



THE INTERNATIONAL
GREEN CONSTRUCTION CODE
*IMPLICATIONS FOR MATERIALS SELECTION
IN COMMERCIAL CONSTRUCTION*

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The International Green Construction Code

Implications for Materials Selection in Commercial Construction

Introduction

It is only recently that green building has been formally embraced across the U.S. The U.S. Green Building Council's (USGBC's) Leadership in Energy and Environmental Design (LEED) program, for instance, didn't become operational until 2000. And it was not until 2004 that the U.S.-based Green Building Institute acquired the rights from Canada to distribute Green Globes¹ in the United States.

Following considerable behind-the-scenes activity in the intervening period, there have been a number of developments over the past three years. In January 2009, the American National Standards Institute approved the National Green Building Standard for residential construction, developed by the National Association of Home Builders (NAHB), as a national standard. One year later the California Building Standards Commission adopted by unanimous vote the nation's first green building code – The California Green Building Standards Code. At about the same time, the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), in cooperation with the Illuminating Engineering Society of North America (IES) and USGBC, released what was described as the first code-intended commercial green building standard in the United States.² And less than two months later, the International Code Council (ICC) released its new International Green Construction Code (IgCC) for public comment, with the intent to formally adopt in 2012.

The International Green Construction Code addresses the full spectrum of commercial construction and has now made its way through a three-year process of publication, public comment and feedback, and revision. Print copies were made public in late March 2012. This article provides an overview of the IgCC, with particular attention given to provisions that relate to building materials selection.

The ICC

The International Code Council (ICC) was established in 1994 for the purpose of developing a single set of model construction codes to replace the three separate regional model codes used throughout the United States. Founding organizations were the Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International, Inc. (SBCCI).

Today the ICC operates as a membership organization, involving representatives of the construction industry and construction code regulators. The organization reports that “fifty states and the District of Columbia have adopted the I-Codes at the state or jurisdictional level,” and “federal agencies including the Architect of the Capitol, General Services Administration, National Park Service, Department of State, U.S. Forest Service and the Veterans Administration also enforce the I-Codes.” It is also reported that the Department of Defense references the International Building Code for constructing military facilities domestically and abroad. Puerto Rico and the U.S. Virgin Islands enforce one or

¹ The Green Globes assessment and rating system is based on the UK-based Building Research Establishment's Environmental Assessment Method (BREEAM). In 1996, the Canadian Standards Association (CSA) published BREEAM Canada for Existing Buildings. The system later became an online assessment and rating tool under the name Green Globes. The Green Globes system is today used in Canada and the U.S. In the U.S., Green Globes is operated by the Green Building Initiative (GBI). In 2005, GBI became the first green building organization to be accredited as a standards developer by the American National Standards Institute (ANSI). The GBI ANSI technical committee was formed in early 2006 and the official Green Globes ANSI standard was published in 2010.

² The ANSI/ASHRAE/USGBC/IES 189.1 Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings was first published in 2009 and most recently revised in 2011.

more of the I-Codes. In addition the I-Codes are reported as providing a reference for code development in other nations.

Over 340 chapters located throughout the U.S. and in several nations support the ICC. Countries in which international chapters are located include Australia, Canada, Kenya, and New Zealand.

The IgCC is the fourteenth of the family of model codes. Model codes previously developed and promulgated by the ICC are listed below.

- International Building Code
- International Energy Conservation Code
- International Existing Building Code
- International Fire Code
- International Fuel Gas Code
- International Mechanical Code
- ICC Performance Code
- International Plumbing Code International
- Private Sewage Disposal Code
- International Property Maintenance Code
- International Residential Code
- International Wildland-Urban Interface Code
- International Zoning Code

As of this writing, jurisdictions that have adopted the IgCC include the states of Maryland and Rhode Island; Phoenix, Scottsdale, and Kayenta Township, Arizona; Fort Collins, Colorado; Richland, Washington; and Boynton Beach, Florida. The State of Florida has approved the IgCC for optional application in retrofitting and new construction of all state-owned or financed facilities, and sections of the IgCC have been adopted by North Carolina and Oregon.

IgCC Basics

Development

Six major players in green standards development participated in development of the IgCC. In addition to the ICC, these were the USGBC, IES, ASHRAE, American Society for Testing and Materials (ASTM), and American Institute of Architects (AIA). Initial development was followed by the standard process employed in all ICC code development – cycles of public comment, feedback, and revision, before acceptance of a final standard.

