NATIONAL FRAME BUILDING ASSOCIATION

Putting the 'Green' Into Post Frame Construction

Accounting for Post Frame Construction in Green Building Certification Systems

April 2010, First Edition

Green building has become a major fixture of the building landscape. In order to maintain market competitiveness, post frame professionals should be aware of the green attributes associated with post frame construction. Since there are few green building professionals knowledgeable about post frame construction, it is important for post frame professionals to communicate these attributes. Aside from being a strong, lightweight, and efficient form of construction, post frame DOES qualify for green building credits based upon several attributes associated with the post frame building system itself. Green attributes are demonstrated in the areas of site specification, materials efficiency and energy efficiency. This white paper explains many of the concepts of green building, the evolution of green building certification systems, and specific features of post frame construction that can qualify as green building methods.

Putting the 'Green' Into Post Frame:

Accounting for Post Frame Construction in Green Building Certification Systems

Green building has become a major part of the building landscape. The value of green building is expected to increase to between $96 and $140 billion by 2013 (McGraw Hill 2009). According to a recent study by Good Energies, Inc., half of all non-residential building stock will consist of green buildings by 2015 (Wall Street Journal 2010). Many groups touting green products and services have sprouted recently. However, the term 'green' is unclear in meaning and impact. It is difficult to navigate through these various claims, products, and systems. Green building, in particular, has several definitions which are very broad and can be interpreted in a variety of ways. It is often more valuable to examine the purpose of green buildings – which is to create a ***safer, more efficient structure for both humans and the environment***.

Post frame construction has always been considered an efficient building system. However, the majority of green building certification systems have been created with conventional wood construction, steel moment frames or monolithic concrete building systems in mind. Efficient **building systems** are often not accounted for in many of the green building certification systems. Unfamiliarity with post frame construction places responsibility for justifying the green building potential upon the post frame builder and design professionals. The purpose of this white paper is to provide tools for the post frame industry to better interpret and use green building certification systems to demonstrate the value of post frame construction. *Post frame construction* ***should be considered*** *a 'green' building system.*

This white paper is the first in a series on the topic of green building in post frame construction. This paper provides a short introduction to post frame, basic terms, history, and concepts associated with green building, and the applications of green building to post frame buildings including the key green building elements related to

post frame construction. Subsequent white papers will explore particular green building certification systems applied to post frame.

Introduction to Post Frame Construction

Post frame construction has been used since the 1930s for a large variety of structures. Originally begun in the agricultural sector, the efficiency of post frame construction resulted in part from material scarcity. The basic system of posts embedded into the ground, a truss roof system and a building skin capable of transferring shear forces has been continually refined over the years. Material innovations including alternative post foundation systems, preservative pressure treated lumber and wood composites including glued laminated timber, nail laminated wood assemblies, laminated veneer lumber, and parallel strand lumber have been incorporated.

Definition of Green Building

Green building certification systems are a manifestation of the larger concept of 'green building.' Green building has many definitions that are very broad and all-encompassing. According to ASTM E 2432, green building is a "*building that provides the specified building performance requirements while minimizing disturbance to and improving the functioning of local, regional, and global ecosystems both during and after its construction and specified service life*" (ASTM 2009). According to the 2008 California Green Building Standards Code, green building is "*a holistic approach to design, construction, and demolition that minimizes the building's impact on the environment, the occupants, and the community*" (ICC 2009). Neither of these definitions are particularly helpful in explaining what IS or IS NOT green building, (e.g., if a building is not green does it, by definition, NOT meet specified building performance , or are non-green building ALWAYS injurious to the environment?). Green building can be summarized as making decisions on material efficiency, energy efficiency, water, and safety of the occupants and surrounding environment. These particular decisions are complex and intertwined. Green building has no one single optimized answer to the particular qualities a structure should have. For instance, changes in the amount of material used in the structure often offset energy needs to heat and cool the structure,

so that optimum energy efficiency and optimum material efficiency may be mutually exclusive.

