

IGCC: Pearl or Peril?

An overview of the potential impacts on the use of concrete, concrete products, and masonry.

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If there is a need for building code requirements governing green building design and construction, the 2012 edition of the International Code Council (ICC) *International Green Construction Code* (IGCC) appears to be a good start. Like most green building design and construction concepts, the emphasis is on energy and water conservation, indoor environmental quality, and minimizing negative environmental impacts related to siting buildings and sitework. This is a general overview about how concrete and masonry systems fair with regard to the specific requirements of the IGCC followed with a brief discussion on overall trends that might result. This document only provides a general overview and specific criteria and exceptions must be determined through appropriate consideration of the individual provisions published in the IGCC and referenced codes and standards. Since the largest potential impacts for concrete, concrete products and masonry are with regard to the design and construction of new buildings, criteria for existing buildings are not addressed.

The information is presented in a manner intended to facilitate use:

- Discussions about requirements that may have a significant direct positive or negative impact on the use of concrete, concrete products, or masonry are shown in black text.
- **Key topics or impact areas are shown in bold text.**
- Discussions about requirements that have little or no significant impact on the use of concrete, concrete products or masonry appear in this blue text. This information is provided to communicate the overall extent of requirements and potential impact of the code.
- Discussions about requirements that are to be determined by the jurisdiction adopting the code appear in this red text. The local concrete and masonry industry representatives are encouraged to take appropriate action to influence the decisions being made by the local jurisdictions where the IGCC is being adopted. This code deviates from traditional model building codes as it requires each adopting jurisdiction to make decisions on the specific criteria of the code.

List of Sections That May Impact the Use of Concrete, Concrete Products, or Masonry

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SECTION A108 Indoor Environmental Quality and Comfort

Chapter 1 - Scope and Administration

SECTION 101 GENERAL

- ✓ The code is designed as an **overlay code**. It is intended to be used with the other applicable ICC codes, including but not limited to the *International Building Code (IBC)*. *Section 101.2*
- ✓ The code is **not applicable to one- and two-family dwellings**, Group R-3 buildings or buildings four stories or less in height designated as Group R-2 or R-4. The code is **applicable to Group R-1** occupancy and use. *Section 101.3*
 - Group R-1 includes: Hotels and motels.
 - Group R-2 includes: Convents, dormitories, fraternities and sororities, monasteries, timeshares
 - Group R-3 includes: Low occupancy care and congregate facilities and boarding houses
 - Group R-4 includes:
- ✓ **Alternative methods of compliance:**
 - Buildings five or more stories in high and in occupancy and use Groups R-2 and R-4 or residential portions of multi-use buildings designed and constructed in accordance with **ICC 700 National Green Building Standard** shall be considered deemed to comply. *Section 101.3*

SECTION 102 APPLICABILITY

No significant impact on concrete, masonry or concrete products.

SECTION 103 DUTIES AND POWER OF THE CODE OFFICIAL

No significant impact on concrete, masonry or concrete products.

SECTION 104 CONSTRUCTION DOCUMENTS

No significant impact on concrete, masonry or concrete products.

SECTION 105 APPROVAL

No significant impact on concrete, masonry or concrete products.

SECTION 106 PERMITS

No significant impact on concrete, masonry or concrete products.

SECTION 107 FEES

No significant impact on concrete, masonry or concrete products.

SECTION 108 BOARD OF APPEALS

No significant impact on concrete, masonry or concrete products.

SECTION 109 CERTIFICATE OF OCCUPANCY

No significant impact on concrete, masonry or concrete products.

Chapter 2 - Definitions

No significant impact on concrete, masonry or concrete products.

Chapter 3 - Jurisdictional Requirements and Life Cycle Assessment

SECTION 301 GENERAL

✓ **Alternative methods of compliance:**

- Any building could be deemed to comply if designed and constructed in accordance with the American Society of Heating Refrigerating and Air-Conditioning Engineers, **ASHRAE Standard 189.1, *Standard for the Design of High-Performance, Green Buildings Except Low-Rise Residential*. Section 101.3**

SECTION 302 JURISDICTIONAL REQUIREMENTS

✓ Jurisdictions are provided **additional criteria that may be adopted** and made applicable to all buildings.

Several of these criteria allow better representation of the sustainability attributes of concrete and masonry construction.

- **One- and two family dwellings and residential building in occupancy and use Groups R-2, R-3, and R-4 are permitted to be included** in the scope of the code as a jurisdictional requirement. The provisions of the ICC 700 *National Green Building Standard* are not as stringent as the requirements of the IGCC. *Sections 302.1 and 101.3*

ACTION: Where state or local jurisdictions are considering the adoption of the IGCC, the criteria of the IGCC should be made applicable to these residential buildings so that the minimization of negative environmentally impacts of building construction is enhanced.

✓ State and local Jurisdictions adopting the code are provided options the place restrictions or limitations on building where specific site conditions exist. *Section 302.1*

- **Prohibition against construction in flood hazard areas** is provided primary to preserve the flood hazard area and retain natural flood protection. However, many communities have historically been located in or near waterways that flood. Real estate, prime for development and which may have already been purchased for development, might be ideal siting for appropriate community development. Further, if prohibitions placed on developing land purchased for the purpose of development could have legal implications. Alternative methods might be for park authority or conservation interests to purchase and preserve flood plain land rather than place prohibitions on development. *Sections 402.2*

ACTION: Prohibitions on land development in flood plains should not be selected as an option.

Alternatively, any building construction within the flood plain should be in accordance with ASCE 24 Flood Resistant Design and Construction except floodwalls and levees should not be considered as providing flood protection to anticipate future removal of such protections and to limit damage should the protective works be over-topped or beached.

- **Prohibition against building construction within a buffer area adjacent to bodies of water** support fish, recreation or industrial use. The buffer area is prescribed to be land within the ordinary high water mark for the body of water. No significant impact on concrete, masonry or concrete products. *Section 402.3*
- **Prohibition on site disturbance within 50 feet of conservation areas.** No significant impact on concrete, masonry or concrete products. *Section 402.5*
- **Prohibition against building construction on land zoned as agricultural** excluding buildings related to agricultural operations. No significant impact on concrete, masonry or concrete products. *Section 402.7*
- **Prohibition against building construction on greenfield sites** (sites not previously developed) unless specific density criteria, access to community assets, or access to public transportation are provided. *Section 402.8*

ACTION: Encourage state or local jurisdictions considering adoption of the code to permit construction on greenfield sites unless it is appropriate for the specific jurisdiction and consistent with community development planning. For smaller communities and many rural communities, these criteria cannot be

met realistically met simply because the community is not large enough to support the minimum number of community assets, meet density requirements or provide public transportation.

- **Provide preferred parking** for high occupancy, low-emission, hybrid and electric vehicles. No significant impact on concrete, masonry or concrete products. *Section 407.4*
- **Limit uplighting, light trespass glare** for all exterior lighting. No significant impact on concrete, masonry or concrete products. No significant impact on concrete, masonry or concrete products, however some designers may favor controlling this via lighting system specifications without consideration of surfaces being lit which may require addition support services and education for concrete surfaces that have a high reflectance. *Section 409.1*
- **Minimum amounts of waste diverted from landfills** is selected from one of three levels selected by the state or jurisdiction adopting the code. The options are 50%, 65% and 75% diversion. Since concrete and masonry constructions result in minimal amounts of materials being disposed of in landfills, generally the higher this value the better it will be for the concrete and masonry industries. *Section 503.1*
ACTION: When states and local jurisdictions are making this selection, the highest level of waste diverted from landfills should be selected.
- **Enhanced energy performance** may be required by jurisdiction by selecting a maximum zero energy performance index (zEPI). This may be problematic and may result in insulation levels within building envelope components that not economically or otherwise justified. The code already sets energy performance criteria that exceeds the *International Energy Conservation Code (ICC)* and *ASHRAE Standard 90.1 Energy Standard for Buildings Except Low-rise Residential Buildings*. *Sections 302.1 and 602.1*
ACTION: States or local jurisdictions considering the adoption of the IGCC should be encouraged to evaluate the impacts of the enhanced energy performance criteria in the code before setting even more stringent energy conservation requirements.
- Controls for heating, ventilating and air-conditioning (HVAC) and lighting systems shall be capable of receiving open and interoperable **automated demand-response** (Auto-DR) signals where Auto-DR services are supported unless buildings loads are small or 20% of the building load is satisfied using renewable energy resources. No significant impact on concrete, masonry or concrete products unless a new facility or building is being constructed by the manufacturer or supplier. *Section 604.1*
- Where **municipal reclaimed water** is accessible and allowed by law, it shall be used to supply water closets, water-supplied urinals water supplied trap primers and applicable industrial uses. No significant impact on concrete, masonry or concrete products unless industrial uses are interpreted as including water for use in concrete mixes. This is most likely a huge stretch. *Section 702.7*
- To **control levels of volatile organic compounds (VOCs)** state and local jurisdictions are provided the opportunity to require post-construction pre-occupancy baseline indoor air quality (IAQ) testing. Concrete and masonry systems may be left exposed and reduce the amount of interior finishes that may contain elevated levels of VOCs. The concrete and masonry systems may also help to reduce the amount of dust and dirt retained in interior finishes, especially carpet. *Section 804.2*
ACTION: Encourage state and local jurisdictions to select this option which in turn could encourage design professionals to select exposed concrete and masonry systems within buildings to minimize the amount of VOCs.
- The state or local jurisdictions are provided the option to require **more stringent sound transmission and sound level criteria**. This is important in sustainable buildings not only because the more stringent requirements improve occupant comfort and productive but also because sustainable buildings are encouraged to be sited in ways to maximize density and near mass transit, both which tend to increase exterior noise levels. Concrete and masonry offer the designer a variety of assemblies that can help satisfy these requirements. *Section 807.1*

ACTION: Encourage state and local jurisdictions to adopt this option to help achieve improved occupant comfort and productivity immediately upon occupancy and over the life of the building as development density increases and mass transit becomes more readily available.

- State and local jurisdictions are provided with the opportunity to require **evaluation of existing buildings**. Since the amount of concrete or masonry used in the renovation of existing buildings is relatively small, the industry may remain silent on this issue. *Section 1007.2*
- State or local jurisdictions adopting the code are provided the option to **require post certificate of occupancy zEPI, energy demand, and CO_{2e} emissions reporting**. This is a requirement that is not easily enforced because if reporting indicates non-compliance most jurisdictions will find that they have not recourse after the occupancy permit has been issued unless they take drastic measures such as condemn the building to prevent occupancy. However, since the amount of concrete or masonry used in the renovation of existing buildings is relatively small, the industry may remain silent on this issue. *Section 1007.3*

SECTION 303 WHOLE BUILDING LIFE CYCLE ASSESSMENT

- The intent of the materials requirement sections may be deemed satisfied though **whole building life cycle assessment** (LCA). The LCA must be conducted on comparable alternative building designs and demonstrate at least a 20% reduction in global warming potential and at least two of five other categories: primary energy use, acidification potential, eutrophication potential, ozone depletion potential or smog potential. While the expense of this approach will tend to limit its use to large projects, it is clearly the most technically accurate approach with regard to achieving improved sustainability. *Section 303.1*

ACTION: Where states or local jurisdictions are considering the adoption of the IGCC, the jurisdiction should be encouraged to adopt the whole building life cycle assessment jurisdictional elective.

Chapter 4 – Site Development and Land Use

SECTION 401 GENERAL

- ✓ Section requires **pre-design site inventory and assessment** including areas requiring protection, hydrological conditions, invasive plant species for removal, and native plant species to be preserved. No significant impact on concrete, masonry or concrete products.

SECTION 402 PRESERVATION OF NATURAL RESOURCES

- ✓ Reduces the use of potable water for irrigation systems excluding new plantings, food production, shade trees and otherwise permitted. No significant impact on concrete, masonry or concrete products.
- ✓ **Restricts development** as noted in discussion in Section 302 Jurisdictional Requirements
- ✓ **Limits land disturbance** on greenfield sites to with 40 feet of the building, 15 feet of hardscapes and utilities and 25 feet for permeable surfaces where compaction must be limited. In some instances this could create difficulties for staging and construction operations, such as having adequate space to accommodate scaffolding the proper and safe use of construction forklifts for loading scaffolds.

SECTION 403 STORMWATER MANAGEMENT

- **Manage stormwater** by infiltration (except on brownfields with contaminated soils), evapo-transpiration; rainwater harvest; and runoff reuse. Pervious pavements may provide a design solution where infiltration stormwater management is being considered.
- **Prohibition on most applications of coal tar sealers.** Coal tar sealers historically have been used to seal cracks in asphalt pavements. Coal tar sealers, while still popular in some small regions of the country have for the most part been replaced asphalt emulsion sealers. Where it is common practice to use coal tar sealers on asphalt pavements or asphalt emulsion sealers are not readily available this prohibition could be favorable to pavement systems other than asphalt.

SECTION 404 LANDSCAPE IRRIGATION AND ORNAMENTAL FOUNTAINS

No significant impact on concrete, masonry or concrete products.

SECTION 405 MANAGEMENT OF VEGETATION SOILS AND EROSION CONTROL

No significant impact on concrete, masonry or concrete products.

SECTION 406 BUILDING SITE WASTE MANAGEMENT

- ✓ Building site waste management plan shall have at least **75% of building site waste diverted from landfills**. No significant impact on concrete, masonry, or concrete products, however, construction wastes is addressed in Section 503.

SECTION 407 TRANSPORTATION IMPACT

- ✓ At least one **paved walkway or bicycle paths** shall be provided. This may result in additional pavement work.
- ✓ **Changing and shower rooms** must be provided for bicyclists. This may result in increased use of “smooth, hard, non-absorbent surfaces” as defined by the International Building Code.
- ✓ **Short and long term bicycle storage** is required for most buildings. This may result in additional pavement work.
- ✓ **Preferred vehicle parking** shall be provided for high occupancy, hybrid, electric, and low-emission vehicles. No significant impact on concrete, masonry, or concrete products.

