

Code Amendments for Sustainability Modifications to the International Building Code, 2012 edition

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These amendments to the International Building Code are intended to provide high performance building requirements for use by state and local governments and Federal Agencies to implement sustainable or green building initiatives. The requirements are formatted to facilitate adoption as amendments to the 2012 International Building Code. In addition to energy efficiency and typical sustainability criteria, enhanced sustainability is accomplished with requirements for increased disaster resistance and improved durability.

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This document is based in part on the requirements for the *Fortified...for safer living* guide. Its use does not constitute compliance with the *Fortified ... for safer living*[®] program. For specific requirements and procedures for compliance refer to the Institute for Business and Home Safety website which can be found at www.disaster-safety.org.

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General Overview of Code Amendments for Sustainability

The Code Amendments for Sustainability, referred to throughout this commentary as “this document” provides recommended minimum building code requirements modifying the International Building Code (IBC)¹. These amendments are based on the philosophy that truly sustainable buildings must be durable and disaster resistant in addition to being designed with appropriate consideration for energy conservation, indoor environmental quality, material resources, site development, and water efficiency. Excessive amounts of maintenance and repair due to normal operations and the need to repair, replace, or demolish and reconstruct all or part of buildings when disasters occur is simply not sustainable. Thus, this document includes provisions that require the building to be designed and constructed to more stringent criteria than many traditional building codes. Typical building code provisions are the absolute minimum for life safety and may not adequately address a level of property protection consistent with the premise of sustainability to help sustain communities when disasters occur. Many of the requirements improving property protection also inherently provide an enhanced level of life safety. The concepts in this document address aspects of building design and construction identified by the National Institute of Building Sciences (NIBS) *Whole Building Design Guidelines*: accessible, aesthetics, cost-effective, functional/operational, historic preservation, productive, secure/safe, and sustainable.²

The key concepts in this document include the generally accepted sustainability features like energy conservation, indoor environmental quality, material resources, site development and water efficiency codified or standardized in other documents. This document however, only includes those green or sustainable features that are within the purview of most building code departments. Requirements for these features are combined with criteria for enhanced building performance and durability.

The use of this document is especially applicable in disaster prone areas. Without first assuring that there is a durable, disaster-resistant building core and shell, when disasters occur, it is just as likely that the more expensive green or sustainable building components that are damaged and/or contaminated will be disposed of in landfills or by incineration as other components of the building. The excessive property losses associated with most disasters is not consistent with the basic premise of sustainability. The approach used for this document is three-fold. First this document is aligned with the recommendations in the Fortified for Safer Business³ of the Institute for Business and Home Safety which address natural disaster resistance excluding flood. The flood damage resistance captures the concepts of many of the recommendations of the Federal Emergency Management Agency.⁴ The third aspect addresses the lack of water supply and limitations and reduced accessibility by emergency responders that are commonly experienced when disasters occur and after disasters. To avoid excess property losses due to individual fires and to reduce the possibility of individual structure fires igniting major conflagrations, sprinkler trade-offs allowed by most building codes are not permitted. In addition to the criteria satisfying the primary intended function, most criteria for enhanced resiliency simply result in more robust building construction that provides additional indirect benefits such as lower operating and maintenance costs, improved security, improved occupant comfort and improved productivity. Following these criteria will not assure that damage to buildings in a disaster will be eliminated but will reduce the amount of damage as well as the number of buildings damaged. This increases the ability for a community to recover after a disaster, help maintain consistent revenue to continue municipal services following a disaster and save on disaster response, relief and recovery costs.

¹ International Code Council, 4051 West Flossmoor Road, Country Club Hills, IL 60478-5795, www.iccsafe.org, 2012

² National Institute of Building Sciences, 1090 Vermont Avenue NW, Suite 700, Washington, DC 20005, www.wbdg.org/wbdg_approach.php, last visited August 2014

³ Institute for Business and Home Safety, 4775 East Fowler Ave Tampa, FL 33617, www.disastersafety.org/fortified-main/fortified-safer-business/, last visited August 2014.

⁴ Federal Emergency Management Agency, www.ready.gov/floods, last visited August 2014

Several of the requirements in this document may not be adequately addressed or are neglected in efforts by others to develop codes and standards for sustainable buildings. These include:

- Design service life plans
- Enhanced fire resistance and protection
- Acoustical requirements to improve occupant comfort and productivity
- Increased wind damage resistance
- Increased flood damage resistance
- Increased hail damage resistance
- Increased seismic damage resistance
- Increased radon penetration resistance
- Resource minimization through both manufacturing and design
- Pollution prevention related to clean air, clean water, conservation and noise control

The packaging of this document is unique. For ease of adoption and enforcement it is written in mandatory language that amends and appends the *International Building Code* (IBC). The amendments and appendices are provided with commentary describing the benefits and rationale.

Expectations are that these building requirements will be immediately adopted as requirements for all new government owned and funded buildings at the Federal, state, and local levels. In addition, jurisdictions may also adopt the requirements for all new buildings intended to receive a sustainability (S) designation which will be useful to incentivize exemplary building practices and identity projects that achieve a specific level of construction practice above minimum building code requirements. Identifying such buildings may facilitate and reduce costs for emergency operations and may assist communities to utilize such structures in their disaster planning. In some jurisdictions, especially those in areas prone to disasters, requiring all new buildings to be more durable and disaster resistant, benefits the entire community.

While the requirements in this document can be applied to all buildings the intent is to only have them as mandatory requirements for new buildings. This approach improves the sustainability and continuity of the community one building at a time. The community's vitality is gradually strengthened over the long term. This phased in strategy is consistent with the routine process of altering building requirements through the adoption of newer building code editions.

Studies show that major improvement to community sustainability and continuity can be achieved in as little as several decades. The National Trust for Historic Preservation reports that nearly a third of all buildings in the United States are demolished and replaced every 25 years⁵. There is a clear need to steer away from the path of disposable buildings if the intent is to have significant long term improvements to the environment and communities as a result of the way buildings are designed and constructed.

Opposition to the adoption of these requirements can be expected. Material interest that cannot or will not provide durable and more disaster resistant construction may argue against these criteria. Those interested in keeping the scope of building codes limited to the absolute minimums for life safety will also be expected to argue against adoption. A third group that can be expected to argue against adoption are those whose interest is focused on keeping the initial cost of construction to an absolute minimum. These are likely to be the same entities often seeking waivers to build less than the current minimum building code requirements in many jurisdictions. The adoption and enforcement of these requirements is encouraged regardless of this opposition because those arguing against them believe the continuation of constructing disposable buildings in the United States without

⁵ **Sustainable Stewardship – Historic preservation plays an essential role in fighting climate change**, Article by Richard Moe in *Traditional Building*, National Trust for Historic Preservation, Washington, DC – 2008.

appropriate consideration of the consequences to the environment or community continuity is fine when it is not.

Forward thinking jurisdictions will probably realize that some moderate increases to initial cost with little or no increase in the life cycle costs, is justified when considering the reduction of negative environmental, social, and economic impacts to their community related to new building design and construction. In fact, many buildings built to these requirements can be expected to have reduced life cycle costs compared to building currently built to the minimum building code requirements and may also comply with criteria for reduced insurance premiums. Individual buildings designed and constructed to these criteria or communities requiring new construction to satisfy these criteria may be eligible for assistance through some state or Federal programs such as the newly developed Department of Homeland Security Resilient Star.⁶ It is also noteworthy that there are Executive Orders, proposed legislation, and Federal agency programs stressing the need for enhanced resiliency. These efforts clearly communicate that the property losses when disasters occur have become a problem. Action needs to take place now to increase the sustainability, durability and disaster resistance of buildings.

Following is sample legislation for adopting the 2012 *International Building Code* with amendments to accomplish implementing a building code program including sustainable features. This legislation can be structured to meet the particular needs of the adopting jurisdiction. Options presented here are:

- Apply the building code with sustainable amendments to all new buildings permitted.
- Apply the building code with sustainable amendments to new government owned, leased, funded or insured buildings permitted.
- Apply the building code with sustainable amendments to new buildings specifically permitted to meet these requirements. Such buildings would be given a special designation on the Certificate of Occupancy.

⁶ Department of Homeland Security/Institute for Business and Home Safety, www.disastersafety.org/resilience-star/, last visited August 2014

LEGISLATION

The *International Codes* are designed.....(No change to text)..... including the information required for insertion into the code text.

[Revise title as follows:]

SAMPLE LEGISLATION FOR ADOPTION OF
THE INTERNATIONAL BUILDING CODE WITH
SUSTAINABILITY REQUIREMENTS
ORDINANCE NO. _____

[Revise introduction language as follows:]

A[N] [ORDINANCE/STATUTE/REGULATION] of the [JURISDICTION] adopting the 2012 edition of the *International Building Code* with sustainable building requirements, regulating and governing the conditions and maintenance of (Check the one that applies)

- all property, buildings and structures;
- all government owned, leased, funded or insured property, buildings and structures;
- all property, buildings and structures to be designated on the certificate of occupancy as sustainable;

by providing(No changes to remaining text) all other ordinances or parts of laws in conflict therewith.

The [GOVERNING BODY] of the [JURISDICTION] does ordain as follows:

[Revise Section 1 as follows:]

Section 1. That a certain document, three (3) copies of which are on file in the office of the [TITLE OF JURISDICTION'S KEEPER OF RECORDS] of [NAME OF JURISDICTION], being marked and designated as the *Building Code*, and further includes the International Building Code, 2012 edition, including Appendix Chapters [~~FILL IN THE APPENDIX CHAPTERS BEING ADOPTED~~] (see *International Building Code* Section 101.2.1, 2012 edition) as published by the International Code Council as further modified with sustainability requirements as shown in this document and with the following Appendix Chapters (Check each that applies)

- Appendix Chapter A – EMPLOYEE QUALIFICATIONS (No changes to this appendix)
- Appendix Chapter B – BOARD OF APPEALS (No changes to this appendix)
- Appendix Chapter C – GROUP U – AGRICULTURAL BUILDINGS (No changes to this appendix)
- Appendix Chapter D – FIRE DISTRICTS (No changes to this appendix)
- Appendix Chapter E – SUPPLEMENTARY ACCESSIBILITY REQUIREMENTS (No changes to this appendix)
- Appendix Chapter F – RODENTPROOFING (Appendix as modified herein)
- Appendix Chapter G – FLOOD-RESISTANT CONSTRUCTION (No changes to this appendix)
- Appendix Chapter H – SIGNS (No changes to this appendix)
- Appendix Chapter I – PATIO COVERS (No changes to this appendix)
- Appendix Chapter J – GRADING (No changes to this appendix)
- Appendix Chapter K – ADMINISTRATIVE PROVISIONS (No changes to this appendix)
- Appendix Chapter L – EARTHQUAKE RECORDING INSTRUMENTATION (No changes to this appendix)
- Appendix Chapter M – TSUNAMI-GENERATED FLOOD HAZARD (No changes to this appendix)
- Appendix Chapter N – MATERIAL RESOURCE MANAGEMENT (New optional appendix)
- Appendix Chapter O – SITEWORK (New optional appendix)
- Appendix Chapter P – RADON MITIGATION (New optional appendix)
- Appendix Chapter Q – SITE SELECTION (New optional appendix)
- Appendix Chapter R – ENHANCED SECURITY (New optional appendix)

be and is hereby adopted(No changes to remaining text) and changes, if any, prescribed in Section 2 of this ordinance.

(No change to Sections 2 through 7)

Code Amendments for Sustainability

Modifications to the International Building Code, 2012 edition CAS-B12 November 2014

Using This Document

Code Amendments for Sustainability Differs from Other Green Construction Codes and Standards. *This document is unique as compared to other programs, standards, or model codes addressing green or sustainability design and construction in two primary ways.*

First, it includes criteria necessary to achieve a level of enhanced resiliency. This is primarily related to improved property protection and long term use and operation of the building. Loss of property and increased costs associated with excessive maintenance and repair, frequent removal and replacement of components and systems, and frequent disposal of building components, systems, and content, whether caused by normal use and routine operations or by disasters, do not support the basic premise of sustainability. Specific criteria for enhanced resilience, developed for the most part to be consistent with the recommendations of the Institute for Business and Home Safety¹ are included in these recommended amendments.

The second significant difference of this document compared to other model codes or standards intended to address green or sustainable building design and construction is that the criteria recommended as amendments to the building code are limited to those within the purview of most building code departments. For example, mandatory criteria for testing, performance monitoring, and other actions that occur after issuance of the certificate of occupancy are intentionally omitted from these recommended amendments. Such criteria are more appropriate for inclusion in other construction documents and contracts with the owner.

Practical Selection of Criteria. *This Commentary is formatted to classify the amendments by type. While some amendments may fit in multiple classifications the primary type of impact is indicated by the designation. Enhanced resilience and enhanced security are addressed in this document along with the five most widely accepted green building concepts to assure green features are housed in appropriately designed building cores and shells. The designation categorizing each code amendment is provided immediately following each section title. In addition to the seven impact areas, there is an eighth designation for general or administrative requirements. The designations are:*

- [EC] = Energy Conservation and Management
- [ER] = Enhanced Resilience
- [ES] = Enhanced Security
- [GA] = General or Administrative Provisions of the Code
- [IQ] = Interior Environmental Quality
- [MR] = Material Resources Conservation and Management
- [SD] = Site Selection and Development
- [WC] = Water Conservation and Management

Designations Facilitate Adoption. *With the criteria classified using these designations, the adopting authority in a jurisdiction may select the types of criteria that are important to its constituents. For a jurisdiction in a disaster prone area, criteria for enhanced resilience may be more important than other criteria for sustainability to help assure long-term continuity and sustainability at the community level. The authority having jurisdiction may choose to only select the criteria for enhancing resilience [ER] as amendments for their building code.*

¹ Institute for Business and Home Safety is a national association representing the insurance and re-insurance industry in the United States. www.disastersafety.org last visited August 2014.

An authority in a jurisdiction may favor using other green building codes and standards to address the five most widely accepted green building concepts. The authority having jurisdiction should then elect to adopt the enhanced resiliency [ER] amendments to their building code along with the adoption of those alternative green codes or standards. Alternatively, the authority may integrate the enhanced resiliency [ER] criteria as a mandatory part of their green or sustainability code.

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CODE AMENDMENTS

CHAPTER 1 SCOPE AND ADMINISTRATION

Section 101 GENERAL

[Modify Section 101.1 as follows:]

[A] **101.1 Title.** These regulations shall be known as the Sustainable Building Code of [Name of Jurisdiction] and hereinafter referred to as “this code.”

[Modify Section 101.2 as follows:]

[A] **101.2 Scope.** The provisions of this code shall.....
(*No change to text*).....to such buildings or structures.

Exceptions:

1. Detached one- and two-family dwellings and multiple single-family dwellings (townhouses) not more than three *stories* above grade plane in height with a separate means of egress and their accessory structures shall comply with the *International Residential Code*.
2. Group U occupancies shall be permitted to comply with the *International Building Code*

[Modify Section 101.3 as follows:]

[A] **101.3 Intent.** The purpose of this code is to establish the minimum requirements to safeguard the public health, safety and general welfare through structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation, building sustainability and safety to life and property from fire and other hazards attributed to the built environment and to provide safety to fire fighters and emergency responders during emergency operations.

COMMENTARY

CHAPTER 1 ADMINISTRATION

Section 101 GENERAL

C101.1 Title. [GA] This section merely amends the title of the International Building Code (IBC) to establish the combination of the 2012 IBC and this document as the Sustainable Building Code.

C101.2 Scope. [GA] Utility and Miscellaneous Group U occupancies are excluded from the mandatory requirements however they must still comply with the basic requirements in the IBC. Mandatory application of these requirements for Group U occupancies would provide limited green benefits because this group includes structures like barns, carports, sheds, silos, stables and tanks which are not conditioned and typically do not have human occupancy. However, the provisions for enhanced resiliency contained in these requirements may be applicable for improved property protection, especially in areas prone to disasters.

C101.3 Intent. [GA] Adds building sustainability to the intent of this code. Sustainability, including appropriate provisions for enhanced resiliency, is the main difference between a code based on this document and a minimum building code such as the International Building Code. Sustainability takes on many forms related to building design, construction, functionality, life cycle costs, and impact to the environment. Sustainable buildings should include appropriate consideration of accessibility, aesthetics, cost effectiveness, functionality, historic preservation, productivity and comfort, safety and security, and sustainability.¹ This code incorporates these features and combines them by amending the IBC to produce a comprehensive code for sustainable buildings.

¹Whole Building Design Guide, National Institute of Building Sciences, 1090 Vermont Avenue, NW, Suite 700 Washington, DC 20005-4950, www.wbdg.org, visited 2013.

[Modify Section 101.4 and add new Section 101.4.7 as follows:]

[A] 101.4 Referenced Codes. The other codes listed in Sections 101.4.1 through ~~101.4.6~~ 101.4.7 and referenced elsewhere in this code shall be considered part of the requirements of this code to the prescribed extent of each such reference. The provisions of this code shall supersede any less stringent requirements of the referenced codes.

[A] 101.4.7 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.

C101.4.7 Wildland Fires. [ER] This section requires the adoption and enforcement of the *International Wildland-Urban Interface Code* within the jurisdiction. *The International Wildland-Urban Interface Code (IWUIC)* regulates exposed exterior construction on the walls, roof, decks, soffit and other exposed exterior surfaces as well as mandating a radius around the structure that must be kept clear of trees, shrubs, brush, etc. The requirements of the *IWUIC* only apply to those areas classified by the authority having jurisdiction as having a higher potential for a wildland-urban fire from the presence of quick-burning forage, limited fire department access, prevalent weather conditions or other mitigating conditions.

Number of Large-Scale Nationally Declared Wildfire Emergencies by State from 2003 through 2012

AK	3	HI	11	ME	-	NJ	5	SD	9
AL	3	IA	-	MI	-	NM	24	TN	1
AR	20	ID	6	MN	-	NV	26	TX	115
AZ	25	IL	-	MO	-	NY	-	UT	11
CA	82	IN	-	MS	-	OH	2	VA	7
CO	21	KS	1	MT	20	OK	70	VT	-
CT	-	KY	1	NC	2	OR	10	WA	27
DE	-	LA	-	ND	-	PA	-	WI	-
FL	11	MA	-	NE	5	RI	-	WV	-
GA	9	MD	-	NH	2	SC	1	WY	8

Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington, DC website: www.nws.noaa.gov/om/hazstats visited 2013.

As can be seen in the table on Nationally Declared Wildfire Emergencies, wildland/urban interface fires commonly occur throughout the United States and the effects can be catastrophic when the weather and terrain conditions are windy and dry. The table only reflects wildland fires.

Communities in areas where there are very dry and windy conditions throughout much of the summer and fall months are most susceptible to out-of-control wildland fires. The table on Total Property Loss Due to Wildfires demonstrates the importance of having criteria for enhanced resilience related to wildland fires. The design and construction criteria provided in Section 701 of this code are only applicable in areas where the exposures are determined to be vulnerable to wildland fires.

Total Property Loss Due to Wildfires Excluding Crop Losses in Millions of 2010 Dollars

Year	Losses	Year	Losses
2012	1,390.0	2007	1,438.5
2011	646.5	2006	207.4
2010	244.9	2005	101.3
2009	111.8	2004	24.3
2008	239.4	2003	2756.0

Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington, DC website: www.nws.noaa.gov/om/hazstats visited 2013

**SECTION 107
SUBMITTAL DOCUMENTS**

[Modify Section 107.2 as follows:]

[A] **107.2 Construction documents.** *Construction documents* shall be in accordance with Sections 107.2.1 through 107.2.5, 7.

[Add new Section 107.2.6 as follows:]

[A] 107.2.6 Design service life plan. A design service life plan (DSLPL) shall be provided for approval prior to the application for a permit. The DSLPL shall comply with the provisions of this section.

[A] 107.2.6.1 Design service life. The DSLPL shall use a design service life of not less than 60 years.

Exceptions:

1. For temporary structures permitted in Section 108, the DSLPL is only required to include cost estimates for removal and disposal of materials and products.
2. Group F, S and U buildings shall be permitted to have a 25 year DSLPL when approved by the building official.

[A] 107.2.6.2 DSLPL scope. The DSLPL shall include routine repair, maintenance, replacement, and disposal cost estimates for the design service life of the building for the following components:

1. Exterior Walls in accordance with Chapter 14,
2. Roof Assemblies and Rooftop Structures in accordance with Chapter 15,
3. Concrete in accordance with Chapter 19,
4. Aluminum in accordance with Chapter 20
5. Masonry in accordance with Chapter 21,
6. Steel in accordance with Chapter 22,
7. Wood in accordance with Chapter 23,
8. Gypsum Board and Plaster in accordance with Chapter 25, and
9. Plastics in accordance with Chapter 26,

**Section 107
SUBMITTAL DOCUMENTS**

C107.2 Construction documents. [GA] This section of the code is expanded by adding criteria for design service life and mandatory peer review.

C107.2.6 Design service life plan. [MR] Requires that a service-life plan be developed and provided prior to application for a building permit. A service-life plan will provide the owner with valuable decision-making information regarding the overall maintenance costs based on the design, materials and construction selected. Maintaining the sustainable systems and building components is critical to achieving the expectations of a sustainable building.

