

# The next phase of green building

The International Green Construction Code and what it means

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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 including 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.

Post-frame structures are 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.

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

Category	Common Names in Systems	Definition
Site	Sustainable Sites (SS), Lot Design	Includes landscaping elements, site preparation, and excavation
Materials	Material Resource (MR), Material Efficiency	Use and disposal of materials. Emphasis on waste management and bio-based materials.
Energy / Atmosphere	Energy / Atmosphere (EA), Energy Efficiency	Issues related to power use, power generation or production of emissions
Water	Water Efficiency (WE)	Indoor and outdoor use of water
Indoor Environmental Quality	IEQ	Includes indoor air quality as well as serviceability issues including noise and vibration
Innovation	Innovation in Design (ID), Innovation in Operation (IO)	New or enhanced green building concepts
Owner Education	Awareness and Education (AE), Homeowner Education	Awareness of how to use, operate and maintain green building systems
Regional	Regional Priority (RP)	Green building practices specific to certain locations
Global Impact	Global Impact	Practices which could increase global warming potential
Linkages	Location and Linkages (LL)	Connection of housing with services and surrounding businesses

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 Dovetail 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 a 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 (CalGreen), which provides a set of baseline building standards for new structures. Structures included in CalGreen appear to be limited to state facilities, residential construction of any kind, hospitals, and schools. Many articles state that CalGreen is applied to all new construction, but the actual working document does not support this claim. Agricultural structures are not mentioned in the CalGreen standard. Mandatory elements of CalGreen include lower water use, mandated reuse/recycling of construction materials,

Chapter	Topic	Category
Chapter 1	Administration	Code Requirements
Chapter 2	Definitions	
Chapter 3	Jurisdictional Requirements and Project Electives	
Chapter 4	Site Development and Land Use	Green Building Areas
Chapter 5	Material Resource Conservation and Efficiency	
Chapter 6	Energy Conservation, Efficiency and Atmospheric Quality	
Chapter 7	Water Resource Conservation and Efficiency	
Chapter 8	Indoor Environmental Quality and Comfort	
Chapter 9	Commissioning, Operation and Maintenance	
Chapter 10	Existing Buildings	Existing Buildings
Chapter 11	Existing Building Site Development	Existing Buildings
Chapter 12	Reference Standards	Code Requirements
Appendix A	Optional Ordinance	Code Requirements
Appendix B	Greenhouse Gas Reductions in Existing Buildings	Green Building Areas
Appendix C	Sustainability Measures	Green Building Areas
Appendix D	Enforcement Procedures	Code Requirements

501	General
502	Material and Waste Management
503	Material Selection
504	Lamps
505	Service Life
506	Construction Phase Material, Storage, Handling and Moisture Control
507	Project Electives

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 structure has been criticized by some environmentalist groups 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 higher energy standards to buildings (through its mandatory provisions) and allow access to green building methods (through its voluntary provisions) in a state-approved transparent method (public information), and third-party membership or involvement is not required.

### International Green Construction Code

Due to the interest in green building and the development of many local green building or energy codes, the International Code Council began work in 2009 on the International Green Construction Code (IgCC). The IgCC is intended to function similarly to the CalGreen code, providing a tiered level

of support.

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 likely will 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.

**Table 2 (above)** displays a breakdown of chapters included in the IgCC. Chapters 1 to 3 cover code requirements,

defining the scope of the code, types of buildings, a standard set of definitions, and ways that jurisdictional requirements and project electives are used. Chapters 4 to 9 are similar to the chapters or categories seen in many of the green building certification systems. These chapters are divided into several subheadings, with project electives located at the end of each chapter. Chapters 10 and 11 address existing buildings. Chapter 12 and Appendices A and D describe references, sample ordinances and enforcement of the code. Appendices B and C discuss greenhouse gas reduction and sustainability measures. These two topics are not featured in many green building certification systems, but have been discussed as deficiencies in previous systems.

The following sections of this article detail IgCC chapters that were deemed important to post-frame and other building technologies, namely the materials and energy sections. Parentheses at the end of quoted passages refer to locations within the IgCC Public Comment Version 1.0.