SECTION 408 HEAT ISLAND MITIGATION

- ✓ In climate zones 1 through 6, most of the contiguous United States, at least 50% of hardscapes shall comply with one of the **heat island mitigation methods**:
 - Hardscapes shall be tested to demonstrate a **minimum solar reflectance value of 0.30**. Pervious and permeable concrete pavements and concrete pavements without stains or added pigments are deemed acceptable without testing. This creates opportunities to promote concrete pavements in lieu of other pavement systems and in lieu of compliance by shading
 - **Hardscapes shaded by structures**. This is an alternate to the use of concrete and pervious concrete.
 - **Hardscapes shaded by trees**. This is an alternate to the use of concrete and pervious pavements.
 - **Pervious pavements** with a percolation rate of at least 2 gallons per minute per square foot and produced using uniform aggregate. This creates opportunities to promote concrete pavements in lieu of other pavement systems and in lieu of compliance by shading.
- ✓ Not less than 75% of **roof surfaces** and covered parking shall comply with one of two options:
 - The **minimum aged solar reflectance value** for flat roofs is 0.55, and for sloped roofs, it is 0.30. Concrete and masonry roof ballast systems may satisfy this requirement, but testing is required.
 - **Vegetative roof**. Vegetative roofs increase weight and may require more robust structural support which may be provided with concrete and masonry systems.

SECTION 409 SITE LIGHTING

- ✓ **Lighting zones** are classified as national and state parks, forest land and rural; predominantly residential; predominantly high-activity commercial; and areas not described in the previous identified classifications.
 - **Uplighting** is limited based on the lighting zone. No significant impact on concrete, masonry or concrete products.

- **Backlighting and glare** are limited based on lighting zone. No significant impact on concrete, masonry or concrete products.

Chapter 5 – Material Resource Conservation and Efficiency

SECTION 501 GENERAL

No significant impact on concrete, masonry or concrete products.

SECTION 502 CONSTRUCTION MATERIAL MANAGEMENT

- ✓ Materials are required to be **stored and handled in accordance with manufacturers' recommendations**. Where manufacturers' recommendations do not exist, industry standards and guidelines shall be followed. This can be problematic where the manufacturers' recommendations differ from referenced standards such as American Concrete Institute 318 Building Code Requirements for Structural Concrete; The joint The Masonry Society 402/602, American Concrete Institute 530/530.1, American Society of Civil Engineers 5/6 *Building Code Requirements and Specifications for Masonry Structures*. As written the manufacturer's recommendations even where they are not be as extensive as the referenced standards shall take presidency over the standards and standard specifications.
 - Requirements are intended to **control construction phase moisture**. Porous, fibrous and other materials subject to moisture damage shall be protected from moisture during the construction phase. Virtually all concrete, masonry, and concrete products are porous and thus must be protected during the construction phase, thus including building elements that have been erected. The intent was probably to address mold and mildew which forms on organic materials, but that restriction is not included in the language the code. Further, depending on interpretation, arguments could be made that all concrete, masonry and concrete products are potentially subject some degree of moisture damage.
 - **Materials damaged by moisture or visually colonized by mold or mildew** shall be cleaned and dried or removed and replaced. Since concrete, masonry and concrete products are not susceptible to nor support the growth of mold and mildew this can be favorable.

SECTION 503 CONSTRUCTION WASTE MANAGEMENT

- ✓ At least **50% of all nonhazardous construction waste is required to be diverted from landfill**. The amount of waste materials is required to be determined by weight or volume but not mixture of weight and volume. This has little impact on concrete or masonry systems for most projects as the amount of waste tends to be very small. Excess ready-mix concrete is typically returned to the producer where it is processed. Waste from concrete products or masonry are typically used elsewhere or crushed and used as aggregate. However, if there is a waste that includes a significant amount of concrete or masonry, the industry is penalized due to the typical volume and weight of these systems compared to that of lightweight framing systems. This occurs because the percentages are based on total waste not waste by each specific building material.

SECTION 504 WASTE MANAGEMENT AND RECYCLING

- ✓ Areas for the **collection and storage of post-occupancy waste** materials including lamps, batteries and electronics are required. The only impact on the concrete, concrete products and masonry industries would be if they are building a new building or facility under the provisions of this Code. No significant impact on concrete, masonry or concrete products.

SECTION 505 MATERIAL SELECTION

- ✓ This section requires that **at least 55% of all major building materials shall be reused materials, have recycled content, be recyclable, be bio-based, or be indigenous**. This includes all concrete, concrete products and masonry. These materials selection requirements are permitted to be **waived where a whole building life cycle assessment** is performed.
- ✓ The material selection criteria shall be **based on either weight or volume** but not by using a mixture of volume for some materials and weight for others. These measurement criteria are not favorable to massive building materials such as concrete, concrete products and masonry. For light frame construction 3 stories and under in height, the foundation system and slab on grade could easily exceed 55% of the total building materials measured by weight or volume. Under such conditions **no material selection criteria will need to be satisfied for light frame above-grade construction**. However, where massive materials are selected for the above grade construction the foundation system and slab on grade will rarely be 55% of the total weight or volume of all building materials. Thus, for massive construction the **concrete, concrete products, and masonry used for above grade construction will need to satisfy the material selection criteria**. Concrete, concrete products, and masonry meet the materials selection requirements because the products are almost always recyclable and typically indigenous and could also contain recycled content.
 - Concrete and concrete products are rarely **used materials**. However, masonry units may be re-used. This set of criteria may encourage more reuse of masonry materials. While information on the proper preparation used masonry units is available, there could be serviceability problems where the appropriate procedures for preparing units for reuse are not strictly followed.
 - Concrete, concrete products, and masonry units may be manufactured with a combination of:
 - **25% post-consumer and pre-consumer recycled content and be recyclable or**
 - **50% post consumer and pre-consumer recycled content where the final product is not recyclable.**These target levels will often be difficult to achieve without a significant use of recycled concrete or masonry as aggregate or using alternative recycled materials as aggregate. **Caution must be exercised when selecting recycled concrete or alternative materials as aggregates**. Some aggregates made from recycled concrete may contain contaminants for its prior applications such as oil for manufacturing floor surfaces or parking areas. While suitable for use as base material they may not be suitable for use in concrete or concrete products. Also some alternative materials which may be considered for concrete may be detrimentally reactive with the cementitious materials in the concrete.
 - Virtually all **concrete, concrete products, and masonry are 100% recyclable** and more than satisfies the requirement of being at least 30% recyclable. While concrete, concrete products, and masonry are not recycled through an established nationally available closed loop manufacturer's take back program; where existing construction is demolished, concrete, concrete products and masonry are commonly crushed for future use as aggregate in new construction.
 - To qualify with the requirements of this section, **bio-based materials** must contain not less than 75% bio-based content as determined by testing, labeled in accordance with sustainable forestry certification, or comply with U.S. Department of Agriculture *Guidelines for Designating Bio-based Products for Federal Procurement*. While this section is not applicable to concrete, concrete products, and masonry, it has set a precedence for qualifying compliance through certification programs which will likely spill over to other materials. The wood industry has argued that if their harvesting must be certified than providers of other materials should have comparable requirements for determining compliance via certification programs.

- Most **concrete, concrete products, and masonry are indigenous** because ingredients are recovered or extracted and manufacturing occur within 500 miles of most construction project sites. The distance, if any, shipped by rail or water is permitted to be multiplied by 0.25 when determining the total distance of the shipment. For example:
 - Aggregate trucked 50 miles to a rail or barge terminal: 50 miles
 - Railed or barged for 1000 miles: $1000 \times 0.25 = 250$ miles
 - Trucked 50 miles to the concrete producer: 50 miles
 - Concrete is shipped 50 miles via truck to the project site: 50 miles

Total Distance: 400 miles

SECTION 506 LAMPS

- ✓ Requirements for low mercury, fluorescent and compact fluorescent lamps. No significant impact on concrete, concrete products or masonry.

SECTION 507 BUILDING ENVELOPE MOISTURE CONTROL

- ✓ Requires **inspection and verification** of the building envelope elements designed to control moisture.
 - The criteria are applicable for the entire:
 - **foundation sub-soil drainage;**
 - **waterproofing;**
 - **dampproofing; and**
 - **under-slab water vapor protection.**

This will have little or no direct impact on the use of concrete, concrete products or masonry since all projects will have these elements. However, the additional inspection will increase total construction costs.

- The criteria are applicable to **no less than 25%** of:
 - **flashings for walls, drainage systems,** windows, exterior doors, and skylights;
 - **exterior wall coverings;** and
 - roof coverings, roof drainage and flashing.

For concrete or masonry drainage type wall systems (**veneers and cavity walls**) this will be an additional cost that may not be applicable to other types construction, such as curtain wall construction thus adding costs to some concrete and masonry systems and limiting the ability to compete, even though the veneers and drainage walls have historically been considered premier construction systems to provide moisture penetration resistance. For concrete and masonry systems designed with external insulation the inspection and verification will be applicable to **any exterior wall coverings, including stucco and adhered veneers.**

Chapter 6 Energy Conservation, Efficiency and CO_{2e} Emission Reduction

SECTION 601 GENERAL

- ✓ Allows compliance by using either **performance-based design** (Sections 602, 608.6, 609, 610 and 611) or **prescriptive based design** (Sections 605, 606, 607, 608, 609, 610 and 611). The implications for the concrete, concrete products, and masonry industries are addressed in the respective sections.

- ✓ All buildings shall be equipped with: metering complying and commissioned. Where required buildings shall be provided with automatic-demand response capabilities. No significant direct impact for concrete or masonry systems.

SECTION 602 MODELED PERFORMANCE PATHWAY REQUIREMENTS

- ✓ Criteria are set for **performance-based compliance**.
 - Modeling shall **use source energy measured in kBtu/sf-yr**. While the source energy issue does not impact the concrete and masonry industries, the measurement criteria are favorable to many concrete and masonry construction systems. Compliance measured in energy per square foot of floor area per year shifts the attention from envelope performance to overall building performance. Many concrete and masonry systems permit shorter floor to floor heights which can significantly reduce the energy required for conditioning the building. However, there is also a drawback. Shorter interior components and exterior walls reduce the amount of concrete or masonry materials where concrete and masonry are used for interior components or exterior wall components.
 - The performance-based design approach utilizes **zero energy performance index (zEPI)** as the measurement criteria which differs for the measurement criteria used currently adopted energy codes and referenced standards, including the International Code Council *International Energy Conservation Code* (IECC) and American Society of Heating Refrigerating and Air-conditioning Engineers (ASHRAE) standards *Energy Standard for Buildings Except Low-Rise Residential Buildings* (ASHRAE 90.1), and *Energy Efficient Design of Low-Rise Residential Buildings* (ASHRAE 90.2). While this approach does not by itself impact the ability of the energy performance design criteria to be satisfied with concrete and masonry systems, it will require the industry to become familiar with a new design approach. The zEPI is equal to 57 times the ratio of the energy use index for the proposed design (EUIp) to the energy use index of the base design (EUI). The energy use index for the base building shall be determined using ASHRAE 90.1 *Appendix G Performance Rating Method*.
 - Electric power is modified based on the electric power grid sub-regions as determined by the U.S. Environmental Protection Agency (EPA). The **conversion factors reflect the regional resources used to generate electric power**. The overall energy performance is now impacted not just by climate and building design, but also by regional methods for electric power generation.
 - **Carbon dioxide equivalents (CO_{2e})** shall be demonstrated to be reduced. The minimum reduction of carbon dioxide equivalent global warming potential for the proposed design (CO_{2e} pd) is determined by dividing the product of the zEPI and carbon dioxide equivalent of the standard reference budget design (CO_{2e} srbd) by the constant 57.

SECTION 603 ENERGY METERING, MONITORING AND REPORTING

- ✓ Requires **metering, monitoring and reporting of energy use** by load and energy types regardless of whether design is performance-based or prescriptive-based. Data must be reported in a fashion that permits the calculation of CO_{2e}. No significant impact on concrete, concrete products, or masonry.
 - **Load types** include: HVAC system total energy use, lighting system total energy use, plug loads, process loads and energy used for building operations loads and other miscellaneous loads.
 - **Energy-type** metering include: gaseous fuels, liquid fuels, solid fuels, electric power, district heating and cooling, combined heat and power, renewable and waste energy, solar electric, solar thermal, waste heat, wind power systems and other renewable energy electric production systems.

SECTION 604 AUTOMATED DEMAND RESPONSE (AUTO-DR) INFRASTRUCTURE

- ✓ Sets criteria for **open and interoperable automated demand-response infrastructure** where electric utility or regional Independent System Operator (ISO) or Regional Transmission Operator (RTO) offer a demand response program to building. No significant impact on concrete, concrete products or masonry.

SECTION 605 BUILDING ENVELOPE SYSTEMS

- ✓ Sets the **prescriptive requirements for building envelop systems**.
- ✓ Requires in addition to complying with Section C402 of the IECC the building envelope systems must also:
 - Building thermal envelope and fenestration tabular values in the IECC shall be no more than 10% less than the values in the IECC tables. Wall, floor, roof and perimeter thermal performance based on thermal resistance insulation is increased to reduce the coefficient of thermal transmission by 10%. This could disqualify some conventional concrete and masonry building envelope systems from meeting the minimum criteria.
 - In locations where the mean annual sunshine percentage is less than 45%, **skylights are not permitted to exceed 5% of the roof area**. No significant impact on concrete, concrete products or masonry.
 - All vertical fenestrations within 45° of the nearest east, south, or west cardinal ordinate must be **shaded with by permanent horizontal exterior projections** with a projection factor of 0.25 or more and not less than one half the height of the glazing. This creates opportunities to provide fenestration shading with balconies. In climates where thermal bridging of concrete slabs through the building thermal envelope creates excessive energy losses the balconies could be supported by properly anchored wing walls. These criteria are not mandatory where:
 - Buildings are located in hurricane-prone regions.
 - Fenestration is located within 18" of the lot-line.
 - Equivalent shading is provided by other buildings, structures, geological formations or other permanent exterior projections which may be concrete or masonry wing walls.
 - The solar heat gain coefficient of the fenestration containing automatically controlled dynamic glazing is appropriately lowered.
 - **Air barriers shall be provided** unless the building thermal envelope is tested to demonstrate that the air leakage through the building thermal envelope is 0.25 cubic feet per minute under a pressure of 0.30 inches of water as determined in accordance with ASTM E779 *Standard Test Method for Determining Air Leakage Rate by Ton Pressurization*.
 - Building entrances **required to be protected with a vestibule** shall conform to ANSI/AMCA 220 *Laboratory Methods of Testing Air Curtain Units for Aerodynamic Performance Rating*.
 - Criteria is provided for **above-deck roof insulation** for existing buildings where the roof slope is 2 vertical to 12 horizontal or less.