Several tools have been presented to illustrate the different choices and help make value-based decisions. The *ecological footprint* is a measure of how much land or space would be needed in order for a product or structure to be considered sustainable. The *ecological rucksack* is a measure of how much material must be transported to create a particular product or structure. A more rigorous process is the *life cycle analysis*, which accounts for the material and energy inputs and outputs through the stages of material extraction, manufacture, use and deconstruction. While all buildings require energy and materials for construction, these tools allow comparisons of different building methods, subsystems and materials to be made. In most of the green building certification systems, a priority is placed upon energy efficiency and indoor air quality. A further concept in green building is the *net zero energy building*, where the building produces enough energy to meet or exceed the operational requirements of the building.

History and Concepts of Green Building

The driving force behind green building has been the environmental movement in the United States. While many environmentalists in the 1960s through 1980s focused on governmental and industrial pollution, the environmentalism of the 1990s and 2000s has shifted to the individual pollution contribution by personal use of energy and materials, as well as the creation of greenhouse gases. Buildings use 40% of all extracted materials in the United States and consume approximately 72% of electricity produced in the United States (EIA 2008). By improving efficient construction and reducing energy use, there is a large potential to save energy and reduce pollution. As a population, the United States spends 90% of time indoors (US EPA 2009), making the quality of air in structures a primary health concern. Some reports have stated that indoor air quality may actually be worse than outdoor air quality.

Another concept that contributed to the development of green building was the idea of sustainability. The Brundtland Report defined sustainable development as meeting "*the*

needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). Sustainability has inspired the concept that humans can improve the environmental health of a site through buildings and construction.

Leadership in Energy and Environmental Design (LEED)

As a result of many of these ideas, the United States Green Building Council (USGBC) was formed in 1993 as a non-profit organization to promote sustainability in the design, construction and operation of buildings (www.usgbc.org). This group developed what was considered the first green building certification system called Leadership in Energy and Environmental Design (LEED). LEED was originally applied to commercial structures, but the current 2009 LEED program contains a suite of green building certification systems including homes, neighborhood development, commercial interiors, core and shell, new construction, and institutions, which includes schools, retail, and healthcare.

A green building certification system is a set of building and construction practices considered to contribute to creating a green building. Various point values are assigned to these practices and the accumulation of enough points results in the recognition of a certified green building. Various levels of achievement depending on points accrued can also be achieved. For the LEED system, the certified level is the base green building considered, while Silver, Gold and Platinum levels represent higher levels of certification. The LEED system contains a series of green building certification systems for different building uses and types. Many companies, universities and municipalities have adopted the LEED standards for all new construction. Two of the most important LEED certification systems for post frame construction are LEED New Construction, and LEED for Homes. Topics included in the LEED systems include Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), Indoor Environmental Quality (IEQ), Innovation in Design/Operation (ID or IO), and Regional Priority (RP).

The Green Building Certification Institute (GBCI) has also developed an accreditation program for engineers, architects and building professionals (www.gbci.com). To begin the process of applying for a LEED building requires the involvement of a GBCI-trained professional. Previously, these professionals were identified as LEED-AP, or accredited professionals, but changes in the accreditation system in 2009 include the designations LEED Green Associate and a series of LEED-AP designations for the different type of construction studied.

The progress of green building and the LEED system have not been without controversy. Many of the practices chosen as 'green' were perceived to have green building effects, but may not. One of the most contentious issues is related to the use of wood and wood products. Currently, LEED applies a credit for certified wood products using only the Forest Stewardship Council (FSC) certification program. FSC is one of a number of forest certification programs and is seen as one of the most rigorous in terms of documentation, especially documentation which does not directly relate to the processing/manufacturing of the wood products themselves (community involvement, labor practices, illegal logging, etc.). At the current time there is no certification process for steel, concrete or rapidly renewable materials such as bamboo. Rapidly renewable materials are another contentious issue due to the lack of sustainable production in favor of quick growth. The lack of certification programs for these materials seems to hold wood and wood products to a higher standard than other building materials. Many members of the wood products community are frustrated by this discrimination given that wood is the only renewable structural material in common use. Other issues with LEED do exist, such as the reluctance to adopt a life cycle analysis tool in the certification process.

Another green building certification system, the Green Building Initiative (GBI) promotes the use of the Green Globes green building certification system in the United States (www.gbi.org). Green Globes is a certification system for commercial construction. This system is often seen as a more user-friendly system compared to LEED in terms of defining construction practices. Green Globes is probably best noted for its use of life

cycle analysis (LCA) in the choice of green building materials. LCA for Green Globes uses the ATHENA Institute's Impact Estimator for Buildings available free online at www.athenasmi.org/tools/impactEstimator/. Categories within the Green Globes system include Energy, Indoor Environment, Site, Water, Resources, Emissions, Project/Environmental Management.