[A] 107.2.6.3 DSLP criteria. The DSLP shall include the following:

1. Building components with descriptions of materials and products.
2. Schedule of routine maintenance, repair, replacement and disposal, for each component.

[A] 107.2.6.4 DSLP retention. The DSLP shall be retained for the design service life of the building, and upon request, made available for review by the authority having jurisdiction. During the design service life of the building the DSLP shall be transferred to each subsequent owner.

[Add new Section 107.2.7 as follows:]

[A] 107.2.7 Peer review statement. The *permit application for buildings more than 75' in height or having long span roofs with spans exceeding 150 feet shall be accompanied by documentation that the structural design has been peer reviewed by another registered design professional where any of the following conditions exist.*

1. Buildings in Seismic Design Category C, D, E, or F.
2. Buildings for Risk Category II where wind speed, V_{ult} , is greater than 115 mph.
3. Buildings for Risk Category III and IV where wind speed, V_{ult} , is greater than 120 mph.

**SECTION 111
CERTIFICATE OF OCCUPANCY**

[Modify Section 111.2 (12) as follows:]

111.2 Certificate issued. After the building official inspects*(No change to text)*.....shall issue a certificate of occupancy that contains the following:

(No change to items 1-11)

C107.2.7 Peer review statement. [GA] Taller buildings or buildings with large roof spans require structural design considerations that are more complex than that commonly required for shorter or smaller roof span buildings. Under these extraordinary circumstances it is prudent for these unusual building designs to have a third party structural peer review to insure sufficient attention has been given to the structural designs. This is especially important in meeting the intent of sustainable buildings.

**Section 111
CERTIFICATE OF OCCUPANCY**

C111.2 Certificate issued. [GA] Identifies that a Certificate of Occupancy be issued for all new buildings after construction is complete and the building can be safely occupied. Stipulates that the identifier “Sustainable” be added to the Certificate of Occupancy to designate that the building has been constructed in compliance with these amendments.

This provision distinguishes buildings constructed under

12. The designation “Sustainable” and any special stipulations and conditions of the building permit.

CHAPTER 2 DEFINITIONS

[Modify Section 202 by adding the definitions as follows:]

(Classroom added for use in Chapter 12)

CLASSROOM: Rooms or spaces in buildings designed for instructional activities on a regular basis.

(Heat Capacity and Solar Reflectance Index added for use in Chapters 14 and 15)

HEAT CAPACITY: The amount of heat necessary to raise the temperature of a given mass 1°F. Numerically, the heat capacity per unit area of surface (Btu/ft²·°F) is the sum of the products of the mass per unit area of each individual material in the roof, wall, or floor surface multiplied by its individual specific heat.

SOLAR REFLECTANCE INDEX (SRI): A measure of a material surface’s ability to reject solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100.

this code and provides a visual notification for fire and maintenance inspectors. It will also assist jurisdictions in keeping track of the resilient sustainable building stock.

Chapter 2 DEFINITIONS

C202.1 Definitions. Definitions of the terms introduced in subsequent sections have been added to help the user. “Classrooms” was added to Section 1207 and, “heat capacity” and “solar reflectance index” have been added to Section 1410.

**CHAPTER 3
USE AND OCCUPANCY
CLASSIFICATION**

[No modifications to Chapter 3.]

**CHAPTER 4
SPECIAL DETAILED
REQUIREMENTS BASED
ON USE AND OCCUPANCY**

**CHAPTER 3
USE AND OCCUPANCY
CLASSIFICATION**

**CHAPTER 4
SPECIAL DETAILED
REQUIREMENTS BASED
ON USE AND OCCUPANCY**

ENHANCED FIRE SAFETY. Fire safety and property protection necessary to achieve the minimum performance necessary for sustainable buildings requires a combination of appropriate levels of active and passive fire protection. These requirements include automatic fire suppression systems (sprinklers) most occupancies and a superior level of passive fire protection.

Sprinkler Trade-offs - Throughout the *International Building Code* (as well as other building codes), fire resistance ratings, egress widths, travel distance and many other safety features are permitted to be relaxed or completely eliminated where automatic sprinkler systems are present. In addition, where automatic sprinkler systems are installed the building height is allowed to be increased by 1 story and areas increased by 200 to 300 percent. While these systems have a good record in controlling fire and allowing escape, they are still vulnerable to human and environmental factors. Further the minimum criteria for sustainable buildings must exceed minimum life safety and address property protection and the welfare of the general public. The recommended amendments include removal of sprinkler trade-offs in favor of combined active and passive protection as necessary to achieve the level of property protection that is appropriate for sustainable buildings. These requirements provide property protection related to fire, smoke, and water damage. The reduced damage is an overall benefit to public welfare. There are less displacement and related community consequences after events. Retaining businesses (employers) and residences (employees) supports community continuity. In addition, after a disaster recovery time is shortened and recovery costs lessened.

Sprinkler Failures. The need for this redundancy of combined active and passive fire protection is primarily related to the possibility of sprinkler failure. The National Fire Protection Association (NFPA)² states that fully functional sprinklers do not operate effectively 13 percent of the time. This is determined from data collected by the United State Fire Administration indicating the failure of operational sprinklers to discharge when called upon by fire. This does not include failure to operate when arson is involved, sprinkler system shut down for maintenance or repair and water service disrupted due to maintenance or disasters. Disasters in this reference include any loss of water supply whether from a catastrophic event or simply a broken or frozen water line. Permitting sprinkler trade-offs for fire safety, structural integrity and egress, raises the potential for death, injury, facility shutdown, repair construction, worker displacement and other hindrances to efficient facility operation and community continuity. If a sprinkler malfunction or failure occurs, the only immediate defense remaining to contain or stop the spread of fire are building elements that have been allowed a reduction in hourly fire-resistance ratings. The enhanced resiliency of buildings depends on both active suppression and passive compartmentation without allowable hourly reductions, to reasonably guarantee that fire does not spread past the area or room of origin.

Fires After Disasters: Fires after other disasters result in large property losses. Water and power services are often disrupted when disasters occur. Thus, even if a building is equipped with sprinklers, the water supply necessary to automatically control or extinguish fires is not available. In addition, availability of emergency responders is often limited, for the most part due to simultaneous multiple incidences. Too, failures in the infrastructure may hamper access by emergency responders or cause a lack of water supply or pressure that limits their suppression capabilities.

After disasters there is a higher probability of fire ignitions. Where electrical power service is still available ignitions may be precipitated from electrical shorts caused by flooding or water entering through damaged building enclosures. In the absence of electrical power, ignitions are also attributable to the use of open flames for light, warmth, cooking, and purifying water. Further, lightning strikes are a common cause of ignition where disasters are storm related.

² U.S. *Experience with Sprinklers*, Hall, J. R., Jr., National Fire Protection Association, Fire Analysis and Research Division, Quincy, MA, March 2012

Fire and other public service officials commonly report that when disaster recovery takes more than a few days there tends to be an increase in the number of fires. A portion of this increase is due to arson. As individuals seek the necessities to survive they resort to vandalism and burglaries, and a common crime following burglaries in such circumstances is arson to reduce or eliminate connections to the perpetrators.

Fires after disasters tend to result in conflagrations engulfing multiple buildings. Thus, lack of water supply for suppression, reduced availability of emergency responders, and increased risk of ignitions demand enhanced passive fire protection. Passive fire protection in the form of compartmentation can contain the fire within the building or the room of origin. Passive fire protection to the structure also helps limit the spread of fire between floors and reduces the possibility of collapse. Finally, passive fire protection for the exterior of buildings serves to limit the spread of fire to adjacent structures.

Maintaining Life Safety. Model building code provisions establish a minimum level of life safety for occupants. Prior to the introduction of mandatory sprinkler requirements, life safety and property protection were provided by using fire-resistance rated structural elements, compartmentalization for fire containment and noncombustible exterior components to reduce the potential spread of fire from one building to another. With the introduction of mandatory criteria for sprinklers, arguments made regarding the cost of sprinklers resulted in modifications to the model building codes that permit reductions in passive fire protection and increase reliance on sprinklers. The minimum life safety and property protection for any building and especially sustainable buildings should be an appropriate redundancy of active and passive fire protection.

Throughout the building code, provisions for life safety of occupants provided by fire-resistance rated elements of the building core and shell are permitted to be relaxed wherever sprinklers are present. These relaxed provisions typically assume that all the fire and life safety features in the building (e.g. fire alarms and sprinklers) remain in operating condition over the life of the building. However, whenever there is a loss of power or water supply operation of these features may be jeopardized. This is especially a concern immediately following disasters. Since many of these relaxations affect the means of egress, sustainable buildings should maintain traditional levels of life safety prescribed by the building code regardless of the presence of sprinklers. These life safety features are especially important when persons with disabilities are present.

Damage Reduction. Limiting the fire to smaller compartments also limits the amount of area that will be damaged by water and smoke when the automatic fire suppression systems activate. This reduces the amount of materials that must be removed, disposed and replaced, and material that must be cleaned or otherwise treated once contaminated by smoke or saturated with water. Also limiting the spread of fire and the damage from water discharged by automatic sprinklers or fire services lessens the time required to return to normal occupancy and operations.

Increased Robustness. It is noteworthy that many of the passive fire protection features formerly required in the building codes where sprinklers were not present added to the robustness of the building. These robust features inherently improve the structural integrity of the building. For example, fire rated wall assemblies may provide alternative load paths to resist collapse. The inherent sound transmission reduction of robust fire-rated construction provides more comfortable and productive spaces. The overall improvement to safety and security creates a more productive and comfortable environment.

SECTION 402 COVERED MALL AND OPEN MALL BUILDINGS

[Modify Section 402.4.2.1 as follows:]

402.4.2.1 Tenant separations. Each tenant space shall be separated from other tenant spaces by a *fire partition fire barrier* complying with Section 708 707. A tenant separation wall is not required between any tenant space and the *mall*.

SECTION 402 COVERED MALL AND OPEN MALL PROTECTION

C402.4.2.1 Tenant separations. [ER] Activities of tenants in adjacent spaces may create an increased risk for fire hazard that is unknown to other tenants. This may be due to inappropriately modifying the already relaxed passive fire protection features or compromising the performance of automatic fire sprinklers. Further routine maintenance operations and refitting spaces for new tenants may result in the sprinkler system being disabled during maintenance and retrofit. This modification provides more robust fire protection between

SECTION 403 HIGH RISE BUILDINGS

[Delete Section 403.2.1.2 as follows:]

~~403.2.1.2 Shaft enclosures.~~ For buildings not greater than 420 feet (128 000 mm) in building height, the required fire-resistance rating of the fire barriers enclosing vertical shafts, other than exit enclosures and elevator hoistway enclosures, is permitted to be reduced to 1 hour where automatic sprinklers are installed within the shafts at the top and at alternate floor levels.

SECTION 404 ATRIUMS

[Modify Section 404.6 by deleting Exception No. 1 as follows:]

~~404.6 Enclosure of atriums.~~ *Atrium spaces.....(No change to text).....* in accordance with Section 711, or both.

Exception: A *fire barrier* is not required where a glass wall forming a smoke partition is provided. The glass wall shall comply with all of the following:

- ~~1. Automatic sprinklers are provided along both sides of the separation wall and doors, or on the room side only if there is not a walkway on the atrium side. The sprinklers shall be located between 4 inches and 12 inches (102 mm and 305 mm) away from the glass and at intervals along the glass not greater than 6 feet (1829 mm). The sprinkler system shall be designed so that the entire surface of the glass is wet upon activation of the sprinkler system without obstruction;~~
 - ~~1.1. The glass wall shall be installed in a gasketed frame in a manner that the framing system deflects without breaking (loading) the glass before the sprinkler system operates; and~~
 - ~~1.2. Where glass doors are provided in the glass wall, they shall be either self-closing or automatic-closing.~~

(No modifications to Exceptions 2 and 3)

tenant spaces by requiring the walls between individual spaces to be constructed as fire barriers in lieu of fire partitions.

SECTION 403 HIGH RISE BUILDINGS

C403.2.1.2 Shaft enclosures. [ER] The minimum code permits the fire resistance rating for shafts in high-rise buildings to be reduced by one hour since the building is provided with automatic sprinkler protection. Buildings in all occupancy groups, except Group F-2 (Low Hazard Factories) and S-2 (Low-Hazard Storage Buildings), built under this code are required to have sprinklers in combination with passive fire protection to achieve an appropriate level of redundancy commensurate with the goal of achieving a sustainable building. Thus, tradeoffs in safety from fire spread through vertical shafts are not permitted. This modification removes the exception that allows the one-hour reduction of the required shaft rating in high-rise buildings. See ENHANCED FIRE SAFETY at the beginning of Chapter 4.

SECTION 404 ATRIUMS

C404.6 Enclosure of atriums. [ER] Removes an exception to allow unrated glass to be used as a fire barrier in an atrium when provided with a deluge water curtain. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**SECTION 406
MOTOR-VEHICLE-RELATED OCCUPANCIES**

[Modify Section 406.5.4.1 by deleting mechanical access column with *story* increase for sprinklers in Table 406.5.4 as follows:]

406.5.4.1 Single Use. Where the *open parking garage*.....
(*No change to text*).....with Table 406.5.4, along with increases allowed by Section 406.5.5.

**SECTION 406
MOTOR-VEHICLE-RELATED OCCUPANCIES**

C406.5.4.1 Single use. [ER] The modifications to Table 406.5.4 remove the story increases for parking structures with mechanical access when sprinkler systems are installed. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**TABLE 406.5.4
OPEN PARKING GARAGES AREA AND HEIGHT**

TYPE OF CONSTRUCTION	AREA PER TIER (square feet)	HEIGHT (in tiers)		
		Ramp Access HEIGHT (in tiers)	Mechanical access	
			Automatic sprinkler system	
			No	Yes
IA	Unlimited	Unlimited	Unlimited	Unlimited
IB	Unlimited	12 Tiers	12 Tiers	18 Tiers
IIA	50,000	10 Tiers	10 Tiers	15 Tiers
IIIB	50,000	8 Tiers	8 Tiers	12 Tiers
IV	50,000	4 Tiers	4 Tiers	4 Tiers

**SECTION 413
COMBUSTIBLE STORAGE**

[Modify Section 413.2 as follows:]

413.2 Attic, under-floor and concealed spaces. *Attic*, under-floor(*No change to text*).....not less than 1 ¾ inch (45 mm) in thickness.

Exceptions:

1. Areas protected by *approved automatic sprinkler systems*
2. Group R-3 and U occupancies

**SECTION 413
COMBUSTIBLE STORAGE**

C413.2 Attic, under-floor and concealed spaces. [ER] Since this document requires most buildings to be fully protected with automatic sprinkler systems, Exception #1 becomes unnecessary and should be deleted. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**SECTION 414
HAZARDOUS MATERIALS**

[Modify Section 414.2.5 by deleting Footnote (b) and modifying Footnote (c) to Table 414.2.5(1) as follows:]

414.2.5 Hazardous materials in Group M display and storage areas and in Group S storage areas. The aggregate quantity of.....(No change to text)..... do not exceed the maximum allowable specified in Table 414.2.5(1).

**SECTION 414
HAZARDOUS MATERIALS**

C414.2.5 Hazardous materials in Group M display and storage and in Group S storage areas [ER] The IBC refers the user to Table 414.2.5(1) for the requirements covering explosion control of hazardous materials. While the provisions of this document require automatic sprinkler protection in most Group M and S-1 occupancies, the presence of sprinklers is not adequate justification to double the allowable quantities of stored corrosives, toxics, oxidizers, unstable reactives and water reactives. Therefore Footnote “b” in the table is deleted. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**[F] TABLE 414.2.5(1)
MAXIMUM ALLOWABLE QUANTITY PER INDOOR AND OUTDOOR CONTROL
AREA IN GROUP M AND S OCCUPANCIES
NONFLAMMABLE SOLIDS AND NONFLAMMABLE AND NONCOMBUSTIBLE LIQUIDS**

CONDITION		MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA	
Material ^a	Class	Solids pounds	Liquids gallons
A. Health-hazard materials—nonflammable and noncombustible solids and liquids			
1. Corrosives ^{b, c}		<i>(No change to table values)</i>	
2. Highly toxics	Not Applicable	20 ^{b, c}	2 ^{b, c}
3. Toxics ^{b, c}		<i>(No change to table values)</i>	
B. Physical-hazard materials—nonflammable and noncombustible solids and liquids			
1. Oxidizers ^{b, c}		<i>(No change to table values)</i>	
2. Unstable (reactives) ^{b, c}		<i>(No change to table values)</i>	
3. Water (reactives)	3 ^{b, c}	<i>(No change to table values)</i>	
	2 ^{b, c}	<i>(No change to table values)</i>	
	1	<i>(No change to table values)</i>	

For SI: 1 pound = 0.454 kg, 1 gallon = 3.785 L.

- a. Hazard categories are as specified in the *International Fire Code*.
- b. Maximum allowable quantities shall be increased 100 percent in buildings that are sprinklered in accordance with Section 903.3.1.1. When Note c also applies, the increase for both notes shall be applied accumulatively.
- c. Maximum allowable quantities shall be increased 100 percent when stored in *approved* storage cabinets, in accordance with the *International Fire Code*. When Note b also applies, the increase for both notes shall be applied accumulatively.
- d. See Table 414.2.2 for design and number of control areas.
- e. Allowable quantities for other hazardous material categories shall be in accordance with Section 307.
- f. Maximum quantities shall be increased 100 percent in outdoor control areas.
- g. Maximum amounts are permitted to be increased to 2,250 pounds when individual packages are in the original sealed containers from the manufacturer or packager and do not exceed 10 pounds each.
- h. Maximum amounts are permitted to be increased to 4,500 pounds when individual packages are in the original sealed containers from the manufacturer or packager and do not exceed 10 pounds each.
- i. The permitted quantities shall not be limited in a building equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.
- j. Quantities are unlimited in an outdoor control area.

**SECTION 420
GROUPS I-1, R-1, R-2, R-3**

[Modify Section 420.2 as follows:]

420.2 Separation walls. Walls separating *dwelling units* in the same building, walls separating sleeping units in the same building and walls separating *dwelling* or *sleeping units* from other occupancies contiguous to them in the same building shall be constructed as ~~fire partitions~~ *fire barriers* in accordance with Sections ~~708~~ 707.3.11 and 707.3.12.

**SECTION 423
STORM SHELTERS**

[Modify Section 423.1 as follows and add new Section 423.1.2:]

423.1 General. In addition to other applicable requirements in this code, storm shelters shall be constructed in accordance with ICC-500.

423.1.1 Scope. This section applies to the construction of storm shelters constructed as separate detached buildings or constructed as safe rooms within buildings for the purpose of providing safe refuge from storms that produce high winds, such as tornados and hurricanes. Such structures shall be designated to be hurricane shelters, tornado shelters, or combined hurricane and tornado shelters.

423.1.2 Where required. Storm shelters shall be provided for occupants of buildings in accordance with Sections 423.1.2.1, 423.1.2.2 or 423.1.2.3

Exceptions:

1. Buildings meeting the requirements for shelter design in ICC/NSSA-500.
2. Where the occupants of the proposed building have an approved storm shelter within 1/4-mile of travel distance of the proposed building available for use and the

**SECTION 420
GROUPS I-1, R-1, R-2, R-3**

C420.2 Separation walls. [ER] The IBC only requires 1-hour fire partitions for horizontal separation between dwelling units and between sleeping units. For enhanced resilient buildings the walls separating units need to be constructed as fire barriers to increase robustness. In addition the fire resistance between units must also be increased. This modification refers the user to new Section 707.3.11 that accomplishes these changes. Fire barriers between dwelling units help contain the fire to the room of origin minimizing damage to other parts of the building which improves the likelihood the facility will remain in operation and reduce the need for the displacement of occupants. See ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**SECTION 423
STORM SHELTERS**

C423.1.2 Where required. [ER] The IBC includes a section that references ICC standard ICC/NSSA-500 *Standard on the Design and Construction of Storm Shelters* for proper design and construction of storm shelters. However, the code provisions do not specify where storm shelter provisions are required. It simply states that if a storm shelter is to be constructed then it must follow the requirements in the standard. The provisions of this document go further by adding a new section (423.1.2) to specify what types of occupancies shall have storm shelters and in which regions they will be required. Specifying which buildings and where storm shelters are required provides a higher degree of protection to the residents of a community. This section also distinguishes requirements for providing storm shelters in regions prone to hurricanes and those prone to tornadoes.

storm shelter has 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.

423.1.2.1 Hurricane areas. Buildings in hurricane-prone regions assigned to Group A-3 (community halls, schools and libraries), B (civic administration), E, I-1, I-2, I-3, M, R and buildings assigned to Occupancy Categories III and IV in accordance with Section 1604.5.

423.1.2.2 Tornado areas. Buildings in hurricane-prone regions assigned to Group A-3 (community halls, schools and libraries), B (civic administration), E, I-1, I-2, I-3, M, R and buildings assigned to Occupancy Categories III and IV in accordance with Section 1604.5 Risk category in areas where the shelter design wind speed for tornadoes of Figure 304.2(1) of ICC/NSSA-500 is 250 mph or greater.