SECTION 606 BUILDING MECHANICAL SYSTEMS

- ✓ This section sets criteria for **building mechanical systems** and has no significant impact on concrete, concrete products, or masonry construction.
 - Specific requirements are provided for **performance-based and prescriptive-based design**.
 - Equipment shall meet minimum **efficiency requirements** that are governed by Federal standards or where Federal standards do not exist, this code.
 - Specific **efficiency requirements** apply to:
 - Ground source heat pumps

- Multi-stage ground source heat pumps
- Stand alone return and exhaust fans
- **Duct and plenums** are required to be insulated, sealed and tested.
- **Piping** for heating, ventilation and air-conditioning is required to be insulated.
- **Economizers** are required for every cooling system that utilizes a fan. Economizers are required to comply with the IECC unless specific performance criteria are met.
- **Air economizers** are required to:
 - have a capacity that does not exceed the lesser of 480,000 Btu/hr or 20% of the building's air economizer capacity.
 - have the capability to modulate outdoor and return air dampers
 - be capable of being sequenced with mechanical cooling equipment unless mixed air temperature limit control is permitted.
 - have the capability to automatically reduce outdoor air intake.
 - have the capability to prevent over-pressurizing by relieving outdoor air intake.
- **Water economizers** are required to:
 - be capable of cooling supply air by indirect evaporation and providing up to 100 percent of the expected system cooling load at outdoor air.
 - have a water-side pressure drop of less than 15 feet of water for pre-cooling coils and water-to-water heat exchangers used a part of a water economizer system
 - have a maximum pressure drop less than 15 feet of water.
 - provide partial cooling where integrated with mechanical cooling systems
 - not increase the building heating energy use during normal operations.
- **Individual fans with motors** equal to or greater than 1.0 horsepower shall be driven by a mechanical or electrical variable speed drive or by a vane-axial fan with variable-pitch blades.
- **Kitchen ventilation and exhaust systems** are required to be accordance with the *International Mechanical Code* and be capable of delivering conditioned supply air to any space containing a kitchen hood.
- **Laboratory exhaust systems** shall meet the provisions of the *International Energy Conservation Code* unless buildings with laboratory exhaust systems having a total exhaust rate greater than 5,000 cfm is provided and equipped with an appropriate exhaust and make-up air flow rates; appropriate heat recovery system to precondition make-up air; or direct makeup auxiliary air supply equal to not less than 75 percent of the exhaust air flow rate.
- ✓ In Group R-1 occupancies, each sleeping room is to be provided with a dedicated system to **automatically control the heating, ventilating and air-conditioning systems**, unless the number of sleeping rooms is 20 or less.

SECTION 607 BUILDING SERVICE WATER HEATING SYSTEMS

- ✓ This section sets criteria for building **service water heating where prescriptive-based design** is used. These criteria have no significant direct impact on the use of concrete, concrete products or masonry. **There are specific criteria for snow melt systems and piping within slabs.**
- ✓ Equipment covered by federal standards must **comply with the criteria of the IECC.**
- ✓ **Thermostats controls for water heaters** in dwelling units are required to have maximum and minimum temperature limits.

- ✓ **Pools in conditioned space** are required to have no less than 25% of the energy required to operate the pool and no less than 50% of the peak energy required to condition the pool area to be provided with onsite renewable energy or heat recovery system.
- ✓ Onsite renewable energy or heat recovery system is required for **snow melt systems**, except where the snowmelt system is provided for areas used for emergency access and egress. The amount of energy provided by these systems are based on peak load demand and must be at least
 - 20% for hydronic snowmelt systems and 50% for electric snowmelt systems
- ✓ **Waste water heat recovery system** are required for restaurants and banquet halls, laundries, boarding houses, hotels, motels, apartment buildings, health clubs, spas, hospitals, psychiatric hospitals, and nursing homes; except for buildings that are single story with slab-on-grade or crawl space construction.
- ✓ Minimum requirements are provided for thermally **insulating service water heating piping**.
- ✓ **Service hot water piping is installed within a slab or below grade** shall be contained in a protective and water proof channel or sleeve that accommodates removal and replacement of piping insulation.
- ✓ Controls that allow **continuous, timer, or water temperature-initiated operation of a circulating pump and gravity and thermosyphon circulation loops and are prohibited**.
- ✓ Service hot water systems shall be **activated on demand** by either a hard-wired or wireless activation control.

SECTION 608 BUILDING ELECTRIC POWER AND LIGHTING SYSTEMS

- ✓ Where **prescriptive-based design** is used the building electric power and lighting systems are required to comply with the provisions of the IECC and met additional criteria in the IGCC. No significant direct impact on the use of concrete, concrete products or masonry.
 - **Automatic shut off is required for hard-wired lighting in sleeping units** of residential occupancies
 - **Automatic occupant sensor light reduction controls** are required to reduce lighting when corridors, enclosed stairwells, storage and stack areas not open to the public and parking garages are not occupied.
 - **A 30% reduction in exterior lighting** shall be automatic within 2 hours after facility operations conclude.
 - **Automatic timers are required to be used to shut of lighting** of building facades, signage, and landscape features when the facility is not operating.
 - **Automatic daylight controls** are required to reduce artificial lighting when adequate daylight is present.
 - A minimum number of **electrical outlets and receptacles equipped with occupant sensors or time switches** are required in office spaces, classrooms, print-shops, copy rooms and computer labs.
 - Computer monitors, plug in space heaters, air purifiers, radios, computer speakers, coffee makers, fans, and task lights are required to be plugged into controlled receptacles.
 - Displays, projectors, and audio amplifiers in offices, classrooms, conference and meeting rooms, and multipurpose rooms are required to be controlled by an occupant sensor.
 - Water dispensers that utilize energy to cool or heat drinking water and lighting integral to vending machines and refrigerator and freezer cases are required to be controlled by time switch controls.
 - Continuously burning pilot lights are prohibited for fixtures providing illumination by combustion of fuel gas.
 - Requirements are provided for **electric transformer efficiencies**.
 - Prior to issuance of the certificate of occupancy, **verification of the type and quantity of luminaries, lamps and ballasts and lighting controls** is required.
 - The ability to **connect main electrical panels to onsite renewable energy** sources is required.

SECTION 609 SPECIFIC APPLIANCES AND EQUIPMENT

- ✓ Energy efficiency and performance requirements are set for both **permanent and portable appliances**. No significant direct impact on the use of concrete, concrete products or masonry.
- ✓ **Permanent appliances** include: lighting, power conversion systems, motors, transmissions, drives, ventilation, and guides for elevators; lighting, drives, energy recovery systems, and handrails for escalators and moving walkways; commercial food service equipment; and conveyors.

SECTION 610 BUILDING RENEWABLE ENERGY SYSTEMS

- ✓ This section sets the **criteria for renewable energy systems** and has no significant direct impact on the use of concrete, concrete products or masonry. While passive solar is a renewable energy system, the current intent is to address passive solar systems on the load reduction side not and not on the providing renewable energy side of the equation for energy performance
 - For both performance-based and prescriptive-based design, **renewable energy shall provide at least 2% of the total annual energy load**.
 - Requirements are set for sizing, installation, inspection, maintenance and performance verification for **solar photovoltaic systems**.
 - Requirements are set for sizing, installation, and location of **wind energy systems**.
 - **Solar water heating equipment shall provide a least 10%** of the hot water usage.
 - Renewable energy systems must be **metered and monitored**.

SECTION 611 ENERGY SYSTEMS COMMISSIONING AND COMPLETION

- ✓ This section sets requirements for commissioning and completion of heating, ventilating and air-conditioning systems (HVAC) and has no significant direct impact on the use of concrete, concrete products or masonry.
 - **Evidence of mechanical systems commissioning and completion** shall be provided by registered design professional.
 - **Testing and balancing of HVAC** systems and controls are required.
 - **Re-commissioning is required** between 18 and 24 months of occupancy.
 - **Commissioning and completion of the building envelope systems** must be verified by a registered design professional.
 - Construction and owner education documents are required.

Chapter 7 Water Resource Conservation, Quality and Efficiency

SECTION 701 GENERAL

- ✓ Provisions address **water conservation, protecting water quality and providing safe water** for consumption. No significant impact on the use of concrete, concrete products or masonry.

SECTION 702 FIXTURES, FITTINGS, EQUIPMENT AND APPLIANCES

- ✓ **Maximum water flow rates** and fixture criteria are provided for showers, food establishment pre-rinse sprays, drinking fountains, non-water urinals, appliances, clothes washers, steam cookers, dishwashers, ice makers,
- ✓ **Use of reclaimed water** for water closets water supplied urinals and applicable industrial uses.
- ✓ **Delivery and distribution of hot and tempered water**.

- ✓ Additional requirements address **water conservation in other fixtures and appliances** including trap primers, water-powered pumps, food service hand-washing faucets, dipping wells, vehicle wash facilities, food waste disposers, combination ovens, autoclaves and sterilizers, liquid ring vacuum pumps, and film processors.

SECTION 703 HVAC SYSTEMS AND EQUIPMENT

- ✓ This section address water **conservation requirements for heating ventilating and air-conditioning systems** and has no direct impact on the use of concrete, concrete products and masonry. Requirements include:
 - No potable water for **closed loop hydronics systems**
 - Lock outs on **humidification systems** when humid levels are within comfort zone.
 - Restrictions on the use of potable water as tempering water for **sanitary discharge**.
 - **Condensate water** shall be collected and reused on site.
 - Once through cooling for **heat exchangers** is prohibited.
 - **Humidifier discharge** shall be reused.
 - Specific requirements addressing location, metering controllers, alarms, drift, water quality, and discharge for **cooling towers evaporative condensers and fluid coolers**.
 - Specific requirements for **exhaust hood scrubber systems**, wash-down systems and water sources.
 - **Restrictions on water use** and requirements for overflow alarms and automatic pump shutoff reservoir discharge and reuse of discharge water for evaporative cooling systems.

SECTION 704 WATER TREATMENT DEVICES AND EQUIPMENT

- ✓ Specific requirements are provided for **water softeners, reverse osmosis water treatment systems, and onsite water treatment systems**. No significant impact on the use of concrete, concrete products, or masonry.

SECTION 705 METERING

- ✓ **Water consumption** from any source associated with the building or building site shall be metered. No significant impact on the use of concrete, concrete products, or masonry.

SECTION 706 NON-POTABLE WATER REQUIREMENTS

- ✓ This section governs the **use of non-potable water** and has no significant impact on the use of concrete, concrete products or masonry.

SECTION 707 RAINWATER COLLECTION AND DISTRIBUTION SYSTEMS

- ✓ This section addresses the construction, installation, alteration, and repair of **rainwater collection and conveyance systems**, including non-potable water connections; water collected for irrigation; piping, plumbing components and materials; insect and vermin control; drainage, freeze protection; trenching; debris excluders; gutters and downspouts; markings; filtration; and disinfection
- ✓ Further provisions address storage tanks and manhole access. Storage tanks are required to be constructed of durable non-absorbent and corrosion resistant materials. **Where rainwater collection and distribution systems are present concrete, concrete products, and masonry** may be appropriate materials for the systems and the infrastructure supporting the systems.

SECTION 708 GRAY WATER SYSTEMS

- ✓ This section has no significant impact on the use of concrete, concrete products, or masonry as it addresses the use of **gray water systems**. The criteria addresses connections to potable and non-potable water;

installation; landscape irrigation use; insect and vermin control; freeze protection; trenching requirements; traps; collection pipes; joints, size; markings; disinfection; storage tanks; make-up water; overflow; access; venting; outlets; drains; valves, pumping and controls; standby power; regulators; testing and inspection; and discharge.

- ✓ Storage tanks must be constructed of durable non-absorbent corrosion resistant materials. **Where gray water systems are used there could be applications for concrete, concrete products and masonry** for the storage tanks and supporting infrastructure.

SECTION 709 RECLAIMED WATER SYSTEMS

- ✓ No significant impact on the use of concrete, concrete products, and masonry as this section addresses **reclaimed water systems**. Included are requirements for permits; potable water connections; installation; applications; components and materials; valves and regulators; trenching; distribution piping; testing; and inspections.
- ✓ **Storage or supporting infrastructure for reclaimed water systems may contain concrete, concrete products or masonry systems** including but not limited to pipe, manholes, and tanks.

SECTION 710 ALTERNATE ON-SITE NON-POTABLE WATER SOURCES

- ✓ This section allows other **alternative on-site non-potable water sources** where approved by the jurisdiction having authority. This includes stormwater, reverse osmosis reject water; foundation drain water and swimming pool back wash water. There is not significant direct impact on the use of concrete, concrete products or masonry.
- ✓ **Alternative on-site non-potable water source systems may contain concrete, concrete products or masonry**. Further collection systems may include pervious or permeable concrete, concrete product or masonry systems.

Chapter 8 Indoor Environmental Quality and Comfort

SECTION 801 GENERAL

This section addresses the **interior environment** as relate to occupant health. An indoor air quality management plan is required. There are not significant impacts on the use of concrete, concrete products, or masonry, but there may be opportunities to use such products to facilitate compliance.

SECTION 802 BUILDING CONSTRUCTION FEATURES, OPERATIONS AND MAINTENANCE FACILITATION

- ✓ **Access to air handling ducts** and equipment and access to and sealing of filter racks is required. No significant impact on the use of concrete, concrete products or masonry.

SECTION 803 HVAC SYSTEMS

- ✓ Criteria are set for **sealing ducts** and heating, ventilating, and air-conditioning equipment; related air distribution components during construction; and criteria for temporary ventilation during construction. This section contains no significant impact on the use of concrete, concrete products or masonry.
- ✓ Where forced-air HVAC is used during construction, **filters must be removed and replaced** with new filters.
- ✓ **Thermal environment conditions for human occupancy** are required to comply with American Society of Heating Refrigerating and Air-conditioning Engineers *Thermal Environmental Conditions on Human Occupancy* (ASHRAE 55).

- ✓ **Smoking shall not be permitted** inside buildings.
- ✓ **Pollutant sources** related to print, copy and janitorial rooms, garages and hangars are required to be controlled.
- ✓ **Air-conditioning system filters** are required to have a minimum efficiency reporting value (MERV) of 11.