Application

The IgCC is an “overlay” code. The administrative requirements work in tandem with the administrative requirements of other I-codes, and the standard is designed so as to not conflict with provisions of other I-codes.

As noted in code documentation, the provisions of the IgCC apply to “the design, construction, addition, alteration, change of occupancy, movement, enlargement, replacement, repair, equipment, location, maintenance, removal and demolition of every *building* or *structure* or any appurtenances connected or attached to such *buildings* or *structures* and to the site on which the *building* is located.” In other words, the IgCC is germane to almost every commercial building project.

The IgCC does not apply to residential structures of four stories or less. In adopting the code, jurisdictions can decide whether ICC 700 (the National Green Building Standard) applies to various types of residential buildings and occupancies that are not covered by the IgCC.

Elements

Subject areas addressed in the IgCC are largely the same as in the majority of other green building initiatives. The list includes:

- (1) Site development and land use,
- (2) Material resource conservation and efficiency,
- (3) Energy conservation, efficiency, and atmospheric quality,
- (4) Water resource conservation and efficiency, and
- (5) Indoor environmental quality and comfort.

In addition, the IgCC includes chapters on:

- (6) Building commissioning, operation, and maintenance,
- (7) Existing buildings, and
- (8) Building additions.

Mandatory Requirements vs. Electives

There are a number of mandatory provisions in the code. Local jurisdictions, in adopting the code, may add to the list of mandatory elements and/or designate certain elements as electives.

In addition to the mandatory provisions, the code calls for each jurisdiction to require that project developers satisfy additional electives. The jurisdiction determines the number of electives that must be satisfied. Lists identifying electives are provided within code documentation. This is discussed in more detail later in this report.

One jurisdictional option is to adopt the ANSI/ASHRAE/USGBC/IES 189.1 green building standard as an optional compliance path; in other words, a jurisdiction may elect to follow the specific provisions of *either* the IgCC or 189.1. If the optional compliance path is adopted, only the administrative provisions of the IgCC apply.

Mandatory Requirements

Mandatory provisions are found in all sections of the IgCC. Also found throughout the document are *recommended* mandatory provisions that only become mandatory if specifically endorsed by the jurisdiction. In other words, what is mandatory within the IgCC will vary to some extent from jurisdiction to jurisdiction.

In the sections that follow, mandatory provisions of the first six sections of the IgCC are discussed. Discussion of most sections is rather cursory, with only key provisions identified. Provisions of the Site Development and Land Use section are highlighted below for the purpose of illustrating mandatory and recommended mandatory aspects. Discussed in most detail is the Material Resource Conservation and Efficiency section – the focus of this paper.

Site Development and Land Use

Exhibit 1 contains a partial listing of mandatory provisions of this section. Provisions highlighted in **red** and marked with an asterisk* become mandatory only if endorsed by the local jurisdiction.

Exhibit 1

A Sampling of Mandatory Provisions in the Site Development and Land Use Section of the IgCC

Limit the Impact of Construction on Site Natural Resources

- Requires inventory/assessment of site natural resources and conditions.
- **Prohibits or limits construction in flood plains.***
- Prohibits construction within jurisdictionally established buffers adjacent to bodies of water and wetlands, with exceptions.
- **Prohibits construction in or within 50 feet of community designated “conservation areas” ***
- Prohibits construction on park land unless the building serves a related purpose.
- **Prohibits construction on agricultural land unless the building serves a related purpose. ***
- **Restricts site disturbance or development of greenfield sites.***
- **Requires management of increased stormwater runoff that would result from development.***
- Limits irrigation, and potable water use for landscape irrigation systems.
- Requires that municipally reclaimed water, where available, or collected rainwater be used for outdoor fountains and water features.
- Manage vegetation, soils, and control erosion.
 - Develop landscape, soil, and water quality protection plan.
 - Protect existing vegetation and soils, and especially topsoil.
 - Restrictions on sources of imported soils.
 - No planting of invasive species.
- Requires development of a building site waste management plan and recycling or salvage of at least 75 percent of land-clearing debris and excavated soils.
 - No diverted materials may be sent to agricultural land, flood hazard areas, or greenfield sites as defined elsewhere in standard.
 - Must effectively destroy and dispose of invasive plant species.
 - Contaminated soils must be effectively removed and properly disposed of.

