbc.org; the Green Building Initiative (GBI), www.thegbi.org; and the National Association of Home Builders (NAHB), www.nahb.org. Readers are encouraged to examine the websites of these organizations for current information. This paper is based on the activities at the end of November 2007.

U. S. Green Building Council (USGBC)

The oldest and most successful of the green building rating systems developers is the U.S. Green Building Council. It is composed of members from virtually every sector of the building industry. Originally the USGBC excluded trade associations as members. That has changed as some of its earlier work was criticized for this exclusivity. The USGBC now has more than 11,000 members and a network of 75 regional chapters. The USGBC's core purpose is to transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy and prosperous environment that improves the quality of life.

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ of the USGBC has become the nationally accepted benchmark for the design, construction and operation of green buildings [USGBC 2005]. LEED gives building owners and operators the tools they need to have an immediate and measurable impact on their buildings' performance. LEED promotes sustainability by recognizing performance in five key areas of human and

environmental health:

- Sustainable site development,
- Water savings,
- Energy efficiency,
- Materials selection, and
- Indoor environmental quality.

The first of the rating systems from USGBC, LEED-NC, concentrated on new commercial construction and major renovations. LEED-NC has been updated since its introduction 1998. Version 2.2 was issued in 2007 and the USGBC continues to refine its LEED documents. In addition to LEED-NC, the USGBC has promulgated or is planning LEED rating systems for:

- Commercial Interiors
- Core and Shell Development
- Existing Buildings Operations and Maintenance
- Healthcare, in development
- Homes, pilot version
- Neighborhood Development, pilot version
- Retail
- Schools

Most of these recognize the unique requirements of these eponymous rating systems and allow more directed rating criteria.

LEED ratings classify buildings into one of four categories by accumulating a maximum of 69 points. There are 1182 buildings that have become LEED-NC certified in one of the four LEED ratings as of the end of November 2007.

In the chase for a consensus-based standard, the USGBC partnered with the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) and the Illuminating Engineers Society of North America (IESNA). Working from LEED-NC, they have developed a draft titled Proposed Standard 189, *Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings.* [USGBC 2007] This document will be a standard for high-performance green buildings. It is not a rating system, though it could be incorporated as the baseline in a green building rating system. It excludes residential buildings three stories or fewer above grade.

This proposed standard, sent to public review in May 2007, includes the following purpose:

> "*to provide minimum requirements for the design of high performance, green buildings to: (a) Balance environmental responsibility, resource efficiency, occupant comfort and well being, and community sensitivity, and (b) Support the goal of development that meets the needs of the present without compromising the ability of future generations to meet their own needs*".

It provides minimum requirements for the design of sustainable buildings to balance environmental responsibility, resource efficiency, occupant comfort and well-being, and community sensitivity. The following sections are included:

- Sustainable Sites
- Water Use Efficiency
- Energy Efficiency
- The Building's Impact on the Atmosphere, Materials and Resources
- Indoor Environmental Quality

- Construction and Operation

In addition, there are both required and informative appendices. Those required are:
- Appendix A: Prescriptive Building Envelope Tables
- Appendix B: Prescriptive Continuous Air Barrier
- Appendix C: Prescriptive Equipment Efficiency Tables.
- Appendix D: Performance Option for Energy Efficiency
- Appendix E: Space Contaminant Concentration Equations

The proposed USGBC standard include both prescriptive and performance criteria to establish a green building.

Green Building Initiative (GBI)

The Green Building Initiative is a not for profit organization whose mission is to accelerate the adoption of building practices that result in energy-efficient, healthier and environmentally sustainable buildings by promoting credible and practical green building approaches for residential and commercial construction.

The GBI was originally created to bring residential green building into the mainstream by helping local and regional home builder associations develop green building programs modeled on the National Association of Home Builders (NAHB) Model Green Home Building Guidelines [NAHB 2006].

GBI based its entry into the green building arena in the United States on an adaptation of the British Research Establishment Environmental Assessment Method (BREEAM) used in Canada. The GBI Green Globes™ environmental assessment and rating system [GBI 2006] debuted in the United States in 2006. Though many aspects of Green Globes are similar to those found in LEED, Green Globes differs in that it is an online tool that allows for self-certification. As a web-based tool, Green Globes also provides interactive, educational links to information on sustainable design strategies and systems.

The Green Globes system is a green management tool that includes an assessment protocol, rating system and guide for integrating environmentally-friendly design into commercial buildings. Once complete, it also facilitates recognition of the project through third-party verification.

