The next phase of green building

The International Green Construction Code and what it means

By Daniel Hindman
Assistant Professor, Virginia Tech

Green building has become the most important new trend in construction. Work on the part of various organizations has resulted in the introduction of a number of green building certification systems.

A recent study commissioned by the United States Green Building Council indicates that $554 billion will be spent between 2009 and 2013 on the construction of green buildings, necessitating the addition of 7.9 million jobs. The annual estimated spending ($138.5 billion per year) is roughly equal to one-quarter of the gross domestic product attributed to construction in 2009.

These estimates are difficult to decipher because many of the 7.9 million jobs will encompass current trades involved in construction rather than new jobs created. Although many people may dispute this estimate, the attention that is focused on green building is unprecedented in the construction industry. As a professor, I find green building to be a huge draw for students, industry and the general public.

A white paper issued by NFBA’s Technical and Research Committee, “Putting the ‘Green’ Into Post Frame Construction,” discusses many of the green building certification systems and provides the background of green building. The Leadership in Energy and Environmental Design (LEED) suite of systems includes LEED New Construction and LEED for Homes, the Green Globes system, and the National Green Building Standard (known as ICC 700) are discussed in the paper. These programs underscore the many tenets of green building. All are voluntary systems through which architects, engineers and contractors register projects and follow a certain set of criteria.

A post-frame structure is very efficient in terms of material use and building envelope construction; the white paper also identified minimized site preparation as an advantage. Further white papers will describe the use of post-frame construction in LEED New Construction, LEED for Homes, Green Globes, and the National Green Building Standard.

Although different green building certification systems address similar areas of construction such as building materials, indoor air quality, and water conservation, they tend to prioritize these areas in different ways. Table 1, which attempts to identify the priorities of these certification systems, features the percentage of total maximum points assigned to each construction category for three different certification systems. Because of differences between systems, not all listed categories are applicable to each system. The ICC 700 system, for example, does not have a separate innovation category, but instead assigns innovation points to each individual category.

Table 1 (below) does not communicate the degree of ease or difficulty required to obtain certain points. Points within systems often do not have the same value. For example, the LEED New Construction Materials section provides 1 point out of 110 if Forest Stewardship Council (FSC)-certified lumber is used as 50% of wood in construction, but the LEED New Construction Innovation section also provides 1 point if at least one LEED-Accredited Professional is a member of the design team.

Table 1: Percentages of Each Category in Different Green Building Systems

<table>
<thead>
<tr>
<th>Category</th>
<th>LEED For Homes</th>
<th>LEED New Construction</th>
<th>ICC 700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sites</td>
<td>16.1%</td>
<td>23.6%</td>
<td>10.7%</td>
</tr>
<tr>
<td>Materials</td>
<td>11.7%</td>
<td>12.7%</td>
<td>20.9%</td>
</tr>
<tr>
<td>Energy/Atmosphere</td>
<td>27.9%</td>
<td>31.8%</td>
<td>37.9%</td>
</tr>
<tr>
<td>Water</td>
<td>11.0%</td>
<td>9.1%</td>
<td>13.0%</td>
</tr>
<tr>
<td>IEQ</td>
<td>15.4%</td>
<td>13.6%</td>
<td>13.8%</td>
</tr>
<tr>
<td>Innovation</td>
<td>8.1%</td>
<td>5.5%</td>
<td>N/A</td>
</tr>
<tr>
<td>Owner Education</td>
<td>2.2%</td>
<td>N/A</td>
<td>2.0%</td>
</tr>
<tr>
<td>Regional</td>
<td>N/A</td>
<td>3.6%</td>
<td>N/A</td>
</tr>
<tr>
<td>Global Impact</td>
<td>N/A</td>
<td>N/A</td>
<td>1.9%</td>
</tr>
<tr>
<td>Linkages</td>
<td>7.4%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Points between systems are similarly difficult to compare. LEED for Homes provides Materials points for material-efficient framing (attention paid to limiting waste, off-site fabrication, use of environmentally preferable products including FSC-certified tropical wood, detailed cut lists, and waste management). LEED New Construction provides Materials points for building reuse; recycling and waste management; and use of regional, rapidly renewable, or certified wood products.