Limit Transportation Impact

- Walkways and bicycle paths connect streets or other paths to the main entrance.
- Requires long and short term bicycle parking and storage based on use and occupancy of the building. No requirement if under 2,500 ft².
- Requires changing and shower facilities for buildings over 10,000 ft² that are required to provide long-term bicycle parking and storage.
- **For buildings over 10,000 ft², an occupant load > 100, and ≥20 employees, convenient parking must be provided for high occupancy, low emission, hybrid, and electric vehicles. ***

Mitigate Heat Island Effects

- Projects located in climate zones 1 through 6 must implement heat island mitigation practices for at least 50 percent of the site hardscape.
- Not less than 75 percent of the roof surfaces of buildings located in climate zones 1 through 3 must implement shall be managed for solar reflectance and thermal emittance.

*Control Light Pollution **

- * **Mandatory only if adopted as a mandatory requirement by the local jurisdiction.**

Energy Conservation, Efficiency, and Atmospheric Quality

As with all green building initiatives, energy conservation and efficiency are at the heart of the IgCC. A considerable portion of the IgCC standard is devoted to energy conservation, efficiency, and atmospheric quality. Only key provisions are highlighted in this report.

Energy Performance, Peak Power, and Reduced CO₂ Emissions

All buildings that consume energy must comply with the requirements of this section. As with many green building initiatives, requirements are spelled out for both *performance* and *prescriptive pathways*.

The foundation of the *performance pathway* is the **zero energy performance index (zEPI)**, a metric that provides a not-to-exceed target value for a project. The index is defined as:

$$\text{zEPI} = 57 \times (\text{EUIp})/\text{EUI} \quad \text{where,}$$

EUIp = the proposed energy use index in source kBtu/square foot/yr for the proposed design of the building and its site.

EUI = the base annual energy use index in source kBtu/square foot/yr for a baseline building and its site calculated as specified.

Each project must deliver a zEPI of 51 or less, a value that is defined as 51 percent of the energy allowable in the 2000 International Energy Conservation Code (IECC). This performance level is also roughly equivalent to a 10 percent improvement over the 2009 IECC standard.

If the *prescriptive pathway* is chosen, a ten percent improvement relative to the IECC is again required, in this case with regard to insulation and fenestration. Assessment of thermal envelope air tightness is also required.

Under both the performance and prescriptive pathways at least two percent of total calculated energy needs must be supplied by on-site renewable energy systems. Alternatively, at least ten percent of annual estimated hot water needs must be provided by solar hot water heating. The total renewable energy requirement may be increased to 5, 10, or 20 percent as a project elective.

The renewable energy requirement is waived if a ten-year commitment is made to procure at least four percent of total energy requirements from renewable sources, or if the total of renewable energy generated on-site, plus purchased renewable energy (again on a ten-year commitment) is at least four percent.

Other key provisions are that:

- Buildings/projects of greater than 25,000 square feet in gross floor area must have meters installed to allow determination of energy use and peak demand for each energy use category.
- Reductions in CO₂e emissions³ relative to a standard reference design must be demonstrated.
- For all buildings, commissioning of mechanical, lighting, electrical, and building envelope systems is required.

³ The term CO₂e refers to carbon dioxide-equivalent emissions. Carbon emissions, such as from methane, are multiplied by 44/12 (the atomic weight of CO₂ divided by the atomic weight of C) in calculating CO₂e.

Water Resource Conservation and Efficiency

Reflecting the growing importance of water issues and conservation needs, an extensive section of the IgCC is devoted to water resource conservation and efficiency. Provisions are aimed at conserving water, protecting water quality, and providing for safe water consumption.

A provision within this section of the code that applies to material use in construction is one that prohibits use of cedar shake roofing materials, wood roofing materials treated with biocides, and lead flashing on collection surfaces when collected water is to be treated to potable water standards.

Indoor Environmental Quality and Comfort

The portion of the code that deals with indoor environmental quality is very similar to those found in leading green building programs and model codes. Mandated under the IgCC is development of an indoor air quality management plan that outlines methods to be used to comply with the following requirements.

- Easy air handling system access, durability and design for easy cleaning of air handling and air-stream surfaces and air handling system filters.
- Compliance with temperature and humidity control, air filter, and pollutant isolation specifications for HVAC systems.
- Indoor air quality and pollutant control for fireplaces and appliances.
- Radon mitigation in high and moderate radon potential zones.
- Building flush out requirements.
- No use of asbestos.
- Limit interior and exterior sound transmission.
- Daylighting for interior spaces.
- Compliance with emissions limits and pollutant control measures for composite wood products,⁴ adhesives and sealants, paints and coatings, flooring, acoustical ceiling tiles and wall systems, and insulation.