The first exception to the provisions for storm shelters is applicable where the whole building is designed to the storm shelter standards, negating the need for a storm shelter area within the proposed building.

The second exception allows a storm shelter located within ¼-mile of travel distance of the proposed building and that is accessible and can accommodate the added occupant load to serve as an alternate place of refuge. NOAA Tornadoes³ 101 advises that the average lead time for tornado warnings is 13 minutes. The ¼-mile distance is assumed to be a reasonable estimate of the ability of ambulatory persons to access shelter within that lead time. If the occupants cannot be expected to traverse that distance within the expected lead time for a tornado warning, or if the expected lead time is less than the average, the proposed building should be provided with its own storm shelter.

The third exception allows the building official to determine the specific circumstances for which the proposed building does not warrant a storm shelter.

C423.1.2.1 Hurricane areas [ER]. Hurricane prone regions are defined in Section 1609.2 of the code and generally cover developable areas along the Atlantic and Gulf coasts of the continental United States extending inland where the design wind speeds are 115 mph (51 m/s) or greater. In addition, hurricane prone regions include the islands of Hawaii, Puerto Rico, Guam, Virgin Islands and American Samoa. These provisions require storm shelters in buildings that are typically depended upon to protect the public evacuating the coastal communities and barrier islands (e.g., community halls, schools,, libraries, hotels and motels) and essential facilities used by emergency personnel to respond to high wind events (e.g., fire stations, police stations, hospitals, public utilities) or protect persons unable to evacuate (e.g., hospitals, nursing homes, assisted living, etc.).

C423.1.2.2 Tornado areas [ER]. Tornado prone regions are established by the storm shelter wind zone map used in ICC 500. Storm shelters are required in all buildings except Group U that are constructed in areas where the shelter design wind zone is 250 mph (112 m/s).

Storm shelters should also be considered in wind zones identified as 200 mph (88 m/s) and 160 mph (72 m/s). The rationale for not including these zones in the modification is there tends to be lower frequencies of damaging EF3 or greater tornadoes in these zones. However, local weather data, geography, and design wind speed may have a significant effect on the extent of anticipated damage. Buildings designed for a design wind speed, V_{ult} , of 115 mph (51 m/s) will be more susceptible to tornado damage than buildings designed to

³ Tornadoes 101, National Oceanic and Atmospheric Administration (NOAA), <http://www.noaa.gov/features/protecting/tornados101.html>

423.1.2.3 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.

CHAPTER 5 GENERAL BUILDING HEIGHTS AND AREAS

[Modify Section 503.1 by changing Table 503 as follows and deleting all instances where Type IIB, IIIB or VB construction occur within the code. (Not shown for brevity):]

Section 503 General Building Height and Area limitations

C503.1 General. The building height and area shall.....*(No change to text)*..... be considered a separate building.

a greater design wind speed regardless of the Enhanced Fujita (EF) rating. Section 1604.5.2 in this document increases the wind load for all buildings. In addition efforts are underway by the structural engineering community in the United States to develop design criteria that are more scientific than the EF rating. The intent is to consider potential effects of wind with less focus on the cost of damage, a process anticipated to be more suitable for structural design.

C423.1.2.3 Combined hurricane and tornado shelters [ER]. In some instances the hurricane exposure may be more severe than the tornado exposure. Thus, where buildings are located in areas that are prone to both hurricanes and tornados the more stringent requirements of ICC/NSSA-500 must be applied.

CHAPTER 5 GENERAL BUILDING HEIGHTS AND AREAS

Section 503 General Building Height and Area limitations

C503.1 General [ER] Table 503 Allowable Building Heights and Areas is modified to improve fire safety in sustainable buildings by requiring the buildings to have at least 1-hour fire resistance rating for the structural elements of the building. This reduction in risk of damage or collapse of the building due to a fire from within is accomplished by removing Type IIB, Type IIIB, and Type VB construction as permissible methods of construction. These construction types permit structural fire resistance rating classifications that are less than one hour. The lack of robustness should a fire occur may result in structural damage requiring extensive and costly repair, removal, disposal and replacement which is not consistent with the basic premise of sustainability.

**TABLE 503
ALLOWABLE HEIGHT AND BUILDING AREAS^{a,b}**

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) HGT(S)	TYPE OF CONSTRUCTION																				
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V													
		A	B	A	B	A	B	HT	A	B												
		UL	160	65	55	65	55	65	50	40												
A-1	S A	<i>(No change to table values in this column)</i>	<i>(No change to table values in this column)</i>	<i>(No change to table values in this column)</i>	2 8,500	<i>(No change to table values in this column)</i>	2 8,500	<i>(No change to table values in this column)</i>	<i>(No change to table values in this column)</i>	1 5,500												
A-2	S A				2 9,500		2 9,500			1 6,000												
A-3	S A				2 9,500		2 9,500			1 6,000												
A-4	S A				2 9,500		2 9,500			1 6,000												
A-5	S A				UL UL		UL UL			UL UL												
B	S A				<i>(No change to table values in this column)</i>		<i>(No change to table values in this column)</i>			<i>(No change to table values in this column)</i>	3 23,000	<i>(No change to table values in this column)</i>	3 19,000	<i>(No change to table values in this column)</i>	<i>(No change to table values in this column)</i>	2 9,000						
E	S A										2 14,500		2 14,500			1 9,500						
F-1	S A										2 15,500		2 12,000			1 8,500						
F-2	S A										3 23,000		3 18,000			2 13,000						
H-1	S A										1 7,000		1 7,000			NP NP						
H-2 ^d	S A										1 7,000		1 7,000			1 3,000						
H-3 ^d	S A										2 14,000		2 13,000			1 5,000						
H-4	S A										3 17,500		3 17,500			2 6,500						
H-5	S A										3 23,000		3 19,000			2 9,000						
I-1	S A										3 10,000		3 10,000			2 4,500						
I-2	S A										1 11,000		NP NP			NP NP						
I-3	S A										1 10,000		1 7,500			1 5,000						
I-4	S A										2 13,000		2 13,000			1 9,000						
M	S A										<i>(No change to table values in this column)</i>		<i>(No change to table values in this column)</i>			<i>(No change to table values in this column)</i>	2 12,500	<i>(No change to table values in this column)</i>	2 12,500	<i>(No change to table values in this column)</i>	<i>(No change to table values in this column)</i>	1 9,000
R-1	S A																4 16,000		4 16,000			2 7,000
R-2	S A	4 16,000	4 16,000	2 7,000																		
R-3	S A	4 UL	4 UL	3 UL																		
R-4	S A	4 16,000	4 16,000	2 7,000																		
S-1	S A	2 17,500	2 17,500	1 9,000																		
S-2	S A	3 26,000	3 26,000	2 13,500																		
U ^c	S A	2 8,500	2 8,500	1 5,500																		

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

A = building area per *story*, S = *stories* above grade plane, UL = Unlimited, NP = Not permitted.

a. See the following sections for general exceptions to Table 503:

1. Section 504.2, Allowable building height and story increase due to automatic sprinkler system installation.
2. Section 506.2, Allowable building area increase due to street frontage.
3. Section 506.3, Allowable building area increase due to *automatic sprinkler system* installation.
4. Section 507, Unlimited area buildings.

b. See Chapter 4 for specific exceptions to the allowable height and areas in Chapter 5.

SECTION 504 BUILDING HEIGHT

[Modify Section 504.2 as follows:]

504.2 Automatic sprinkler system increase. Where a Group F-2 or S-2 occupancy building is equipped throughout with an *approved automatic sprinkler system* in accordance with Section 903.3.1.1 and the occupant load is less than or equal to one person per 10,000 square feet (929 m²), the value specified in Table 503 for maximum *building height* is increased by 20 feet (6096 mm) and the maximum number of *stories* is increased by one. These increases are permitted in addition to the *building area* increase in accordance with Sections 506.2 and 506.3. For Group R buildings equipped throughout with an *approved automatic sprinkler system* in accordance with Section 903.3.1.2, the value specified in Table 503 for maximum *building height* is increased by 20 feet (6096 mm) and the maximum number of *stories* is increased by one, but shall not exceed 60 feet (18 288 mm) or four *stories*, respectively.

Exception: The use of an *automatic sprinkler system* to increase *building heights* shall not be permitted for the following conditions:

1. Buildings, or portions of buildings, classified as a Group I-2 occupancy of Type HB, III, IV or V construction.
2. Buildings, or portions of buildings, classified as a Group H-1, H-2, H-3 or H-5 occupancy.
3. Buildings where an *automatic sprinkler system* is substituted for fire-resistance rated construction in accordance with Table 601, Note d.

SECTION 506 BUILDING AREA MODIFICATIONS

[Delete Section 506.3 as follows:]

~~**506.3 Automatic sprinkler system increase.** Where a building is equipped throughout with an *approved automatic sprinkler system* in accordance with Section 903.3.1.1, the *building area* limitation in Table 503 is permitted to be increased by an additional 200 percent (*Is* = 2) for buildings with more than one *story above grade plane* and an additional 300 percent (*Is* = 3) for buildings with no more than one *story above grade plane*. These increases are permitted in addition to the height and *story* increases in accordance with Section 504.2.~~

~~**Exception:** The use of an *automatic sprinkler system* to~~

SECTION 504 BUILDING HEIGHT

C504.2 Automatic sprinkler system increase [ER]. Where low hazard manufacturing facilities and storage buildings (i.e. F-2 and S-2 occupancy groups) have a low occupant load the risk of damage and threat to life tends to be minimal. Therefore such buildings equipped with automatic sprinkler protection are permitted an increase in building height and story height.

SECTION 506 BUILDING AREA MODIFICATIONS

C506.3 Automatic sprinkler system increase [ER]. Commensurate with the concept of sustainability an appropriate level of redundancy is achieved by removing the provisions that allow increases in the area of building when sprinkler protection is provided. See ENHANCED FIRE SAFETY at the beginning of Chapter 4.

increase the building area limitation shall not be permitted for the following conditions:

1. Buildings classified as a Group H-1 occupancy.
2. Buildings, or portions of buildings, classified as either a Group H-2 or H-3 occupancy. For buildings containing such occupancies, the allowable area shall be determined in accordance with Section 508.4.2, with the sprinkler system increase applicable only to the portions of the building not classified as Group H-2 or H-3.
3. Buildings where an *automatic sprinkler system* is substituted for fire-resistance rated construction in accordance with Table 601, Noted.

[Modify Section 506.4.1 as follows:]

506.4.1 Area determination. The total allowable building area.... *(No change to text)*by the number of stories above grade plane as listed below:

(No change to Items 1-2).

3. No story shall exceed the allowable *building area per story (Aa)*, as determined in Section 506.1, for the occupancies on that *story*.

Exceptions:

1. Unlimited area buildings in accordance with Section 507.
2. The maximum area of a building equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.2 shall be determined by multiplying the allowable area per *story (Aa)*, as determined in Section 506.1, by the number of *stories above grade plane*.

**SECTION 507
UNLIMITED AREA BUILDINGS**

[Modify Section 507.2 as follows:]

507.2 Nonsprinklered Group F-2 and S-2, one story. The area of a Group F-2 or S-2 building of Type IIA, IIIA, IV or VA construction no more than one *story* in height shall not be limited where all of the following are met;

(1) The building is surrounded and adjoined by *public ways* or *yards* not less than 60 feet (18 288 mm) in width.

C506.4.1 Area determination [ER]. Commensurate with the concept of sustainability an appropriate level of redundancy is achieved by removing this provisions that allows the aggregate area of the building to be increased when sprinkler protection is provided. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**SECTION 507
UNLIMITED AREA BUILDINGS**

Commensurate with the concept of sustainability an appropriate level of life safety and property protection is achieved by modifying the provisions of Section 507 for unlimited area buildings. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

C507.2 Group F-2 and S-2, one story [ER]. Under some circumstances Group F-2 and S-2 occupancy buildings will be permitted without sprinkler protection. However, consistent with providing for more robust buildings, single story Group F-2 and S-2 buildings with low occupant loads are permitted to be of unlimited area provided they are fully sprinklered and the 60 feet of public ways or yards around

(2) The building is provided with an automatic sprinkler system throughout in accordance with Section 903.3.1.1

(3) The occupant load is less than or equal to one (1) person per 10,000 square feet (929 m²).

(4) The S-2 occupancy meets the requirements of Exception 3 to Section 903.3.1.1.

[Modify Section 507.3 as follows:]

507.3 Group B, F, M or S sprinklered, one story. The area of a Group A-4, B, F, M or S building of Type IIA construction no more than one story above grade plane of any construction type, or the area of a Group A-4 building no more than one story above grade plane of other than Type V construction, shall not be limited where the building is provided with an *automatic sprinkler system* throughout in accordance with Section 903.3.1.1 and is surrounded and adjoined by *public ways* or *yards* not less than 60 feet (18 288 mm) in width and where the maximum allowable floor area per sprinkler riser, in accordance with NFPA 13 Section 5.2 is separated with fire barriers having a fire resistance rating in accordance with Table 707.3.10.

Exceptions:

(No change to Exceptions)

[Modify Section 507.3.1 as follows:]

507.3.1 Mixed occupancy buildings with Groups A-1 and A-2. Group A-1 and A-2 occupancies of ~~other than Type V~~ Type I and II construction shall be permitted within mixed occupancy buildings of unlimited area complying with Section 507.3, provided:

(No change to Items)

[Delete Section 507.4 as follows:]

~~**507.4 Two story.** The area of a Group B, F, M or S building no more than two stories above grade plane shall not be limited where the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1, and is surrounded and adjoined by *public ways* or *yards* not less than 60 feet (18 288 mm) in width.~~

the perimeter of the building are maintained.

C507.3 Sprinklered one story [ER]. This modifies the code to further require that the construction type be limited to Type I or II and that fire barriers be required to separate the building into areas less than or equal to the maximum area permitted per sprinkler riser coverage based on the hazard classification design of the sprinkler system.

Providing passive separation between the areas covered by individual sprinkler risers will greatly increase the compartmentation within unlimited area buildings and therefore mitigate fire spread. If the sprinkler system is overrun by a rapid spreading fire, the damage will be contained within the area of origin and mitigate additional loss. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

C507.3.1 Mixed occupancy buildings with Group A-1 and A-2 [ER]. This modification expands the limitations from Type V to all combustible types of construction. This correlates with the revision to Section 507.3.

C507.4 Two-story [ER]. The IBC permits two-story Group B, F, M and S buildings to be of unlimited area provided they have 60 feet of open space and are fully sprinklered. This change removes the two-story unlimited area building option from this code. Multi-story buildings pose a much higher risk to damage and collapse from a fire. Sustainable buildings need to be constructed of higher fire resistant materials if they are to be more than one story and of unlimited area. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**SECTION 508
MIXED USE AND OCCUPANCY**

[Modify Section 508.3.3 as follows:]

508.3.3 Separation. No separation is required between nonseparated occupancies.

Exceptions:

1. Group H-2, H-3, H-4 or H-5 occupancies shall be separated from all other occupancies in accordance with Section 508.3.3.
2. Group I-1, R-1, R-2 and R-3 *dwelling units* and *sleeping units* shall be separated from other occupancies contiguous to them in accordance with the requirements of Section ~~420~~ Sections 508.4.4 and 707.3.11

[Modify Section 508.4.4 by replacing Table 508.4 and modifying Footnote (d) as follows:]

508.4.4 Separation. Individual occupancies... (no change to text) ...Table 508.4

**SECTION 508
MIXED USE AND OCCUPANCY**

C508.3.3 Separation [ER]. This section directs the code user to new Section 707.3.11 which provides passive fire-rated compartmentation between residential dwelling and sleeping units. Compartmentation in Group R buildings increases the life safety and property protection features of the building which is consistent with the enhanced resilience concept for sustainability.

C508.4.4 Separation, [ER]. Table 508.4 REQUIRED SEPARATION OF OCCUPANCIES (hours) shows the fire rated separation that is required between occupancies in buildings built using the “separated occupancies” option for buildings with mixed occupancies. The table is modified to eliminate the reduction in required hourly fire resistant rating when sprinkler protection is provided. In addition, fire resistance ratings are being required between all mixed occupancy uses to improve fire safety to the occupants and property contained in a sustainable building. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)^d**

Occupancy	A, E	B	I	R ^a	F-2, S-2 ^b , U	F-1, S-1, M	H-1	H-2	H-3, H-4, H-5
A, E	2	2	2	2	1	2	NP	4	3
B	—	N	2	2	1	2	NP	3	2
I	—	—	2	2	2	2	NP	NP	NP
R ^a	—	—	—	2	2 ^c	2	NP	NP	NP
F-2, S-2 ^b , U	—	—	—	—	1	2	NP	4	3
F-1, S-1, M	—	—	—	—	—	2	NP	3	2
H-1	—	—	—	—	—	—	N	NP	NP
H-2	—	—	—	—	—	—	—	N	1
H-3, H-4, H-5	—	—	—	—	—	—	—	—	1

N = No fire rated separation requirement.

NP = Not permitted.

a See Section 420.

b. The required separation from areas used only for private or pleasure vehicles shall be reduced by 1 hour but to not less than 1 hour.

c. See Section 406.3.4.

d. Except as required in Section 707.3.12, separation is not required between occupancies of the same classification.

**SECTION 509
INCIDENTAL USES**

[Modify Section 509.1 with changes to Table 509 as follows:]

Section 509.1 General. Incidental use areas located.....*(No change to text)*..... are limited to those uses in Table 509

**SECTION 509
INCIDENTAL USES**

These provisions require most buildings to be sprinklered. To provide redundancy, incidental uses are required to be provided with fire rated barriers in addition to the automatic sprinkler protection. This is intended to improve property protection in conjunction with life safety for the occupants. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4. The following modifications for incidental use areas elevate property protection to a level that is consistent with the basic premise of sustainable practices.

C509.1 General [ER]. Table 509 INCIDENTAL USE AREAS is modified to incorporate the appropriate levels of passive and active fire protection for rooms and spaces in buildings where the risk of damage to the structure and safety to life from fire is higher than the surrounding uses in the building. Structural fire resistance ratings are not permitted to be eliminated or reduced simply because sprinkler protection is provided. Collection areas for sorted waste or cotton linen are recognized as being a higher hazard area in the code. To address the risk of this higher hazard both passive and active fire protection are required.

**TABLE 509
INCIDENTAL USE AREAS**

ROOM OR AREA	SEPARATION AND/OR PROTECTION
Furnace room where any piece of equipment is over 400,000 Btu per hour input	1 hour or provide automatic sprinkler system
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower	1 hour or provide automatic sprinkler system
Refrigerant machinery rooms	1 hour or provide automatic sprinkler system
Hydrogen cut-off rooms, not classified as Group H	1-hour in Group B, F, M, S and U occupancies. 2-hours in Group A, E, I and R occupancies.
Incinerator rooms	2 hour and provide automatic sprinkler system
Paint shops, not classified as Group H, located in occupancies other than Group F	2 hours; or 1 hour and provide automatic fire-extinguishing system
Laboratories and vocational shops, not classified as Group H, located in a Group E or I-2 occupancy	1 hour or provide automatic sprinkler system
Laundry rooms over 100 square feet	1 hour or provide automatic sprinkler system
Group I-3 cells equipped with padded surfaces	1 hour
Waste and linen collection rooms located in either Group I-2 occupancies or ambulatory care facilities	1 hour
Waste and linen collection rooms over 100 square feet	1 hour or <u>and</u> provide automatic sprinkler system
Stationary storage battery systems having a liquid electrolyte capacity of more than 50 gallons for flooded lead-acid, nickel cadmium or VRLA , or more than 1000 pounds for lithium-ion and lithium metal polymer used for facility standby power, emergency power or uninterrupted power supplies	1-hour in Group B, F, M, S and U occupancies. 2-hours in Group A, E, I and R occupancies.

[Modify Section 509.4 as follows:]

509.4 Separation and protection. The incidental uses listed in Table 509 shall be separated from the remainder of the building and protected or equipped with an automatic sprinkler system, or both, in accordance with the provisions of that table.

509.4.1 Separation. Where Table 509 specifies a fire resistance-rated separation, the incidental uses shall be separated from the remainder of the **building** by a **fire barrier** constructed in accordance with Section 707 or a **horizontal assembly** constructed in accordance with Section 711, or both. ~~Construction supporting 1-hour fire barriers or horizontal assemblies used for incidental use separations in buildings of Type IIB, IIIB and VB construction is not required to be fire-resistance rated unless required by other sections of this code.~~

509.4.2 Protection. ~~Where Table 509 permits an automatic sprinkler system without a fire barrier, the incidental uses shall be separated from the remainder~~

C509.4 Separation and protection [ER]. This change removes language to reflect that incidental use areas are required to be separated from the remainder of the building by minimum one hour fire barriers.

C509.4.1 Separation [ER]. This document prohibits the use of Type IIB, IIIB and VB construction, as discussed in Section 503.1 General. This change removes unnecessary language.