While the LEED home rating system was only published in 2009, another green building system sponsored by the National Association of Home Builders (NAHB) has taken prominence in the residential construction area. The National Green Building Standard is an ANSI-approved standard for the construction of residential green buildings administered by the International Code Council, the authors of the IBC and IRC (ICC 2008). The previous document, which was the predecessor of the National Green Building Standard, was the NAHB Green Scoring Tool. The ANSI standards process requires the National Green Building Standard, designated ICC-700, to conform to certain practices and maintain a consensus-based process for amendments and changes. The National Green Building Standard consists of seven areas including Lot Design, Resource Efficiency, Energy Efficiency, Water Efficiency, Indoor Environmental Quality, Homeowner Education and Global Impact. A building must conform to green practices in each category to obtain a minimum point value to be considered a green building in this system. The National Green Building Standard differs from LEED in the definition of building practices and specific construction recommendations rather than more broadly defined conceptual goals. Categories for the National Green Building Standard include Lot Design, Resource Efficiency, Energy Efficiency, Water Efficiency, Indoor Environmental Quality, and Operation Maintenance and Building Owner Education.

International Code Council Contributions to Green Building

A further addition to green building has been contributed by the International Code Council (ICC), the authors of the International Building Code and International Residential Code. The ICC Evaluation Service has begun the Sustainable Attributes Verification and Evaluation (SAVE™) program. The SAVE™ program produces Validation of Attributes Reports™ (VAR™) which provide third party verified sustainable

attributes of building products. The VAR™ identify sustainable attributes, while evaluation reports (ESR) from the ICC-ES provide engineering and building science data.

The VAR™ includes volatile organic compound (VOC) contents, as well as percentages of recycled materials. SAVE™ is intended to be a clearinghouse of sustainability criteria from manufacturers in an easily accessible, online location to help improve the use and validation of green building products. The SAVE™ program (http://saveprogram.icc-es.org/) provides standard sets of test criteria and also is a preventative measure against "green-washing", or the unclear or unverifiable statements related to sustainable attributes. Other systems have begun to grow, including a similar system from TECO (http://verified.tecotested.com/verification), and a database from the National Association of Home Builders (http://www.greenapprovedproducts.com/) listing green-approved products for the National Green Building Standard. These product verification standards are important to insure that different green building certification systems (LEED, Green Globes, National Green Building Standard) conform to standardized, quantifiable measures of sustainability for the materials used.

In a further move by the ICC, the International Green Construction Code (IGCC) has recently been posted for public comment. The IGCC should be available for adoption in the first quarter of 2012. This document is targeted towards commercial construction, whereas the National Green Building Standard was focused on residential construction. This document represents a significant step by ICC to help develop a standardized set of principles and building practices which can be identified as green building. The standard can be accessed at http://www.iccsafe.org/cs/igcc.

Proliferation of Green Building Systems

Aside from the green building certification systems mentioned so far, a variety of local and regional systems have begun, including Earthcraft Virginia (www.ecvirginia.org), Earthcraft (www.earthcrafthouse.com), Built Green (www.builtgreen.net), MN Greenstar (www.mngreenstar.org), and Alliance for Environment and Sustainability

(www.alliancees.org). Most of these systems focus on single or multifamily housing. Some of these systems refer to LEED or the National Green Building Standard as parent documents and then contain customized information for a specific locality.

Post Frame Construction Contributions to Green Building

The concepts of green building embedded in the various green building certification systems have been previously discussed. These green building certification systems have particular assumptions about buildings and construction which may not completely correspond with post frame construction systems. This section discusses some basic characteristics shared by the majority of post frame building system. In order to be considered a green building from any of the green building certification systems, the building will need credit for other green building features. Three areas which the post frame building system impacts green building are the *site specification*, *material efficiency* and *energy efficiency*. Additionally, many green building certification systems provide credits for innovative design and operation.

