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Post-frame: As GREEN as it gets

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Post-frame: As green as it gets

By John Fullerton
NFBA Vice President

University of Wisconsin - Madison Professor David R. Bohnhoff, P.E., Ph.D., has been researching post-frame buildings for more than 30 years. He is considered a leading experts on post-frame building design.

In his research of post-frame and other building systems in the context of the modern inclination of building customers to desire "green" or environmentally-friendly buildings, he reached a significant conclusion: "Post-frame buildings are as 'green' as it gets."

At the NFBA's annual convention and trade show, Frame Building Expo, Bohnhoff provided a presentation on the subject. This article summarizes some key points, and gives additional information from other sources.

In his research, Bohnhoff found that in comparison to other building systems, post-frame buildings are arguably the most green buildings one can erect for several important reasons. First, manufacturers of nearly all building materials claim, in one way or another, that they are green for various reasons, making the notion somewhat murky and leading many people to question the legitimacy of various claims of greenness.

The majority of non-renewable resources used throughout a building's life cycle consist of fossil fuels burned to create energy to manufacture and install the building components, and to power the building throughout its length of service.

Post-frame buildings are efficient both in terms of construction and long-term energy use. There is a low environmental impact compared to any other building type, not only because of the green attributes of the materials used, but because those materials are used conservatively. Fewer materials are needed to create the same strength characteristics as other buildings types, so less carbon dioxide and other wastes are produced in both manufacture and installation. Because post-frame buildings are the most economical and quickest to erect, they are the greenest of buildings, even if one does not consider the greenness of their building materials.

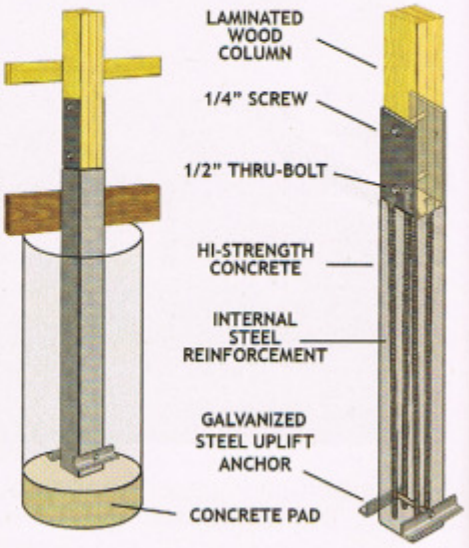
This is because post-frame buildings are design-efficient. Wide spacing between posts and other structural members means that they need fewer materials to achieve equivalent load capacities. There are less structural members for a builder to install. Therefore, they use fewer building material resources, as well as less labor and fuel to erect than other types of buildings.

Post-frame buildings are almost always the most economical buildings to erect because of these material and labor efficiencies.

Bohnhoff also notes that a basic, rectangular design is more efficient to install and thermal bridging is less likely compared to buildings with staggered roof lines and additional corners or other architectural flare that might result in additional materials, installation time and disruptions in insulation. Although amenable to these architectural flares, post-frame structures may be designed to maximize the inherent efficiency of a basic rectangular design. These efficiencies also mean that post-frame buildings have the lowest embodied energy compared to almost any other type of modern building system.

Post-frame buildings are wood-framed buildings. Wood is arguably the most green building material available today. Wood is a naturally-occurring and renewable resource Growing trees removes carbon dioxide — the primary greenhouse gas that, according to most experts, causes global climate change. Production of most other building materials emits carbon dioxide into the atmosphere.

Bohnhoff also notes that some green rating systems unfairly and unnecessarily penalize wood in favor of other resources that are not nearly as good for the environment. Some programs may provide additional points earned toward



Pre-cast reinforced concrete columns are provided by NFBA member company Perma-Column, Inc. www.permacolumn.com

green certification for use of materials that are rapidly renewable. They define rapidly renewable as resources that may be regenerated in a short period of time, typically 10 years — a timeline that specifically excludes most wood products. Other biomass-based resources that meet this definition of rapidly renewable, such as bamboo or jute, deplete the soil of vital nutrients and may require large amounts of chemical fertilizers, herbicides or pesticides — all of which are used in very small amounts (if at all) in the production of most wood products.

Also, many will try to work loopholes in green rating systems to earn additional points, often with results that are undeniably of negative environmental impact. These problems are symptomatic of green rating systems.