Several flooring and ceiling materials are not required to demonstrate compliance with volatile organic compound (VOC) and formaldehyde emissions limits given material characteristics. For flooring, those materials deemed to comply are ceramic and concrete tile, clay pavers, concrete, concrete pavers, metal, and organic-free mineral-based flooring products. The list is similar for ceiling materials: ceramic tile, clay masonry, concrete, concrete masonry, metal, and organic-free mineral-based.

Material Resource Conservation and Efficiency

The key feature of the Materials Selection section is the requirement that at least 55 percent of materials (based on mass, volume, or cost) be used, recycled, recyclable, bio-based, and/or indigenous in any combination.⁵ This requirement is referred to in this report as the “55 percent rule.” These requirements serve to favor different materials in various ways. Requirements related to materials conservation and efficiency are summarized in Exhibit 2. The 55 percent rule need not be met when a whole building life cycle assessment is performed (see section on LCA, page 12).

⁴ Composite wood products are defined within the IgCC as hardwood plywood, particleboard, and medium density fiberboard.

⁵ Should a material comply with more than one section, the material value shall be multiplied by the number of sections that it complies with.

Exhibit 2

Mandatory Provisions of the Material Resource Conservation and Efficiency Section

Material and Waste Management

- Requires that at least 50 percent of construction waste materials be diverted from disposal and allows the jurisdiction to increase the percentage of materials to be diverted to 65 or 75 percent.
- In cases of deconstruction and demolition, requires deconstruction to recover and divert from landfills a minimum of 50 percent of materials.
- Requires that areas be provided in buildings for the storage of recyclable post construction phase waste materials.
- Requires that space be provided in buildings for the storage of discarded lamps, batteries, electronics and other items that require special disposal practices specific to a given jurisdiction.

Material Selection

At least **55 percent** of the total materials used in each building project (based on mass, vol., or cost) must be any combination of the following:* **

- Used materials.
- Recycled content materials (must contain at least 25 percent combined post-consumer and pre-consumer recovered material and must be recyclable – or must contain 50 percent combined post- and pre-consumer recovered material).
- Recyclable materials (with a minimum recovery rate of 30 percent).
- Bio-based materials.

A bio-based material is defined as complying with one or more of the following:

- The bio-based content is not less than 75 percent per ASTM D6866.
 - Wood and wood products used to comply with this section, other than salvaged or re-used wood products must be certified under the SFI, FSC, PEFC, or equivalent forest certification standards, and third-party audited.
 - A material that meets requirements of USDA 7 CFR, part 2902.
- Indigenous materials (materials recovered, harvested, extracted and manufactured within 500 miles of the site, with special provisions for material transported by water or rail; mileage on materials transported via water or rail multiplied by 0.25.

Moisture Control and Material Storage and Handling

- Materials stored on site during the construction phase must comply with manufacturer's recommendations for storage and handling.
- Porous or fibrous materials and other materials subject to moisture damage must be protected from moisture during the construction phase. Material damaged by moisture or that are visibly colonized by fungi either prior to delivery or during the construction phase shall be cleaned and dried or, where damage cannot be corrected by such means, shall be removed and replaced.

* When a whole building life cycle assessment is performed, it is not necessary to comply with the material selection provisions.

** Minimum percentage may be increased to 70 or 85 percent as a project elective.

One effect of the “**55 percent rule**” in the materials selection (a percentage that project developers are encouraged to raise to 70 or 85 percent) is to increase pressure for use of used, recycled, recyclable, bio-based, and indigenous materials. It also raises the bar with respect to use of certified wood. When working under the LEED program, for instance, it is common to specify wood but to forego the singular certified wood credit; under the IgCC, foregoing the certified requirement could mean also foregoing a large contribution toward overall materials selection requirements. The same is true regarding recycled content, recyclable, and indigenous provisions.