Site specification

- Minimize soil disturbance and erosion – Post frame construction requires minimal soil disturbance in most cases, since only post holes need to be dug. Further credit for this reduction in soil could also be obtained in some 'Innovative Solution' sections.
- Reduce Local Heat Island Effects – Due to the limited soil disturbance for posts, there is less possibility that current trees and shrubs on the site need to be disturbed in order to construct the building. By providing shade and vegetation around the structure, the 'heat island' effect, attributed to heat radiated from buildings and surrounding man-made materials, is mitigated.
- Pest Control – the use of termite barriers and preservative pressure treated (PPT) lumber prevents long term decay of a building. Additional points may be gained for use of certain PPT that do not contain arsenic or pentachlorophenol.

Material Efficiency

Typical post frame construction uses a system of posts and trusses. The structure is also engineered with a specific documentation of framing elements and cut lists. Since little site cutting is needed for these materials, post frame construction contributes to several of the following areas:

- Lower Framing Material Waste
- Detailed Framing Documentation
- Cut List for Lumber
- Offsite Fabrication (NOTE: Some systems require ALL components to be panelized / constructed offsite for this credit)

In addition to these credits, post frame far exceeds what are termed 'Framing Efficiencies' which are usually realized by spacing 2x4 or 2x6 studs in a wall up to 24 inches on center. The purpose of this credit is to allow larger spaces for insulation and reduce thermal breaks. Additionally, post frame wall systems offer a great reduction in the amount of concrete needed for securing the post or a pier system compared to a continuous frost wall with footings.

Energy Efficiency

- Exceed IECC insulation – The large cavity created in post frame walls allows for a higher level of insulation than recommended by the International Energy Conservation Code (IECC). Based upon current IECC calculations, filling the cavity with most types of standard wall insulation should provide this level of compliance. This finding should be confirmed with actual energy calculations of the structure.
- Reduced Envelope Leakage – With fewer wood elements in the exterior walls and more insulation coverage comes the potential for reduced envelope leakage. This finding should be confirmed with actual leakage measurement of the structure.

Conclusion

The green building movement is predicted to grow and become a major force in construction. Post frame buildings contain many features as a building system that make them inherently green. However, most of the green building certification systems do not comprehend these advantages of post frame construction. Post frame construction causes less site disturbance, uses materials more efficiently and creates larger insulation cavities to promote energy efficiency. These advantages create more resource and energy efficient buildings, which is the goal of green buildings. Post frame professionals must be able to interpret and communicate the advantages of post frame for green building use to make post frame construction more marketable.

Acknowledgements

This white paper was assembled with the involvement of members of the NFBA Technical and Research (T&R) committee.

References

ASTM. 2009. ASTM E 2432-05 Standard Guide for General Principles of Sustainability Related to Buildings. American Society of Testing and Materials. West Conshohocken, PA.

CIB. 1994. First International Conference on Sustainable Construction. Conseil International du Batiment. November 6-9, 1994. Tampa, FL.

EIA. 2008. *EIA Annual Energy Outlook*. Environmental Information Administration. http://www.eia.doe.gov/aer/pdf/aer.pdf. Accessed on January 15, 2010.

GBCI website

ICC. 2009. *2008 California Green Building Standards Code*. California Code of Regulations, Title 24, Part 11. http://www.documents.dgs.ca.gov/bsc/2009/part11_2008_calgreen_code.pdf. Accessed on January 20, 2010.

ICC. 2008. *National Green Building Standard*. ICC 700-2008. International Code Council.

McGraw Hill. 2009. *Green Outlook 2009: Trends Driving Change*. McGraw Hill Construction.

NAHB. 2009. www.nahbrc.org. Accessed on January 15, 2010.

U.S. EPA. 2009. The Inside Story: A Guide to Indoor Air Quality. http://www.epa.gov/iaq/pubs/insidest.html. Accessed on January 15, 2010.

USGBC website. www.usgbc.org. Accessed on January 15, 2010.

Wall Street Journal. 2010. "Half of Non-Residential Buildings Will Be Green by 2015 – Study" January 6, 2010. http://blogs.wsj.com/venturecapital/2010/01/06/half-of-non-residential-buildings-will-be-green-by-2015-study/tab/print/. Accessed on January 20, 2010.

WCED 1987. World Commission on Environment and Development. *Our Common Future.* Oxford Press. New York. p.8.