A F F O R D A B L E H O U S I N G

ISSUES

SHIMBERG CENTER FOR AFFORDABLE HOUSING

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Building Green Buildings

Green Building is a process that involves incorporating environmental considerations into every phase of the home building process. That means that during the design, construction, and operation of a home, energy and water efficiency, lot development, resource efficient building design and materials, indoor environmental quality, homeowner maintenance, and the home's overall impact on the environment are all taken into account. Although Green Building programs are appearing across the country, many jurisdictions do not have the resources to create a program from scratch. Accordingly, the National Association of Home Builders (NAHB), with a panel of experts, developed a list of Green Building Guidelines. The guidelines are summarized in this newsletter. The complete NAHB Model Green Home Building Guidelines *publication is available on the Internet at http://www.nahb.org/fileUpload_details.aspx?contentTypeID=7&contentID=1994.*

Before proceeding, it is important to recognize that the builder must keep in mind that: 1) environmental considerations should be incorporated into the project from the very beginning because it is much harder to weave green home concepts into a project after the house plans are finished, and 2) the house should be looked at as a whole as the builder determines which of the green home guideline items to put into the house. For example, making a home's building envelope tighter through air sealing and quality building techniques can affect the way in which the builder designs the home's ventilation system.

Another important point cited by the NAHB is that these guidelines should be considered as a dynamic list. Granted that the guidelines were developed on the best available scientific data, there are still many unknowns that may become better understood as time passes. As we build more green buildings and as we learn more about the tradeoffs and interactions, this list of guidelines may change. There is also the

local priority aspect. For example, a recirculating hot water system that reduces water consumption may be a desirable option in a region that suffers from severe water shortages even though the recirculating system consumes more energy that other system designs.

Now to answer the question, "Why should we care about green building?" There are many compelling reasons for changing the way in which we build and operate homes. Although we cannot avoid impacting the environment when we build a house, green building can work toward minimizing that environmental impact.

These guidelines were designed with the mainstream home builder in mind. We recognize that many home building companies already incorporate some elements of green building into their current practices. However, the purpose of these guidelines is to highlight ways in which a mainstream home builder can effectively weave environmental concerns holistically into a new home and to provide a tool that local associations can use to create a green home building program.

At the time these guidelines were created, there were 28 green home building programs in operation throughout the United States. These programs have done a great job at spreading the word about green home building. However, there are numerous other locales that are interested in green home building that do not have the resources but have not had the resources to create a program from scratch. These guidelines are intended to serve as a toolkit for home builder associations to create new programs, and to help those programs expand and flourish.

Guiding Principles

As noted above, during the process of building a green home, a builder takes numerous considerations into account simultaneously and consciously incorporates environmental issues into all decisions. The attached model green home building guidelines consist of a variety of distinct line items that a builder can choose from in creating a green home. For organizational purposes, we have grouped the line items into overarching sections, or guiding principles. Below are the guiding principles addressed in green home building:

Guiding Principle – Lot design, preparation, and development

Resource efficient site design and development practices help reduce the environmental impacts and improve the energy performance of new housing. For instance, site design principles such as saving trees, constructing onsite storm water retention / infiltration features, and orienting houses to maximize passive solar heating and cooling are basic processes used in the design and construction of green homes.

Guiding Principle – Resource efficiency

Most successful green homes started with the consideration of the environment at the design phase—the time at which material selection occurs. Creating resource efficient designs and using resource efficient materials can maximize function while optimizing the use of natural resources.

For instance, engineered wood products can help optimize resources by using materials in which more than 50% more of the log is converted into structural lumber than conventional dimensional lumber 1.

Resource efficiency is also about reducing jobsite waste. Invariably, there are leftover materials from the construction process. Developing and implementing a construction waste management plan helps to reduce the quantity of landfill material. The average single-family home in the U.S., at 2,320 ft2 (NAHB, 2003), is estimated to generate between 6,960 and 12,064 lbs. of construction waste. Thus, by creating an effective construction waste management plan and taking advantage of available recycling facilities and markets for recyclable materials, construction waste can be reduced by at least two-thirds, creating potential cost savings for builders

and reducing the burden on landfill space.

Lastly, basing the selection of building materials on their environmental impact can be tricky. For instance, a product might be renewable, but on the other hand it takes a relatively great amount of energy to transport the product to a project's job site. While one way to compare products is to look at a product's or a home's life-cycle environmental impacts through a process called Life Cycle Analysis (LCA). An LCA of a building product covers its environmental impacts "cradle-to-grave" through six basic steps: 1) Raw material acquisition, 2) Product manufacturing process, 3) Home building process, 4) Home maintenance and operation, 5) Home demolition, and 6) Product reuse, recycling, or disposal. There are numerous reasons why building products are not commonly selected via LCAs. One of the issues is the availability of data – there is a lack of data to feed into tools that allow for an LCA on a product or system.