Recycled Content Materials

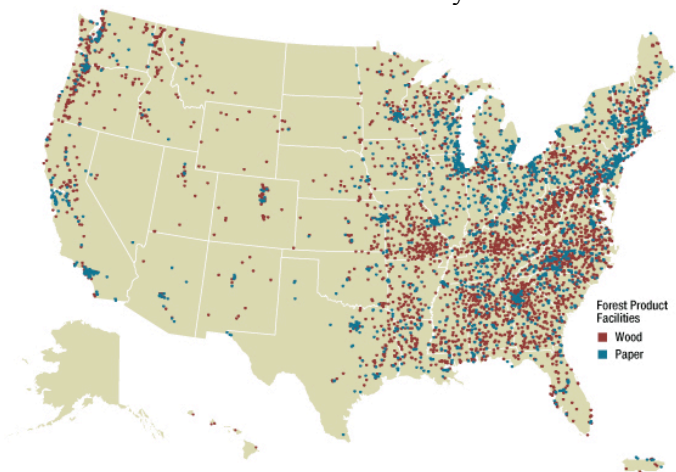
Within the IgCC a recycled content material is one having at least 25 percent combined post-consumer and pre-consumer recovered content⁶ *and that is also recyclable*, OR one that has at least 50 percent combined post-consumer and pre-consumer recovered content. Recyclable is explicitly defined as a building material or building component that can be recycled into the same material or another material with a minimum recovery rate of not less than 30 percent through recycling and reprocessing or reuse, or that is recyclable through an established, nationally available, closed-loop manufacturer’s take-back program.

The considerable emphasis on recycling and recycled content rewards materials that are commonly recycled, such as steel, and is likely to stimulate efforts to increase recycling on the part of the wood and concrete industries. The standard is likely to serve as an incentive for increasing material recovery and reuse for all materials.

Bio-Based Materials

The bio-based requirement is favorable to wood use as well as to bamboo and other agricultural fibers. However, as with other green building initiatives, the IgCC requires that wood, and wood alone, be certified and third-party audited to obtain recognition under the materials selection provisions.^{7,8} This requirement overlooks the availability of other third-party certification programs (e.g., organic certification as defined in the U.S. by the National Organic Program or the USDA Certified Biobased Product program⁹) that could be referenced to assure responsible production of other bio-based materials.

Figure 1
U.S. Forest Products Industry - 2011



Source: U.S. Environmental Protection Agency (2011)
(www.epa.gov/sectors/sectorinfo/sectorprofiles/forest/map.html)

⁶ Unlike the LEED program, equal weight is given to pre- and post-consumer recovered content.

⁷ The IgCC certification requirement for wood does allow more latitude than many green building initiatives, including LEED; the IgCC allows certification under a wide range of forest certification standards including the Sustainable Forestry Initiative (SFI), Forest Stewardship Council (FSC), those endorsed by the Programme for the Endorsement of Forest Certification (PEFC), or equivalent forest certification standards.

⁸ See also Dovetail report *Are Life Cycle Based Labeling and a Broadening of Environmental Certification Programs Needed?* (<http://www.dovetailinc.org/files/DovetailLCA0905.pdf>)

⁹ <http://www.biopreferred.gov/Labeling.aspx>

Indigenous Materials

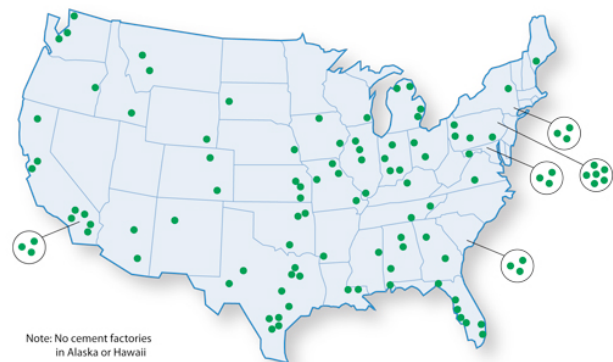
The indigenous materials specifications in the IgCC are similar to those in LEED and a number of existing green building programs, with the exception that shipping by rail or water is recognized as having a much lower environmental impact than over-the-road hauling. If transported by land/truck, materials must be recovered, harvested, extracted, and manufactured within a 500-mile radius of the building site. However, transport distances by rail or water are multiplied by 0.25 under the standard, extending the applicable radius for such materials to a potential maximum of 2,000 miles.¹⁰

The forest products industry mill map of the United States (Figure 1 – previous page) suggests that indigenous materials credits should be easily obtainable for wood building materials, and to some extent this is true. Receiving such credits for structural wood products (lumber, engineered wood, structural panels) is more difficult than the map suggests, however, in that production of these materials largely occurs in the far northwest and southeastern regions of the U.S. and across Canada. The use of rail or water transport greatly expands the potential for garnering indigenous materials credits for these materials.

The material perhaps best positioned to benefit from indigenous material credits is concrete, in that cement manufacturing plants are located throughout the U.S. (Figure 2). Eight additional plants are located across southern Canada. Sand and gravel mining is also ubiquitous.