C509.4.2. Protection [ER]. This document requires all incidental use areas to have fire resistance rated barriers enclosing the higher hazard spaces in Table 509. This change removes language that becomes redundant because fire barriers and opening protection are required. Where buildings are not sprinklered, the modifications to Sections 509.4.2 Protection and 509.4.2.1 Protection

~~of the building by construction capable of resisting the passage of smoke. The walls shall extend from the top of the foundation or floor assembly below to the underside of the ceiling that is a component of a fire-resistance-rated floor assembly or roof assembly above or to the underside of the floor or roof sheathing, deck or slab above. Doors shall be self- or automatic-closing upon detection of smoke in accordance with Section 716.5.9.3. Doors shall not have air transfer openings and shall not be undercut in excess of the clearance permitted in accordance with NFPA 80. Walls surrounding the incidental use shall not have air transfer openings unless provided with smoke dampers in accordance with Section 710.7. Where *an automatic sprinkler system* is not required in the building, only the space occupied by the incidental use in accordance with Table 509 need be equipped with an *automatic sprinkler system*.~~

509.4.2.1 Protection limitation. Except as specified in Table 509 for certain incidental uses, where an *automatic sprinkler system* is provided in accordance with Table 509, only the space occupied by the incidental use need be equipped with such a system:

limitation only require the automatic sprinkler protection for incidental use areas in accordance with Table 509.

**SECTION 510
SPECIAL PROVISIONS**

[Delete Section 510.5 as follows:]

~~**510.5 Group R-1 and R-2 buildings of Type IIIA construction.** The height limitation for buildings of Type IIIA construction in Groups R-1 and R-2 shall be increased to six stories and 75 feet (22 860 mm) where the first floor assembly above the *basement* has a *fire-resistance rating* of not less than 3 hours and the floor area is subdivided by 2-hour fire resistance-rated *fire walls* into areas of not more than 3,000 square feet (279 m²).~~

**SECTION 510
SPECIAL PROVISIONS**

C510.5 Group R-1 and R-2 buildings of Type IIIA construction [ER]. The noticeable shift to combustible construction materials for residential occupancy buildings is potentially increasing the risk from fire for the building and occupants. The modifications to Table 503 that allow buildings to be constructed with only one-hour fire resistance provide two distinct safety features. The first is the increased compartmentalization of the building to reduce fire spread and damage using passive fire protection methods. The second safety provision is the ability of the structure to be constructed in such a way that it better retains its structural integrity after being subject to a fire. This section was deleted based on the revisions to Table 503, which do not permit Type IIIA construction in R-1 and R-2 occupancies.

Passive non-combustible compartmentation within residential dwelling and sleeping units coupled with sprinkler protection throughout provides residents with an area of refuge within their own unit. This is important with a new trend where some fire services are advising condominium and apartment dwellers to remain in their units. The containment of fire to the room of origin will allow the facility to remain in operation and eliminate the displacement of residents from the facility.

[Add new Section 511 as follows:]

SECTION 511 COLLECTION AREAS FOR RECYCLABLES

511.1 Collection areas. Collection areas for recyclables shall be designed and constructed in accordance with Section 713.13 and the provisions of this section.

511.1.1 Interior collection area enclosure. Walls, floors and ceiling systems shall be completely separated from other parts of the building by noncombustible construction having a fire resistance rating of not less than 2-hours and constructed in accordance with Section 707 or 711 of the IBC.

511.1.2 Exterior collection areas. Exterior walls of buildings adjacent to exterior storage areas shall be non-combustible construction with a minimum 2-hour fire resistance rating for any portion of the building exterior that is less than 30 ft (9 m) from the storage area measured vertically and horizontally.

SECTION 511 COLLECTION AREAS FOR RECYCLABLES

This section addresses collection areas for recyclable materials generated by the occupancy and use of the sustainable building. Activities within sustainable buildings must be consistent with general practices related to sustainable development. Recycling areas for sustainable buildings encourage operations within buildings that divert solid wastes from landfills and minimize the overall quantities of virgin materials needed to produce new products.

The U.S. Green Building Council (USGBC) cites that "... recycling one ton of paper prevents the processing of 17 trees and saves three cubic yards of landfill space." USGBC further states: "Recycled aluminum requires only 5% of the energy required to produce virgin aluminum from bauxite..."

C511.1 Collection Areas [ER]. The potential fire hazard for the storage of materials is greater when combustible materials are separated from noncombustible materials. In normal waste these materials are combined. Standard practice for collecting recyclables is such that paper, plastics, cardboard and metals are separated. This section requires enhanced fire protection be provided for collection areas where there is a potential for materials to be separated. If the materials are not separated the collection areas may be treated as waste collection rooms and meet Section 509 requirements of the IBC.

C511.1.1 Interior Collection Areas [ER]. This section sets criteria for fire separation of collection rooms for recyclable materials from other occupied areas within the building based on the higher fire hazard potential than normal waste collection rooms.

C511.1.2 Exterior Collection Areas [ER]. This section sets criteria for fire separation of the occupied areas within the building from collection areas for recyclables located outside and in the near vicinity of the building's exterior wall. When collection areas are positioned more than 30 feet from the building, the threat of a fire event that will endanger building occupants or pose damage to the building or its contents is considered to be low. The separation distance is similar to the requirements for other fire safety issues established in the IBC.

511.2 Collection areas required. Collection areas for recyclable materials shall be provided for occupancy classifications: Group A Assembly, Group B Business, Group E Educational, Group I Institutional, Group M Mercantile, and Group R Residential and comply with the provisions of this section. Recyclable materials shall include corrugated cardboard, glass, metals, paper, and plastics.

511.3 Number of collection areas. There shall be at least one separate collection area for every 100,000 ft² (9,290 m²) of floor area and no less than one separate collection area for every four stories.

Exception: Group M Mercantile shall be permitted to have one collection area.

511.4 Size of collection areas. Aggregate collection area shall not be less than the area provided in Table 511. Any individual collection area shall not be less than 80 ft² (7.4 m²).

511.2 Collection areas required [ER]. Buildings such as schools, restaurants, offices, hospitals, retail establishments and residences have the potential to generate large amounts of waste that can be recycled. This section identifies those occupancies where collection areas for recyclables are to be provided. Group F Factory, Group H High Hazard, Group S Storage, and Group U Utility and miscellaneous are excluded from these requirements because the amount or type of waste generated, or where the structure is constructed of fire-resistance rated materials, may not justify the dedicated space required by the provisions of this section.

511.3 Number of collection areas [ER]. Proximity to collection areas for recyclables can influence occupant behavior. The US Green Building Council has developed minimum criteria for the number of collections that should be provided for a building. This section establishes the number of collection areas based on the USGBC minimums. The exception permits a single collection area for Group M Mercantile to accommodate large single occupant retail facilities and facilities housing multiple retailers that share a common collection area.

511.4 Size of Storage and Collection Areas [ER]. The US Green Building Council has developed minimum criteria for the size of collections that should be provided for a building. This section establishes the size of the collection areas based on the USGBC minimums. The intent is to assure adequate storage and collection areas to support sustainable practices during building occupancy.

**TABLE 511a
MINIMUM COLLECTION AREAS**

TOTAL BUILDING AREA IN SQUARE FEET	MINIMUM COLLECTION AND STORAGE AREA IN SQUARE FEET
5000 or less	80
More than 5000 up and including 15,000	125
More than 15,000 up and including 50,000	175
More than 50,000 up and including 100,000	225
More than 100,000 up and including 200,000	275
More than 200,000	500

^aSource: *New Construction and Major Innovation Versions 2.2 Reference Guide Third Edition*, U.S. Green Building Council, October 2007

CHAPTER 6 TYPES OF CONSTRUCTION

[Construction Types IIB, IIIB and VB are to be deleted wherever they occur within the code. In some instances, an entire section may need to be deleted or in most cases just the reference to the deleted construction type should be deleted. This amendment is not shown, for brevity.]

SECTION 602 CONSTRUCTION CLASSIFICATION

[Modify Section 602.1 with changes to Table 601 as follows:]

602.1 General. Buildings and structures... *(no change to text) ...* unless required by other provisions of this code.

CHAPTER 6 TYPES OF CONSTRUCTION

TYPES OF CONSTRUCTION [ER]. This Chapter of the code describes the types of constructed permitted by the code based on non-combustible and combustible materials used. In addition, the user is referred to Table 601 for the fire resistance requirements based on the type of construction desired. Maintaining the structural integrity of building in addition to compartmentalizing the occupied spaces are key components for a sustainable building. This assures that any fire event has reduced impact on the rest of the structure and provides safety to the occupants. Mitigating the down time or re-location of businesses and staff after a fire event limits the social and economic impact to the community. The construction types are modified in Table 601 and are considered modified throughout this sustainable code by limiting them to construction types with a fire resistance rating (i.e Types IA, IB, IIA, IIIA, IV and VA).

SECTION 602 CONSTRUCTION CLASSIFICATION

C602.1 General. [ER]. This revision to Table 601 FIRE RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (hours) adds an entry to direct the user of the code to the additional requirements for providing fire rated separations between tenant spaces in sustainable buildings. Buildings constructed with fire separations in accordance with Section 508.4 for mixed occupancies meet this requirement for tenant separation. This is intended to improve property protection in conjunction with life safety for the occupants by requiring a minimum level of fire containment. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (hours)**

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A ^d	B	A ^d	B	HT	A ^d	B
Primary structural frame ^a (see Section 202)	3 ^a	2 ^a	1	θ	1	θ	HT	1	θ
Bearing walls									
Exterior ^{f, g}	3	2	1	θ	2	2	2	1	θ
Interior	3 ^a	2 ^a	1	θ	1	θ	1/HT	1	θ
<u>Tenant Separation</u>	<u>See Section 707.3.11</u>								
<u>Residential spaces</u>	<u>See Section 707.3.12</u>								
<u>Non-residential spaces</u>	<u>See Section 402.4.2.1</u>								
<u>Mall tenant spaces</u>	<u>See Section 402.4.2.1</u>								
Nonbearing walls and partitions	See Table 602								
Exterior	See Table 602								
Nonbearing walls and partitions									
Interior ^e	0	0	0	θ	0	θ	See Section 602.4.6	0	θ
Floor construction and associated secondary members (see Section 202)	2	2	1	θ	1	θ	HT	1	θ
Roof construction and associated secondary members (see Section 202)	1 ^{1/2} ^b	1 ^{b, c}	1 ^{b, c}	θ ^c	1 ^{b, c}	θ	HT	1 ^{b, c}	θ

For SI: 1 foot = 304.8 mm.

- a. Roof supports: *Fire-resistance ratings* of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
- b. Except in Group F-1, H, M and S-1 occupancies, 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-treated wood members shall be allowed to be used for such unprotected members.
- c. In all occupancies, heavy timber shall be allowed where a 1-hour or less *fire-resistance rating* is required.
- d. ~~An approved automatic sprinkler system in accordance with Section 903.3.1.1 shall be allowed to be substituted for 1-hour fire-resistance-rated construction; provided such system is not otherwise required by other provisions of the code or used for an allowable area increase in accordance with Section 506.3 or an allowable height increase in accordance with Section 504.2. The 1-hour substitution for the fire resistance of exterior walls shall not be permitted.~~
- e. Not less than the *fire-resistance rating* required by other sections of this code.
- f. Not less than the *fire-resistance rating* based on fire separation distance (see Table 602).
- g. Not less than the *fire-resistance rating* as referenced in Section 704.10

[Modify Section 602.4.3 as follows:]

602.4.3 Roof framing. Wood-frame or glued-laminated arches for roof construction, which spring from the floor line or from grade and do not support floor loads, *(no change to text)*.....to the underside of the members. Splice plates shall be not less than 3 inches (76 mm) nominal in thickness. ~~Where protected by approved automatic sprinklers under the roof deck, framing members shall be not less than 3 inches (76 mm) nominal in width.~~

C602.4.3 Roof framing [ER]. The code permits roof members in buildings constructed of heavy timber members (Type IV) to be reduced in size where sprinklers are present. This change is intended to improve property protection in conjunction with life safety for the occupants by maintaining an appropriate minimum level of robustness and structural fire performance See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

CHAPTER 7

FIRE AND SMOKE PROTECTION FEATURES

SECTION 701 GENERAL

[Add new Section 701.3 as follows:]

701.3 Wildland interface areas. Buildings in wildland interface areas with a moderate, high or extreme fire hazard severity shall comply with this chapter and the provisions of Chapter 5 of the *International Wildland-Urban Interface Code*.

SECTION 705 EXTERIOR WALLS

CHAPTER 7

FIRE AND SMOKE PROTECTION FEATURES

SECTION 701 GENERAL

C701.3 General [ER]. This section mandates compliance with Chapter 5 of the *ICC International Wildland Urban Interface Code (IWUIC)*.

The IWUIC provides an excellent filter to identify those structures that due to any combination of vegetation type, terrain slope, prevailing wind speed, available water, access and defensible area must provide mitigation requirements based on the extent of vulnerable exposure, while clearly recognizing those structures which do not need any additional protection. The potential of wildland urban interface exists in a large portion of the United States. Much of the focus has been on the wildfires in California, which have caused enormous property loss. In the commentary to Section C101.4.7 there are numerous locations throughout the US that are susceptible to out-of-control wildland fires due to very dry and windy conditions throughout much of the summer and fall months. The State of Texas leads the way in terms of total number of nationally declared wildfire emergencies from 2003 to 2012 with 118 followed by California (82) and Oklahoma (70). Other states such as Arkansas, Arizona, Colorado, Montana, Nevada, New Mexico and Washington also have a high incident of wild fires.

SECTION 705 EXTERIOR WALLS

Commensurate with the concept of sustainability an appropriate level of life safety and property protection is achieved by modifying the provisions of Section 705.8 for openings in exterior walls of buildings. Structures within close proximity are at risk of fire from other buildings due to radiant heat transfer as well as falling debris and burning embers. These changes are intended to improve property protection in conjunction with life safety for the occupants by requiring a minimum level of fire containment to prevent fire spread between buildings. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

[Modify Section 705.8.1 by replacing Table 705.8, modifying the table nomenclature and deleting Footnote (i) as follows:]

Section 705.8.1 Allowable area of openings. The maximum area of.....*(No change to text)*.....specified in Table 705.8.

C705.8.1 Allowable area of openings. [ER]. Exterior walls are required to have a fire resistance rating based on proximity to property lines by Table 602. In addition, per Table 705.8 MAXIMUM AREA OF EXTERIOR WALL OPENINGS BASED ON FIRE SEPARATION DISTANCE AND DEGREE OF OPENING PROTECTION, there are limits on the amount of the openings permitted within the walls to prevent the spread of fire between buildings. The code permits the allowable area of the openings to be increased for sprinkler protection. This table replaces Table 705.8 in the code to require the same limits on the size of the openings in buildings whether or not the building is provided with sprinkler protection.

**TABLE 705.8
MAXIMUM AREA OF EXTERIOR WALL OPENINGS BASED ON FIRE SEPARATION DISTANCE AND DEGREE OF OPENING PROTECTION**

FIRE SEPARATION DISTANCE (feet)	DEGREE OF OPENING PROTECTION	ALLOWABLE AREA ^a
<u>0 to less than 3</u> ^{b,c}	<u>Unprotected (UP)</u>	<u>Not Permitted</u>
	<u>Protected (P)</u>	<u>Not Permitted</u>
<u>3 to less than 5</u> ^{d,e}	<u>Unprotected (UP)</u>	<u>Not Permitted</u>
	<u>Protected (P)</u>	<u>15%</u>
<u>5 to less than 10</u> ^{g,f,i}	<u>Unprotected (UP)</u>	<u>10%</u> ^h
	<u>Protected (P)</u>	<u>25%</u>
<u>10 to less than 15</u> ^{g,f,g}	<u>Unprotected (UP)</u>	<u>15%</u> ^h
	<u>Protected (P)</u>	<u>45%</u>
<u>15 to less than 20</u> ^{f,g}	<u>Unprotected (UP)</u>	<u>25%</u>
	<u>Protected (P)</u>	<u>75%</u>
<u>20 to less than 25</u> ^{f,g}	<u>Unprotected (UP)</u>	<u>45%</u>
	<u>Protected (P)</u>	<u>No Limit</u>
<u>25 to less than 30</u> ^{f,g}	<u>Unprotected (UP)</u>	<u>70%</u>
	<u>Protected (P)</u>	<u>No Limit</u>
<u>30 or greater</u>	<u>Unprotected (UP)</u>	<u>No Limit</u>
	<u>Protected (P)</u>	<u>Not Required</u>

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.

(No change to Footnotes (a) through (h)).

- i. — Not applicable to Group H-1, H-2 and H-3 occupancies.
- j. For special requirements for Group U occupancies, see Section 406.3.2.

[Modify Sections 705.8.2 and 705.8.5 as follows:]

705.8.2 Protected openings. Where openings are required to be protected, *fire doors* and fire shutters shall comply with Section 716.5 and *fire window assemblies* shall comply with Section 716.6.

Exception: ~~Opening protectives are not required where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 and the exterior openings are protected by a water curtain using automatic sprinklers approved for that use.~~

705.8.5 Vertical separation of openings. Openings in exterior walls in adjacent *stories*.....(*No change to text*)..... to the flame barriers or vertical separation unless otherwise required by the provisions of this code.

Exceptions:

1. This section shall not apply to buildings that are three *stories* or less *above grade plane*.
2. ~~This section shall not apply to buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2~~
3. Open parking garages.

[Modify Section 705.11 as follows:]

705.11 Parapets. Parapets shall be provided on *exterior walls* of buildings.

Exceptions:

(*No change to Exceptions 1, 2 or 3*)

~~4. One-hour fire-resistance-rated exterior walls that terminate at the underside of the roof sheathing, deck or slab, provided:~~

~~4.1. Where the roof/ceiling framing elements are parallel to the walls, such framing and elements supporting such framing shall not be of less than 1-hour fire-resistance-rated construction for a width of 4 feet (1220 mm) for Groups R and U and 10 feet (3048 mm) for other occupancies, measured from the interior side of the wall.~~

C705.8.2 Protected openings [ER]. As previously discussed sustainable buildings should not be designed on the premise that a water supply is always available. In addition, adjacent structures are commonly fed from the same water main and thus will have a diminished available water supply to maintain a water curtain deluge design, i.e., due to sprinkler activation and fire hose demand in an adjacent building. For these reasons the exception to allow a tradeoff for passive protection of the opening in exterior walls is not permitted.

C705.8.5 Vertical separation of openings [ER]. The exception to allow a trade-off for buildings that provide automatic sprinkler systems was removed for two reasons. The first reason is the elimination of unprotected construction types; therefore, all exterior-bearing walls will have a minimum one-hour fire-resistive rating. In any vertically stacked building design of four stories or more, all of the exterior walls (except for possibly the top floor) will be considered bearing and therefore have a minimum one-hour rating. Secondly, documented cases have shown that the vertical spread of fire on combustible exterior walls of sprinklered buildings were still very difficult to control, resulting in large property losses, loss of revenue and lost jobs.

C705.11. Parapets [ER]. The code requires parapets on the exterior walls to minimize the spread of fire from the building to adjacent properties. There code provides numerous exceptions where parapets can be eliminated when the threat of fire spread is reduced by incorporating other fire safety features. Some of these exceptions do not provide the level of fire protection and robustness consistent with the concepts of sustainability. Parapets provide property protection in conjunction with life safety for the occupants by preventing fire spread between buildings and thus reducing the risk of major conflagrations especially in urban environments. By deletion of Exceptions 4 and 5 the elimination of parapets is limited to buildings where the roof construction is 2-hour fire resistance rated or the building is small or not built in close proximity to other buildings.

4.2. Where roof/ceiling framing elements are not parallel to the wall, the entire span of such framing and elements supporting such framing shall not be of less than 1-hour fire-resistance-rated construction.

4.3. Openings in the roof shall not be located within 5 feet (1524 mm) of the 1-hour fire-resistance-rated exterior wall for Groups R and U and 10 feet (3048 mm) for other occupancies, measured from the interior side of the wall.

4.4. The entire building shall be provided with not less than a Class B roof covering.

5. In Groups R-2 and R-3 where the entire building is provided with a Class C roof covering, the exterior wall shall be permitted to terminate at the underside of the roof sheathing or deck in Type III, IV and V construction, provided:

5.1. The roof sheathing or deck is constructed of *approved* noncombustible materials or of fire-retardant-treated wood for a distance of 4 feet (1220 mm); or

5.2. The roof is protected with 0.625-inch (16 mm) Type X gypsum board directly beneath the underside of the roof sheathing or deck, supported by a minimum of nominal 2-inch (51 mm) ledgers attached to the sides of the roof framing members for a minimum distance of 4 feet (1220 mm).

(No change to Exception 6)

SECTION 706 FIRE WALLS

[Modify Section 706.3 as follows:]

706.3 Materials. Fire walls shall be of any *approved* non-combustible material permitted in NFPA 221. ~~materials.~~

SECTION 706 FIRE WALLS

Commensurate with the concept of sustainability an appropriate level of life safety and property protection is achieved by modifying the provisions of Section 706 for fire walls in buildings. These changes address damage reduction, increased robustness and sprinkler tradeoffs which improve property protection in conjunction with life safety for the occupants. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

C706.3 Materials [ER]. Prohibits the use of combustible assemblies for fire walls. A fire wall constructed of combustible material will generally need to be removed and

Exception: Buildings of Type V construction.