SECTION 804 SPECIFIC INDOOR AIR QUALITY AND POLLUTION CONTROL MEASURES

- ✓ **Fireplaces and appliances** shall be vented to the outdoors and provided with combustion air from the outdoors. This is applicable to fireplaces and heaters constructed of concrete, concrete products or masonry.
- ✓ **Wood stoves and wood burning fireplace inserts** shall be listed and labeled in accordance with U.S. Environmental Protection Agency standards of performance for New Residential Wood Heaters, 40 CFR Part 60, subpart AAA. This may be interpreted as being applicable to fireplaces and heaters constructed of concrete, concrete products or masonry.
- ✓ **Biomass fireplaces, stoves and inserts** are required to comply with ASTM International E 1509 *Standard Specification for Room Heaters, Pellet Fuel-Burning Type* or Underwriters Laboratories (UL) 1482 *Room Heaters, Solid Fuel Type* and be listed with Canadian Standards Association (CSA) B366.1 *Solid-Fuel-Fired Central Heating Appliances* or UL 391 *Solid-Fuel and Combination-Fuel Central and Supplementary Furnaces*. This may be interpreted as being applicable to fireplaces and heaters constructed of concrete, concrete products or masonry.
- ✓ Post-construction, pre-occupancy indoor air quality **testing for volatile organic compounds (VOC)** is required. Exposed concrete, concrete products, or masonry may be used to reduce the use of interior finishes that elevate VOCs. Sealers, stains, integral admixtures and other treatments for concrete, concrete and masonry must comply with this section.

SECTION 805 PROHIBITED MATERIALS

- ✓ **Specific materials are prohibited.** While this section does not directly impact the use of concrete, concrete products, or masonry; systems constructed with urea-formaldehyde foam insulation these products may be impacted.
 - Asbestos-containing materials
 - Urea-formaldehyde form insulation

SECTION 806 MATERIAL EMISSIONS AND POLLUTANT CONTROL

- ✓ **Composite wood products** that contain urea-formaldehyde and are not sealed that are used on the interior of buildings are required to demonstrated emission limits in compliance with Section 93120 of Title 17, California Code of Regulations, *Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products*.
- ✓ No less than 85% of **site applied adhesives, sealants, paints, coatings, and inks**, used on the interior are required to have volatile organic compound limits and satisfy other criteria of:
 - U.S. Environmental Protection Agency (EPA) *Determination of Volatile Matter Content, Water Content, Density, Volume Solids* (EPA 24)
 - South Coast Air Quality Management District Methods (SCAQMD):
 - *Distillation of Solvents from Paints, Coatings and Inks* (SCAQMD 302)
 - *Determination of Exempt Compounds* (SCAQMD 303)
 - *Determination of Volatile Organic Compounds (VOC) in Various Materials* (SCAQMD 304)

- *Determination of Volatile Organic Compounds (VOC) in Materials Used for Pipes and Fittings (SCAQMD 316A)*
- *Determination of Volatile Organic Compounds (VOC) In Adhesives Containing (SCAQMD 316B)*
- *Adhesives and Sealant Applications (SCAQMD Rule 1168)*

Adhesives, sealants, paints, coatings, and inks may be components of concrete, concrete products or masonry systems. This section is only applicable to site applied treatments.

- No less than 85% of **site-applied interior architectural coatings** are required to comply with VOC content limits as determined in accordance with in accordance California Department of Public Health (CDPH) Environmental Health Laboratory Branch (EHLB) *Standard Method for Testing VOC Emissions from Indoor Sources* (CDPH Section 01350). Architectural coatings may be components of concrete, concrete products or masonry systems. This section is only applicable to site applied treatments.
- No less than 85% of the total area of **flooring** installed inside the building is required to meet criteria as determined in accordance with California Department of Public Health (CDPH) Environmental Health Laboratory Branch (EHLB) *Standard Method for Testing VOC Emissions from Indoor Sources* (CDPH Section 01350). This may create opportunities low VOC flooring systems such as exposed concrete, concrete products, or masonry.
- No less than 85% of **acoustical ceiling tiles and wall systems** are required to meet criteria as determined in accordance with California Department of Public Health (CDPH) Environmental Health Laboratory Branch (EHLB) *Standard Method for Testing VOC Emissions from Indoor Sources* (CDPH Section 01350). While it appears that these criteria are intended for acoustical ceilings and surface treatments, these criteria could be interpreted as also applying to acoustical concrete and masonry systems.
- No less than 85% of **insulation** is required to meet criteria as determined in accordance with California Department of Public Health (CDPH) Environmental Health Laboratory Branch (EHLB) *Standard Method for Testing VOC Emissions from Indoor Sources* (CDPH Section 01350). These criteria may be applicable to insulation strategies used in conjunction with concrete and masonry systems.

SECTION 807 ACOUSTICS

- ✓ Jurisdictions are provided an option to required enhanced **acoustical criteria** for improved occupant comfort. The option for requiring these criteria is provided in Section 302. Several of the criteria may be satisfied with concrete, concrete products or masonry construction.
- ✓ For **air-borne sound**:
 - Sound transmission classifications for concrete **masonry and clay masonry may be determined in accordance with The Masonry Society Standard Method for Determining the Sound Transmission Class Rating for Masonry Walls** (TMS 302). **All other materials components and systems must be tested** in accordance with ASTM International *Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements* (ASTM E90).
 - Wall and floor/ceiling assemblies that separate **assembly and factory** occupancies form one another or from business, institutional, mercantile or residential occupancies must have an apparent **sound transmission class (STC) of no less than 60**, 55 if field tested.
 - Wall and floor/ceiling assemblies that separate **business, institutional, mercantile or residential** occupancies from one another must have an apparent **sound transmission class (STC) of no less than 50**, 45 if field tested.

- Wall and floor/ceiling assemblies that separate **condominiums** for one another or from business, institutional, mercantile or residential occupancies must have an apparent **sound transmission class (STC) of no less than 55**, 50 if field tested.
- Wall and floor/ceiling assemblies that separate **mechanical equipment room** or space from other parts of the building must have an apparent **sound transmission class (STC) of no less than 50**, 45 if field tested.
- Wall and floor/ceiling assemblies that separate **generator equipment room** or space from other parts of the building must have an apparent **sound transmission class (STC) of no less than 60**, 55 if field tested.
- Restrictions are set for the **maximum noise levels from mechanical and generator equipment** as measured on the outside of the building.
- Restrictions are set for the **maximum sound levels of mechanical systems and heating ventilating and air-conditioning systems** within rooms containing such equipment.
- ✓ For **structure-borne sound**:
 - The impact insulation classification (IIC) is required to be determined in accordance with ASTM International *Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine* (ASTM E492).
 - For floor/ceiling assemblies between **dwelling rooms and dwelling units** and between such rooms and public or service areas or occupancies classified as assembly, business, education, institutional, mercantile, or residential must have an **ICC of no less than 50**, 45 if field tested.
- ✓ **Sound level verifications** by an approved agency and funded by the owner are required.

SECTION 808 DAYLIGHTING

- ✓ Minimum requirements for **fenestration are provided with planning of interior spaces**. Depending on the daylighting strategy this could mean less interior partitions for open areas or partitions that are light in color to reflect daylight. Except for possibly influencing the number of permanent interior partitions used in the building, there is no significant impact on the use of concrete, concrete products or masonry.
- ✓ **No advertisements or displays** may be affixed to fenestration used for daylighting
- ✓ **Not less than 50% of floor area** of 1- or 2-story buildings and **25% of buildings 3 or more stories** in height is required to be daylit.
- ✓ Daylighting may be determined using **performance-based design or prescriptively**.
 - The **prescriptive requirements**, which exclude consideration of overlapping areas, are:
 - For side-lighting, the daylit area is to extend laterally to the nearest 56-in high partition; distance equal to the floor to ceiling height; or 1.5 times the distance from the floor to the top of the fenestration.
 - Separate criteria are provided for sloped glazing used as side-lighting.
 - For top-lighting, the day lit area is required to extend laterally and longitudinally to the nearest 56-in high partition or 0.7 times the height from the floor to the bottom of the daylighting well.
 - **Performance criteria** for daylighting include:
 - Minimum and maximum light levels on surfaces 30 inches above the floor for a time period before the peak solar angle during the spring equinox.
 - Minimum and maximum light levels on surfaces 30 inches above the floor for a time period after the peak solar angle during the spring equinox.
- ✓ Assumptions for sky conditions, referred to as **sky types**, used to performance analyses are provided.

Chapter 9 Commissioning, Operations and Maintenance

SECTION 901 GENERAL

- ✓ Provisions address both **pre-occupancy and post-occupancy commissioning, operations, and maintenance**. Post-occupancy inspections are typically not within the purview of the building code department. Once an occupancy permit has been issued there is little recourse available for most building code departments unless the property or portions thereof is to be condemned. It is unlikely that a property will be condemned for being non-compliant with the commissioning, operations, and maintenance provisions. While some of the commissioning, operations and maintenance requirements may seem onerous, some degree of commissioning of heating ventilating and air-conditioning (HVAC) systems is already mandatory for buildings designed in accordance American Society of Heating Refrigerating and Air-conditioning Engineers (ASHRAE) *Energy Standard for Buildings Except Low-Rise Residential Buildings* (ASHRAE 90.1).

SECTION 902 APPROVED AGENCY

- ✓ There are two **options for collecting and reporting** this information:
 - One is for this **service to be provided by the building code department**. Most jurisdictions lack resources to address anything outside of major life safety issues and are not likely to enforce commissioning, operations, and maintenance issues which have not historically been part of the code but are addressed in the contract documents between the owners, designers, and contractors.
 - Another is for the **services to be provided by an approved agency**.

SECTION 903 COMMISSIONING

- ✓ **Minimum of two reports** are required, pre-occupancy and post-occupancy.
- ✓ **Pre-occupancy report** based on periodic evaluations
 - **Site Development**
 - Natural resource and baseline conditions of the building site
 - Landscape irrigation system
 - Top soil and vegetation protection measures and set back areas
 - Imported soils and soil restoration and re-use
 - Erosion and sediment control
 - Hardscape and shading provided by structures and vegetation
 - Vegetative roofs
 - Site lighting
 - **Moisture control**
 - Foundation sub-soil drainage system
 - Foundation waterproofing
 - Foundation dampproofing
 - Under slab water vapor protection
 - Flashing at: exterior windows, doors, skylights, wall flashing and drainage systems
 - Exterior wall covering
 - Roof covering, roof drainage and flashing
 - **Energy consumption monitoring, targeting and reporting**
 - Monitoring system

- Calibration
- **Mechanical system completion** for all buildings
 - Air system balancing
 - Hydronic system balancing
 - Mechanical system manuals
- **Mechanical systems** for building over 5,000 square feet in floor area
 - Commissioning required and noted in plans and specifications
 - Documentation of commissioning outcomes
 - Preparation and availability of commissioning plan
 - Balance air and hydronics heating, ventilating, and air-conditioning systems (HVAC)
 - Functional performance testing of HVAC equipment
 - Functional performance testing of HVAC controls and control systems
- **Lighting**
 - Auto-demand reduction control system functionality
 - Plug load controls
 - Specified transformer name plate efficiency rating
 - Verification of lamp and ballast
 - Installation of lighting controls
- **Water resource conservation, quality and efficiency**
 - Appliances
 - Hot water distribution
 - Soil percolation tests
- **Indoor environmental quality and comfort**
 - Air-handling system access
 - Air-handling system filters
 - Listings, installation, and ventilation of fireplaces and combustion appliances
 - Sound transmission related to mechanical and emergency generator equipment
 - HVAC system background noise
- ✓ **Post-occupancy report** provided within 30 months after occupancy
 - **Site development**
 - Stormwater management system operation
 - Erosion and sediment control
 - Hardscape and shading provided by structures and vegetation
 - Vegetative roofs
 - **Energy consumption monitoring, targeting and reporting**
 - Calibration
 - **Mechanical systems** for building over 5,000 square feet in floor area
 - Balance air and hydronics heating, ventilating, and air-conditioning systems (HVAC)
 - Functional performance testing of HVAC equipment
 - Functional performance testing of HVAC controls and control systems
 - Preparation of preliminary commissioning report
 - Acceptance of HVAC systems and equipment verification report
 - Preparation and distribution of final HVAC system completion

- **Lighting**
 - Auto-demand reduction control system functionality
 - Connection of appliances to switched receptacles
 - Verification of lamp
 - Installation and calibration of lighting controls
- **Water resource conservation**, quality and efficiency
 - Cooling tower performance
 - Rainwater system water quality
 - Gray water system water quality
- **Indoor environmental quality** and comfort
 - Air-handling system access
 - Air-handling system filters
 - Temperature and humidity in occupied spaces

SECTION 904 BUILDING OPERATIONS AND MAINTENANCE

- ✓ Requires building **operation and maintenance documents**, at least one copy provided to the owner and at least one copy to remain with the building over its life:
 - Approved construction documents, including **approved plans and specifications**.
 - **As built plans and specifications**, including locations of ductwork, piping, valves, controls, equipment, lighting access panels and similar components where they are concealed or installed.
 - Environmental corrective actions, remediation or restoration of **brownfield sites**.
 - Copy of **certificate of occupancy**.
 - **Manufacturer's specifications and recommendations** illustrating to the owner intended maintenance and operation of the building, site, and systems. This may be interpreted as being applicable to all building components and if so interpreted, specific provider or general industry recommendations for the maintenance and cleaning of concrete, concrete products or masonry may need to be included in the documents. This includes items such as routine cleaning, re-pointing masonry, maintaining water percolation through pervious pavements, and maintenance and replacement of sealant joint materials. Items specifically listed include:
 - **Vegetative shading, vegetative roofs, and natural resource protections and setbacks;**
 - Water-conserving landscape and irrigation systems;
 - Stormwater management systems
 - Permanent erosion control systems
 - **Landscape or tree management plans**
 - Flooring, carpeting, tile, walk-off mats;
 - Natural materials including but not limited to wood, bio-based materials, and stone;
 - Exterior wall finishes;
 - Roof coverings;
 - **Exterior doors, windows and skylights;**
 - Routine maintenance including painting and refinishing;
 - **HVAC maintenance schedule;**
 - **Air filters and water filters;**
 - **Time clocks;**
 - **Programmable controls and thermostats;**
 - **Domestic hot water systems;**
 - **Glazing inspection schedule;**
 - Building envelope performance criteria for replacements and repairs;

- Building envelope schedule maintenance including but not limited to sealants, mortar joints, and screens;
- Lamp specifications, maintenance, cleaning, replacement schedule and procedures, and disposal;
- Programmable and automatic controls;
- Occupant and daylight sensors;
- Domestic fixtures;
- Water-regulating devices including faucets and valves;
- Irrigation, rainwater and gray water catchment;
- Humidification and dehumidification;
- Green cleaning products, procedures, and techniques;
- Recommended window cleaning schedule;
- Ventilation controls;
- Floor finishes;
- Fireplaces and combustion appliances.