The rating system is based on seven areas of assessment:
- Project Management
- Site
- Energy
- Water
- Resources
- Emissions, Effluents & Other Impacts
- Indoor Environment

Projects receive a rating into one of four levels based on the percentage of points, up to 1000, maximum. There were 15 building that have achieved one of the four Green Globes ratings as of the end of November 2007.

The GBI is now in the process of writing a consensus based standard based on its Green Globes Rating System. The first draft is not yet available for comment.

National Association of Home Builders (NAHB)

The third party in green building standard development is the National Association of Home Builders. NAHB is different from USGBC and GBI in that, as its name implies, it is an association primarily of and for home builders. This association was founded 1942 and has a solid network of local and regional subsidiaries. With over 235,000 members, it certainly brings players to the field.

As was noted under the Green Building Initiative, NAHB developed a *National Model Green Home Building Guideline* [NAHB 2006]. This guide was prepared under NAHB by a consortium of home builders, material associations, building officials and designers. The NAHB rating system is based on the following topics:

- Lot Design, Preparation and Development
- Resource Efficiency
- Energy Efficiency
- Water Efficiency
- Indoor Environmental Quality
- Operation, Maintenance and Homeowner Education
- Global Impacts
- Appendix: Site Planning and Land Development

Homes are classified into one of three levels of green building. Through the work of NAHB local and regional affiliates and the GBI over 5000 homes have been classified as green as of the end of November 2007.

In early 2007 the NAHB partnered with the International Code Council to transfer the *National Model Green Home Building Guideline* into a consensus-based standard. This proposed standard has gone through two reviews as of early December 2007. The *National Green Building Standard* [NAHB 2007] is expected to be approved in early 2008. This standard will cover residential buildings as identified by the *International Building Code*. These include one- and two-family dwellings, apartments, townhouses, condominiums, hotels and dormitories.

The NAHB *National Green Building Standard* is a rating system based on the following areas:

- Green Subdivisions
- Lot Design, Preparation and Development
- Resource Efficiency
- Energy Efficiency
- Water Efficiency
- Indoor Environmental Quality

- Operation, Maintenance and Building Owner Education

The influence of the builder is more evident in this standard than in others.

Comparison of Proposed Standards

Though specifics of each green building standard vary, there is general agreement in categories and scope. Table 1 provides comparison of the chapters in the three proposed green building standards. It is important to recognize that revisions to the proposed standards will be made. The comparison is based on the following versions:

- ASHRAE/USGBC/IESNA: May 2007 draft [USGBC 2007]
- Green Globes: Internal committee draft, no reference available
- NAHB: August 2007 draft [NAHB 2007]

Most of these chapter titles were carried over from the green building rating system or guideline by the same organization.

Table1. Comparison of Chapter Titles in Proposed Green Building Standards in the USA

ASHRAE/USGBC/IESN STANDARD 189 [1]	**GBI GREEN GLOBES** [1]	**NAHB NATIONAL GREEN BUILDING STANDARD**
		Green Subdivisions
Sustainable Site	Site Development	Lot Design, Preparation and Development
The Building's Impact on the Atmosphere, Materials and Resources	Resources, Materials and Solid Waste	Resource Efficiency
Energy Efficiency	Energy	Energy Efficiency
Water Use Efficiency	Water	Water Efficiency
Indoor Environmental Quality.	Indoor Environment	Indoor Environmental Quality
	Emissions, Effluents & Other Impacts	
Construction and Operation	Project Management	Operation, Maintenance and Building Owner Education

[1] Not in same sequence as in proposed standard.

INCENTIVES TO USE GREEN BUILDING STANDARDS

While there may not be a national green building standard required by the United States federal government, there are reasons to apply one when designing and constructing a building. Of course there are the benefits of lower utility and operating costs with a green building. More recently, studies have shown higher worker productivity in green buildings. Further, twenty-five states and ninety-two cities, towns and municipalities have passed 256 requirements for or incentives to design and build green buildings. Some of the incentives are to private developers.

Density bonuses allow more profitable development. Fees for permitting construction are reduced. There is a faster turn-around for approval of plans. Tax abatements and low interest loans backed by the state offer financial rewards for the developer. Property tax credits accrue to the owner. [CSI 2008]

Governments require buildings constructed for them to obtain a recognized green rating. Similarly, developers planning to lease building space to governmental agencies know that a green-rated building is a necessity. Obviously there is the financial and altruistic reward for managing and operating an energy efficient building. Recent investigations have indicated that worker productivity is better in day-lit buildings and those with lower indoor pollution.