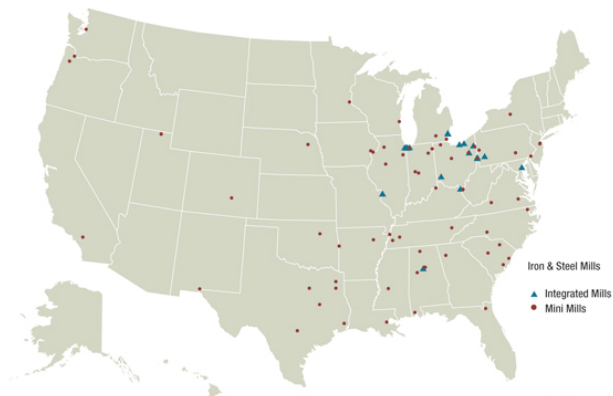
Steel is theoretically the material least well positioned to garner indigenous material credits, given that the only active iron mines in North America are located in northern reaches of Minnesota and Michigan, northern Quebec and Newfoundland, Canada, and at a number of locations in central and southern Mexico. Moreover, U.S. steel mills, and particularly structural steel mills, are heavily concentrated in the eastern half of the country, far from several of the nation's fastest growing areas (Figure 3). However, the expanded indigenous materials radius of 2,000 miles that results from transport by rail or water increases opportunities for obtaining this credit.

Figure 2
U.S. Cement Manufacturing Plants - 2010



Source: Energy Efficiency and Renewable Energy Division, U.S. Dept. of Energy (2010) (www1.eere.energy.gov/manufacturing/tech_deployment/winter2010.html#target)

Figure 3
U.S. Iron and Steel Mills - 2011



Source: U.S. Environmental Protection Agency (2011) (www.epa.gov/sectors/sectorinfo/sectorprofiles/ironsteel/map.html)

¹⁰ For example, if materials for a project are transported 1,800 miles by rail or water this is calculated as equivalent to 450 miles for truck transport ($1800 * 0.25 = 450$). Given that the distance from Pennsylvania to Arizona is approximately 2,000 miles, a large number of North American sourced materials are likely to qualify as IgCC indigenous materials when transported by rail or water.

Moisture Control and Material Storage and Handling

The IgCC requirement that material damaged by moisture or visibly colonized by fungi be cleaned and dried or removed and replaced could prove problematic for use of blue-stained wood.¹¹ As a fungus causes blue stain, albeit one that has no impact on strength, a literal interpretation of code language could lead to rejection of stained wood on the part of building inspectors. Training, clarification, or a standardized code interpretation may be needed to address this issue.

Building Commissioning, Operation, and Maintenance

This section of the code calls for development and implementation of a comprehensive commissioning plan to ensure that building and site systems are designed and installed in accordance with project and code requirements and construction documents and that such systems function as intended. In addition it is required that a Building Owner Education Manual be provided that includes information about building performance goals and reasoning behind the building's features and systems design. The Building Owner Education Manual is not simply a collection of brochures representing materials used in construction but rather a thoughtful explanation of building design and engineering. Documentation must include care and maintenance instructions and recommended replacement schedule information for natural materials including, but not limited to, wood, bio-based materials, and stone. If not already available in an easy-to-use format, manufacturers will undoubtedly be asked to provide such documentation.

Project Electives

In addition to mandatory requirements, a project developer must comply with a certain number of elective elements. Electives are selected from a series of tables. The potential number of electives to be fulfilled for each element is shown in Table 1. The jurisdiction determines the number of project electives that must be fulfilled for each project and within each code element.

Table 1
Number of Project Electives

Element Within the Code	Number of Electives to be Fulfilled
Site Development and Land Use	0-6
Materials Resources Conservation and Efficiency	0-4
Energy Conservation, Efficiency, and Atmospheric Quality	0-10
Water Resource Conservation and Efficiency	0-6
Indoor Environmental Quality and Comfort	0-3

Requirements Determined by the Jurisdiction

The adopting jurisdiction can tailor IgCC requirements in five ways:

- 1) By adopting ANSI/ASHRAE/USGBC/IES 189.1 as an alternative compliance path; in this case, only the administrative requirements apply (requiring further action only on #2 below);
- 2) By determining whether ICC 700 (the National Green Building Standard) applies to various types of residential buildings and occupancies;

¹¹ As explained by the U.S. Forest Products Laboratory (<http://www.fpl.fs.fed.us/documnts/techline/blue-stain.pdf>), blue stain is caused by microscopic fungi that commonly infect only the sapwood of trees, using parts of the sapwood (including simple sugars and starches) for food. They cannot grow in heartwood or most wetwood that does not contain the necessary food substances. Blue stain fungi are prone to cause bluish or grayish discoloration of the wood but they do not cause decay. Blue stain has no effect on the strength of the wood.