[Modify Section 706.4 by deleting Footnote (a) in Table 706.4 as follows:]

706.4 Fire-resistance rating. *Fire walls shall.....(No change to text).....required by Table 706.4.*

replaced after a fire event even if it performed its intended function. Having to remove, dispose and replace materials after a fire event is not consistent with the basic premises of sustainability. Non-combustible fire walls, especially masonry and concrete, are more likely to sustain fire exposure or be easily repaired in place without replacement.

C706.4 Fire resistance ratings [ER]. Table 706.4 FIRE WALL FIRE-RESISTANCE RATINGS in the code allows the reduction in the fire resistance rating for fire walls from 3-hours to 2-hours for Types II and V construction. The resilience of buildings is enhanced by reducing the risk from fire spread when the fire walls are required to have a 3-hour fire resistance rating, especially in Type V construction.

**TABLE 706.4
FIRE WALL FIRE-RESISTANCE RATINGS**

GROUP	FIRE-RESISTANCE RATING (hours)
A, B, E, H-4, I, R-1, R-2, U	3 ^a
F-1, H-3b, H-5, M, S-1	3
H-1, H-2	4
F-2, S-2, R-3, R-4	2

a. In Type II or V construction, walls shall be permitted to have a 2-hour fire-resistance rating.

b. For Group H-1, H-2 or H-3 buildings, also see Sections 415.6 and 415.7.

[Modify Section 706.5 by deleting Exception 3 as follows:]

706.5 Horizontal continuity. *Fire walls shall be.....(No change to text)..... the exterior surface of exterior walls.*

Exceptions:

(No change to Exceptions 1 and 2)

~~3. Fire walls shall be permitted to terminate at the interior surface of noncombustible exterior sheathing where the building on each side of the fire wall is protected by an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.~~

[Modify Section 706.6 as follows:]

706.6 Vertical continuity. *Fire walls shall extend from the foundation to a termination point at least 30 inches (762 mm) above both adjacent roofs.*

C706.5 Horizontal continuity [ER]. This modification provides enhanced resilience by requiring fire walls to extend 18-inches past the exterior walls of all buildings, fully sprinklered or not. This change maintains the code requirements for the extension of fire walls past exterior walls.

C706.6 Vertical Continuity [ER]. The code requires fire walls to extend above the roof to minimize the spread of fire from one side of the wall to the building on the adjacent side. The code provides numerous exceptions where the fire wall extension can be eliminated when the threat of fire spread is reduced by incorporating other fire safety

zExceptions:

(No change to Exception 1, delete Exception 2)

~~2. Two-hour fire-resistance-rated walls shall be permitted to terminate at the underside of the roof sheathing, deck or slab, provided:~~

~~2.1. The lower roof assembly within 4 feet (1220 mm) of the wall has not less than a 1-hour fire-resistance rating and the entire length and span of supporting elements for the rated roof assembly has a *fire-resistance rating* of not less than 1 hour.~~

~~2.2. Openings in the roof shall not be located within 4 feet (1220 mm) of the *fire wall*.~~

~~2.3. Each building shall be provided with not less than a Class B roof covering.~~

(No change to Exception 3, delete Exception 4)

~~4. In buildings of Type III, IV and V construction, walls shall be permitted to terminate at the underside of combustible roof sheathing or decks, provided:~~

~~4.1. There are no openings in the roof within 4 feet (1220 mm) of the *fire wall*;~~

~~4.2. The roof is covered with a minimum Class B roof covering, and~~

~~4.3. The roof sheathing or deck is constructed of *fire-retardant-treated wood* for a distance of 4 feet (1220 mm) on both sides of the wall or the roof is protected with 5/8-inch (15.9 mm) Type X gypsum board directly beneath the underside of the roof sheathing or deck, supported by a minimum of 2-inch (51 mm) nominal ledgers attached to the sides of the roof framing members for a minimum distance of 4 feet (1220 mm) on both sides of the *fire wall*.~~

(No change to Exceptions 5 and 6)

[Modify Section 706.8 as follows:]

706.8 Openings. Each opening through a *fire wall* shall be protected in accordance with Section 716.5 and shall not exceed 156 square feet (15 m²). The aggregate width of openings at any floor level shall not exceed 25 percent of the length of the wall.

features. Exceptions 2 and 4 are eliminated because they do not provide the level of fire protection and robustness consistent with the concepts of sustainability. Fire walls provide property protection in conjunction with life safety for the occupants by preventing fire spread between buildings and thus reducing the risk of major conflagrations especially in urban environments.

C706.8 Openings [ER]. The codes limit the size of openings in fire walls to minimize spread of fire. Consistent with the basic premise of sustainability this modification maintains the code requirements for size of opening in fire walls whether or not the building is fully sprinklered.

Exceptions:

1. Openings are not permitted in party walls constructed in accordance with Section 706.1.1.
2. ~~Openings shall not be limited to 156 square feet (15 m²) where both buildings are equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.~~

SECTION 707 FIRE BARRIERS

[Add new Sections 707.3.11 and 707.3.12 as follows:]

707.3.11 Separation of dwelling units and sleeping units. The separation between individual dwelling units and sleeping units, and between dwelling units and sleeping units and other spaces in the building shall be fire barrier assemblies or horizontal assemblies with a minimum fire-resistance rating of 2-hour.

707.3.12 Separation of tenant spaces. In addition to the requirements of Section 508, individual tenant spaces in a building shall be separated by fire barrier assemblies or horizontal assemblies, or both, with a minimum fire-resistance rating of 1-hour.

SECTION 707 FIRE BARRIERS

C707.3.11 Separation of dwelling units and sleeping units [ER]. This modification requires a minimum two-hour separation between dwelling units and sleeping units as well as hourly separation between other occupancies.

New Section 707.3.11 provides passive fire-rated compartmentation between residential dwelling and sleeping units. This coupled with sprinkler protection throughout will provide residents with an area of refuge within their own dwelling units in case fire blocks their egress path from the building. This is especially important for dwellings housing the aging population.

Such added levels of protection increase the comfort individuals may feel in their day-to-day living environment with others in close proximity to their dwelling and sleeping units.

In addition, these fire barriers between dwelling units help contain the fire to the room of origin minimizing damage to other parts of the building which improves the likelihood the facility will remain in operation and reduce the need for the displacement of residents.

Typically passive fire protection is achieved with more robust construction systems. Such systems inherently improve the quality of the living environment by reducing the intrusion of noise from adjacent dwelling units.

C707.3.12 Separation of tenant spaces [ER]. This modification requires a minimum one-hour separation between all tenant spaces in buildings.

New Section 707.3.12 provides passive fire-rated compartmentation between tenant spaces. This coupled with sprinkler protection throughout will provide occupants with an area of refuge within their own tenant space in case fire blocks their egress path from the

building. Such added levels of protection increase the security individuals may feel in their day-to-day work environment resulting in improved productivity.

In addition, these fire barriers between tenant spaces helps contain the fire to the area of origin minimizing damage to other parts of the building which improves the likelihood the facility will remain in operation and reduce the need for the displacement of businesses.

Typically passive fire protection is achieved with more robust construction systems. Such systems inherently improve comfort and productivity by reducing the intrusion of noise from adjacent tenant spaces.

[Modify Section 707.6 as follows:]

707.6 Openings. Openings in a *fire barrier* shall be protected in accordance with Section 716. Openings shall be limited to a maximum aggregate width of 25 percent of the length of the wall, and the maximum area of any single opening shall not exceed 156 square feet (15m²). Openings in enclosures for *exit* access stairways and ramps, interior exit stairways and ramps and exit passageways shall also comply with Sections 1022.3 and 1023.5, respectively.

Exceptions:

1. ~~Openings shall not be limited to 156 square feet (15 m²) where adjoining floor areas are equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.~~

(No change to Exceptions 2 through 5)

C707.6 Openings [ER]. This modification provides enhanced resilience by requiring opening protective devices in fire barriers to meet the area limitations in all buildings, fully sprinklered or not. This change maintains the code requirements for size of opening protectives of fire barrier walls.

**SECTION 708
FIRE PARTITIONS**

[Modify Sections 708.1, 708.3 and 708.4 as follows:]

708.1 General. The following wall assemblies shall comply with this section.

1. ~~Walls separating dwelling units in the same building as required by Section 420.2.~~
2. ~~Walls separating sleeping units as required by Section 420.2.~~
3. Walls separating tenant spaces in *covered* and *open mall buildings* as required by Section 402.4.2.1
4. *Corridor* walls as required by Section 1018.1.
5. Elevator lobby separation as required by Section 713.14.1

(No change to Section 708.2)

708.3 Fire-resistance rating. *Fire partitions* shall have a *fire-resistance rating* of not less than 1 hour.

Exceptions:

1. ~~*Corridor* walls permitted to have a ½ hour fire-resistance rating by Table 1018.1.~~
2. ~~*Dwelling unit* and *sleeping unit* separations in buildings of Type HB, HIB and VB construction shall have fire-resistance ratings of not less than ½ hour in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.~~

708.4 Continuity. *Fire partitions* shall extend..... *(No change to text)*..... to afford the required *fire-resistance rating* of the wall supported, except for walls separating tenant spaces in *covered and open mall buildings*, walls separating *dwelling units*, walls separating *sleeping units* and *corridor* walls, in buildings of Type IIB, IIIB and

**SECTION 708
FIRE PARTITIONS**

Passive compartmentation within residential dwelling and sleeping units coupled with sprinkler protection throughout will provide residents with an area of refuge within their own unit. The containment of fire to the room of origin reduces the amount of damage and thus the need for repairs and the removal, disposal and replacement of materials. Minimizing damage allows for continued operations and avoids displacement of residents. This is accomplished by requiring fire resistance rated construction between dwelling units and between dwelling units and other spaces and corridors.

C708.1 General [ER]. Items (1) and (2) are deleted because changes to Section 420.2 require that walls separating dwelling and sleeping units must be fire barriers in accordance with 707.3.11.

C708.3 Fire-resistance rating [ER]. Removes Exceptions #1 and #2 permitting corridors and dwelling and sleeping units to be less than a one-hour rating. All corridors serving an occupant load greater than ten are required to be rated one-hour.

C708.4 Continuity [ER]. Fireblocking and draftstopping in combustible construction is addressed in the code to reduce fire spread within concealed spaces and makes the building more robustness. This change retains the fireblocking and draftstopping of combustible fire partitions consistent with the concept of sustainability. See ENHANCED FIRE SAFETY,

VB construction.

Exceptions:

(No change to Items 1 through 5)

- 6. Fireblocking or draftstopping is not required at the partition line in buildings equipped with an *automatic sprinkler system* installed throughout in accordance with Section 903.3.1.1 or 903.3.1.2, provided that automatic sprinklers are installed in combustibile floor/ceiling and roof/ceiling spaces.

**SECTION 711
HORIZONTAL ASSEMBLIES**

[Modify Section 711.3 as follows:]

711.3 Fire-resistance rating. The *fire-resistance rating* of floor and roof assemblies shall.....*(No change to text)*..... *Horizontal assemblies* separating dwelling units in the same building and *horizontal assemblies* separating sleeping units in the same building shall be a minimum of 1-hour fire-resistance-rated construction as required in Section 707.3.11.

Exception: *Dwelling unit* and sleeping unit separations in buildings of Type HB, HIB, and VB construction shall have *fire-resistance ratings* of not less than 1/2 hour in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

**SECTION 713
SHAFT ENCLOSURES**

[Modify Section 713.11 as follows:]

713.11 Enclosure at the bottom. Shafts that do not extend to the bottom of the building or structure shall comply with one of the following:

(No change to Items 1 and 2, and modify Exception 1 to Item 3.)

- 3. They shall be protected by *approved fire dampers* installed in accordance with their listing at the lowest floor level within the shaft enclosure.

Exceptions:

- 1. The fire-resistance-rated room separation is not required, provided there are no openings

at the beginning of Chapter 4.

**SECTION 711
HORIZONTAL ASSEMBLIES**

C711.3 Fire-resistance rating [ER]. Passive compartmentation between residential dwelling and sleeping units coupled with sprinkler protection throughout will provide residents with an area of refuge within their own unit. The containment of fire to the room of origin reduces the amount of damage and thus the need for repairs and the removal, disposal and replacement of materials. Minimizing damage allows for continued operations and avoids displacement of residents. This is accomplished by requiring a minimum of one hour fire resistance rated construction between floors. See ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**SECTION 713
SHAFT ENCLOSURES**

C713.11 Enclosure at the bottom [ER]. This section of the code identifies alternate treatments for enclosing shafts that do not extend to the bottom of the building. Enhanced fire protection is an essential component to achieve the necessary robustness and property protection for sustainable buildings. This is accomplished through an appropriate level of redundancy achieved by combining passive fire protection and sprinklers. This change retains draftstopping regardless of the presence of sprinklers to achieve the enhanced level of protection.

in or penetrations of the shaft enclosure to the interior of the building except at the bottom. The bottom of the shaft shall be closed off around the penetrating items with materials permitted by Section 718.3.1 for draftstopping, or the room shall be provided with an approved automatic sprinkler system.

(No change to Exceptions 2 and 3)

[Modify Section 713.14.1 as follows:]

713.14.1 Elevator lobby. An enclosed elevator lobby shall be provided at each floor where an elevator shaft enclosure connects more than three stories. The lobby enclosure shall.....*(No change to text)*.....shall be protected as required for corridors in accordance with Section 717.5.4.1. Elevator lobbies shall have at least one means of egress complying with Chapter 10 and other provisions within this code.

Exceptions:

1. Enclosed elevator lobbies are not required at the level(s) of exit discharge, provided the level(s) of exit discharge is equipped with an automatic sprinkler system in accordance with Section 903.3.1.1.
2. Elevators not required to be located in a shaft in accordance with Section 712.1 are not required to have enclosed elevator lobbies.
3. Enclosed elevator lobbies are not required where additional doors are provided at the hoistway opening in accordance with Section 3002.6. Such doors shall comply with the smoke and draft control door assembly requirements in Section 716.5.3.1 when tested in accordance with UL 1784 without an artificial bottom seal.
4. Enclosed elevator lobbies are not required where the building is protected by an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2. This exception shall not apply to the following:
 - 4.1. Group I-2 occupancies;
 - 4.2. Group I-3 occupancies; and

C713.14.1 Elevator lobby [ER]. This modification retains the fire partitions for separation of elevator lobbies regardless of the presence of sprinklers. These partitions serve as important fire safety features for occupants. A physical separation is provided for persons discharging from an elevator onto a floor where a fire may be occurring. Further the partitions reduce the potential for fire and smoke spread through the elevator shaft. Elevator lobbies protected with fire partitions may also serve as areas of refuge. SEE ENHANCED FIRE SAFETY AT THE BEGINNING OF CHAPTER 4.

4.3. Elevators serving floor levels over 75 feet (22 860 mm) above the lowest level of fire department vehicle access in high-rise buildings.

5. Smoke partitions shall be permitted in lieu of *fire partitions* to separate the elevator lobby at each floor where the building is equipped throughout with an *automatic sprinkler system* installed in accordance with Section 903.3.1.1 or 903.3.1.2. In addition to the requirements in Section 710 for smoke partitions, doors protecting openings in the smoke partitions shall also comply with Sections 710.5.2.2, 710.5.2.3, and 716.5.9 and duct penetrations of the smoke partitions shall be protected as required for *corridors* in accordance with Section 717.5.4.1.
6. Enclosed elevator lobbies are not required where the elevator hoistway is pressurized in accordance with Section 909.21.
7. Enclosed elevator lobbies are not required where the elevator serves only *open parking garages* in accordance with Section 406.5.

SECTION 716 OPENING PROTECTIVES

[Modify Section 716.5.5 as follows:]

716.5.5 Doors in interior exit stairways and ramps and exit passageways. *Fire door* assemblies in interior exit stairways and ramps and exit passageways shall have a maximum transmitted temperature rise of not more than 450°F (250°C) above ambient at the end of 30 minutes of standard fire test exposure.

Exception: ~~The maximum transmitted temperature rise is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 903.3.1.1 or 903.3.1.2.~~

SECTION 718 CONCEALED SPACES

SECTION 716 OPENING PROTECTIVES

C716.5.5 Doors in exit enclosures and exit passageways [ER]. This section retains the requirement that fire door assemblies in exit enclosures and exit passageways shall have a maximum transmitted temperature end point of not more than 450° F (250° C) above ambient at the end of 30 minutes of standard fire test exposure regardless of the presence of sprinklers. This requirement helps assure that means of egress are appropriately protected in the event of sprinkler system malfunctions or failures. SEE ENHANCED FIRE SAFETY AT THE BEGINNING OF CHAPTER 4.

SECTION 718 CONCEALED SPACES

Draftstopping and firestopping in attics and concealed spaces are recognized in the code as a means to reduce the

spread of fire in buildings especially since fires in these areas are not easily detected or readily accessible to emergency responders. The function of draftstopping and firestopping is especially important in buildings of combustible construction. SEE ENHANCED FIRE SAFETY AT THE BEGINNING OF CHAPTER 4.

[Modify Section 718.3.2 as follows]

718.3.2 Groups R-1, R-2, R-3 and R-4. Draftstopping shall be provided in floor/ceiling spaces in Group R-1 buildings, in Group R-2 buildings with three or more *dwelling units*, in Group R-3 buildings with two *dwelling units* and in Group R-4 buildings. Draftstopping shall be located above and in line with the *dwelling units* and *sleeping unit* separations.

Exceptions:

- ~~1. Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.~~
- ~~2. Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.2, provided that automatic sprinklers are also installed in the combustible concealed spaces.~~

[Modify Section 718.3.3 as follows:]

718.3.3 Other groups. In other groups, draftstopping shall be installed so that horizontal floor areas do not exceed 1,000 square feet (93 m²).

Exception: ~~Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1~~

[Modify Section 718.4.2 as follows:]

718.4.2 Groups R-1 and R-2. Draftstopping shall be provided in *attics*, mansards, overhangs or other concealed roof spaces of Group R-2 buildings with three or more *dwelling units* and in all Group R-1 buildings. Draftstopping shall be installed above, and in line with, *sleeping unit* and *dwelling unit* separation walls that do not extend to the underside of the roof sheathing above.

C718.3.2 Groups R-1, R-2, R-3 and R-4 [ER]. This modification retains draftstopping requirements in floor/ceiling spaces of Group R-1 buildings, Group R-2 buildings with three or more dwelling units, Group R-3 buildings with two dwelling units, and in Group R-4 buildings.

C718.3.3 Other Groups [ER]. This modification retains draftstopping in other than Group R buildings such that horizontal floor areas do not exceed 1,000 square feet (93 m²).

C718.4.2 Groups R-1 and R-2 [ER]. This modification retains draftstopping in attics, mansards, overhangs or other concealed roof spaces of all Group R-1 buildings and Group R-2 buildings with three or more dwelling units.

Exceptions:

1. Where *corridor* walls provide a *sleeping unit* or *dwelling unit* separation, draftstopping shall only be required above one of the *corridor* walls.
2. ~~Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.~~
3. In occupancies in Group R-2 that do not exceed four *stories above grade plane*, the *attic* space shall be subdivided by *draftstops* into areas not exceeding 3,000 square feet (279 m²) or above every two *dwelling units*, whichever is smaller.
4. ~~Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.2, provided that automatic sprinklers are also installed in the combustible concealed space where the draftstopping is being omitted.~~

[Modify Section 718.4.3 as follows:]

718.4.3 Other groups. Draftstopping shall be installed in *attics* and concealed roof spaces, such that any horizontal area does not exceed 3,000 square feet (279 m²).

Exception: ~~Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1~~

C718.4.3 Other groups [ER]. This modification retains draftstopping in other than Group R-1 or R-2 buildings for attics and concealed roof spaces, such that any horizontal area does not exceed 3,000 square feet (279 m²). Draftstopping reduces the risk to spread of fire in concealed floor spaces. See ENHANCED FIRE SAFETY at the beginning of Chapter 4.

CHAPTER 8 INTERIOR FINISHES

SECTION 803 WALL AND CEILING FINISHES

[Modify Section 803.9 with changes to Table 803.9 as follows:]

Section 803.9 Interior finish requirements based on group. Interior wall and ceiling finish.....*(No change to text)*.....in accordance with ASTM E84 or UL 723 is required.

CHAPTER 8 INTERIOR FINISHES

INTERIOR FINISHES [ER] This chapter of the building code is used to regulate interior finishes, trim and decorative materials. In most cases, these provisions are intended to minimize the spread of fire or the effects of burning materials on the building occupants. The modifications to this chapter provide fire safety and add durability criteria appropriate for sustainable buildings.