Chapter 10 Existing Buildings

There is little or no significant impact on the use of concrete, concrete products, or masonry for existing building applications. For this reason no detailed discussion is provided for existing buildings.

Chapter 11 Existing Building Site Development

There is little or no significant impact on the use of concrete, concrete products, or masonry for existing building applications. For this reason no detailed discussion is provided for existing buildings.

Chapter 12 References

References impacting the use of concrete, concrete products, and masonry are included in discussions within the specific sections impacting the use of concrete, concrete products and masonry.

Appendix A Project Electives

SECTION A101 GENERAL

- ✓ Criteria are provided for jurisdictions adopting the *International Green Construction Code* (IGCC) to achieve greater benefit than would be obtained with the minimum requirements of the IGCC.
ACTION: While some of these criteria may be favorable to the use of concrete, concrete products, and masonry; it may be in the best interest of the industry to encourage jurisdictions to not immediately add criteria intended to provide a greater benefit or to only add a few items crucial for local development, until such time that the impacts of minimum criteria are realized. Criteria that may be considered crucial for some jurisdictions may be those related to water conservation where availability of water resources is limited.

SECTION A102 APPLICABILITY AND CONFORMANCE

- ✓ The jurisdiction sets the number of additional project elective credits that must be obtained within each of 5 categories. The design team selects the specific criteria for the specific project. The elective categories are: site project; material resource conservation and efficiency; energy conservation, efficiency and earth atmospheric quality; water resource conservation and efficiency; and indoor environmental quality and comfort.

SECTION A103 DEFINITIONS

No significant impact on the use of concrete, concrete products, or masonry.

SECTION A104 SITE PROJECT ELECTIVES

- ✓ **Flood hazard area**
 - Where less than 25% of the building site is within a flood hazard area, building and **site improvements must be located outside the flood hazard area** and grading or fill shall not be used to alter the site to obtain an elevation above that of the flood hazard elevation.
 - Where 25% or more of the building site is within a flood hazard area, the **lowest floors of the building located in the flood hazard area must be at least 1 foot above the design flood elevation**. The use of grading or fill is not permitted to achieve an elevation above flood hazard elevation. Flood resistant construction will typically be required below flood elevation. According to the American Society of Civil Engineers Flood Resistant Design and Construction (ASCE 24) referenced in most building codes, only concrete, masonry or pressure treated lumber is permitted for construction below flood elevation.
 - **Separate criteria are provided for existing buildings.**
- ✓ **Develop infill sites.**
- ✓ **Develop brownfield sites.**
- ✓ **Restoration with native or adaptive vegetation for at least 25% of the non-building site.**
- ✓ **Mixed-use development** that is at least two stories in height with no less than 8 dwelling units located above the first story and the first story having assembly, business, mercantile, daycare or work/live units. This type of construction is commonly referred to as pedestal construction which may require the residential occupancies above the lower floors to be separated from the lower floors with at least two-hour non-combustible construction.
- ✓ Install changing and shower rooms for buildings with the floor area less than 10,000 square feet.
- ✓ Add **long-term bicycle storage** that is at least twice the minimum amount and have the spaces either within the building, under covered, or as bicycle storage lockers.
- ✓ **Heat island mitigation**
 - In climate zones 1 through 6, **increase the minimum amount of area used for heat island mitigation from 50% to 75%**. Both pervious pavements or unpigmented concrete pavements or other pavement having a minimum solar reflectance of 0.30 qualify as options to satisfy these criteria. Additional credit is provided if the increase is from 50% to 100%.
 - In climate zones 7 or 8, **at least 50% of the hardscape must comply with heat island mitigation criteria.**
 - **Apply the roof covering heat island mitigation criteria in climate zones 4 through 8.**

SECTION A105 MATERIAL RESOURCE CONSERVATION AND EFFICIENCY

- ✓ **20% increase in the minimum amount of waste diverted from landfills** as indicated as mandatory within the jurisdiction. This can be beneficial to concrete, concrete products, and masonry because there is little waste sent to landfills with these types of construction systems.
- ✓ **No more than 4 pounds of building construction waste per 1 square foot of construction** is disposed of in landfills. This can be beneficial to concrete, concrete products, and masonry because there is little waste sent to landfills with these types of construction systems.

- ✓ Two levels of increased use of **re-used, recycled content, recyclable, bio-based, and indigenous materials** are provided. Concrete, concrete products and masonry may be used to significantly influence the determination of compliance. The criteria are that such materials constitute:
 - **70% of the total building materials**, based on mass, volume, or cost, singularly or in combination.
 - **85% of the total building materials**, based on mass, volume, or cost, singularly or in combination.
- ✓ Additional credit may be available where **more rigorous building design service life** calculations are performed based on maintenance, repair, and replacement information available in manufacturer's literature or other approved sources. The concrete, concrete product and masonry industry groups should make sure that appropriate and accurate data is available, including information in such sources as *R.S. Means Facilities Maintenance and Repair Costs*. Documentation is required for:
 - **Structural elements** and concealed materials and assemblies
 - Materials and assemblies where **replacement is cost prohibitive or impractical**.
 - **Major materials and assemblies that are replaceable**.
 - **Roof coverings**.
 - **Mechanical, electrical and plumbing equipment and systems**.
 - Site hardscape.
- ✓ **Design for deconstruction of at least 90% of the total** components, assemblies, or modules or **allow the entire building to be reused**. Prefabricated systems lend themselves to deconstruction, and this could be applicable to some concrete, concrete product, and masonry systems. Since Type I non-combustible construction allows unlimited heights and areas for all occupancies except high and some moderate hazard facilities Type I construction is arguable ideal for building reuse, as no structural or passive fire protection changes need to be made to accommodate most occupancies. Appropriately fire rated concrete and masonry construction may be used to help assure future building re-use.
- ✓ Use at least **75% of an existing building's** core and shell. The capability of applying this provision in the future should be considered in the design and construction of new buildings. If new buildings are not adequately resilient the ability to re-use the building in the future is jeopardized. Information on enhanced resilience is provided in the "General Discussion" which follows this section by section critique.
- ✓ Use at least **75% of a historic building's** core and shell. The capability of applying this provision in the future should be considered in the design and construction of new buildings. If new buildings are not adequately resilient the ability to re-use the building in the future is jeopardized. Information on enhanced resilience is provided in the "General Discussion" which follows this section by section critique.

SECTION A106 ENERGY CONSERVATION, EFFICIENCY AND EARTH ATMOSPHERE QUALITY

- ✓ Credits are provided for pursuing **additional energy conservation and renewable energy strategies**. Where such strategies place an emphasis on increased use of thermally resistant insulation, this could be a disadvantage for concrete, concrete products and masonry systems. However where design professionals are appropriately knowledgeable of the use of thermal mass not only for reducing the required thermal resistance insulation in envelope components, but also for holistic building design, this could be advantageous for concrete, concrete product, and masonry systems. These approaches, which include but are not limited to passive solar design, radiant heating, natural ventilation, and using the building's mass to reduce and delay energy loads and peak energy loads, tend to be a bit more complex to analyze and design. However, considerable additional credits may be obtained by lowering the zero energy performance index (zEPI).

- Where the zEPI does not exceed 46, 1 credit may be permitted
 - Where the zEPI does not exceed 41, 2 credits may be permitted
 - Where the zEPI does not exceed 36, 3 credits may be permitted
 - Where the zEPI does not exceed 31, 4 credits may be permitted
 - Where the zEPI does not exceed 26, 5 credits may be permitted
 - Where the zEPI does not exceed 21, 6 credits may be permitted
 - Where the zEPI does not exceed 16, 7 credits may be permitted
 - Where the zEPI does not exceed 11, 8 credits may be permitted
 - Where the zEPI does not exceed 6, 9 credits may be permitted
 - Where the zEPI is 0, 10 credits may be permitted
- ✓ **Mechanical system compliance** using the prescriptive method
- **Heating equipment efficiency** must be at least 10% greater than that permitted by either the *International Energy Conservation Code* or American Society for Heating Refrigerating and Air-Conditioning Engineers *Energy Standard for Buildings Except Low-Rise Residential Buildings* (ASHRAE 90.1) or be *ENERGY STAR* qualified.
 - **Cooling equipment efficiency** must be at least 10% greater than that permitted by either the *International Energy Conservation Code* or American Society for Heating Refrigerating and Air-Conditioning Engineers *Energy Standard for Buildings Except Low-Rise Residential Buildings* (ASHRAE 90.1) or be *ENERGY STAR* qualified.
 - **Ground source and multi-stage ground source heat pumps** must meet specific performance criteria.
 - **Duct insulation** shall be at least R-8 in conditioned spaces and R-11 where located outside conditioned spaces.
 - **Duct systems** must be tested to determine compliance with air leakage criteria.
 - **Service water heating equipment efficiency** must be at least 10% greater than that permitted by either the *International Energy Conservation Code* or American Society for Heating Refrigerating and Air-Conditioning Engineers *Energy Standard for Buildings Except Low-Rise Residential Buildings* (ASHRAE 90.1) or be *ENERGY STAR* qualified. There are restrictions based on occupancy.
- ✓ **Lighting system efficiency** credits may be obtained by reducing both the interior and exterior lighting power load by 10% as compared to the *International Energy Conservation Code*.
- ✓ **Passive design** credits may be obtained where it is demonstrated that the annual energy reduction is at least 40%. Passive design requires thermal energy storage which may be provided with concrete, concrete products, or masonry. The passive design approach is limited to only one credit regardless of the energy savings. For many designs it may be beneficial to integrate the passive design features that will assist in lowering the zero energy performance index (zEPI) and obtaining multiple credits in lieu of a single credit.
- ✓ The use of **renewable energy** allows the ability to achieve a credit.

SECTION A107 WATER RESOURCE CONSERVATION AND EFFICIENCY

- ✓ **Methods and criteria to achieve credits** related to indoor water use are provided. This section has no significant impact on the use of concrete, concrete products, or masonry with the possible exception of products used for collection and storage.
- **On site waste water treatment.**
 - On site non-potable water for **outdoor hose connections.**

- Use of non-potable water for **flushing water closets and urinals**.
- Non-potable water for **automatic fire sprinkler systems**.
- On-site non-potable **water for fire pumps**.
- On-site non-potable **water as make-up water for industrial processes**.
- On-site non-potable water for **cooling tower make-up water**.
- On site collection and **reuse of graywater**.

SECTION A108 INDOOR ENVIRONMENTAL QUALITY AND COMFORT

- ✓ Reduction of **volatile organic compound (VOC)** emissions
 - For **flooring materials use ceramic and concrete tile, clay pavers, concrete, concrete pavers**, metal, or organic free mineral-based flooring. These materials are considered deemed to comply with the VOC criteria.
 - For **ceilings materials use ceramic and concrete tile, clay pavers, concrete, concrete pavers**, metal, or organic free mineral-based ceiling materials. These materials are considered deemed to comply with the VOC criteria.
 - For Wall **materials use ceramic and concrete tile, clay pavers, concrete, concrete pavers**, metal, or organic free mineral-based ceiling materials. These materials are considered deemed to comply with the VOC criteria.
 - A minimum of 50% of all adhesives, sealants, architectural paints and coatings, flooring, acoustical tiles wall systems and insulation must have a total VOC limit of 500 micrograms per cubic meter.
- ✓ Credit may be obtained by providing views to the exterior of the building for at least 50% of the net floor area by providing direct view of at least 45 square feet of **clear vision glass**.

Appendix B Radon Mitigation

SECTION B101 GENERAL

- ✓ Sets criteria for **radon mitigation** and is applicable where jurisdictions adopt Appendix B. Radon mitigation has an impact on the design and construction of slab-on-grade and foundations systems constructed with concrete, concrete products, or masonry. However the design and construction strategies with these systems have already been developed and are readily available as design and construction options in areas with high radon concentrations. Jurisdictions which already adopt the radon mitigation appendix of the *International Residential Code* and adopting these criteria will extend the application beyond low-rise residential buildings.

SECTION B012 DEFINITIONS

- ✓ **No significant impact on concrete, concrete products, or masonry systems.**

SECTION B201 MITIGATION PROCEDURES

- ✓ **Sub floor preparation**
 - A layer of **gas-permeable materials** must be placed under all concrete slabs and other floor systems directly in contact with the ground. The layer must be:
 - Not less than 4 in. of clean aggregate.
 - Not less than 4 in. of sand overlain with geotextile drainage matting.
 - Geotextile drainage matting or other approved materials to permit depressurization over the entire subfloor area.

- **Sub-slab radon suction pit** must be provided
 - 6-in polyvinyl chloride or equivalent **gas-tight pipe** must be used for venting.
 - **Soil gas retarder** of at least 6-mil polyethylene or 3-mil cross laminated polyethylene or equivalent must be placed over the gas permeable layer.
 - **Radon entry routes must be closed and sealed.** This includes floor openings, joints in concrete, drains, sumps, foundation walls, dampproofing, air-handling units in crawl spaces, ducts, crawl space floors, and crawl space doors.
- ✓ Criteria are provided for ventilation pipes.
- ✓ Systems may be designed and constructed for passive sub-membrane depressurization, but must be equipped with a power source should active depressurization be required.

Appendix C Optional Ordinance

No significant impact on concrete, masonry or concrete products.

Appendix D Enforcement Procedures

No significant impact on concrete, masonry or concrete products.

***** END SECTION BY SECTION CRITIQUE *****

GENERAL DISCUSSION

The 2012 edition of the *International Green Construction Code* (IGCC) does not contain any specific criteria which place an unreasonable hardship on the concrete, concrete products, or masonry industries. More than not, the IGCC provides specific criteria for building design and construction that are suitable or even favorable for the use of concrete, concrete products and masonry.