- 3) By identifying one or more recommended mandatory elements as mandatory within the jurisdiction, and if so, at what level compliance is required;
- 4) By specifying a higher threshold for key metrics such as percentage of construction or demolition wastes that must be diverted from landfill or the upper limit for the zEPI;
- 5) By specifying the number of electives for which compliance is required in addition to mandatory requirements.

Selection of Electives by Project Developers

Project developers choose from a list of potential electives, selecting not less than the minimum number. Upon selection, these become mandatory requirements for the project.

An important option available to project developers is compliance with a performance, rather than prescriptive, path in satisfying code requirements. A key element of the performance path is the conduct of a whole building life cycle assessment (LCA) to inform project decisions. LCA provides powerful insights into environmental impacts of project design and materials selection decisions. Use of the LCA option provides an immediate tangible advantage to project developers in that when a whole building life cycle assessment is performed, it is not necessary to comply with the material selection provisions (i.e., the “55 percent rule”) shown in Exhibit 2.

As spelled out in the IgCC, a whole building life cycle assessment must demonstrate that the building project achieves not less than a 20 percent improvement in environmental performance as compared to a reference design of similar usable floor area, function, and configuration that meets the minimum energy requirements of this code and the structural requirements of the International Building Code. Improvement is required for global warming potential and at least two of the following impact measures:

- Primary energy use
- Acidification potential
- Eutrophication potential
- Ozone depletion potential
- Smog potential

Compliance with these provisions requires that an assessment take into account the full life cycle, from resource extraction to demolition and disposal, including but not limited to on-site construction; maintenance and replacement; relocation and reconfiguration; and material and product embodied acquisition, process, and transportation energy. Operational energy is also to be considered, with the associated downside that it can mask the environmental trade-offs associated with material selection.¹²

Comparing Provisions of the IgCC and ANSI/ASHRAE/USGBC/IES 189.1

The ANSI/ASHRAE/USGBC/IES 189.1 standard is in many ways similar to the IgCC – perhaps not surprising in view of the fact that 189.1 serves as an alternate compliance path for the IgCC. However, in several important ways the ANSI/ASHRAE/USGBC/IES standard is markedly different. Two examples are the materials selection provisions and the provisions related to use of life cycle assessment.

¹² The inclusion of operational energy in the life cycle assessment may make sense from a building performance perspective, but it is primarily a function of design (e.g., how tight or insulated the building is) and not highly correlated to the choice of materials. Operational energy assessments can mask differences in environmental impacts and the embodied energy for various structures and their materials. Conducting assessments both *with* and *without* inclusion of operational energy – an easy thing to do – solves this problem and helps project developers better understand the resource extraction, manufacturing, and transportation differences between construction materials, in addition to the operational considerations.

Materials Selection Provisions

IgCC

Under the IgCC, at least 55 percent of the total materials used in a building project (based on mass, volume, or cost) must be used, recycled, recyclable, bio-based, and/or indigenous, in any combination (as shown Exhibit 2). In addition, wood and wood products must be third-party certified under the SFI, FSC, PEFC, or equivalent forest certification standards. These provisions provide considerable latitude to the project developer in meeting the Material Resource Conservation and Efficiency requirements.

ANSI/ASHRAE/USGBC/IES189.1

In contrast, consider the material selection requirements under ANSI/ASHRAE/USGBC/IES 189.1. The standard specifies that at least 45 percent of the total materials used in each building project must be reduced impact materials, defined as materials that meet the following requirements.

- The sum of post-consumer recycled content plus one-half of pre-consumer recycled content shall constitute a minimum of 10 percent based on cost of total materials.¹³
- Regional materials must comprise a minimum of 15 percent of the total cost of materials.
- Bio-based materials (with at least 50 percent bio-based content) must comprise a minimum of 5 percent of the total cost of materials.
- All raw materials must be harvested or extracted in accordance with the laws of the country of origin. No imported wood is allowed that appears on the CITES list.
- At least 60 percent of the wood and wood products used must be chain-of-custody certified under a certification system developed using ISO/TEC Guide 59¹⁴, or the World Trade Organization document “Technical Barriers to Trade.”¹⁵ This effectively means that any of the primary forest certification systems in use in the U.S. today (SFI, FSC, CSA, ATFS, PEFC endorsed) may be employed.