For all three certification systems featured in Table 1, the Energy/Atmosphere category is the most heavily credited. The next most heavily weighted categories are “Site” and “Materials,” which shifted positions between the two LEED and the ICC 700 systems. Energy, materials and site categories are the most important factors considered in green building certification systems. Priorities of different systems can be difficult to understand due to the effects of voluntary point systems.

The percentages and rankings of categories were formed by the groups that began green building programs. The processes used to develop green building standards are often arbitrary. However, some standards now follow a process similar to the public comment and revisions process for building codes. The ICC 700 is the sole ANSI-approved standard with formalized procedures. The LEED program has begun to comply with recommendations from the International Organization of Standards for certification programs.

Implementing local Green Building codes

A white paper by Dowell Partners, Inc., “Potential Game Changers in Green Building: New Developments Signal a Fundamental Shift and Perhaps Significant Opportunity for Building Materials Suppliers” (Bowyer, Bratkovich, Howe, & Fernholz, 2010), was published in April 2010. This paper discussed the inclusion of green building provisions in various energy codes and building codes throughout the country. Bowyer and colleagues cited studies that showed the growth of local and state green building requirements, with the introduction of 200 bills in 2008 to include green building provisions in 33 states. On December 28, 2009, New York City adopted a new energy conservation code, the NYCECC, which often is referred to as green building code. This code discusses energy use, energy audits and lighting regulations. The NYCECC is part of Mayor Bloomberg’s plan to reduce the energy consumption of buildings in New York City. Many other local jurisdictions have published similar standards.

Perhaps the largest green building-type standard is the 2008 California Green Building Standards Code (CaGreen), which provides a set of baseline building standards for new structures. Structures included in CaGreen appear to be limited to state facilities, residential construction of any kind, hospitals, and schools. Many articles state that CaGreen is applied to all new construction, but the actual working document does not support this claim. Agricultural structures are not mentioned in the CaGreen standard. Mandatory elements of CaGreen include lower water use, mandated reuse/ recycling of construction materials.
Reduced use of polluting materials and greater energy efficiency in new buildings.

CalGreen's two-tiered system of green building provisions includes mandatory and voluntary provisions. All provisions, regardless of their category, are listed in individual sections related to green building categories similar to those in Table 1. Chapter 11 discusses mandatory versus voluntary provisions. This section has been criticized by some environmentalists as confusing and difficult to understand. The CalGreen code is NOT a green building system or a replacement for them. CalGreen is a method to apply green building or energy codes, the International Code Council began work on. The CalGreen code is intended to function similarly to the International Green Construction Code (IGCC). The IGCC also can be used to administer under the International Residential Code (IRC). However, the IGCC also can be used to set the level of jurisdictional requirements for ICC 700 performance. Even though ICC 700 is a green building certification system, the IGCC is not such a system. The current stage for the IGCC is response to the first public comment period. The IGCC will become a building code in early 2012. Because most jurisdictions adopt code procedures one cycle behind current publishing, the IGCC will likely become fully effective in some areas of the United States by 2015.

Unlike other ICC products, the IGCC will have a three-tiered structure that includes:

- Mandatory provisions recommended by the IGCC
- Mandatory provisions recommended by the jurisdiction
- Voluntary provisions (project electives) with the amount chosen by jurisdiction

The IGCC applies to all structures administered under the International Building Code (IBC) and is written as a companion document to ICC 700, which is intended for structures corresponding to the International Residential Code. However, the IGCC also can be used to set the level of jurisdictional requirements for ICC 700 performance. Even though ICC 700 is a green building certification system, the IGCC is not such a system. The current stage for the IGCC is response to the first public comment period. The IGCC will become a building code in early 2012. Because most jurisdictions adopt code procedures one cycle behind current publishing, the IGCC will likely become fully effective in some areas of the United States by 2015.