However, the IGCC is clearly remiss in that it does not adequately encourage or require the building core and shell to be adequately resilient to achieve good sustainable building design. For the most part the IGCC does not address the need of a stronger, more durable, more robust and longer lasting building core and shell as a prerequisite to adding green features such as low-flow fixtures and energy efficiency lighting, appliances and equipment. The latter is typically swapped out multiple times over the life a building providing many opportunities for improvement; however the core and shell is rarely upgraded. Priorities may be been misplaced and this is especially true in disaster prone areas which is virtually anywhere in the United States. When disaster occurs, if the building cores and shells are not adequately resilient, the property loss tends to be very high. Regardless of whether plumbing fixtures, lighting, equipment, or appliances are conventional or high-efficiency, if they become irreparable or contaminated during disasters, they are equally land-filled along with other building components and contents.

Further there will be increased costs for design, purchase, construction, and installation of high-efficiency components, equipment, appliances and systems. History has demonstrated that these cost increases drive owners toward more Type V construction. This was experienced with the adoption of energy conservation codes in the 1980s and 1990s. The more onerous prescriptive thermal resistance insulation requirements, which did not adequately accounting for the benefits of thermal mass, placed a hardship on the concrete, concrete products, and masonry industries and discouraged designers from selecting more energy efficient building designs that utilize passive solar, natural ventilation, peak load reduction and shifting and radiant systems to optimize efficiency and comfort. This was compounded by the increased design and construction costs for all building construction types which encouraged more owners to accept the Type V construction, the minimum type legally permitted by the building code. The trend toward more Type V construction was to offset the initial cost increases associated with the mandatory energy conservation measures.

Minimum building code has become the standard of practice in the United States for the design and construction of buildings, other than owner-occupied, -designed, and -built. Without the needed criteria for enhanced resilience, these additional costs will drive builders and developers to more extensive use of Type V construction placing communities at an increased risk when disasters occur. In addition the less robust Type V construction tends to be less durable and has long-term impacts on community residents, businesses, and revenue.

The IGCC also does not adequately reward optimized density. A high-rise condominium built to the International Building Code and referenced codes and standards will tend to be far more energy efficient per dwelling unit than mid-rise construction designed and built in accordance with the IGCC. In addition, the occupants in the high-rise building will be provided with Type I, the most robust type of construction, while those in the mid-rise building will likely be provided with a lesser type of construction, potentially Type V which is the least permitted by code.

ACTION: Where jurisdictions are adopting the IGCC they should also consider adoption criteria for enhanced resiliency. While the additional enhanced resiliency criteria will, like the green building design and construction features, add to the initial costs of construction; they will provide significant long-term benefits to the community and minimize losses, recovery time, emergency response, and disposal of damaged building materials and

contents when disaster occur. Jurisdictions interested in integrating a level of enhanced resilience may do so by adopting the attached Appendix E as a further modification to the IGCC.

The requirements of Appendix E are founded on the basic concepts of the National Institute of Building Sciences and Sustainable Building Industries Council *Whole Building Design Guidelines* and the specific criteria endorsed by the Institute for Business and Home Safety. The overall approach of the Whole Building Design Guidelines is to integrate:

- | | |
|-------------------------------|-----------------------|
| Accessibility | Historic Preservation |
| Aesthetics | Productivity |
| Cost-Effectiveness | Security and Safety |
| Functionality and Operability | Sustainability |

Specific requirements are based on recommendations endorsed by the Institute for Business and Home Safety (IBHS). IBHS, the national association representing insurance and re-insurance industries, supports material-neutral solutions to achieve enhanced resilience for better buildings.

Building cores and shells that are more robust, durable, and disaster resistant with long design service lives are clearly more sustainable. Less energy and materials are required for routine maintenance, repairs, and removal and replacement of components. In addition, when a disaster occurs less materials and building contents will need to be disposed inland fills and communities with more resilient buildings will be capable for recovering more quickly.

While the IGCC criteria for energy, water, and material resource conservation are all excellent strategies for sustainability, it is crucial that these features added to achieve improved conservation be incorporated into buildings with sustainable cores and shells.

Any jurisdiction considering the adoption of the IGCC with the intention of obtaining more sustainable buildings in their communities should also consider including the following Appendix E, in their Code, especially if the jurisdiction is in a disaster prone area, whether it be hail storm, wind storm, tornado, flood, earthquake, snow storm, terrorism, or accidental catastrophe.

***** END GENERAL DISCUSSION *****

**Proposed Modifications to Achieve Enhanced Resilience
in the
International Code Council
2012 International Green Construction Code
June 4, 2012**

**APPENDIX E
ENHANCED BUILDING RESILIENCE**

The provisions in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

**SECTION E101
GENERAL**

E101.1 Purpose. The purpose of this Appendix is to promote enhanced public health, safety and general welfare and to reduce public and private property losses due to hazards and natural disasters associated with fires, flooding, high winds and earthquakes. Where adopted, this Appendix provides mandatory modifications to the requirements of the International Building Code or the building code of the adopting jurisdiction.

**SECTION E102
BUILDING HEIGHTS AND AREA**

E102.1 General. In order to limit the impact of fires on the *building* the *building* shall comply with Sections E102.1 through E102.5.

E102.2 Height and Area Limitations. Allowable heights and areas for all *buildings* shall be in accordance with Table E102.1 where building height limitations are in feet above grade plane, story limitations are stories above grade plane, and area limitations are determined by the definition of “Area, building,” per floor.

**TABLE E102.1
ALLOWABLE HEIGHT AND BUILDING AREAS^a**

**Building height limitations shown in feet above grade plane. Story limitations shown as stories above grade plane.
Building area limitations shown in square feet, as determined by the definition of “Area, building,” per story**

GROUP	HGT (feet)	TYPE OF CONSTRUCTION					
		Type I		Type II	Type III	Type IV	Type V
		A	B	A	A	HT	A
	UL	160	65	65	65	50	
		STORIES (S) Area (A)					
A-1	S	UL	5	3	3	3	2
	A	UL	UL	15,500	14,000	15,000	11,500
A-2	S	UL	11	3	3	3	2
	A	UL	UL	15,500	14,000	15,000	11,500

TABLE E102.1 continued

GROUP	HGT (feet)	TYPE OF CONSTRUCTION					
		Type I		Type II	Type III	Type IV	Type V
		A	B	A	A	HT	A
		UL	160	65	65	65	50
STORIES (S) Area (A)							
A-3	S A	UL UL	11 UL	3 15,500	3 14,000	3 15,000	2 11,500
A-4	S A	UL UL	11 UL	3 15,500	3 14,000	3 15,000	2 11,500
A-5	S A	UL UL	UL UL	UL UL	UL UL	UL UL	UL UL
B	S A	UL UL	11 UL	5 37,500	5 28,500	5 36,000	3 18,000
E	S A	UL UL	5 UL	3 26,500	3 23,500	3 25,500	1 18,500
F-1	S A	UL UL	11 UL	4 25,000	3 19,000	4 33,500	2 14,000
F-2	S A	UL UL	11 UL	5 37,500	4 28,500	5 50,500	3 21,000
H-1	S A	1 21,000	1 16,500	1 11,000	1 9,500	1 10,500	1 7,500
H-2 ^d	S A	UL 21,000	3 16,500	2 11,000	2 9,500	2 10,500	1 7,500
H-3 ^d	S A	UL UL	6 60,000	4 26,500	4 17,500	4 25,500	2 10,000
H-4	S A	UL UL	7 UL	5 37,500	5 28,500	5 36,000	3 18,000
H-5	S A	4 UL	4 UL	3 37,500	3 28,500	3 36,000	3 18,000
I-1	S A	UL UL	9 55,000	4 19,000	4 16,500	4 18,000	3 10,500
I-2	S A	UL UL	4 UL	2 15,000	1 12,000	1 12,000	1 9,500
I-3	S A	UL UL	4 UL	2 15,000	2 10,500	2 12,000	2 7,500
I-4	S A	UL UL	5 60,500	3 26,500	3 23,500	3 25,500	1 18,500
M	S A	UL UL	11 UL	4 21,500	4 18,500	4 20,500	3 14,000
S-1	S A	UL UL	11 48,000	4 26,000	3 26,000	4 25,500	3 14,000
S-2 ^{b, c}	S A	UL UL	11 79,000	5 39,000	4 39,000	5 38,500	4 21,000
U ^c	S A	UL UL	5 35,500	4 19,000	3 14,000	4 18,000	2 9,000

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m².

UL = Unlimited, NP = Not permitted.

a. See the following sections for general exceptions to Table E102.1:

1. Section 506.2, Allowable area increase due to street frontage of the IBC.

- 2. Section 507, Unlimited area buildings of the IBC.
- b. For open parking structures, see Section 406.5 of the IBC.
- c. For private garages, see Section 406.3 of the IBC.
- d. See Section 4157 for limitations of the IBC.

E102.3 Building Height and Area Increases.

E102.3.1 Increases in building height in accordance with Section 504.2, *Automatic sprinkler system increase*, of the *International Building Code* shall not be permitted

E102.3.2 Increases in building area in accordance with Section 506.3, *Automatic sprinkler system increase*, of the *International Building Code* shall not be permitted

E102.4 Single occupancy buildings with more than one story. Exception 2 of Section 506.4.1, *Area determination* of the *International Building Code* that allows area increases for *automatic sprinkler systems* shall not be permitted.

E102.5 Mixed Use and Occupancy. All buildings containing mixed occupancies shall be in accordance with this section.

TABLE E102.5,1 INCIDENTAL ACCESSORY OCCUPANCIES^a	
Room or Area	Separation and/or Protection
Furnace room where any piece of equipment is over 400,000 Btu per hour input	1-hour and provide automatic sprinkler system
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower.	1-hour and provide automatic sprinkler system
Refrigerant machinery rooms	1-hour and provide automatic sprinkler system
Parking garage (Section 406.2 of the Code, <i>Parking garages</i>)	2-hour and provide automatic sprinkler system
Hydrogen cut off rooms	2-hour and provide automatic sprinkler system
Incinerator rooms	2-hour and provide automatic sprinkler system
Laundry rooms over 100 square feet	1-hour and provide automatic sprinkler system
Storage rooms over 100 square feet	1-hour and provide automatic sprinkler system
Waste and linen collection rooms other than rooms designated for the collection of recyclables	1-hour and provide automatic sprinkler system
Rooms designated for the collection of recyclables	2-hour and provide automatic sprinkler system
Stationary storage battery systems having a liquid electrolyte capacity of more than 50 gallons, or lithium ion capacity of 1,000 pounds used for facility standby power, emergency power or uninterrupted power supplies	2-hour and provide automatic sprinkler system
Rooms in non-high-rise buildings containing fire pumps	2-hour and provide automatic sprinkler system
Rooms in high-rise buildings containing fire pumps	2-hour and provide automatic sprinkler system
^a The requirements in this table take precedence over Table 508.2.5, <i>Incidental accessory occupancies</i> of the <i>International Building Code</i> .	

E102.5.1 Separation of incidental accessory occupancies. The incidental accessory occupancies listed in Table E102.2 shall be separated from the remainder of the *building* by fire barriers.

E102.5.2 Separation of mixed occupancies. All occupancies except incidental accessory occupancies in Table E102.2.1 shall be separated from each other by fire barriers in accordance with Table E102.2.2

TABLE E102.5.2 REQUIRED SEPARATION OF OCCUPANCIES (HOURS)									
Occupancy	A ^d	E	B	I	F-2, S-2 ^{b,c} , U ^b	F-1, S-1, M	H-1	H-2	H-3, H-4, H-5
A ^d	N	2	2	2	1	2	NP	4	3
E ^d	—	N	2	2	1	2	NP	4	3
B	—	—	N	2	1	2	NP	3	2
I	—	—	—	N	2	2	NP	NP	NP
F-2, S-2 ^{b,c} , U ^c	—	—	—	—	N	2	NP	4	3 ^a
F-1, S-1, M	—	—	—	—	—	N	NP	3	2 ^a
H-1	—	—	—	—	—	—	N	NP	NP
H-2	—	—	—	—	—	—	—	N	1
H-3, H-4, H-5	—	—	—	—	—	—	—	—	N

N = No separation requirement.

NP = Not permitted.

a. For Group H-5 occupancies, see Section 903.2.5.2 of the *International Building Code*.

b. Areas used only for private or pleasure vehicles shall be allowed to reduce separation by 1 hour.

c. See Section 406.3.4 of the *International Building Code*.

d. Commercial kitchens need not be separated from the restaurant seating areas that they serve.

SECTION E103 TYPES OF CONSTRUCTION

E103.1 General. In order to limit the impact of fires on the *building* the *building* shall comply with Section E103.2.

E103.2 Fire-Resistance Rating. Building elements shall have a fire resistance rating not less than that specified in Table E104.1 and exterior walls shall have a fire resistance rating not less than that specified in Table 602, *Fire-Resistance Rating for Exterior Walls Based on Fire Separation Distance* of the *International Building Code*.

TABLE E103.1 FIRE-RESISTANCE RATING FOR BUILDING ELEMENTS (HOURS) ^a									
BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary Structural Frame ^{g,h}	3 ^b	2 ^b	1	NP	1	NP	HT	1	NP
Bearing Walls									
Exterior ^{f,g}	3	2	1	NP	2	NP	2	1	NP
Interior	3 ^b	2 ^b	1	NP	1	NP	1/HT	1	NP
Non-bearing Walls and Partitions	See Table 602 of the <i>IBC</i>								
Exterior									
Non-bearing Walls and Partitions ^e									
Interior	0	0	0	NP	0	NP	See Section 602.4.6 of the <i>IBC</i>	0	NP

TABLE E103.1 CONTINUED									
FIRE-RESISTANCE RATING FOR BUILDING ELEMENTS (HOURS) ^a									
BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Floor Construction and Secondary Members ^h	2	2	1	NP	1	NP	HT	1	NP
Roof Construction and Secondary Members ^h	1- 1/2 ^b	1 ^{c,d}	1 ^{c,d}	NP	1 ^{c,d}	NP	HT	1 ^{c,d}	NP

For SI: 1 foot = 304.8 mm.
NP = Not Permitted.

^a The requirements in this table take precedence over Table 601, *Fire resistance rating for building elements of the International Building Code*.