Overall, the prescriptive nature of these guidelines, which are not accompanied by the words “in any combination,” present a far more formidable task to the project developer than the more flexible wording under the IgCC.

Life Cycle Assessment

IgCC

As noted earlier, if the performance path is selected within the IgCC, it must be demonstrated through the use of a comprehensive whole building LCA that the building project achieves not less than a 20 percent improvement in environmental performance as compared to a reference design of similar usable floor area and function. This magnitude of improvement is required in global warming potential

¹³ An interesting and curious aspect of this standard is that for steel, the average industry recycled content for the country involved is allowed to be used as the recycled content of steel. What this means in practical terms is that in the United States, light steel framing is credited with a recycled content more than three times higher than it actually is.

¹⁴ International Organization for Standardization. 1994. Code of Good Practice for Standardization, ISO/TEC Guide 59. (http://www.iso.org/iso/catalogue_detail.htm?csnumber=23390)

¹⁵ World Trade Organization. 1995. The World Trade Agreement on Technical Barriers to Trade. (http://www.wto.org/english/tratop_e/tbt_e/tbtagr_e.htm#Agreement)

and at least two additional impact measures from among a list that includes primary energy use, and potential for ozone depletion, smog development, acidification, and eutrophication. Also as explained previously, completion of an LCA eliminates the need for compliance with a number of prescriptive requirements.

ANSI/ASHRAE/USGBC/IES 189.1

ANSI/ASHRAE/USGBC/IES 189.1 calls for development of LCAs for a minimum of two building alternatives, with demonstration of at least a 5 percent improvement in the selected design (over the alternative design) in at least two of the following categories:

- Land use (or habitat alteration)
- Resource use
- Climate change
- Ozone depletion potential
- Human health effects
- Ecotoxicity
- Smog
- Acidification
- Eutrophication

Again the LCA is to be comprehensive, from extraction of raw materials through building demolition, disposal, recycling, and reuse. And, as with the IgCC, the conduct of an LCA as specified eliminates the need for compliance with a number of prescriptive provisions regarding materials selection (as are outlined on the previous page). In this standard, consideration of operational energy is optional; as with the ICC, users would benefit from assessment that does not include operational energy or that is performed with and without consideration of operational energy.

A general observation is that the 5 percent threshold for improvement, as specified in ANSI/ASHRAE/USGBC/IES guidelines for LCA, seems rather low as an environmental performance improvement goal.

Summary

The IgCC is the latest manifestation of green building standards moving into codes. The 2012 standard brings the combined thinking of a number of players into model code development. Focused on commercial construction, the code also recognizes the National Green Building Standard for use with low-rise residential projects.

Key aspects of the IgCC include the following:

- The IgCC contains a number of mandatory provisions, which can be increased based on preferences of the local jurisdiction.
- Materials selection provisions are notably different than in other code initiatives and leading green building programs, providing greater flexibility to project developers.
- The “**55 percent of all materials**” rule in the materials selection section raises the stakes for use of used, recycled, recyclable, bio-based, and indigenous materials, and is likely to encourage product manufacturers to increase performance in all areas. An exception is that the *ANSI/ASHRAE/USGBC/IES 189.1* alternative pathway credits light frame steel with having a far higher recycled content than it actually does, creating a disincentive to improvement.
- The “**55 percent of all materials**” rule is also likely to increase interest in using certified wood, since for any wood to qualify under this rule it must be third-party certified, and because choosing to forego use of certified wood would have a significant impact on the ability to comply with materials selection requirements if building a wood structure.
- The conduct of a whole building life cycle assessment eliminates the prescriptive requirements regarding materials use (the “55 percent rule”), creating a significant incentive for use of LCA in the design, materials selection process.

- A requirement that operational energy be included in the whole building life cycle assessment serves to mask even large differences in the embodied energy of different building materials. Those interested in creating environmentally better structures should, if electing the performance option, also perform an assessment without including operational energy to inform the materials selection process.
- The requirement that material visibly colonized by fungi be cleaned and dried or removed and replaced could prove problematic for use of blue-stained wood – the performance properties of which are undiminished by the presence of the blue stain fungus.

The Bottom Line

Provisions of the IgCC present both opportunities and challenges to material manufacturers. Opportunities arise from the fact that rules governing materials selection are more flexible than in other standards, giving both project developers and vendors leeway in designing environmentally better structures. Conversely, the bar has been raised in several categories – such as in recycled, recyclable, and bio-based content – and is likely to spur efforts on the part of manufacturers to increase performance in these areas.

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