One such tool created by the National Institute of Standards and Technology (NIST) is the Building for Environmental and Economic Sustainability (BEES) software program. BEES has ten impact categories: Acid rain, Ecological toxicity, Eutrophication, Global warming, Human toxicity, Indoor air quality, Ozone depletion, Resource depletion, Smog, and Solid waste. Since information is not available to conduct full LCAs on all available building products, we have instead included an LCA mindset in creating the list of line items in the Resource Efficiency section. Our hope is that in the future the prescriptive line items in the guidelines will eventually be replaced with a full LCA approach for the home as a system and the components therein.

Guiding Principle – Energy efficiency

Energy consumption has far-reaching environmental impacts: from the mining of fossil fuel energy sources to the environmental emissions from burning non-renewable energy sources. And each home consumes energy year after year, meaning that the environmental impacts associated with that use accrue over time. Therefore, energy efficiency is weighted heavily in a green building program.

Energy consumption not only occurs during the operation of a home, but also during the construction of a home and, indirectly, in the production of the materials which go into the home.

Although the energy used to heat and cool a home over its life far outweighs that to manufacture the materials and construct it, the large number of homes built (currently about 1.85 million per year) renders the energy used during the construction phase significant. 1 www.healthyhomedesigns.com/information14.php

On average, a home built between 1990 and 2001 consumed about 12,800 kWh per year for space and water heating, cooling, and lights and appliances. Where natural gas is used, consumption averages 69,000 cubic feet per household annually. Total energy expenditures during a year cost these homeowners about $1,6002. Energy efficiency improvements that make a home 20% more efficient—a conservative estimate for many green homes—could significantly reduce a homeowner's annual utility bill expenses.

No matter what the climate, energy efficiency is considered a priority in most existing green building guidelines/programs. Moreover, as the cost to heat and cool a home becomes more unpredictable, it is advantageous to every homeowner to be "insulated" from inevitable utility bill increases. As with all aspects of these guidelines, the greatest improvements result from a "whole systems" approach. Energy performance does not end with increased R-values, the use of renewable energy, and/or more efficient HVAC equipment. Rather, there needs to be a balance between these features and careful window selection, building envelope air sealing, duct sealing, and proper placement of air and vapor barriers from foundation to attic to create a truly high performance, energy-efficient home that is less expensive to operate and more comfortable to live in than a conventionally-constructed home.

Guiding Principle – Water efficiency

The mean per capita indoor daily water use in today's homes is slightly over 64 gallons. Implementing water conservation measures can reduce usage to fewer than 45 gallons3. For this reason, green homes are especially welcomed in areas affected by long- and short-term drought conditions.

The importance of water resources is becoming increasingly recognized, especially in the western third of the country. Choices between sending water to growing urban areas versus making water available for irrigation highlight the issues surrounding the scarcity of this valuable resource.

Green homes often conserve water both indoors and out. More efficient water delivery systems indoors and native and drought-resistant landscaping choices outdoors can help prevent unnecessary waste of valuable water resources. Communities can obtain additional benefits when builders effectively use native species in landscaping. Current research and practice has shown that natural processes can be a successful means of filtering and removing contaminants from storm water and wastewater.

Guiding Principle –Indoor environmental quality

Healthy indoor environments attract many people to green building. After energy efficiency, the quality of a home's indoor air is often cited as the most important feature of green homes. Pam Sessions, President of Hedgewood Properties in Atlanta, explained during the 2002 National Green Building Conference that the majority of people interested in green homes in the Atlanta market indicated that indoor air quality was their top issue of interest.

An increase in reported allergies and respiratory ailments and the use of chemicals that can off gas from building materials have contributed to a heightened awareness of the air we breathe inside our homes. Even though there is no authoritative definition of healthy indoor air, there are measures that can mitigate the effects of potential contaminants including: controlling the source, diluting the source, and capturing the source through filtration.

Guiding Principle – Operation, Maintenance and Homeowner Education

Improper or inadequate maintenance can defeat the designer's and builders best efforts to create a resource-efficient home. For example, homeowners often fail to change air filters regularly or neglect to operate bath and kitchen exhaust fans to remove moist air. Many homeowners are unaware of the indoor environmental quality impact of using common substances in and around the house such as pesticides, fertilizers, and common cleaning agents. By providing homeowners with a manual that explains proper operation and maintenance procedures, offers alternatives to toxic cleaning substances and lawn and garden chemicals, and points out watersaving practices, a builder can help assure that the green home that was so carefully built will also be operated in an environmentally responsible manner.