SECTION 803 WALL AND CEILING FINISHES

C803.9 Interior finish requirements based on group [ER]. The revisions to Table 803.9 INTERIOR WALL AND CEILING FINISH REQUIREMENTS BY OCCUPANCY for interior wall and ceiling finishes are based on the premise that sustainable buildings warrant a higher degree of life safety and property protection related to structure fires. This is provided with automatic sprinkler protection systems combined with appropriate flame spread classifications. See ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**TABLE 803.9
INTERIOR WALL AND CEILING FINISH REQUIREMENTS BY OCCUPANCY^k**

GROUP	SPRINKLERED ^l			NONSPRINKLERED		
	Interior exit stairways, interior exit ramps and exit passageways ^{ab}	Corridors and enclosures for exit access stairways and exit access ramps	Rooms and Enclosed spaces ^e	Interior exit stairways, interior exit ramps and exit passageways ^{ab}	Corridors and enclosures for exit access stairways and exit access ramps	Rooms and Enclosed spaces ^c
A-1, A-2	B	B	E	A	A ^d	B ^e
A-3 ^f , A-4, A-5	B	B	E	A	A ^d	C
B, E, M, R-1,	B	E	E	A	B	C
R-4	B	E	E	A	B	C
F	E	E	E	B	C	C
H	B	B	E	A	A	B
I-1	B	E	E	A	B	B
I-2	B	B	B ^{hi}	A	A	B
I-3	A	A ^j	E	A	A	B
I-4	B	B	B ^{hi}	A	A	B
R-2	E	E	E	B	B	C
R-3	E	E	E	A	C	C
S	E	E	E	B	B	C
U	No Restrictions			No Restrictions		

For SF: 1 inch = 25.4 mm, 1 square foot = 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 fireblocked as required by Section 803.11.1.
- b. ~~In other than Group I-2 occupancies in buildings less than three stories above grade plane, Class B interior finish for nonsprinklered buildings and Class C interior finish for sprinklered buildings shall be permitted in interior exit stairways and ramps.~~
- c. 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 the rooms or spaces on both sides shall be considered one. In determining the applicable 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.
- d. Lobby areas in Group A-1, A-2 and A-3 occupancies shall not be less than Class B materials.
- e. Class C interior finish materials shall be permitted in places of assembly with an occupant load of 300 persons or less.
- f. For places of religious worship, wood used for ornamental purposes, trusses, paneling or chancel furnishing shall be permitted.
- g. Class B material is required where the building exceeds two stories.
- h. Class C interior finish materials shall be permitted in administrative spaces.
- i. Class C interior finish materials shall be permitted in rooms with a capacity of four persons or less.
- j. Class B materials shall be permitted as wainscoting extending not more than 48 inches above the finished floor in corridors and exit access stairways and ~~ramps.~~
- k. Finish materials as provided for in other sections of this code.
- l. ~~Applies when protected by an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.~~

[Modify Section 803.11.2 as follows:]

803.11.2 Set-out construction. Where walls and ceilings are required to be of fire-resistance-rated or noncombustible construction and walls are set out or ceilings are dropped distances greater than specified in Section 803.11.1, Class A finish materials, in accordance with Section 803.1.1 or 803.1.2 shall be used.

Exceptions:

1. ~~Where interior finish materials are protected on both sides by an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2.~~
2. Where interior finish materials are attached to noncombustible backing or furring strips installed as specified in Section 803.11.1.1.

**SECTION 804
INTERIOR FLOOR FINISH**

[Modify Section 804.4.2 as follows:]

804.4.2 Minimum critical radiant flux. In all occupancies, interior floor finish and floor covering materials in enclosures for stairways and ramps, exit passageways, corridors and rooms or spaces not separated from corridors by partitions extending from the floor to the underside of the ceiling shall withstand a minimum critical radiant flux. The minimum critical radiant flux shall not be less than Class I in Groups I-1, I-2 and I-3 and not less than Class II in Groups A, B, E, H, I-4, M, R-1, R-2 and S.

Exception: Where a building is equipped throughout with an ~~automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2~~, Class II materials are permitted in any area where Class I materials are required, and materials complying with the DOC FF-1 “pill test” (CPSC 16 CFR, Part 1630) or with ASTM D 2859 are permitted in any area where Class II materials are required.

C803.11.2 Set-out construction [ER]. This section requires that where walls and ceilings are of fire-resistance-rated or noncombustible construction, and walls are set-out or ceilings are dropped distances greater than specified in Section 803.11.1, Class A finish materials (in accordance with Section 803.1.1 or 803.1.2) shall be used and attached to noncombustible backing or furring strips installed as specified in Section 803.11.1. This requirement of the code is retained regardless of the presence of fire sprinklers. See ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**SECTION 804
INTERIOR FLOOR FINISH**

C804.4.2 Minimum critical radiant flux [ER]. This section requires that interior floor finish and floor covering materials in exit enclosures, exit passageways, and corridors shall not be less than Class I in Groups I-2 and I-3, and not less than Class II in Groups A, B, E, H, I-4, M, R-1, R-2, and S. In all areas, floor covering materials shall comply with the DOCCF-1 “pill test” (CPSC16 CFR, Part 1630). This requirement of the code is retained regardless of the presence of fire sprinklers. See ENHANCED FIRE SAFETY at the beginning of Chapter 4.

[Add new Section 809 as follows:]

SECTION 809
EMISSION REQUIREMENTS AND
VOC CONTENT

809.1 General. Adhesives and sealants, paints and coatings, floor covering materials, composite wood, wood structural panel and agrifiber products and ceiling and wall systems used in the interior of all buildings shall comply with Section 8.4.2 of ASHRAE Standard 189.1 and this section.

Exceptions

1. Clay and concrete tile and pavers.
2. Concrete.
3. Glass (free of organic coatings).
4. Masonry (clay, concrete, glass, cast stone or natural stone).
5. Metal.
6. Mineral based materials (organic free).

SECTION 809
EMISSION REQUIREMENTS AND
VOC CONTENT

For sustainable buildings there are additional provisions added to minimize the impact of materials on the interior environment affecting the health, comfort and productivity of building occupants. This is primarily accomplished by limiting the introduction of volatile organic compounds (VOCs) into the built environment. Prominent means that can inadvertently introduce VOCs into the environment are carpets, adhesives and sealants, paints and coatings, composite wood-based products, wood structural panels and agrifiber products. Requirements consistent with those promulgated by the California Department of Health Services, the California Air Resources Board, Green Seal and the US Environmental Protections Agency (US EPA) are included for these products in new sections. They are:

C809.1 General [IQ]. These provisions refer the user to Section 8.4.2 of *American Society of Heating, Refrigerating and Air-conditioning Engineers* Standard for the Design of High-Performance Green Buildings Except Low-rise Residential Buildings (ASHRAE 189.1) for interior material requirements. However, the ASHRAE 189.1 provisions for hard surface flooring are limited to office spaces and classrooms whereas these provisions are applicable to most occupancies.

Notably there are many types of hard surface materials that inherently comply with the emission and VOC limits of this section. The most commonly used materials that are deemed to comply are listed in this exception. This negates activities and cost for unnecessary sampling and testing of these materials to show compliance.

**CHAPTER 9
FIRE PROTECTION SYSTEMS**

**SECTION 903
AUTOMATIC SPRINKLER SYSTEMS**

[Modify Section 903.2 and add new Section 903.2.13 as follows:]

[F] **903.2 Where required.** Approved *automatic sprinkler systems* in new buildings and structures shall be provided in the locations described in Sections 903.2.1 through ~~903.2.12~~ 903.2.13.

Exception:

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 smoke detection system in accordance with Section 907.2 and are separated from the remainder of the building by not less than 1-hour *fire barriers* constructed in accordance with Section 707 or not less than 2-hour *horizontal assemblies* constructed in accordance with Section 711, or both

[F] **903.2.1 Group A.** An *automatic sprinkler system* shall be provided throughout buildings and portions thereof used as Group A occupancies.....*(No change to text)*..... For Group A-5 occupancies, the *automatic sprinkler system* shall be provided in the spaces indicated in Section 903.2.1.5.

[F] **903.2.1.1 Group A-1.** An *automatic sprinkler system* shall be provided for Group A-1 occupancies where one of the following conditions

**CHAPTER 9
FIRE PROTECTION SYSTEMS**

FIRE PROTECTION SYSTEMS. [ER] Fire safety and property protection necessary to achieve the minimum performance necessary for sustainable buildings requires a combination of appropriate levels of active and passive fire protection. Automatic fire suppression systems (sprinklers) and a superior level of passive fire protection for most occupancies are required. The combination appropriately provides control and containment in the building to limit the extent of fire, smoke and water damage. In addition, containment and other passive fire protection provide property protection should the sprinkler system become inoperable or the water supply be unavailable. See the commentary discussion of **ENHANCED FIRE SAFETY** at the beginning of Chapter 4.

**SECTION 903
AUTOMATIC SPRINKLER SYSTEMS**

C903.2 Where required [ER]. Experience has shown that sprinkler protection improves life safety in buildings and may also reduce the extent of damage. To enhance resiliency in a sustainable building the thresholds where sprinklers are required have been reduced in those occupancies where the risk of a fire happening is higher. In addition sprinkler protection will be required in some business occupancies to improve the level of property protection and life safety.

exists:

1. The *fire area* exceeds ~~12,000~~ 6,000 square feet (~~1115~~ 557.5 m²);
2. The *fire area* has an *occupant load* of ~~300~~ 150 or more;
3. The *fire area* is located on a floor other than a *level of exit discharge* serving such occupancies; or
4. The *fire area* contains a multitheater complex.

[F] **903.2.1.2 Group A-2.** An *automatic sprinkler system* shall be provided for Group A-2 occupancies where one of the following conditions exists:

1. The *fire area* exceeds ~~5,000~~ 2,500 square feet (~~464.5~~ 232.2 m²);
2. The *fire area* has an *occupant load* of 100 or more; or
3. The *fire area* is located on a floor other than a *level of exit discharge* serving such occupancies.

[F] **903.2.1.3 Group A-3.** An *automatic sprinkler system* shall be provided for Group A-3 occupancies where one of the following conditions exists:

1. The *fire area* exceeds ~~12,000~~ 6,000 square feet (~~1115~~ 557.5 m²);
2. The *fire area* has an *occupant load* of ~~300~~ 150 or more; or
3. The *fire area* is located on a floor other than a *level of exit discharge* serving such occupancies.

[F] **903.2.1.4 Group A-4.** An *automatic sprinkler system* shall be provided for Group A-4 occupancies where one of the following conditions exists:

1. The *fire area* exceeds ~~12,000~~ 6,000 square feet (~~1115~~ 557.5 m²);
2. The *fire area* has an *occupant load* of ~~300~~ 150 or more; or
3. The *fire area* is located on a floor oth-

er than a *level of exit discharge* serving such occupancies.

[F] **903.2.1.5 Group A-5.** *(No change to 903.2.1.5)*

[F] **903.2.2 Ambulatory care facilities.** *(No change to 903.2.2)*

[F] **903.2.3 Group E.** An *automatic sprinkler system* shall be provided for Group E occupancies as follows:

1. Throughout all Group E *fire areas* greater than ~~12,000~~ 6,000 square feet (~~1115~~ 557.5 m²) in area.
2. Throughout every portion of educational buildings below the lowest *level of exit discharge* serving that portion of the building.

Exception: *(No change to Exception)*

[F] **903.2.4 Group F-1.** An *automatic sprinkler system* shall be provided throughout all buildings containing a Group F-1 occupancy where one of the following conditions exists:

1. A Group F-1 *fire area* exceeds ~~12,000~~ 6,000 square feet (~~1115~~ 557.5 m²).
2. A Group F-1 *fire area* is located more than three stories above *grade plane*.
3. The combined area of all Group F-1 *fire areas* on all floors, including any mezzanines, exceeds ~~24,000~~ 12,000 square feet (~~2230~~ 1115 m²).
4. A Group F-1 occupancy used for the manufacture of upholstered furniture or mattresses exceeds 2,500 square feet (232 m²).

[F] **903.2.4.1 Woodworking operations.** An *automatic sprinkler system* shall be provided throughout all Group F-1 occupancy *fire areas* that contain woodworking operations in excess of 2,500 square feet (232 m²) in area which generate finely divided combustible waste or use finely divided combustible materials.

[F] 903.2.5 Group H. (No change to 903.2.5)

[F] 903.2.6 Group I. (No change to 903.2.6)

[F] 903.2.7 Group M. An automatic sprinkler system shall be provided throughout buildings containing a Group M occupancy where one of the following conditions exists:

1. A Group M *fire area* exceeds ~~12,000~~ 6,000 square feet (~~1115~~ 557.5 m²).
2. A Group M *fire area* is located more than three *stories above grade plane*.
3. The combined area of all Group M *fire areas* on all floors, including any mezzanines, exceeds ~~24,000~~ 12,000 square feet (~~2230~~ 1115 m²).
4. A Group M occupancy used for the display and sale of upholstered furniture or mattresses exceeds ~~5,000~~ 2,500 square feet (~~464~~ 232 m²).

[F] 903.2.7.1 High-piled storage. (No change to 903.2.7.1)

[F] 903.2.8 Group R. (No change to 903.2.8)

[F] 903.2.9 Group S-1. An *automatic sprinkler system* shall be provided throughout all buildings containing a Group S-1 occupancy where one of the following conditions exists:

1. A Group S-1 *fire area* exceeds ~~12,000~~ 6,000 square feet (~~1115~~ 557.5 m²).
2. A Group S-1 *fire area* is located more than three *stories above grade plane*.
3. The combined area of all Group S-1 *fire areas* on all floors, including any mezzanines, exceeds ~~24,000~~ 12,000 square feet (~~2230~~ 1115 m²).
4. A Group S-1 *fire area* used for the storage of commercial trucks or buses where the *fire area* exceeds ~~5,000~~ 2,500 square feet (~~464~~ 232 m²).
5. A Group S-1 occupancy used for the display and sale of upholstered furniture or mattresses exceeds ~~2,500~~ 2,500 square feet (232 m²).

[F] **903.2.9.1 Repair garages.** An *automatic sprinkler system* shall be provided throughout all buildings used as repair garages in accordance with Section 406, as shown:

1. Buildings having two or more *stories above grade plane*, including basements, with a fire area containing a repair garage exceeding ~~10,000~~ 5,000 square feet (~~929~~ 464 m²).
2. Buildings no more than one *story above grade plane*, with a fire area containing a repair garage exceeding ~~12,000~~ 6,000 square feet (1115 557.5 m²).
3. Buildings with repair garages servicing vehicles parked in basements.
4. A Group S-1 *fire area* used for the repair of commercial trucks or buses where the *fire area* exceeds ~~5,000~~ 2,500 square feet (~~464~~ 232 m²).

[F] **903.2.9.2 Bulk storage of tires.** Buildings and structures where the area for the storage of tires exceeds ~~20,000~~ 10,000 cubic feet (~~566~~ 283 m³) shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

[F] **903.2.10 Group S-2 enclosed parking garages.** An *automatic sprinkler system* shall be provided throughout buildings classified as enclosed parking garages in accordance with Section 406.4 as follows:

1. Where the *fire area* of the enclosed parking garage exceeds ~~12,000~~ 6,000 square feet (~~1115~~ 557.5 m²); or
2. Where the enclosed parking garage is located beneath other groups.

Exception: Enclosed parking garages located beneath Group R-3 occupancies.

[F] **903.2.10.1 Commercial parking garages.** An *automatic sprinkler system* shall be provided throughout buildings used for storage of commercial trucks or buses where the *fire area* exceeds 5,000 ~~2,500~~ square feet (~~464~~ 232 m²).

[F] **903.2.11 Specific building areas and hazards.** (*No change to 903.2.11*)

[F] **903.2.12 During construction.** (*No change to 903.2.12*)

[Add new Section 903.2.13 as follows:]

903.2.13 Group B. An *automatic sprinkler system* shall be provided throughout buildings containing a Group B occupancy where one of the following conditions exists:

1. A Group B fire area exceeds 6,000 square feet (556 m²).
2. A Group B fire area is located more than three stories above grade plane.
3. The combined area of all Group B fire areas on all floors, including any mezzanines, exceeds 12,000 square feet (1115 m²).

[Modify Section 903.3.1.2 as follows:]

[F] **903.3.1.2 NFPA 13R sprinkler systems.** *Automatic sprinkler systems* in any Group R occupancies ~~up to and including four stories~~ in height shall be ~~permitted to be~~ installed throughout in accordance with NFPA 13R. *Automatic sprinkler systems* in accordance with NFPA 13R shall not be permitted.

[Modify Section 903.3.5.1.1 and delete Section 903.3.5.1.2 as follows:]

[F] **903.3.5.1.1 Limited area sprinkler systems.** Limited area sprinkler systems serving fewer than 20 sprinklers (*No change to text*) shall comply with each of the following requirements:

1. Valves shall not be installed between the

C903.3.1.2 NFPA 13R sprinkler systems [ER]. NFPA 13R sprinkler systems provide less property protection than a system installed in accordance with NFPA 13. One of the most significant differences is that NFPA 13 R systems do not require sprinkler protection in concealed combustible spaces like attics. This change requires all sprinklered buildings to be sprinklered with an NFPA 13 system in lieu of using reduced fire protection permitted with NFPA 13R sprinkler systems.

C903.3.5.1.1 Limited area sprinkler systems [ER]. Consistent with Section 903.3.1.2 modifications to this section simply are a continuation of criteria that prohibit NFPA 13R fire sprinkler systems in lieu of NFPA 13.

domestic water riser control valve and the sprinklers.

Exception: An *approved* indicating control valve supervised in the open position in accordance with Section 903.4.

2. The domestic service shall be capable of supplying the simultaneous domestic demand and the sprinkler demand required to be hydraulically calculated by NFPA 13, or NFPA 13D or NFPA 13R.

~~[F] 903.3.5.1.2 Residential combination services. A single combination water supply shall be allowed provided that the domestic demand is added to the sprinkler demand as required by NFPA 13R.~~

C903.3.5.1.2 Residential combination services [ER]. Consistent with Section 903.3.1.2 modifications to this section simply are a continuation of criteria that prohibit NFPA 13R fire sprinkler systems in lieu of NFPA 13.

[Modify Section 903.4 as follows:]

[F] 903.4 Sprinkler system supervision and alarms. All valves controlling the water supply for *automatic sprinkler systems*, pumps, tanks, water levels and temperatures, critical air pressures and water-flow switches on all sprinkler systems shall be electrically supervised by a *listed* fire alarm control unit.

Exceptions:

(No changes to Exceptions 1 and 2)

~~3. *Automatic sprinkler systems* installed in accordance with NFPA 13R where a common supply main is used to supply both domestic water and the *automatic sprinkler systems* and a separate shutoff valve for the *automatic sprinkler system* is not provided.~~

(No changes to Exceptions 4 through 7)

**SECTION 905
STANDPIPE SYSTEMS**

[Modify Section 905.4.1 as follows:]

[F] 905.4.1 Protection. Risers and laterals of Class I standpipe systems not located within an enclosed

**SECTION 905
STANDPIPE SYSTEMS**

C905.4.1 Protection [ER]. Regardless of the pres-

stairway or pressurized enclosure shall be protected by a degree of *fire resistance* equal to that required for vertical enclosures in the building in which they are located.

Exception: ~~In buildings equipped throughout with an approved automatic sprinkler system, laterals that are not located within an enclosed *stairway* or pressurized enclosure are not required to be enclosed within fire-resistance-rated construction.~~

SECTION 907 FIRE ALARM AND DETECTION SYSTEMS

[Modify Section 907.2 as follows:]

[F]907.2 **Where required – new buildings and structures.** An *approved* fire alarm system installed in accordance with the provisions of this code and NFPA 72 shall be provided in new buildings and structures in accordance with Sections 907.2.1 through 907.2.23 and provide occupant notification in accordance with Sections 907.2.1 through ~~907.2.23~~ 907.2.24 and provide occupant notification in accordance with 907.5, unless other requirements are provided by another section of this code.

(No change to remainder of text).

[Modify Sections 907.2.1 through 907.2.10 as follows:]

[F]907.2.1 **Group A.** A manual fire alarm system that activates the occupant notification system in accordance with Section 907.5 shall be installed in Group A occupancies where the occupant load due to the assembly occupancy is 300 or more. Group A occupancies not separated from one another in accordance with Section 707.3.9 shall be considered as a single occupancy for the purposes of applying this section. Portions of Group E occupancies occupied for assembly purposes shall be provided with a fire alarm system as required for the Group

ence of sprinklers, standpipe risers and laterals need to be maintained within fire resistance enclosures to increase the likelihood they will continue to function during a fire event. This change prohibits increasing the fire exposure of the risers and laterals which are crucial components of the automatic fire sprinkler system. See ENHANCED FIRE SAFETY at the beginning of Chapter 4.

SECTION 907 FIRE ALARM AND DETECTION SYSTEMS

Activation of fire alarm systems by automatic detectors and manual pull stations helps insure occupants are notified of a fire emergency. When the fire is not large enough to activate the sprinklers the fire alarm system can still be activated. Manual pull stations thereby reduce response time required to control, contain and extinguish the fire. Manual pull stations remain operable if there is a disruption of water supply or other events that prevent operation of the sprinkler system. See discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

C907.2 Where required [ER]. There are eleven modifications to this section. One adds a new section 907.2.24 that requires smoke detection in buildings constructed in areas designated as wildland-urban interface areas. The modifications to Sections 907.2.1 through 907.2.10 simply retain the requirement for manual pull stations or smoke detectors in Group A, B, E, F, I, M and R occupancies regardless of the presence of sprinklers.

E occupancy.