Unlike other ICC products, the IGCC will have a three-tiered structure that includes:

- Mandatory provisions recommended by the IGCC
- Mandatory provisions recommended by the jurisdiction
- Voluntary provisions (project electives) with the amount chosen by jurisdiction

The IGCC is intended to function similarly to the CalGreen code, providing a tiered level of support.

Chapter 1: Administration

The purpose of the IGCC is to "safeguard the environment, public health, safety and general welfare through the establishment of requirements to reduce the negative potential impacts and increase the positive potential impacts of the built environment on the natural environment and building occupants by means of minimum requirements related to conservation of natural resources, materials and energy; the employment of renewable energy technologies; protection of air quality; and building operations and maintenance" (101.3). This code is an overlay on current IBC provisions and also refers to other documents including the International Energy Construction Code (IECC). When a conflict between these codes occurs, the specific requirement supersedes a more general requirement, or the most "practical and effective requirement" may be used (102.1.1).

One of the most difficult issues regarding the IGCC is deciphering exactly which structures it involves. The scope of the IGCC includes any structure compliant with the IBC. Post-frame buildings will be administered under the IGCC if they are currently administered under the IBC. Despite further discussions with an IGCC committee member, clarity is lacking regarding the types of buildings and building uses that are included and excluded.

Upon review of the document, there are few if any references specific to agricultural structures. This is a weakness of the current version of the IGCC. The document appears to apply a broad brush and is not specific about the ways in which certain building types will use the code. There are building applications for which IGCC provisions are unrealistic, such as defining air leakage of a free-standing barn with side curtains or any open-air pavilion.

Chapter 3: Jurisdictional Regulations and Project Electives

Chapter 3 defines the differences between IGCC's three tiers of green building provisions. While there is some separation of these tiers compared to the CalGreen document, this section remains difficult to understand. Table 302 is provided as the template from which to choose the provisions recommended by individual jurisdictions. Many of the requirements that are listed in the IGCC chapters are included. Most decisions require a yes/no answer if the provision is to be included. The jurisdiction also chooses the number of electives that each project must meet (between 0 and 14). It is assumed that any provisions not listed in Table 302 or included in the project electives are mandatory according to the IGCC. Engineers and contractors must be aware of differences in the IGCC from jurisdiction to jurisdiction because they can greatly affect a project.

Table 303 lists project electives that are detailed in Chapters 3 through 8. Chapter 3 lists provisions for completing a whole building project, while Chapters 4 through 8 list provisions specific to their categories. Project electives tend to go beyond mandatory and jurisdiction-mandated green building provisions.

Chapter 5: Material Resource Conservation and Efficiency

Chapter 5 includes provisions related to the materials and waste management of the structure. Table 3 (above) displays the different categories included in Chapter 5. Not all of these provisions are required by the IGCC. A brief synopsis of each section is provided below.

Research conservation and efficiency can be accomplished by reuse or recycling of materials. This section contains post-construction provisions for recyclable and hazardous materials such as lamps, batteries and electronics. Another aspect of the IGCC that is unclear is how far into the life of a building the requirements extend. Some provisions in Appendix D list time periods of 2 years after the date of occupancy during which green building provisions can be investigated, but no other discussion of building expectations is presented.

• 503 Material Selection — Material selection addresses used materials, recycled content, recyclable materials (having the potential to be recycled but not necessarily of recyclable materials), bio-based materials and indigenous materials. A large number of wood certification programs are listed under bio-based materials, including the Sustainable Forest Initiative, FSC, and any system conforming to PEFC standards. Indigenous materials are present within a 500-mile radius of a structure. A provision for environmental stewardship of building materials is also included, stating that 75 percent of all building materials must come from manufacturing/processing facilities that correspond to the United States Clean Air Act, Clean Water Act, Resource Conservation and noise control. Third-party evaluations can be substituted and will become more important in the future. Another interesting provision is the use of used materials, which has not been viewed favorably by the IBC.