Guiding Principle – Global Impact

There are some issues related to home building and land development that do not fit nicely into the context of the aforementioned guiding principles. For these items that are a by-product of home construction, we have added a separate principle – global impact. One example of an issue having global impact is the selection of paints that contain relatively low or no volatile organic compounds (VOCs). Although the VOC content of paint is often considered for indoor environmental reasons, the vast majority of VOCs are released by the time the paint is dry. However, the release of VOCs from wet paint help form ground-level ozone pollution. Therefore, the use of low- or no-VOC paints falls under the global impact principle because the environmental impact of using paints with relatively high VOC levels is greater on the global scale than it is on the indoor environment

Guiding Principle – Site planning and land development

The process of green home building should not stop at the house. If a builder is also involved in the development of the community, site planning and land development can be part of the process. Therefore, information about low-impact site planning and land development is included in Appendix A. Considering the entire community and existing infrastructure in addition to the individual building(s) can amplify the benefits of green home building. For example, by improving a subdivision's storm water management plan and preserving natural resources through careful design and construction practices, a builder can influence not only the resource efficiency of each particular house but also the entire subdivision's overall environmental impact. Low Impact Development (LID), which uses various land planning and design practices and technologies to simultaneously conserve and protect natural resources and reduce infrastructure costs, is one way to approach green development.

Homeowners Can Benefit

The previous section highlighted the environmental benefits of green building practices. However, green building is much more than just reducing a home's environmental footprint. Homeowners can also realize direct benefits by owning a green home. Here are some of the primary benefits that owners of green homes have experienced compared to owners of conventional homes:

- **Lower operating costs** – Homeowners receive less expensive utility bills due to energy and water efficiency measures.
- **Increased comfort** – Green homes have relatively even temperatures throughout the home, with fewer drafts and better humidity control.
- **Improved environmental quality –** By following the attached guidelines, builders pay extra attention to construction details that control moisture, choose materials that contain fewer chemicals, and design air exchange / filtration systems that can contribute to a healthier indoor environment.
- **Enhanced durability and less maintenance** – Green homes incorporate building materials and construction details that strive to increase the useful life of the individual components and the whole house. Longer-lived materials not only require fewer resources for replacement but also reduce maintenance and the economic costs of repair. Green homes have lawns that require less weeding and watering, building elements that require less maintenance, and more durable building components that reduce the time needed for upkeep. It is important to note that a builder can only do so much when it comes to how the home will perform. Homeowners play a big role in the house performance and, therefore, should be instructed on how to operate the green home as it was intended.

Development of the Guidelines

The NAHB Green Home Building Guidelines was developed through a public process that included the following major steps:

1. An extensive review of the existing local green home builder programs - primarily home builder association programs, but also including several public sector and non-profit programs. All but three of the 28 existing programs are voluntary and market-driven.
2. A review of the voluntary energy efficiency programs endorsed by the National Association of Home Builders (NAHB).
3. A review of the leading life cycle analysis (LCA) tools available for use by residential design and construction professionals in North America (e.g., BEES, ATHENA).

4. Input through an open process from numerous individuals on the NAHB Advisory Group and the Stakeholder Group.
5. Applying certain criteria to each line item in order to give the line items point values.

Each line item in the guidelines has a point value attributed to it. Once the Stakeholder Group members finalized the list of line items for inclusion in the guidelines, the NAHB Research Center team looked at each line item through three different lenses: 1) Environmental Impact, 2) Building Science and Best Building Practices, and 3) Ease of Implementation. The team used publicly available information, experiential data, and other data inputs to assign each line item points via these three criteria. Each line item's final point total was calculated by weighting the criteria. Environmental Impact received the greatest weight, followed by Building Science and Best Building Practices, with Ease of Implementation receiving the least weight.

Environmental Impact – The main purpose of these guidelines is to provide a framework for builders to reduce a home's environmental impact. We assessed how each line item helped make a home more energy efficient, improved indoor environmental quality, and so on. Assigning a value to each line item is an inexact science since all of the necessary data is not available. In addition, some line items had impacts that spanned multiple principles and, in some cases, the impact was positive for one guiding principle while negative for another. With that as background, the NAHB Research Center team took into account all of the above considerations and available data to assess the environmental impact of implementing each line item. Using qualitative and quantitative information, the team assigned value to each line item based on the positive impact to the environment.