~~**Exception:** Manual fire alarm boxes are not required where the building is equipped throughout with an *automatic sprinkler system* and the occupant notification appliances will activate throughout the notification zones upon sprinkler waterflow.~~

[F] **907.2.2 Group B.** A manual fire alarm system shall be installed in Group B occupancies where one of the following conditions exists:

1. The combined Group B occupant load of all floors is 500 or more.
2. The Group B *occupant load* is more than 100 persons above or below the lowest *level of exit discharge*.
3. The *fire area* contains an ambulatory care facility.

~~**Exception:** Manual fire alarm boxes are not required where the building is equipped throughout with an *automatic sprinkler system* and the occupant notification appliances will activate throughout the notification zones upon sprinkler waterflow.~~

[F] **907.2.2.1 Ambulatory care facilities.** *Fire areas* containing ambulatory care facilities shall be provided with an electronically supervised automatic smoke detection system installed within the ambulatory care facility and in public use areas outside of tenant spaces, including public corridors and elevator lobbies.

~~**Exception:** Buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1, provided the occupant notification appliances will activate throughout the notification zones upon sprinkler waterflow.~~

[F] **907.2.3 Group E.** A manual fire alarm system that initiates the occupant notification signal utilizing an emergency voice/alarm communication system meeting the requirements of Section 907.5.2.2 and installed in accordance with Section 907.6 shall be installed in Group E occupancies. When *automatic sprinkler systems* or smoke detectors are installed, such systems or detectors shall be connected to the building fire alarm system.

Exceptions:

(No change to Exceptions 1 and 2)

- ~~3. Manual fire alarm boxes shall not be required in Group E occupancies where the building is equipped throughout with an *approved automatic sprinkler system*, the emergency voice/alarm communication system will activate on sprinkler water flow and manual activation is provided from a normally occupied location.~~

[F] **907.2.4 Group F.** A manual fire alarm system that activates the occupant notification system in accordance with Section 907.5 shall be installed in Group F occupancies where both of the following conditions exist:

1. The Group F occupancy is two or more *stories* in height; and
2. The Group F occupancy has a combined *occupant load* of 500 or more above or below the lowest *level of exit discharge*.

~~**Exception:** Manual fire alarm boxes are not required when the building is equipped throughout with an *automatic sprinkler system* in accordance with 903.3.1.1 and the occupant notification appliances will activate upon sprinkler waterflow.~~

[F] **907.2.5 Group H.** *(No changes to 907.2.5)*

[F] **907.2.6 Group I.** A manual fire alarm system that activates the occupant notification system.... *(No change to text)*.....in accordance with Sections 907.2.6.1, 907.2.6.2 and 907.2.6.3

(No changes to Exceptions in Section 907.2.6)

[F] **907.2.6.1 Group I-1.** In Group I-1 occupancies, an automatic smoke detection system shall ne installed in *corridors*, waiting areas open to *corridors*, *habitable spaces* other than *sleeping units* and kitchens. The system shall be activated in accordance with 907.5.

Exceptions:

- ~~1. Smoke detection in *habit-*~~

~~able spaces is not required where the facility is equipped throughout with an automatic sprinkler system in accordance with 903.3.1.1.~~

2. Smoke detection is not required for exterior balconies.

[F] 907.2.6.3.3 Automatic smoke detection system. An automatic smoke detection system shall be installed throughout resident housing areas, including *sleeping units* and contiguous day rooms, group activity spaces and other common spaces normally accessible to residents.

Exceptions:

(No change to Exceptions 1 and 2)

- ~~3. Smoke detectors are not required in *sleeping units* with four or fewer occupants in smoke compartments that are equipped throughout with an approved automatic sprinkler system installed in accordance with 903.3.1.1.~~

[F] 907.2.7 Group M. A manual fire alarm system that activates the occupant notification system in accordance with Section 907.5 shall be installed in Group M occupancies where one of the following conditions exists:

1. The combined Group M *occupant load* of all floors is 500 or more persons.
2. The Group M *occupant load* is more than 100 persons above or below the lowest *level of exit discharge*.

Exceptions:

1. A manual fire alarm system is not required in *covered or open mall buildings* complying with Section 402.
- ~~2. Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system installed in accordance with 903.3.1.1~~

~~and the occupant notification appliances will automatically activate upon sprinkler waterflow.~~

[F] **907.2.8 Group R-1.** Fire alarm systems and alarms shall be installed in Group R-1 occupancies as required in Sections 907.2.8.1 through 907.2.8.3.

[F] **907.2.8.1 Manual fire alarm system.** A manual fire alarm system that activates the occupant notification system in accordance with 907.5 shall be installed in Group R-1 occupancies.

Exceptions:

1. A manual fire alarm system is not required in buildings not more than two *stories* in height where all individual *sleeping units* and contiguous *attic* and crawl spaces are separated from each other and public or common areas by at least 1-hour *fire partitions* and each individual *sleeping unit* has an *exit* directly to a *public way, egress court* or *yard*.
2. ~~Manual fire alarm boxes are not required throughout the building when the following conditions are met:~~
 - 2.1. ~~The building is equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2;~~
 - 2.2. ~~The notification appliances will activate upon sprinkler water flow; and~~
 - 2.3. ~~At least one manual fire alarm box is installed at an approved location.~~

[F] **907.2.9 Group R-2.** Fire alarm systems and alarms shall be installed in Group R-2 occupancies as required in Sections 907.2.9.1 through 907.2.9.3.

[F] **907.2.9.1 Manual fire alarm system.** A manual fire alarm system that activates the occupant notification system in accordance with 907.5 shall be installed in Group R-2 occupancies where:

(No change to Items 1 and 2)

3. The building contains more than 16 *dwelling units* or *sleeping units*.

Exceptions:

1. A fire alarm system is not required in buildings not more than two *stories* in height where all *dwelling units* or *sleeping units* and contiguous *attic* and crawl spaces are separated from each other and public or common areas by at least 1-hour *fire partitions* and each *dwelling unit* or *sleeping unit* has an *exit* directly to a *public way, egress court* or *yard*.
2. ~~Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or Section 903.3.1.2 and the occupant notification appliances will automatically activate throughout the notification zones upon sprinkler flow.~~
3. ~~A fire alarm system is not required in buildings that do not have interior *corridors* serving *dwelling units* and are protected by an *approved automatic sprinkler system* installed in accordance with Section 903.3.1.1 or 903.3.1.2, provided that *dwelling units* either have a *means of egress door* opening directly to an exterior *exit access* that leads directly to the *exits* or are served by open-ended *corridors* designed in accordance with Section 1026.6, Exception 4.~~

[F] **907.2.10 Group R-4.** Fire alarm systems and smoke alarms shall be installed in Group R-4 occupancies as required in Sections 907.2.10.1 through 907.2.10.3.

[F] 907.2.10.1 Manual fire alarm system.

A manual fire alarm system that activates the occupant notification system in accordance with Section 907.5 shall be installed in Group R-4 occupancies.

Exceptions:

1. A manual fire alarm system is not required in buildings not more than two *stories* in height where all individual *sleeping units* and contiguous *attic* and crawl spaces to those units are separated from each other and public or common areas by at least 1-hour *fire partitions* and each individual *sleeping unit* has an *exit* directly to a *public way, egress court* or *yard*.
2. ~~Manual fire alarm boxes are not required throughout the building when the following conditions are met:~~
 - 2.1. ~~The building is equipped throughout with an *automatic sprinkler system* installed in accordance with Section 903.3.1.1 or 903.3.1.2;~~
 - 2.2. ~~The notification appliances will activate upon sprinkler waterflow; and~~
 - 2.3. ~~At least one manual fire alarm box is installed at an *approved* location.~~
3. Manual fire alarm boxes in resident or patient sleeping areas shall not be required at exits where located at all nurses' control stations or other constantly attended staff locations, provided such stations are visible and continuously accessible and that travel distances required in Section 907.4.2.1 are not exceeded.

[F] 907.2.10.2 Automatic smoke detection system. An automatic smoke detection system that activates the occupant notification system in accordance with Section

907.5 shall be installed in *corridors*, waiting areas open to *corridors* and *habitable spaces* other than *sleeping units* and kitchens.

Exceptions:

1. ~~Smoke detection in *habitable spaces* is not required where the facility is equipped throughout with an *automatic sprinkler system* installed in accordance with Section 903.3.1.1.~~
2. An automatic smoke detection system is not required in buildings that do not have interior *corridors* serving *sleeping units* and where each *sleeping unit* has a *means of egress* door opening directly to an *exit* or to an exterior *exit access* that leads directly to an *exit*.

[Add Section 907.2.24 as follows:]

907.2.24 Wildland urban interface areas. In all buildings where a fire alarm system is required by 907.2, an automatic smoke detection system shall be installed throughout buildings located within areas designated by the jurisdiction as being a wildland urban interface area.

[Modify Section 907.4.3.1 as follows:]

[F] **907.4.3.1 Automatic ~~sprinkler system~~ heat detectors.** For conditions other than specific fire safety functions noted in Section 907.3, approved automatic heat detection connected to the fire alarm system shall be installed in areas where ambient conditions prohibit installation of smoke detectors. An automatic sprinkler system installed in such areas in accordance with Section 903.3.1.1 or 903.3.1.2 and that is connected to the fire alarm system shall be *approved* as automatic heat detection.

[Modify Section 907.6.5 as follows:]

[F] **907.6.5 Monitoring.** Fire alarm systems required by this chapter or by the *International Fire Code* shall be monitored by an *approved* supervising station in accor-

C907.2.24 Wildland urban interface areas [ER]. Due to the increased risk of fire in wildland urban interface areas, this section is modified to require both automatic smoke detection and alarm systems to enhance the safety to the occupants in buildings located in these more hazardous areas. Early notification also allows quicker emergency response which reduces potential damage to property. This change requires smoke detectors in addition to fire alarms where buildings are located in wildland urban interfaces areas as determined by this code.

C907.4.3.1 Automatic heat detectors [ER]. As previously discussed, notification of occupants is a priority for sustainable buildings. This section simply requires heat detectors as a component of the notification system where the ambient conditions do not permit the installation of smoke detectors.

dance with NFPA 72.

Exception: Monitoring by a supervising station is not required for:

(No change to Exceptions 1 through 3)

4. Smoke detection systems required by Section 907.2.24 which are located in wildland urban interface areas designated as extreme hazard.

SECTION 913 FIRE PUMPS

[Modify Section 913.2.1 as follows:]

913.2.1 Protection of fire pump rooms. Fire pumps shall be located in rooms that are separated from all other areas of the building by 2-hour *fire barriers* constructed in accordance with Section 707 or 2-hour *horizontal assemblies* constructed in accordance with Section 711, or both.

Exceptions:

1. ~~In other than high-rise buildings, separation by 1-hour *fire barriers* constructed in accordance with Section 707 or 1-hour *horizontal assemblies* constructed in accordance with Section 711, or both, shall be permitted in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 or 903.3.1.2.~~
2. Separation is not required for fire pumps physically separated in accordance with NFPA 20.

CHAPTER 10 MEANS OF EGRESS

C913.2.1 Protection of fire pump rooms [ER]. Regardless of the presence of sprinklers, fire pumps need to be maintained within 2-hour fire resistance enclosures to increase the likelihood they will continue to function during a fire event. This change prohibits increasing the fire exposure of the fire pump See ENHANCED FIRE SAFETY at the beginning of Chapter 4.

CHAPTER 10 MEANS OF EGRESS

Fire safety and property protection necessary to achieve the minimum performance necessary for sustainable buildings requires a combination of appropriate levels of active and passive fire protection. These requirements include automatic fire suppression systems (sprinklers) for most occupancies in addition to superior levels of passive fire protection. The combination appropriately provides control and containment in the building to limit the extent of fire, smoke and water damage. Fire safety features including travel distances, numbers of exits and egress capacity regardless of the presence of sprinklers are equally important. In addition to providing life safety these components also increase the robustness of the building and improve comfort and sense of security. The use of containment and other passive fire protection continue to provide property

SECTION 1005 MEANS OF EGRESS SIZING

[Modify Sections 1005.3.1, and 1005.3.2 as follows:]

1005.3 Required capacity based on occupant load. The required capacity, in inches (mm), of the *means of egress* for any room, area, space or story shall not be less than that determined in accordance with Sections 1005.3.1 and 1005.3.2:

1005.3.1 Stairways. The capacity, in inches (mm), of *means of egress stairways* shall be calculated by multiplying the *occupant load* served by such *stairway* by a *means of egress* capacity factor of 0.3 inch (7.6 mm) per occupant. Where *stairways* serve more than one story, only the *occupant load* of each story considered individually shall be used in calculating the required capacity of the *stairways* serving that story.

Exception: For other than Group H and I-2 occupancies, the capacity, in inches (mm), of *means of egress stairways* shall be calculated by multiplying the *occupant load* served by such *stairway* by a *means of egress* capacity factor of 0.2 inch (5.1 mm) per occupant in buildings provided the building is:

1. equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 and
2. equipped with an emergency voice/alarm communication system in accordance with Section 907.5.2.2. and

protection should the sprinkler system become inoperable or the water supply be unavailable. See the commentary discussion on Maintaining Life Safety at the beginning of Chapter 4 under ENHANCED FIRE SAFETY.

SECTION 1005 MEANS OF EGRESS SIZING

NFPA 101, *Life Safety Code*, a nationally recognized code for safe egress from buildings, does not permit reductions in egress capacity where sprinklers are present. The following two changes recognize the benefits of redundancy with sprinklers and adequate egress capacity.

C1005.3.1 Stairways [ER]. The code permits the reductions in the width of means of egress stairways for occupancies other than Group H (high hazard) and Group I-2 (facilities providing medical care on a 24-hr basis for more than five persons, such as hospitals and nursing homes) where the building is equipped with an automatic sprinkler system or an emergency voice/alarm communication system. The permitted reduction decreases the egress capacity by one third. There are two modifications to allow this reduction in egress width. First the reduction in means of egress stairway width is only permitted where the building is equipped with both automatic sprinkler and communication systems. Also, the reduction in means of egress stairway width requires a third means of egress stairway to be provided to maintain the overall egress capacity. Maintaining egress capacity is not only important for evacuation but also for access by emergency responders.

3. provided an additional means of egress stairway such that the total egress capacity, in inches (mm), for all egress stairways from the story is greater than or equal to the required capacity based on 0.3 inches (7.6 mm) per occupant.

1005.3.2 Other egress components. The capacity, in inches (mm), of *means of egress* components other than *stairways* shall be calculated by multiplying the *occupant load* served by such component by a *means of egress* capacity factor of 0.2 inch (5.1 mm) per occupant.

Exception: ~~For other than Group H and I-2 occupancies, the capacity, in inches (mm), of *means of egress* components other than *stairways* shall be calculated by multiplying the *occupant load* served by such component by a *means of egress* capacity factor of 0.15 inch (3.8 mm) per occupant in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 903.3.1.1 or 903.3.1.2 and an *emergency voice/alarm communication system* in accordance with Section 907.5.2.2.~~

SECTION 1007 ACCESSIBLE MEANS OF EGRESS

[Modify Sections 1007.2.1, 1007.3, 1007.4 and 1007.7.6 as follows:]

1007.2.1 Elevators required. In buildings where a required *accessible* floor is ~~four~~ one or more *stories* above or below a *level of exit discharge*, at least one required accessible means of egress shall be an elevator complying with Section 1007.4.

Exceptions: *(No change to Exceptions)*

C1005.3.2 Other egress components [ER]. To maintain egress capacity the reduction for exit width for other egress components in fully sprinklered buildings is prohibited.

SECTION 1007 ACCESSIBLE MEANS OF EGRESS

Comfort and safety for occupants with disabilities is an important feature to consider for buildings. The building code addresses this with occupant evacuation elevators, minimum egress widths and areas of refuge to exit stairs. In general these features also facilitate general evacuation of the building population. Further increased egress widths accommodate evacuation while emergency responders are accessing upper floors. Regardless of sprinkler protection, sustainable buildings need to maintain these accessible egress widths and areas of refuge.

C1007.2.1 Elevators required [ER]. This change requires at least one occupant evacuation elevator for any multi-story building with accessible floors above ground level.

1007.3 Stairways. In order to be considered part of an *accessible means of egress*, a *stairway* between *stories* shall have a clear width of 48 inches (1219 mm) minimum between *handrails* and shall either incorporate an *area of refuge* within an enlarged floor-level landing or shall be accessed from either an *area of refuge* complying with Section 1007.6 or a *horizontal exit*. *Exit access stairways* that connect levels in the same story are not permitted as part an *accessible means of egress*.

Exceptions:

- 1: ~~The clear width of 48 inches (1219 mm) between handrails is not required at exit stairways in buildings or facilities equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.~~
- 2: ~~Areas of refuge are not required at exit stairways in buildings or facilities equipped throughout by an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.~~

(No change to Exceptions 3 through 6)

1007.4 Elevators. In order to be considered part of an *accessible means of egress*, an elevator shall comply with the emergency operation and signaling device requirements of Section 2.27 of ASME A17.1. Standby power shall be provided in accordance with Chapter 27 and Section 3003. The elevator shall be accessed from either an *area of refuge* complying with Section 1007.6 or a *horizontal exit*.

Exceptions:

1. Elevators are not required to be accessed from an *area of refuge* or *horizontal exit* in *open parking garages*.
- 2: ~~Elevators are not required to be accessed from an area of refuge or horizontal exit in buildings and facilities equipped throughout by an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.~~

(No change to Exceptions 3 and 4)

1007.7.6 Stairway. *Stairways* that are part of the *means of egress* for the exterior area for assisted rescue shall provide a clear width of 48 inches (1219

C1007.3 Stairways [ER]. This change retains the requirement that emergency egress stairways have areas of refuge and at least 48 inches between stairway handrails regardless of the presence of an automatic sprinkler system.

C1007.4 Elevators [ER]. This change retains the requirement that elevators have access from areas of refuge or horizontal exits regardless of the presence of an automatic sprinkler system.

C1007.7.6 Stairway [ER]. This change retains the requirement that exterior egress stairways have at least 48 inches between stairway handrails regardless of the presence of an automatic sprinkler system.

mm) between *handrails*.

Exception: The clear width of 48 inches (1219 mm) between *handrails* is not required at *stairways* serving buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 903.3.1.1 or 903.3.1.2.

**SECTION 1014
EXIT ACCESS**

[Modify Table 1014.3 and Footnotes (a) and (b) to table as follows:]

1014.3 Common paths of egress travel. The *common path of egress travel*.....(*No change to text*).....in Table 1014.3

**SECTION 1014
EXIT ACCESS**

C1014.3 Common path of egress travel [ER]. Limiting the distance any occupant has to travel before they can choose distinct routes leading to exits is important for life safety. This is especially significant for persons with disabilities. The revisions to Table 1014.3 COMMON PATH OF EGRESS TRAVEL for common paths of travel maintain an appropriate distance regardless of the presence of sprinklers.

**TABLE 1014.3
COMMON PATH OF EGRESS TRAVEL**

OCCUPANCY	WITHOUT SPRINKLER SYSTEM MAXIMUM DISTANCE (feet)		WITH SPRINKLER SYSTEM (feet)
	Occupant Load		
	≤ 30	> 30	
B, S ^d	100	75	400 ^a
U	100	75	75 ^a
F	75	75	400 ^a
H-1, H-2, H-3	Not Permitted 25 ^a	Not Permitted	25 ^a
R-2	75	75	125 ^b
R-3 ^e	75	75	125 ^b
I-3	100	100	400 ^a
All others ^{c, f}	75	75	75 ^a

For SI: 1 foot = 304.8 mm.

- a. ~~Buildings Not permitted for Group H-1, H-2 and H-3 occupancies unless~~ equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.
- b. Buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where *automatic sprinkler systems* are permitted in accordance with Section 903.3.1.2.

(No change to footnotes (c) through (f))

SECTION 1015 EXITS AND EXIT ACCESS DOORWAYS

[Modify Section 1015.1 as follows:]

1015.1 Exits or exit access doorways from spaces. Two *exits* or *exit access* doorways from any space shall be provided where one of the following conditions exists:

1. The occupant load of the space exceeds one of the values in Table 1015.1.

Exceptions:

1. ~~In Groups R-2 and R-3 occupancies, one means of egress is permitted within and from individual dwelling units with a maximum occupant load of 20 where the dwelling unit is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2.~~
2. Care suites in Group I-2 occupancies complying with Section 407.4.3

(No change to Items 2 and 3.)

[Modify Section 1015.2.1 as follows:]

1015.2.1 Two exits or exit access doorways. Where two *exits* or *exit access* doorways are required from any portion of the *exit access*, the *exit* doors or *exit access* doorways shall be placed a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the building or area to be served measured in a straight line between *exit* doors or *exit access* doorways. Interlocking or scissor stairs shall be counted as one *exit stairway*.

Exceptions:

1. Where *interior exit stairways* are interconnected by a 1-hour fire-resistance-rated *corridor* conforming to the requirements of Section 1018, the required *exit* separation shall be measured along the shortest direct line of travel within the *corridor*.
2. ~~Where a building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2, the separation distance of the *exit* doors or *exit access* doorways shall not be less than one-third of the length of the maximum~~

SECTION 1015 EXITS AND EXIT ACCESS DOORWAYS

C1015.1 Exits or exit access doorways from spaces [ER]. Building code provisions are to assure adequate egress based on the characteristics of the occupancy and numbers of people. This is a life safety feature which is especially important when the number of people approaches the maximum occupant load or includes persons with disabilities. The revisions retain the limit on the occupant load for R-2 and R-3 occupancies regardless of the presence of sprinklers.