### 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, indoor 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 covers. 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 conversations 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-stall 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 life cycle assessment, while the other chapters 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 these provisions 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-

601	General
602	Energy Performance, Peak Power and Reduced CO2e Emissions
603	Energy Use and Atmospheric Impacts
604	Energy Metering, Monitoring and Reporting
605	Automated Demand Response (Auto-DR) Infrastructure
606	Building Envelope Systems
607	Building Mechanical Systems
608	Building Service Water Heating Systems
609	Building Electrical Power and Lighting Systems
610	Specific Appliances and Equipment
611	Building Renewable Energy Systems
612	Energy Systems Commissioning and Completion
613	Jurisdictional Requirements and Project Electives

March 15 <sup>th</sup> 2010	Public Version 1.0 Available
March 15 <sup>th</sup> to May 14 <sup>th</sup> 2010	Public Version 1.0 Comment Period
August 14 <sup>th</sup> to 22 <sup>nd</sup> 2010	Public Hearings
November 2 <sup>nd</sup> 2010	Public Version 2.0 Available
November 2 <sup>nd</sup> 2010 to January 3 <sup>rd</sup> 2011	Public Version 2.0 Comment Period
May 16 <sup>th</sup> to 22 <sup>nd</sup> 2011	Development Hearing
November 3 <sup>rd</sup> to 6 <sup>th</sup> 2011	Final Action Hearing (ICC Governmental Members Only)
Early 2012	2012 IGCC Available

ing debate that seems to have been won in favor of energy efficiency. Please note that all compact fluorescent fixtures cannot be disposed of in municipal waste, but must be properly recycled to prevent hazardous material exposure.

• **505 Service Life** — This section presents a building service life plan and tackles issues that many of the green building certification systems hesitate to address, such as the length of time a building should be in service. The base life expectancy of a building is to be 60 years. There is a provision based upon the code official ruling to change this provision to 25 years if a dismantling and reuse plan is in place. This section may have interesting implications for the agricultural sector. Current agricultural building lifespans are not 60 years, and this design may be considered unfeasible given current building practices. There is no mention of agricultural structures in

this provision.

• **506 Construction Phase Material Storage, Handling and Moisture Control** — This provision relates to manufacturer recommendations for product handling and addresses moisture control.

• **507 Project Electives** — Project electives in Chapter 5 extend the efforts in many of the sections detailed above. Some project electives include a higher percentage of waste recovery of material, a higher percentage of materials specified in Section 503, and an increase in building service life to 200 years.

#### Chapter 6: Energy Conservation, Efficiency, and Atmospheric Quality

Table 4 (above, top) shows the different sections listed in Chapter 6. Not all of these provisions are required by the IgCC itself. A brief synopsis of each section is provided below.

• **602 Energy Performance, Peak**

#### Power, and Reduced CO2e Emissions

— This section discusses the maximum total annual net energy use (TANEU) of a particular building. The maximum TANEU 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 TANEU 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 pro-

duction 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.

• **605 Automated Demand Response (Auto-DR) Infrastructure** — Auto D-R 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 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** — Energy use requirements 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 photovoltaic (electric productng), solar thermal systems, and metering procedures

• **612 Energy Systems Commissioning and Completion** — Development of building commissioning plan and performance testing of HVAC, lighting, and electrical equipment.

• **613 Jurisdictional Requirements and Project Electives** — Project electives provide higher levels of compliance with the previous sections such as a lower TANEU value, increased insulation, and monitoring provisions.

### IgCC Implementation Timeline

Table 5 (Page 44) presents the timeline of IgCC actions. The Public Comment 1.0 version was released on March 15, 2010, and is the version discussed in this article. The comment period is closed; the second public version is being drafted and will be available on November 2, 2010. Anyone with comments or questions regarding the IgCC, can have their opinions heard between November 2, 2010, and January 3, 2011. Final development of the IgCC is slated for early 2012.

### Summary and Conclusions

This article describes the next development in green building: the inclusion of green building provisions in mandatory building codes. The IgCC is in development and is expected to be available for adoption in 2012. This code will address all structures currently governed by the IBC code, including post-frame buildings. This article discussed the Public Comment 1.0 version of the IgCC. No mention of agricultural structures or any specific implications for agricultural buildings were made. Depending on the jurisdiction and application of the IBC this may not be a problem, but other jurisdictions may find it difficult to navigate this code.

### 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 comply with manufacturing 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 and energy use.
- Air leakage testing of buildings will be required.

Copies of the IgCC are available at the International Code Council web site 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

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