• 504 Lamps — Provisions for the amount of mercury allowed in lamps. The issue of increasing lighting efficiency by using a known hazardous chemical (mercury) in light fixtures is an interest-
This section discusses the maximum total annual net energy use (TANUE) of a particular building. The maximum TANUE is rated at 70 units for the IgCC mandatory provisions. The section also details requirements of allowed carbon dioxide equivalent (CO2e) emissions.

### 603 Energy Use and Atmospheric Impacts

This section discusses the way the predicted TANUE of a structure is calculated for comparison with the value from Section 602. Factors in the TANEU calculation include annual energy delivered, energy savings from renewable energy derived on site, and savings from waste energy recovery. The values are divided by the total annual energy considered for a standard reference design and multiplied by 77. Emission calculation procedures for on-site energy production are also provided. This section may be important in bio-fuel production facilities as well as sawmills and other operations that generate substantial amounts of energy for consumption.

### 604 Energy Metering, Monitoring, and Reporting

Energy use shall be metered and monitored in line with the provision.

### 605 Automated Demand Response (Auto-DR) Infrastructure

Auto-DR systems lower lighting and HVAC use during peak energy demand hours. These systems help improve electrical grid reliability, manage electrical costs, and alert consumers to reduce consumption when the grid is near capacity.

### 606 Building Envelope Systems

Recommendations for the use of insulation, glazing materials, and air barriers in the building envelope. One interesting provision is the requirement that all structures pass an air leakage test of less than 2.0 cfm/sq.ft. There is no discussion of how this air leakage test is to be measured.

### 607 Building Mechanical Systems

Mechanical system provisions are based on the IECC.

### 608 Building Service Water Heating Systems

Water heating provisions are based on the IECC.

### 609 Building Electrical Power and Lighting Systems

Electrical power and lighting provisions are based on the IECC.

### 610 Specific Appliances and Equipment

— This section includes higher levels of compliance related to specific equipment, including permanent fixtures and portable equipment used in the function of the structure.

### 611 Building Renewable Energy Systems

— Provisions for solar and other renewable energy for consumption.

### 612 Energy Systems Commissioning

— Development of building commissioning plan and performance testing of HVAC, lighting, and electrical equipment.

### 613 Jurisdictional Requirements and Project Electives

— This section provides higher levels of compliance and an increased number of required project electives.

### Consideration points include

- Definitions of structures that are included and excluded are vague.
- There are questions regarding the way that nonconventional structures (such as open-air) conform to the IgCC.
- Provisions in this code are in a three-tiered system, with a set of project electives and the IgCC mandating green building provisions and the jurisdiction having some oversight.
- Engineers and contractors need to locate the Table 302 list of jurisdictional requirements for areas in which their structures will be placed and identify the number of required project electives.
- Ensuring that products or processes are in compliance with the IgCC and other standards (Section 503) will cause third-party certification of products to become more important.
- Building service life that is mandated at 60 years (Section 505) may become an issue for agricultural and related structures.
- Provisions are listed for CO2 emissions.
- The air leakage testing of buildings will be required.

Copies of the IgCC are available at the International Code Council web site. A draft of the IgCC is available at http://www.iccsafe.org/cs/IGCC/Pages/default.aspx. The site asks users to register to obtain the free version. This registration also allows comment on the draft version. The intent of this article is to help readers understand the basics of the IgCC and to encourage readers to find out more about the proposed code.

### References


Daniel Hindman, Ph.D., named to the Rural Design Hall of Fame in 2010, teaches courses in Wood Science and Forest Products at Virginia Tech in Blacksburg, Va. Contact him at dhindman@vt.edu