Bohnhoff notes that a truly fair and comprehensive life cycle analysis from cradle to grave of a building's life cycle is crucial for assessing the environmental impact of a building, and that the focus of effects of erecting a building are largely measured in terms of the quantity of non-renewable and non-recyclable resources expended throughout that life cycle.

In addition to the information pro-

vided by Bohnhoff, we've found other information about some uniquely green aspects of post-frame buildings.

Compared to using wood as the primary structural building material, concrete requires 1.7 times and steel requires 2.4 times more energy than wood for the same type building. Similarly, environmental emissions and water use are greater for many other building materials, such as plastic, vinyl, steel and concrete products, compared to both preservative-treated and untreated wood. A steel-framed building generated 1.45 times more greenhouse gas emissions, and concrete 1.81 times more, compared to wood framing. The wood design had the lowest water pollution index, with the steel design generating 120 times and the concrete design generating 1.9 times more water pollution than the wood option. (Source: ATHENA™ Sustainable Materials Institute)

Post-frame buildings may use any type of interior finish or exterior siding or roofing product, so in this sense post-frame buildings are generally not different from any other type of building. However, many post-frame buildings use steel siding and roofing that is of a thinner gauge than other types of buildings with steel finishes (hence requiring less resources) and steel building products are almost entirely composed of recycled content. Quality paint systems used on many post-frame buildings also are also maintenance-free, and may go for decades without re-painting or replacement.

Contrary to a common misconception, harvesting wood does not cause deforestation. Responsible forest management over the past 100 years has left the United States and Canada with more wood growing now than a century ago. Net growth of forests in the United States substantially exceeds harvest. In the 1990s, growth exceeded harvest by a 31 percent.

According to a United Nations report: The U.S. has experienced net growth in the area covered by forests since the 1920s. Today, 33 percent of the U.S. is forested, constituting two-thirds of the forest at the time of European settlement. Substantial natural and artificial reforestation now exceeds forest temporarily lost from harvesting. Populations of many forest wildlife species have substantially increased, as have recreational and other public uses of forest land.

This is not to say that products besides wood do not have environmentally beneficial attributes as well. Many products may also be considered green for various reasons...and almost any building product may also be incorporated into post-frame structures.

A wide variety of materials may be used for post-frame construction. Almost any type of interior or exterior finish may be used with post-frame. This versatility is also a key aspect to post-frame's greenness. Many people have widely divergent opinions on what is or is not green — so if customers have specific preferences, one can customize options to meet their unique demands.

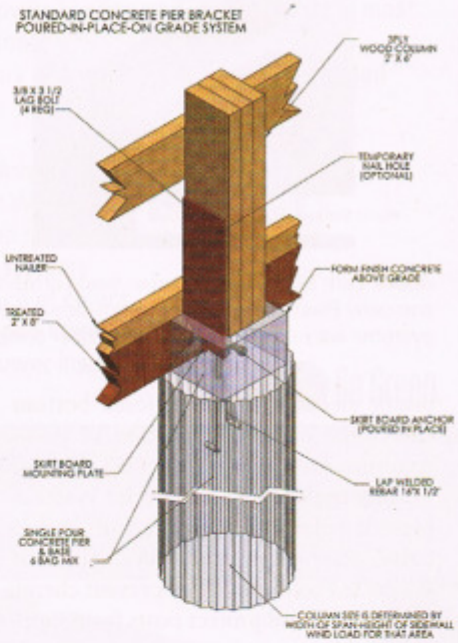
Many post-frame buildings use pressure-preservative treated wood. Technically, treated wood is considered a pesticide; pesticides are not usually considered friendly to the environment. However, buildings that do not use treated wood frequently have insecticides applied directly to the soil in larger concentrations than what may leach from treated wood, or are otherwise treated for pests using liquid, powdered or gaseous insecticides that are more likely to come in contact with building inhabitants than treated wood used for building walls. The active ingredient in most treated wood is copper, but other pesticides may use more toxic elements to control pests.

New wood treatment formulas do not contain arsenic or other toxic substances used in the past, so builders today may offer arsenic-free and other building solutions for those who prefer them. Borate-treated wood also offers an alternative that is even more environmentally-friendly than copper-based treatments, although it must be frequently painted or otherwise protected from soil contact and outdoor exposure to retain effective treatment.

If a customer simply does not want a building that puts treated wood directly in contact with the soil, post-frame offers many unique options. Although one may avoid the expense and limitations of using traditional foundations by simply embedding a treated wood foundation into the ground, post-frame buildings may easily be installed atop a traditional foundation as well. Posts and other structural components may be bolted onto a reinforced concrete slab or a traditional cast-in-place concrete or masonry block foundation.