MASONRY CONTRIBUTIONS TO SUSTAINABLE BUILDINGS

The following list, based on the Brick Industry Association *Technical Note* 48 [BIA 2007], identifies sustainable design strategies which utilize masonry. Not all of these are likely to be in each of the proposed green building standards. Members of the masonry industry are trying to incorporate as many as possible.

Environmentally Responsive Sites:

Urban Development: Masonry is suitable and highly adaptable to urban infill projects.

Reuse Existing Buildings: Masonry buildings can be renovated and reused.

Location on Site: Site building to optimize solar radiation (passive solar heating and cooling possible).

Maintain Open Space: Masonry construction requires minimal disruption of site.

Storm Water Design: Reduce quantity and improve quality of runoff with permeable unit pavements. Support grass or other plant growth in open cell concrete pavers.

Heat Island Effect: Light-colored pavers and veneers can help reduce heat build-up.

Energy Efficiency, Thermal Comfort and Energy Analysis:

Improved Energy Performance: Thermal mass of masonry helps reduce heat transfer; pressure-equalized brick rain screen walls lower heat transfer.

Thermal Comfort: Thermal mass helps reduce indoor temperature swings. Shifts peak heating and cooling loads to off-peak hours

Energy Analysis: Energy modeling reflects benefits of thermal mass.

Environmentally Preferable Materials:

Life Cycle Assessment: Can show masonry as best option due to long life and low maintenance.

Avoidance of Construction Waste: Use modular design to avoid waste.

Recycling of Construction Waste: Masonry units and their packaging are 100% recyclable.

Use of Salvaged Materials: Salvaged masonry units and pavers can be reused if they meet the appropriate standard of use.

Recycled Content: Brick may contain recycled sawdust, sludge, metallic oxides. Block contains recycled aggregates and slag cement and fly ash. Mortar and grout may use fly ash and slag cement.

Regional Materials: Masonry unit manufacturing plants are located near raw materials and available throughout the United States.

Materials That Do Not Require On-site Finishes: No finishes are required of brickwork; can be used inside as well. Many concrete masonry units need no finishes.

Durability and Design for Service Life:

Durability: Masonry has a useful life of more than 100 years.

Termite Resistant Materials in Areas of Termite Infestation: Insects do not eat masonry.

Weather-resistant Barrier or Drainage Plane Inside Siding or Veneer: Masonry veneer and cavity walls introduced the drainage wall.

Flashing: Flashing is always present in well-detailed brick buildings.

Renewable Energy:

Passive Solar Heating: Thermal mass of masonry walls and floors can be used in passive solar designs.

Manufacturing with Renewable Energy: Brick plants are fired with methane from landfills; sawdust is used as a burnout material and for firing.

Safety and Security:

Fire-resistant Construction: Masonry will not burn or emit toxic fumes.

Impact-resistant Construction: Msonry resists damage from wind-borne debris and other impacts.

Efficient Use of Materials:

Materials with Multiple Functions: Masonry can serve as structure and finish, provide acoustic separation, and provide thermal mass.

Use Products that Contain Fewer Resources than Traditional Products: Thinner brick units use less material and weigh less; hollow brick units use less material and can be reinforced.

Acoustic Comfort:

Acoustic Comfort: Masonry walls provide an STC of 45 or higher.

Superior Indoor Air Quality:

Avoid Volatile Organic Compounds: Interior brick walls avoid paints. Interior brick floors avoid carpets and adhesives.

Mold: With moisture-tolerant materials and finishes, masonry is not a food source for mold and can be easily cleaned.

CONCLUSION

As in most countries, standards for sustainable buildings are in a state of flux. The United States is at a disadvantage in that there is no government-mandated standard. Rather, three organizations are developing consensus-based standards for adoption. The content of these documents is similar. Each of these is based on a green building rating system or guide. At end of November 2007 the LEED Green Building Rating System of the US Green Building Council is most widely used in commercial and industrial buildings. The *National Model Green Home Building Guideline* of the National Association of Home Builders is most widely used for residential design and construction.

Readers are encouraged to examine the following websites for current information:

U. S. Green Building Council, www.usgbc.org;
Green Building Initiative, www.thegbi.org;
National Association of Home Builders, www.nahb.org.

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