^b Roof supports: Fire-resistance rating of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

^c Fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire retardant wood members shall be allowed to be used for such unprotected members.

^d In all occupancies, heavy timber shall be allowed where 1-hour or less fire-resistance rating is required.

^e Not less than the fire-resistance rating required by other Sections of the *International Building Code*.

^f Not less than the fire-resistance rating based on fire separation distance (see Table 602 of the *International Building Code*)

^g Not less than the fire-resistance rating as referenced in Section 704.10 of the *International Building Code, Exterior structural members*.

^h See Section 202 of the *International Building Code, Definitions*.

SECTION E104

FIRE AND SMOKE PROTECTION FEATURES

E104.1 General. In order to limit the impact of fires on the *building* the *building* shall comply with Sections E104.1 through E104.12.

E104.2 Allowable area of openings. The maximum area of unprotected and protected openings permitted in an exterior wall in any story of the building shall not exceed the percentages specified in Table E104.2.

E104.3 Protected Openings. The exception for opening protectives in Section 705.8.2, *Protected openings* of the *International Building Code*, shall not be permitted.

E104.4 Vertical Separation of Openings. Exception 2 that eliminates vertical separation of openings where automatic sprinklers are present in Section 705.8.5, *Vertical separation of openings* of the *International Building Code*, shall not be permitted.

E104.5 Parapets. Exception 5 in Section 705.11, *Parapet construction* of the *International Building Code* that eliminates exterior wall parapets shall not be permitted for Group R-2 occupancies.

E104.6 Fire Walls. Fire walls shall meet the requirements of this section.

E104.6.1 Materials. Fire walls for all types of construction shall be of any approved noncombustible material permitted in NFPA 221.

E104.6.2 Fire Resistance Rating. The fire-resistance ratings shall meet or exceed the ratings provided in Table E104.6.2.

E104.6.3 Exception 3 in Section 706.5, *Horizontal continuity* of the *International Building Code* that allows termination of fire walls at the interior surface of noncombustible exterior sheathing where *automatic sprinkler systems* are present shall not be permitted.

E104.6.4 Exception 2 in Section 706.8, *Openings* of the *International Building Code* that allows increased area of openings through fire walls where *automatic sprinkler systems* are present shall not be permitted.

E104.7 Fire Barriers. Fire barriers shall comply with the provisions of this section

E104.7.1 The fire resistance rating of the separation between individual dwelling units and sleeping units, and between dwelling units and sleeping units and other spaces in the building shall have a minimum 2-hour fire-resistance rated construction as required in Table 707.3.10, *Fire-Resistance Rating Requirements for Fire Barrier Assemblies or Horizontal Assemblies Between Fire Areas* of the *International Building Code*.

E104.7.2 Exception 1 in Section 707.6, *Openings* of the *International Building Code* that allows openings in a fire barrier to be larger than 156 sqft where *automatic sprinkler systems* are provided shall not be permitted.

E104.8 Shaft Enclosures. Exception 5 in Section 713.14.1, *Elevator lobby* of the *International Building Code* that allows smoke partitions in lieu of fire partitions to separate the elevator lobby at each floor shall not be permitted.

E104.9 Fire Partitions. Fire partitions shall comply with the provisions of this section.

E104.9.1 Fire partitions in Section 708.1, *General* of the *International Building Code*, shall not be permitted for walls separating dwelling units in the same building.

E104.9.2 Fire partitions in Section 708.1, *General* of the *International Building Code*, shall not be permitted for walls separating sleeping units in the same building.

E104.9.3 Fire partitions in Section 708.1, *General* of the *International Building Code*, shall not be permitted for corridor walls separating corridors from dwelling units or sleeping units in the same building.

E104.9.4 Exception 6 in Section 708.4, *Continuity* of the *International Building Code* that allows elimination of fireblocking or draftstopping shall not be permitted.

E104.10 Horizontal Assemblies. Horizontal assemblies shall comply with the requirements of this Section.

E104.10.1 Horizontal assemblies separating dwelling units in the same building and separating sleeping units in occupancies in the same building shall have a minimum 2-hour fire-resistance rated construction as required in Table 707.3.10, *Fire-Resistance Rating Requirements for Fire Barrier Assemblies or Horizontal Assemblies Between* of the *International Building Code*.

E104.10.2 The exception in Section 711.3, *Fire-resistance rating* of the *International Building Code* that allows a reduction of the fire-resistance rating of separations between dwelling unit and sleeping unit where *automatic sprinkler systems* are present shall not be permitted.

E104.11 Opening Protectives. The provisions of this section shall apply to opening protectives.

E104.11.1 The Exception in Section 716.5.5 of the *International Building Code*, *Doors in exit enclosures and exit passageways* that eliminate the maximum transmitted temperature requirements shall not be permitted.

E104.11.2 The Exception in Section 716.5.5.1, *Glazing in doors*, of the *International Building Code* that eliminates the maximum transmitted temperature requirements shall not be permitted.

E104.12 Concealed Spaces. Exceptions 1 and 2 in Section 718.3.2, *Groups R-1, R-2, R-3 and R-4* of the *International Building Code* that eliminate draftstopping where *automatic sprinkler systems* are present shall not be permitted for Groups R-1, R-2 or R-4 occupancies.

TABLE E104.2 MAXIMUM AREA OF EXTERIOR WALL OPENING BASED ON FIRE SEPARATION DISTANCE AND DEGREE OF OPENING PROTECTION ^a		
Fire Separation Distance (feet)	Degree of Opening Protection	Allowable Areas ^b
0 to less than 3 ^{c,d}	Unprotected (UP)	Not Permitted
	Protected (P)	Not Permitted
3 to less than 5 ^e	Unprotected (UP)	Not Permitted
	Protected (P)	15%
5 to less than 10 ^g	Unprotected (UP)	10%
	Protected (P)	25%
Fire Separation Distance (feet)	Degree of Opening Protection	Allowable Areas ^b
10 to less than 15 ^{f,g}	Unprotected (UP)	15%
	Protected (P)	45%
15 to less than 20 ^{f,g}	Unprotected (UP)	25%
	Protected (P)	75%
20 to less than 25 ^{f,g}	Unprotected (UP)	45%
	Protected (P)	No Limit
25 to less than 30 ^{f,g}	Unprotected (UP)	70%
	Protected (P)	No Limit
30 or greater	Unprotected (UP)	No Limit
	Protected (P)	Not Required
<p>For SI: 1 foot = 304.8 mm UP = Unprotected openings in buildings P = Openings protected with an opening protective assembly in accordance with section 705.8.2 of the ICC <i>International Building Code</i></p> <p>^a The requirements in this table take precedence over Table 705.8, <i>Maximum area of exterior wall openings based on fire separation distance and degree of opening protections</i> of the Code. ^b Values indicated are the percentage of the area of the exterior wall per story. ^c For the requirements for fire walls of buildings with differing heights see Section 706.6.1 of the ICC <i>International Building Code</i>. ^d For openings in a fire wall for building son the same lot, see Section 705.8 of the ICC <i>International Building Code</i>. ^e The maximum percentage of unprotected and protected openings shall be 25% for Group R-3 occupancies. ^f The area of unprotected and protected openings shall not be limited for Group R-3 occupancies with a fire separation distance of 5 feet or greater. ^g <i>International Building Code</i> Includes buildings accessory to Group R-3.</p>		

TABLE E104.6.2 FIRE WALL FIRE-RESISTANCE RATINGS	
GROUP	FIRE-RESISTANCE RATING (hours)
A, B, E, H-4, I, R-1, R-2, U	3
F-1, H-3 ^a , H-5, M, S-1	3
H-1, H-2	4 ^a
F-2, S-2, R-3, R-4	2

a. For Group H-1, H-2 or H-3 buildings, also see Sections 415.4 and 415.5 of the International Building Code.

SECTION E105 INTERIOR FINISHES

E105.1 General. In order to limit the impact of fires on the *building* the *building* shall comply with Sections E105.1 through E105.3.

E105.2 Interior Wall and Ceiling Finishes. Interior wall and ceiling finishes and conform to the requirements of this section.

E105.2.1 Finish by occupancy. Interior wall and ceiling finishes based on occupancy shall conform to the requirements in Table E105.1.

TABLE E105.2 INTERIOR WALL AND CEILING FINISH REQUIREMENTS BY OCCUPANCY			
GROUP	EXIT ENCLOSURES AND EXIT PASSAGEWAYS ^a	CORRIDORS	ROOMS AND ENCLOSED SPACES ^b
A-1, A-2	A	A	B
A-3, A-4, A-5	A	A	C
B, E, M, R-1, R-4	A	B	C
F	B	C	C
H	A	A	B
I-1	A	B	B
I-2, I-3, I-4	A	A	B
R-2	B	B	C
R-3	A	C	C
S	B	B	C
U	No Restrictions		

For SI: 1 inch = 25.4 mm, 1 square inch = 0.0929m²

^a Class C interior finish materials shall be permitted for wainscoting or paneling of not more than 1,000 square feet of applied surface area in the grade lobby where applied directly to a noncombustible base or over furring strips applied to a noncombustible base and fire blocked as required by Section 803.11.1 of the *International Building Code*.

^b Requirements for rooms and enclosed spaces shall be based upon spaces enclosed by partitions. Where a fire-resistance rating is required for structural elements, the enclosing partitions shall extend from the floor to the ceiling. Partitions that do not comply with this shall be considered enclosing spaces and rooms or spaces on both sides shall be considered as one. In determining the applicability of the requirements for rooms and enclosed spaces, the specific occupancy thereof shall be the governing factor regardless of the group classification of the building or structure.

E105.2.2 Set-out construction. The exception in Section 803.11.2, *Set out construction* of the *International Building Code* for the Class A interior finish materials where *automatic sprinkler systems* are provided shall not be permitted.

E105.3 Interior Floor Finishes. The Exception in Section 804.4.2 of the *International Building Code* *International Building Code*, *Minimum critical radiant flux* which eliminates the requirement for minimum critical radiant flux for floor finishes and floor coverings in exit enclosures, exit passageways, and corridors where *automatic sprinkler systems* are provided shall not be permitted.

SECTION E106 FIRE PROTECTION SYSTEMS

E106.1 General. In order to limit the impact of fires on the *building* the *building* shall comply with Sections E106.1 through E106.4.

E106.2 Automatic Sprinkler Protection. Except for Group F-2 Occupancies, an *approved automatic sprinkler systems* shall be provided throughout all new buildings in accordance with Section 903 of the *International Building Code*.

Exceptions:

1. All Group F-2 occupancies
2. In Group S-2, Storage Occupancies located in close proximity to a Group F-2, Industrial Occupancy where the noncombustible products that are manufactured in the Group F-2 building are stored, the sprinkler protection shall be permitted to be omitted when *approved* by the *building official*.
3. Spaces or areas in telecommunications buildings used exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided those spaces or areas are equipped throughout with an automatic fire alarm system and are separated from the remainder of the building by fire barriers consisting of not less than 1-hour fire-resistance-rated walls and 2-hour fire-resistance-rated floor/ceiling assemblies.

E106.2.1 Automatic Sprinkler Systems. Sprinkler systems shall be designed and installed in accordance with Section 903.3.1.1 of the *International Building Code*, *NFPA 13 sprinkler systems*. Sprinkler systems designed and installed in accordance with Section 903.3.1.2 of the *International Building Code*, *NFPA 13R sprinkler systems*, shall not be permitted.

E106.3 Standpipes. Standpipes shall comply with the requirements of this Section.

E106.3.1 The exceptions 1 and 4 of Section 905.3.1, *Building height* of the *International Building Code*, allowing Class I standpipes where *automatic sprinkler systems* are provided shall not be permitted

E106.3.2 The exception to Section 905.3.4, *Stages* of the *International Building Code*, that allows only a 1-1/2 inch hose connection for Class II or Class III standpipes where automatic sprinkler systems are provided shall not be permitted.

E106.3.3 The exception to Section 905.4.1, *Protection* of the *International Building Code* that allows elimination of the fire-resistance rated enclosure for laterals where *automatic sprinkler systems* are provided shall not be permitted.

E106.4 Fire Alarm and Detection Systems. Fire alarms and detection systems shall comply with the provisions of this Section.

E106.4.1 Exception 2.1 of Section 907.2.8.1, *Manual fire alarm systems* of the *International Building Code* that eliminates fire alarm boxes for Group R-1 occupancies in accordance with, shall not be permitted.

E106.4.2 Exception 2 of Section 907.2.9.1 *Manual fire alarm systems* of the *International Building Code* that eliminates fire alarm boxes for Group R-2 occupancies shall not be permitted

SECTION E107 MEANS OF EGRESS

E107.1 General. In order to limit the impact of fires on the *building* the *building* shall comply with Sections E107.1 through E107.6.

E107.2. Accessible Means of Egress. Accessible means of egress shall comply with the requirements of this Section.

E107.2.1 Exception 1 of Section 1007.3, *Stairways*, of the *International Building Code* that reduces in the clear width between handrails shall not be permitted.

E107.2.2 Exception 2 of Section 1007.3, *Stairways*, of the *International Building Code* that eliminates of areas of refuge shall not be permitted.

E107.2.3 Exception 2 of Section 1007.4, *Elevators*, of the *International Building Code* that eliminates requirements for elevator access from areas of refuge or horizontal exit shall not be permitted.

E107.3 Exit Access. Footnote b to Table 1014.3, *Common path of egress travel*, of the *International Building Code* that increases the length of common path of egress travel in Group R-2 occupancies shall not be permitted.

E107.4 Exits and Exit Access Doorways. Exits and exit access doorways shall comply with the requirements of this Section.

E107.4.1 Exception 1 in Section 1015.1 (1), *Exits or exit access doorways from spaces*, of the *International Building Code* that reduces the number of means of egress shall not be permitted.

E107.4.2 Exception 2 of Section 1015.2.1, *Two exits or exit access doorways*, of the *International Building Code* that counts scissor stairs as two exits shall not be permitted.

E107.5 Exit Access Travel Distance. Exit access travel distance shall comply with the requirements of this Section.

E107.5.1 Maximum travel distance shall not exceed 200 feet.

E107.5.2 Distance limitations through atrium spaces shall conform with Section 404, *Atriums* of the *International Building Code* .