Post-frame buildings may use enhanced wood protection techniques and products developed specifically for post-frame buildings, such as plastic sleeves or boots, and concrete posts or piers. Some examples follow.

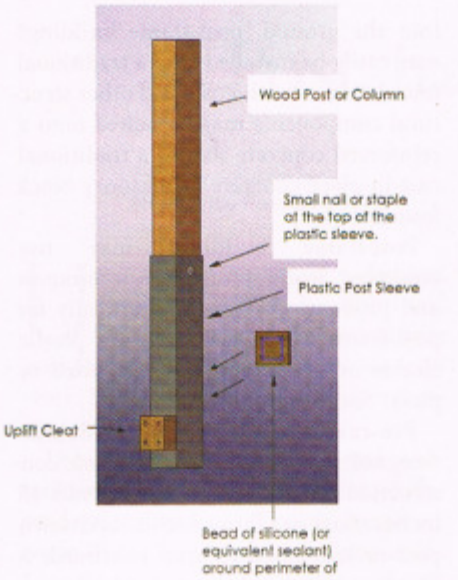
Pre-cast reinforced concrete columns designed specifically for post-frame construction use a bracket that extends 18 inches above grade to which a solid-sawn post or laminated column is affixed. A standard non-treated wood column can be bolted into the "U" shaped connection bracket, eliminating the need for treated wood.

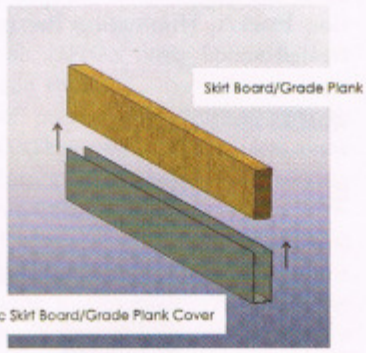


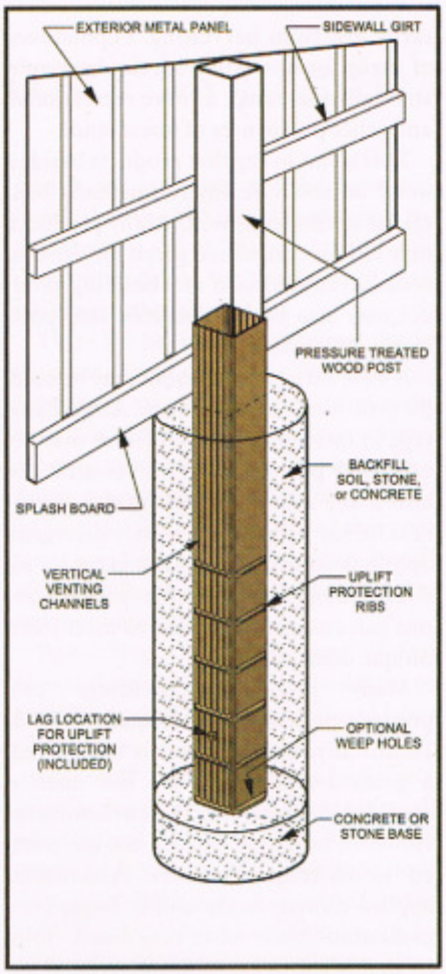
Poured-in-place concrete piers are provided by NFBA member company Concrete Pier Systems, www.concretepiersystems.com

Poured-in-place concrete piers use a pier bracket placed over a hole filled with concrete. Once the concrete sets, the post-frame is bolted onto the brackets.

HDPE plastic barrier wood protection systems provide enhanced protection of copper-based chemical-treated wood posts and laminated columns. A







Asphalt and Polyethylene Based Barrier Wrap Protection Systems are provided by NFBA member company PostSaver, USA, www.postsaverusa.com

Above Left: HDPE plastic barrier wood protection systems are provided by NFBA member company Plasti-Sleeve, www.plasti-sleeve.com. Above Right: Blow-molded plastic barrier systems are provided by NFBA member company Post Protector, www.postprotector.com

plastic sleeve with an enclosed bottom covers the embedded portion of posts, columns, or skirtboards.

Blow-molded plastic barrier systems provide enhanced protection of copper-based chemical-treated wood posts or laminated columns. They prevent chemical leaching and protect posts from moisture and insects.

Polyethylene post sleeve and footing forms provide enhanced protection of copper-based chemical-treated wood posts or laminated columns by enclosing the post and creating a foundation-strength base.