Building Science and Best Building Practices – Certain green building practices dramatically impact how a house operates. For example, the sealing of a home's building envelope has an impact on the home's HVAC system. In addition, some measures such as proper flashing details and installation of weather barriers enhance durability, minimize the possibility of indoor environmental problems, and are considered "best building practices." Line items that help a home perform effectively as a system for the long-term were assigned a higher point value. **Ease of Implementation** – Some line items are easier to implement than others. The NAHB Research Center team compared each line item to current home building practices and estimated how difficult it would be for a builder to implement the line item relative to primarily cost and time. For instance, would it take longer to install a new technology? Would subcontractors need to be educated on the use of a new product? Would a new technology cost more to buy? A line item will have a positive environmental impact only if it is implemented. Line items that were relatively easy to implement (and therefore more likely to be implemented) were assigned a greater point value than the items that are more difficult to implement.

Green Programs and Homes Differ Across the Country When assigning points to the line items, the NAHB Research Center assumed the home would be built in Baltimore, MD, which is in Zone 4 of DOE's proposed climate zone map. The map can be viewed at the following URL: http://www.energycodes.gov/implement/pdfs/color_map_climate_zones_Mar03.pdf

For associations located outside of Zone 4 that are interested in creating a green building program, point values can be customized for some line items most affected by climate conditions. For example, an association in Florida, you will likely want to increase the point values attributed to installing an energy efficient air conditioning system and decrease the point

value associated with installing a high efficiency heating system. Similarly, in the southwestern United States associations would likely place higher value on water efficiency measures. A thermometer symbol in the User Guide identifies line items that most likely will see point value changes due to climatic differences across the country.

Additional factors can lead to the decision to alter point values for a certain location, such as the availability of materials, the recycling marketplace, and the existence of rebate programs.

Determining a line item's point value is accomplished by way of consensus among the members of the green home building program's development committee. This is primarily a qualitative process and some acknowledgment of the decision-making process should be clearly stated in the program.

Various Levels of "Green"

Homebuilders differ in their relative knowledge and comfort level with green building concepts.

Some builders have been building green for years, while others are being introduced to the ideas for the first time. Recognizing this broad range of knowledge, the NAHB Research Center team established various thresholds to delineate different levels of green building effort.

The first step was to identify practices that should be part of any home building project. The first level of green building, Bronze, includes additional line items that in the end show that a builder paid special attention to a project's environmental impact. The next two levels of green home building, Silver and Gold, include additional line items that place increasingly greater emphasis on the home's environmental impact. The "How to Use the Guidelines" section of this document outlines how to score a home to determine if it meets or exceeds any of the green home building levels noted above.

The Uncertainties of Green Building

It should be noted that although many green building programs have been in existence for 10 years or more, the concept and practice of green building is not clearly defined and straightforward. Many gray areas remain in identifying and quantifying the precise environmental impact for each particular line item. For example, there is very little publicly available information regarding manufacturing processes that document energy consumption, impact on natural resources, or CO2 emissions for each building material.

In addition, a particular guideline may contain tradeoffs and carry with it contradictory characteristics. For example, a recirculating hot water system can help save conserve water, but may use a relatively large amount of energy in its operation. Although the guidelines in their current form are based on experiential evidence and the latest independent scientific research available, they still may leave many questions unanswered due to the lack of scientific and quantitative data.

Finally, assigning a particular degree of importance to different criteria undoubtedly involves a certain amount of personal or local value judgment. Life Cycle Assessment (LCA) tools are beginning to sort out such questions, but the tools still remain in their infancy. Therefore, this set of green home building guidelines should be viewed as a dynamic document that will change and evolve as new information becomes available, improvements are made to existing techniques and technologies, and new research tools are developed. How to Use the Guidelines

Job Opportunity

Coordinator, Research Programs and Services – Shimberg Center, University of Florida

The Shimberg Center for Affordable Housing at the University of Florida is currently accepting applications for Coordinator, Research Programs and Services. The position is located within the Florida Housing Data Clearinghouse, a long-term project of the Shimberg Center. The primary responsibilities of this position are to develop and manage the Clearinghouse assisted housing inventory of federal, state, and locally subsidized housing and to initiate research proposals and coordinate applied research projects dealing with the assisted housing market, housing program evaluation, special needs populations and other related topics. Beginning salary range is $40,000 to 45,000. Master's degree or a bachelor's degree in an appropriate area of specialization with two years of appropriate experience is required. A Master's degree or higher is preferred.

For further information on the position and to view application instructions and complete an online resume, please visit www.hr.ufl.edu/job and click on "Job Opportunities." Reference number for this vacancy is **REQ # 32006**. This is a full-time, time-limited position. If an accommodation due to a disability is needed to apply for this position, please call (352) 392-4621 or the Florida Relay System at (800) 955-8771 (TDD). An Equal Opportunity Institution.

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