E107.5.3 Exit access in buildings with one exit shall conform to Section 1021.2, *Single exits* of the *International Building Code*

E107.6 Corridors. Corridors shall comply with the requirements of this Section.

E107.6.1 The fire-resistance rating of corridor walls shall be at least 1-hour.

E107.6.2 Exception 2 in Section 1018.4, *Dead ends*, of the *International Building Code* that increases the length of dead-end corridors shall not be permitted.

SECTION E108 EXTERIOR WALLS

E108.1 General. In addition to the requirements for Exterior Walls in Chapter 14 of the *International Building Code*, the exterior wall coverings shall also comply with Sections E108.2 through E108.4.

E108.2 Exterior wall covering limitations for reduced damage from fire. Exterior wall coverings shall comply with E108.2.1 and E108.2.2 to reduce damage from fire exposure

E108.2.1 Vinyl siding and Exterior insulation and finish systems (EIFS). Vinyl siding conforming to the requirements of Chapter 14 of the *International Building Code* and Exterior insulation and finish systems (EIFS) conforming to the requirements of Chapters 14 and 26 of the *International Building Code* shall only be permitted to be installed on exterior walls of buildings with a minimum fire separation distance of 30 feet.

E108.2.2 Fire Separation 5 Feet or Less. Combustible exterior wall coverings are not permitted on exterior walls having a fire separation distance or 5 feet (1524 mm) or less.

E108.3 Exterior wall covering limitations for reduced damage from hail. Vinyl siding conforming to the requirements of Chapter 14 of the *International Building Code* and Exterior insulation and finish systems (EIFS) conforming to the requirements of Chapters 14 and 26 of the *International Building Code* shall comply with sections E108.3.1 and E108.3.2.

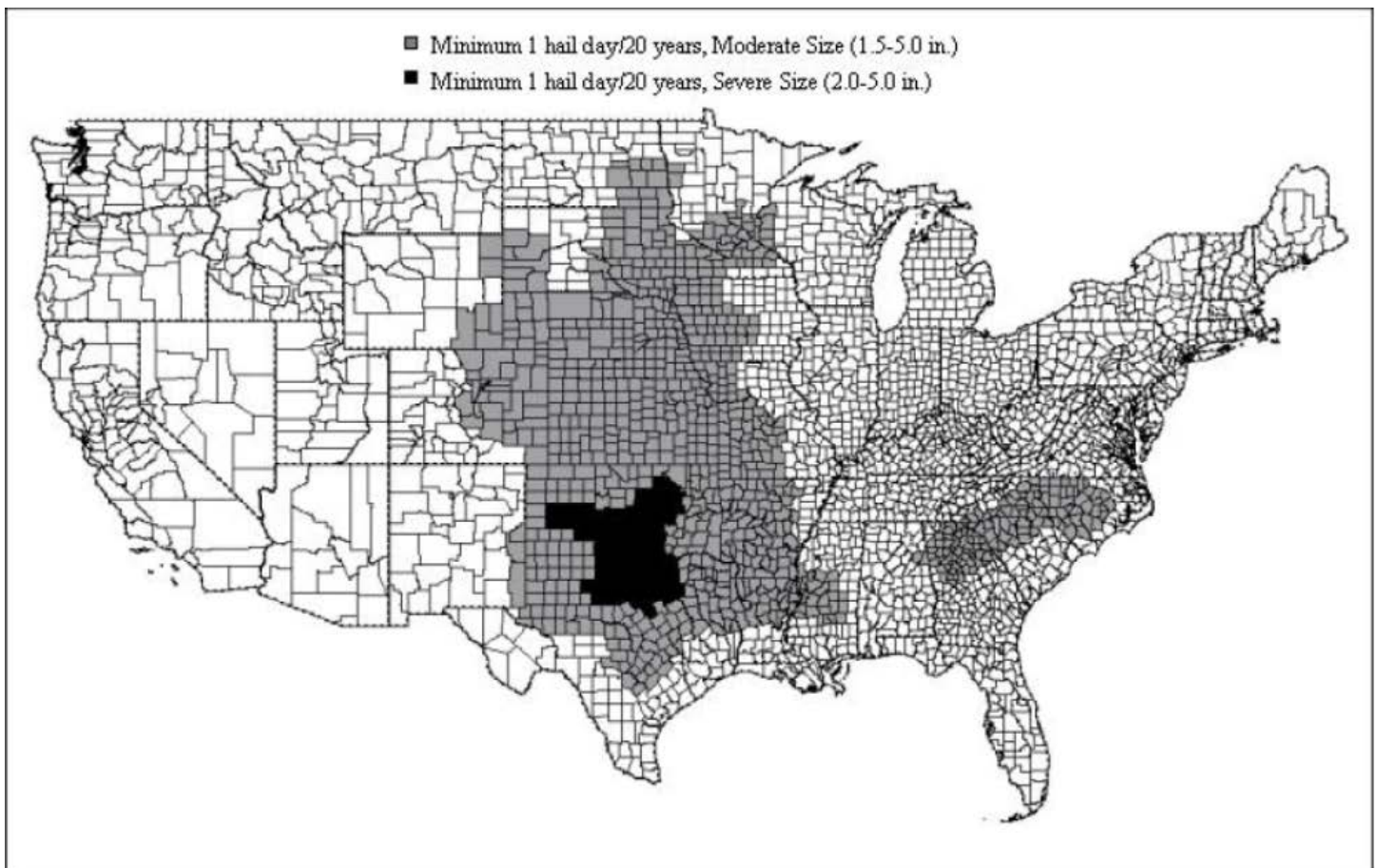


FIGURE E108.3

E108.3.1 Hail Exposure regions. Hail exposure regions in Figure E108.3 shall be as follows:

- (a) **Moderate** - One or more hail days with hail diameters greater than 1.5 in (38 mm) in a twenty (20) year period.
- (b) **Severe** - One or more hail days with hail diameters greater than 2.0 in (50 mm) in a twenty (20) year period.

E108.3.2 Exterior wall coverings subject to hail exposure. Wall coverings used in regions where hail exposure is Moderate or Severe, as determined in accordance with Section E108.3.1 and Figure E108.3, shall be tested, classified, and labeled in accordance with UL 2218 or FM 4473.

E108.4 Exterior wall covering limitations for reduced damage from wind. Vinyl siding and Exterior insulation and finish systems (EIFS) conforming to the requirements of Chapter 14 of the *International Building Code* shall only be permitted to be installed on exterior walls of buildings located outside hurricane-prone regions as defined in Section 1609.2.

SECTION E109 ROOF ASSEMBLIES

E109.1 General. In addition to the requirements for Roof Assemblies and Rooftop Structures in Chapter 15 of the *International Building Code*, the roof coverings shall also comply with Sections E109.2 through E109.4.

E109.2 Non-classified roofs. Non-classified roof coverings in accordance with Section 1505.5 of the *International Building Code* shall not be permitted on *buildings*.

E109.3 Roofs in Warm and Dry Climates. Roofs in climate zones 1, 2, 3, 4, 5B (dry), and 6B (dry) of the *International Energy Conservation Code (IECC)* shall have a Class A roof covering or Class A roof assembly according to UL 790. For roof coverings where the profile allows a space between the roof covering and roof decking, the space at the eave ends shall be firestopped to preclude entry of flames or embers.

E109.4 Roof coverings subject to hail exposure. Roof coverings used in regions where hail exposure is Moderate or Severe, as determined in accordance with Section E104.4.1 and Figure E102.3, shall be tested, classified, and labeled in accordance with UL 2218 or FM 4473.

E109.4.1 Hail Exposure regions in Figure E108.3 shall be as follows:

- (a) **Moderate** - One or more hail days with hail diameters greater than 1.5 in (38 mm) in a twenty (20) year period.
- (b) **Severe** - One or more hail days with hail diameters greater than 2.0 in (50 mm) in a twenty (20) year period.

The following references are added to Chapter 35 as follows:

UL 2218, *Impact Resistance of Prepared Roof Covering Materials*. UL 2218, *Impact Resistance of Prepared Roof Covering Materials*.

FM 4473, *Specification Test Standard for Impact Resistance Testing of Rigid Roof Materials by Impacting With Freezer Ice Balls*.

SECTION E110 STRUCTURAL

E110.1 General. In order to limit the impact of natural disasters on the *building* and occupants the *building* shall comply with Sections E110.1 through E110.5.

E110.2 Snowloads. In order to limit the impact of snow on the *building* the *building* shall comply with Section E110.2.1

E110.2.1 Ground snowloads. The ground snowloads to be used in determining the design snow loads for roofs shall be equal to 1.2 times the ground snowloads determined in accordance with ASCE 7 or Figure 1608.2 for the contiguous United States and Table 1608.2 for Alaska in the *International Building Code*. Site-specific case studies shall be made in areas designated “CS” in Figure 1608.2. Ground snow loads for sites at elevations above the limits indicated in Figure 1608.2 and for all sites within the CS areas shall be *approved*. Ground snow load determination for such sites shall be based on an extreme value statistical analysis of data available in the vicinity of the site using a value with a 2-percent annual probability of being exceeded (50-year mean recurrence interval). Snow loads are zero for Hawaii, except in mountainous regions as *approved* by the *building official*.

E110.3 Wind loads. In order to limit the impact of wind on the *building* the *building* shall comply with Section E110.3.1

E110.3.1 Determination of wind loads. Wind loads on every building or structure shall be determined in accordance with Chapters 26 to 30 of ASCE 7 or provisions of the alternate all-heights method in Section 1609.6. The type of opening protection required, the ultimate design wind speed, V_{ult} , and the exposure category for a site is permitted to be determined in accordance with Section 1609 or ASCE 7. The design wind pressure, p , and design wind force, F , determined in accordance with ASCE 7 or 1609.6 shall be based on a design wind speed equal to the basic wind speed (or locally adopted basic wind speed in special wind zones, if higher) determined in accordance with Section 1609.3 as follows:

1. Ultimate design wind speed from Figure 1609A plus 20-mph.
2. Ultimate design wind speed from Figure 1609B plus 10 mph
3. Ultimate design wind speed from Figure 1609C.

Component and cladding loads shall be determined for the design wind speed defined assuming terrain Exposure C, regardless of the actual local exposure. Wind shall be assumed to come from any horizontal direction and wind pressures shall be assumed to act normal to the surface considered.

E110.4 Flood loads. Buildings designed and constructed in flood hazard areas defined in Section 1612.2 of the Code shall comply with the following.

E110.4.1 Floors above base flood elevation. Floors required by ASCE 24 to be built above base flood elevations shall have the floor and their lowest horizontal supporting member not less than the higher of the following:

- (a) Design flood elevation,
- (b) Base flood elevation plus 3 feet, or
- (c) advisory base flood elevation plus 3 feet, or
- (d) 500-year flood, if known

E110.4.2 Flood protective works. Buildings designed and constructed in accordance with ASCE 24 shall not consider levees or floodwalls for providing flood protection during the design flood.

E110.5 Earthquake loads. In order to limit the impact of seismic events on the *building* the *building* shall comply with Section E110.5.1 and E110.5.2

E110.5.1 Seismic design importance factor. Where the ASCE 7 mapped 0.2 sec spectral response acceleration parameter, S_s , shown on Figures 1613.3.1(1), 1613.3.1(3), 1613.3.1(4) or 1613.3.1(6) of the *International Building Code*, is greater than or equal to 40%g, the importance factor, I , in Table 11.5-1 of ASCE 7 shall be:

1. Not less than 1.15 for Occupancy Category II buildings
2. Not less than 1.35 for Occupancy Category III buildings
3. Not less than 1.6 for Occupancy Category IV buildings

E102.4.2 Seismic Design Categories C, D, E and F. If the *seismic design category* is determined to be C, D, E or F in accordance with Section 1613.3.5 of the *International Building Code*, a site specific geotechnical report complying with the provisions of ASCE 7 Section 11.8 is required, and the building shall be designed by a *registered design professional*.

E110.6 Storm Shelters. *Buildings* and structures shall be provided with storm shelters conforming to the requirements of Section 423 of the *International Building Code* where required by Sections E110.6.1 through E110.6.2 of this code.

E110.6.1 Storm shelters required. Storm shelters shall be provided for occupants of buildings in accordance with Sections E110.6.1.1, E110.6.1.2 and E110.6.2.

Exceptions:

1. *Buildings* meeting the requirements for shelter design in ICC/NSSA 500.
2. Where storm shelters within 1/4-mile of the proposed *building* are available and have adequate size to accommodate the added occupant load of the proposed *building*.
3. Where the code official determines the *building* size, location or occupant load does not warrant shelters.

E110.6.1.1 Hurricane areas. In hurricane-prone regions as defined in Section 1609.2 of the *International Building Code*, the following buildings shall be provided with storm shelters:

1. Community halls, gymnasiums and libraries assigned to Group A3 occupancy classification.
2. Civic administration facilities assigned to Group B occupancy classification.
3. Buildings assigned to Group E, I-1, I-2, I-3, M or R occupancy classifications.
4. Buildings assigned to Risk Category I in accordance with Section 1604.5 of the *International Building Code*.

E110.6.1.2 Tornado areas. In areas where the shelter design wind speed for tornadoes of Figure 304.2.(1) of ICC/NSSA 500 is 160 mph or greater, tornado shelters shall be provided, except that such shelters shall not be required for buildings classified as Group U occupancies or classified as Risk Category I according to Table 1604.5.

E110.6.2 Combined hurricane and tornado shelters. Where combined hurricane and tornado shelters are provided the shelter shall comply with the more stringent requirements of ICC/NSSA-500 for both types of shelters.

E110.7 Wildland In order to limit the impact of wildland fires on the *building* the *building* shall comply with Sections E110.7.1 through E110.7.3

E110.7.1 Wildland Fires. The provisions of the International Code Council (ICC) *International Wildland-Urban Interface Code* shall apply to the construction, alteration, movement, repair, maintenance and use of any building, structure or premises within the wildland interface areas in this jurisdiction.

E110.7.2 Exterior walls. Exterior wall requirements shall be based on the Fire Hazard Severity specified in Table 502.1 in the *International Wildland-Urban Interface Code*.

E110.7.3 Smoke Detection. An automatic smoke detection system shall be installed throughout buildings located within areas designated by the jurisdiction as being a wild land urban interface area.

***** End Proposed Modification to International Green Construction Code, Appendix E *****