An Asphalt and Polyethylene Based Barrier Wrap Protection System has received AWPA recognition for protecting wood with or without pesticide chemical treatment. The surface of the wood is coated with asphalt, and a heavy-duty polyethylene shrink film is factory applied to offer a durable protective outer layer. The barrier protection system retains chemical penetration and enhances the service life of wooden posts treated with all types of water-borne wood preservatives.

Green building materials are important. However, over the entire life span of a building the amount of energy required to produce and erect it is insignificant to the amount of energy consumed by the building's use over many decades.

The Centre for Sustainable Technology at The University of Newcastle in Australia created computer models that demonstrate that more than 95.8 percent of total energy used went to heating, cooling, lighting and other power over the term of a typical building's life cycle, while only 4.8 percent of energy use was attributable to energy used for fabrication and construction of the building itself (LCA Fact Sheet, Centre for Sustainable Technology, The University of Newcastle, www.cbpi.com.au/resources/general/lca_fact_sheet.pdf

This is where post-frame takes its lead in the green building race and turns it into a landslide victory.

Compared to other structural materials, wood is the best insulator against heat and cold, making it the most energy-efficient material to use for a structure. Like steel-frame buildings, framing members may interrupt insulation systems installed within the wall cavity. However, wood has natural insulating properties and does not conduct heat around the insulation system like a steel structural member may.

According to the Southern Pine Council, wood is 15 times as efficient an insulator as concrete, 400 times as efficient as steel, and 1,770 times as efficient as aluminum (http://products.construction.com/Manufacturer/Southern-Pine-Council-NST345/green/C/NST37557-31).

ComCheck Analysis confirms that post-frame buildings achieve the highest R-values compared to steel-framed and brick or masonry buildings. On a stud-frame building, studs less than four inches wide are typically installed every 16 inches on center. Most post-frame buildings have a six- or eight-inch post every eight feet or more on center. Insulation is installed

in between these members. There is a break in the thermal insulation barrier every eight feet or more in a post-frame building, compared to a break every 16 inches for stud-frame. Larger, contiguous spans of insulation are much more efficient than shorter, more frequently interrupted insulation barriers.

Also, because posts for post-frame are usually six inches or wider, compared to the four-inch studs used in most stud-frame construction, there is a much wider wall cavity in which one may place thick fiberglass batt or other insulation. Insulation may be as thick as eight inches in post-frame walls.

Post-frame buildings also easily accommodate almost any type of insulation system, and a popular choice is a reflective air and moisture-resistant barrier system, such as Thermax. Thermax and similar insulation installs between the frame and the exterior cladding, making a completely contiguous external envelope. With wall infill insulation wrapped in an uninterrupted reflective vapor barrier, one may achieve extraordinary insulation R-values. This means that post-frame buildings can achieve the highest insulation R-values of any type of building for long-term energy savings over the life cycle of the building.

Post-frame buildings may be designed to accommodate new technologies, such as passive solar heating, geo-thermal heating and cooling systems, radiant systems and more. There are photovoltaic systems now available that are ideally-suited for sloped, steel post-frame roofs. With proper design, the structure will accommodate passive solar water heating systems. Post-frame buildings are also largely maintenance-free, so less fuel, labor and materials are used to maintain the building over its lifetime.

Post-frame buildings not only have the lowest embodied energy and make the least site disturbance during construction, they also may be easily disassembled, recycled or reused Compared to buildings with basements and heavy concrete footings, post-frame buildings leave the site in clean condition if they are removed. This, combined with the "greenness" of materials used, speed and efficiency of erection, long-term energy efficiency and low long-term maintenance requirements, combine to make post-frame "as 'green' as it gets."

Furthermore, post-frame buildings are almost always the most economical building choice, making the investment in saving the environment "one building at a time" affordable - so post-frame buildings are "green buildings" that save you some real "green!" ■

Opinions expressed in this and other articles in Frame Building News are those of the author(s) and not necessarily those of NFBA or the publisher.

Correction

An editing error generated an opposite meaning in a paragraph of "The Religion of Green," by Dr. Dave Bohnhoff, Ph.D., in the April *Frame Building News*.

On Page 60, the top of the second column should have read: "Given that commercial fertilizers rely on non-renewable fossil fuels, tilled agricultural land is much more susceptible to wind and water erosion than land that's not tilled, and pesticides adversely affect virtually all animals as well as those plants not being cultivated, why promote rapidly renewable materials over materials such as wood?"

Frame Building News regrets the error.