C1015.2.1 Two exits or exit access doorways [ER]. Where two means of egress are required, the code prescribes that they be located remotely from each other. This insures that at least one means of egress remains available should a fire incident render the other path inaccessible. This revision maintains the remoteness requirements regardless of the presence of sprinklers.

~~overall diagonal dimension of the area served.~~

SECTION 1016 EXIT ACCESS TRAVEL DISTANCE

[Modify Table 1016.2 as follows and delete Footnotes (b) and (c):]

Section 1016.2 Limitations. *Exit access travel.....(No change to text).....*given in Table 1016.2

SECTION 1016 EXIT ACCESS TRAVEL DISTANCE

C1016.2 Limitations [ER]. Table 1016 EXIT ACCESS TRAVEL DISTANCE specifies the maximum travel distances to reach exits on any floor in a building. Regardless of the presence of sprinklers, this revision requires maximum travel distances for all occupancies. The revised travel distances for institutional occupancies are based on the NFPA Life Safety Code. The travel distances for the hazardous occupancies remain unchanged because a higher degree of life safety for these occupancies is already provided in the code. These changes are based on the premise that sustainable buildings are also being provided with automatic sprinkler protection systems and the combination of sprinkler protection and allowable travel distances provides a higher degree of life safety for the occupants and limits the fire exposure. See Maintaining Life Safety in commentary discussion under ENHANCED FIRE SAFETY at the beginning of Chapter 4.

**TABLE 1016.2
EXIT ACCESS TRAVEL DISTANCE^a**

OCCUPANCY	WITHOUT SPRINKLER SYSTEM	WITH SPRINKLER
	DISTANCE	SYSTEM
	(feet)	(feet)
A, E, F-1, M, R, S-1	200	250 ^b
I-1, I-2	Not Permitted <u>200</u>	250 ^e
B	200	300 ^e
F-2, S-2, U	300	400 ^e
H-1	Not Permitted <u>75</u>	75 ^e
H-2	Not Permitted <u>100</u>	100 ^e
H-3	Not Permitted <u>150</u>	150 ^e
H-4	Not Permitted <u>175</u>	175 ^e
H-5	Not Permitted <u>200</u>	200 ^e
I-2, I-3, I-4	Not Permitted <u>150</u>	200 ^e

For SI: 1 foot = 304.8 mm.

- a. See the following sections for modifications to *exit access* travel distance requirements:
- Section 402.8: For the distance limitation in *malls*.
 - Section 404.9: For the distance limitation through an *atrium* space.
 - Section 407.4: For the distance limitation in Group I-2.
 - Sections 408.6.1 and 408.8.1: For the distance limitations in Group I-3.
 - Section 411.4: For the distance limitation in special amusement buildings.
 - Section 1015.4: For the distance limitation in refrigeration machinery rooms.
 - Section 1015.5: For the distance limitation in refrigerated rooms and spaces.
 - Section 1021.2: For buildings with one *exit*.
 - Section 1028.7: For increased limitation in assembly seating.
 - Section 1028.7: For increased limitation for assembly open-air seating.
 - Section 3103.4: For temporary structures.
 - Section 3104.9: For pedestrian walkways.
- b. Buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where *automatic sprinkler systems* are permitted in accordance with Section 903.3.1.2.
- c. Buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

SECTION 1018 CORRIDORS

[Modify Table 1018.1 and Footnote (c) as follows:]

Section 1018.1 Construction. Corridors shall be.....*(No change to text)*.....with Section 708 for *fire partitions*.

SECTION 1018 CORRIDORS

C1018.1 Construction [ER]. Table 1018.1 CORRIDOR FIRE-RESISTANCE RATING specifies the minimum fire resistance rating for corridors. Regardless of the presence of sprinklers, this revision requires fire rated corridors for all occupancies. Fire rated corridors serve an important life safety feature by protecting the egress path leading to the building exits. In addition, fire rated walls create compartments within the building to restrict the spread of fire and smoke. These compartments not only reduce the extent of damage due to fire and smoke but also from water used for suppression purposes consistent with the basic premise of sustainable buildings. See the commentary discussion at the beginning of Chapter 4 on ENHANCED FIRE SAFETY.

**TABLE 1018.1
CORRIDOR FIRE-RESISTANCE RATING**

OCCUPANCY	OCCPANT LOAD SERVED BY CORRIDOR	REQUIRED FIRE-RESISTANCE RATING (Hours)	
		Without Sprinkler System	With Sprinkler System ^c
H-1, H-2, H-3	All	Not Permitted	1
H-4, H-5	Greater than 30	Not Permitted	1
A, B, E, F, M, S, U	Greater Than 30	4	0 1
R	Greater than 10	Not Permitted	0.5 1
I-2 ^a , I-4	All	Not Permitted	0 1 ^c
I-1, I-3	All	Not Permitted	1 ^b

a. For requirements for occupancies in Group I-2, see Sections 407.2 and 407.3.

b. For a reduction in the *fire-resistance rating* for occupancies in Group I-3, see Section 408.8.

c. Buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 or 903.3.1.2 where allowed.

c. Non-rated corridors are permitted for Group I-2 and I-4 buildings of Type I or IIA construction.

[Modify Section 1018.4 as follows:]

1018.4 Dead ends. Where more than one *exit* or *exit access* doorway is required, the *exit access* shall be arranged such that there are no dead ends in *corridors* more than 20 feet (6096 mm) in length.

Exceptions:

1. In occupancies in Group I-3 of Occupancy Condition 2, 3 or 4 (see Section 308.5), the dead end in a *corridor* shall not exceed 50 feet (15 240 mm).
2. In occupancies in Groups B, E, F, I-1, M, R-1, R-2, R-4, S and U where the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1, the length of dead-end *corridors* shall not exceed 50 feet (15 240 mm).
3. A dead-end *corridor* shall not be limited in length where the length of the dead-end *corridor* is less than 2.5 times the least width of the dead-end *corridor*.

**SECTION 1021
NUMBER OF EXITS AND
EXIT CONFIGURATION**

[Modify Tables 1021.2(1) and 1021.2(2) as follows:]

Section 1021.2 Exits from stories. Two *exits*, or *interior exit ramps*.....(No change to text).....one of the following conditions.

C1018.4 Dead ends [ER]. Persons located in portions of the building serviced by dead end corridors are restricted to one direction of egress for the length of the dead end corridor. Further, dead end corridors may create confusion during evacuation when people can not readily identify the end of the corridor as being a dead end and not leading to an exit. Regardless of the presence of sprinklers, this revision maintains the limit on dead end distances in corridors. See the commentary discussion at the beginning of Chapter 4 on ENHANCED FIRE SAFETY.

**SECTION 1021
NUMBER OF EXITS AND
EXIT CONFIGURATION**

C1021.1 Exits from stories. From a life safety point of view one of the basic tenets of building codes is to insure that occupants have sufficient means of egress to escape the building in the event of a fire incident. This concept is met by providing more than one means of egress or exit from any story based on the occupancy characteristics of that story and giving consideration to the travel distance to reach an

**TABLE 1021.2(1)
STORIES WITH ONE EXIT OF ACCESS TO ONE EXIT FOR R-2 OCCUPANCIES**

STORY	OCCUPANCY	MAXIMUM NUMBER OF DWELLING UNITS	MAXIMUM EXIT ACCESS TRAVEL DISTANCE
Basement, first, or second or third story	R-2 ^{a, b}	4 dwelling units	125 feet
Fourth <u>Third</u> story and above	NP	NA	NA

For SI: 1 foot = 304.8 mm.

NP – Not Permitted

NA – Not Applicable

- a. Buildings classified as Group R-2 equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 ~~or 903.3.1.2~~ and provided with *emergency escape and rescue openings* in accordance with Section 1029.
- b. This table is used for R-2 occupancies consisting of *dwelling units*. For R-2 occupancies consisting of *sleeping units*, use Table 1021.2(2).

**TABLE 1021.2(2)
STORIES WITH ONE EXIT OF ACCESS TO ONE EXIT FOR OTHER OCCUPANCIES**

STORY	OCCUPANCY	MAXIMUM OCCUPANTS PER STORY	MAXIMUM EXIT ACCESS TRAVEL DISTANCE
First story or basement	A, B ^b , E, F ^b , M, U, S ^b	49 occupants	75 feet
	H-2, H-3	3 occupants	25 feet
	H-4, H-5, I, R-1, R-2 ^{a, c} , R-4	10 occupants	75 feet
	S	29 occupants	100 feet
Second story	B, F, M, S	29 occupants	75 feet
Third story and above	NP	NA	NA

For SI: 1 foot = 304.8 mm.

NP – Not Permitted

NA – Not Applicable

- a. Buildings classified as Group R-2 equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 ~~or 903.3.1.2~~ and provided with *emergency escape and rescue openings* in accordance with Section 1029.
- b. Group B, F and S occupancies in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 shall have a maximum travel distance of 100 feet.
- c. This table is used for R-2 occupancies consisting of *sleeping units*. For R-2 occupancies consisting of *dwelling units*, use Table 1021.2(1).

CHAPTER 11 ACCESSIBILITY

[No modifications to Chapter 11.]

CHAPTER 12 INTERIOR ENVIRONMENT

SECTION 1203 VENTILATION

exit or a choice of two separate egress paths. Occupancy characteristics that can affect egress choices include but are not limited to awareness of surroundings while in the building and the number of occupants on a floor. For sustainable buildings life safety is given increased emphasis to insure an improved level of safety for the occupants. This includes less reliance on mechanical fire safety systems and more attention to following traditional means of egress and exiting requirements in building codes.

Consistent with traditional building code requirements the change to Table 1021.1 STORIES WITH ONE EXIT OR ACCESS TO ONE EXIT FOR R2 OCCUPANCIES restores the common values for single exits in Group R2 occupancies to no more than two stories whether the building is sprinklered or not. Similarly, changes to Table 1021.2 STORIES WITH ONE EXIT OR ACCESS TO ONE EXIT FOR OTHER OCCUPANCIES remove the increased travel distances permitted due to the presence of sprinklers. See the commentary discussion at the beginning of Chapter 4 on ENHANCED FIRE SAFETY.

CHAPTER 11 ACCESSIBILITY

CHAPTER 12 INTERIOR ENVIRONMENT

This chapter of the building code is used to regulate the ventilation, temperature control, lighting, sound transmission, room dimensions, surrounding materials, and rodent proofing as related to design and construction of interior spaces. Provisions are modified to provide a higher degree of consideration for the impact the interior environment has on the occupants of sustainable buildings.

SECTION 1203 VENTILATION

Improved Air Quality – Part of satisfying the requirements for sustainable buildings involves providing a healthy interior environment. Improving air quality enhances occupant comfort and productivity. Criteria for interior healthy environments are addressed in ANSI/ASHRAE/USGBC/IES Standard 189.1 *Standard for the Design of High Performance Green Buildings Except Low-rise Residential Buildings* (ASHRAE 189.1). ASHRAE 189.1 contains provisions that

go beyond the current responsibility of most building departments addressing items and setting criteria that are applicable after the issuance of the Certificate of Occupancy (CO) for the building. For example ASHRAE 189.1 sets requirements for maintaining, monitoring and periodically inspecting systems and components. Such standard requirements are useful to assure proper operation of buildings but are not necessarily appropriate for building code requirements even for sustainable buildings. Thus this document only refers to requirements in ASHRAE 189.1 that can be inspected prior to the issuance of the Certificate of Occupancy (CO).

[Modify Section 1203.1 as follows:]

1203.1 General. Buildings shall be provided with natural ventilation in accordance with Section 1203.4, or mechanical ventilation in accordance with the *International Mechanical Code*. In addition, buildings shall comply with Sections 4 through 6 of ASHRAE Standard 62.1 and Sections 8.3.1.3 and 8.3.1.4 of ASHRAE Standard 189.1.

Where the air infiltration rate in a *dwelling unit* is less than 5 air changes per hour when tested with a blower door at a pressure 0.2 inch w.c. (50 Pa) in accordance with Section 402.4.1.2 of the *International Energy Conservation Code*, the *dwelling unit* shall be ventilated by mechanical means in accordance with Section 403 of the *International Mechanical Code*.

Exception:

Group F buildings shall not be required to comply with Section 8.3.1.3 Filtration and Air Cleaner Requirements in ASHRAE Standard 189.1.

[Modify Section 1203.5 as follows:]

1203.5 Other ventilation and exhaust systems. Other ventilation and exhaust systems shall be provided in accordance with 1205.3.1 and 1205.3.2

1203.5.1 Carbon dioxide (CO₂) levels. Where required by Section 7.4.3.2 of ASHRAE Standard 189.1, demand control ventilation (DCV) shall be provided.

1205.3.2 Flammable or combustible hazards and other contaminants. *Ventilation and exhaust systems for occupancies and operations involving flammable or combustible hazards or other contaminant sources as covered in the *International Mechanical Code* or the *International Fire Code* shall be provided as required by both codes.*

C1203.1 General [IQ] – Similar to ASHRAE 189.1, minimum criteria for ventilation rates are based on the provisions of ANSI/ASHRAE Standard 62.1 *Ventilation for Acceptable Indoor Air Quality* (ASHRAE 62.1). Specific sections of ASHRAE 189.1 are referenced to achieve ventilation rates appropriate for sustainable buildings. With regard to filtration and air cleaners the minimum efficiency reporting values (MERV) are set at 8 for air cleaners on cooling systems on most buildings. The MERV is determined in accordance with ANSI/ASHRAE Standard 52.2, *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size* (ASHRAE 52.2). In areas where the outside environment is classified as a “non-attainment area” for air quality according to the National Ambient Air Quality Standards the air cleaner shall have a MERV of 13. Standard 189.1 is also referenced for indoor air quality requirements associated with tobacco smoke.

Filtration and air cleaners systems for manufacturing facilities need to be designed accordingly for the specific processes and operations. Because of the varied designs, systems and components that may be needed it is not appropriate to specify the MERV for such facilities. Air quality in manufacturing facilities is regulated by Occupational Safety and Health Administration (OSHA) requirements for the workplace environment⁴.

⁴29CFR Part 1910, Occupational Safety and Health Standards, Occupational Health and Safety Administration, US Department of Labor

**SECTION 1204
TEMPERATURE CONTROL**

[Add new Section 1204.2 as follows:]

1204.2 HVAC controls for Group R-1. Automatic controls for HVAC equipment serving guest rooms in R-1 occupancies shall be provided in accordance with Section 7.4.3.9 of ASHRAE Standard 189.1.

**SECTION 1205
LIGHTING**

[Add new Section 1205.3.1 as follows:]

1205.3.1 Light Pollution Reduction. The angle of maximum candela from each interior luminaire as located in the building shall intersect with opaque interior surfaces.

[Modify Section 1207 and add new Table 1207 as follows:]

**SECTION 1207
SOUND TRANSMISSION**

**SECTION 1204
TEMPERATURE CONTROL**

HVAC Controls for Group R-1 [EC]. The present code specifies the minimum temperature that must be maintained in interior spaces of buildings where human comfort is required and that HVAC equipment controls be programmable. The mandatory reference to ASHRAE 189.1 further conserves energy by automatically adjusting temperatures in unoccupied rooms of hotels and motels.

**SECTION 1205
LIGHTING**

C1205.3.1 Light Pollution Reduction. The *International Energy Conservation Code* (IECC) has provisions for minimum light levels in occupied spaces through natural means such as windows and with artificial light systems. However, the location and direction of interior light fixtures can result in portions of the light being emitted overflowing through windows to the outside and creating light pollution. This not only creates a nuisance but also wastes energy by inadvertently providing light to the outside. To reduce the light being directed outside this section requires the main stream of light (i.e. candela) to be directed toward interior opaque surfaces such as walls and floors. This reduces the likelihood that internal lighting will produce unnecessary light pollution and waste electricity.

**SECTION 1207
SOUND TRANSMISSION**

Occupant comfort and productivity is highly influenced by the distracting noises. Providing an environment that optimizes comfort and productivity is a basic premise of sustainable buildings. This is commonly achieved by reducing intrusion of airborne and structure borne sound into occupied spaces.

[Modify Section 1207.1 as follows:]

1207.1 Scope. This section shall apply to ~~common interior walls, partitions and floor/ceiling assemblies between adjacent dwelling units or between dwelling units and adjacent public areas such as hall, corridors, stairs or service areas,~~ airborne sound, both interior and exterior, and structure borne sound in use and occupancy classifications A, B, E, I, M and R.

[Modify Section 1207.2 as follows and add Table 1207:]

1207.2 Air-Borne Sound. Walls, partitions, and flooring/ceiling assemblies ~~separating dwelling units from each other and from public or service areas shall have a shall comply with Table 1207. The sound transmission class (STC) shall be determined of not less than 50 (45 if field tested) for air-borne noise when tested in accordance with ASTM E90 or ASTM E413 for all assemblies, or TMS 0302 for masonry assemblies. The Outdoor-Indoor Transmission Class (OITC) shall be determined in accordance with ASTM E1332.~~ Penetrations or openings in construction assemblies for piping; electrical devices; recessed cabinets; bathtubs; soffits; or heating, ventilating, or exhaust ducts shall be sealed, lined, insulated or otherwise treated to maintain the required ratings. ~~This requirement shall not apply to dwelling unit entrance doors; however, such doors shall be tight fitting to the frame and sill.~~

1207.2.1 Masonry. ~~The sound transmission class of concrete masonry and clay masonry shall be calculated in accordance with TMS 0302 or determined through testing in accordance with ASTM E90.~~

C1207.1 Scope [IQ]. Presently the code only specifies that building assemblies (e.g. walls and floor/ceilings) between dwelling units or between dwelling units and public spaces be constructed to reduce sound transmission. The revisions to this section extend the requirements to assembly, business, educational, institutional (assisted living, nursing homes, hospitals, prisons, etc) and mercantile occupancies. The provisions also expand airborne sound transmission requirements so they not only address airborne sources within the building but also to minimize airborne sound that is outside the building from infiltrating into the interior of the building.

C1207.2 Air-borne Sound [IQ]. Sound transmission requirements for interior and exterior air-borne sound appropriate for sustainable buildings are provided in new Table 1207, MINIMUM STC REQUIREMENTS FOR WALLS AND FLOOR/CEILING ASSEMBLIES. The interior sound transmission limits have been expanded to include assemblies separating classrooms from each other and other noise producing spaces such as rest rooms, showers, music rooms, cafeterias and gymnasiums. This section also includes alternate methods for determining compliance.

TABLE 1207
MINIMUM STC RATINGS FOR WALLS AND FLOOR/CEILING ASSEMBLIES^a

	Dwelling units	Sleeping Unit	Tenant Spaces	Classroom
Dwelling unit	50	50	50	50
Sleeping Unit	50	50	50	50
Tenant space	50	50	50	50
Classroom	50	50	50	50
Public space	50	50	50	50
Music rooms, mechanical rooms, cafeterias, gymnasiums, auditoriums and natatoriums	60	60	60	60
Restrooms and showers	53	53	53	53
Exterior, opaque assemblies	50 ^b	50 ^b	50 ^b	50 ^b
Exterior, fenestration	30 ^c	30 ^c	30 ^c	30 ^c

a. The STC rating shall be permitted to be reduced by 5 decibels where field tested

b. A minimum OITC rating of 40 shall be permitted.

c. A minimum OITC rating of 30 shall be permitted.

[Modify Section 1207.3 as follows:]

1207.3 Structure-Borne Sound. Floor/ceiling assemblies between separating dwelling units, sleeping units, tenant spaces and classrooms, or and between dwelling units such rooms and units and public or service area within the structure shall have an impact insulation classification (IIC) rating of not less than 50 (45 if field tested) when tested in accordance with ASTM E492.

SECTION 1210
TOILET AND BATHROOM REQUIREMENTS

[Modify Section 1210.2.1. as follows:]

C1207.3 Structure-Borne Sound [IQ]. This section is modified to clarify that the sound transmission for floor/ceiling assemblies applies to assembly, business, educational, institutional (e.g., assisted living, nursing homes, hospitals, prisons, etc), mercantile in addition to assemblies between dwelling units or between dwelling units and public spaces.

SECTION 1210
TOILET AND BATHROOM REQUIREMENTS

Water Damage. Water is essential to humans, however it can also be one of the more challenging elements to be considered in the design, construction and operation of buildings. When water is not properly contained within a building it can result in significant damage. Moisture damage can jeopardize a material's ability to provide its intended function which may be in the form of deterioration, dimensional changes, or degradation of thermal, acoustical or other properties. The damage may not be limited to the direct moisture effects to organic materials but also may result in the growth of mold and mildew. The resulted cleaning, repair, or the removal, disposal and replacement of materials are not consistent with the premise of sustainability. The modifications to 2910 and 2911 are intended to reduce the risk of water damage.

1210.2.1 Floors and wall bases. ~~In other than dwelling units,~~ Toilet, bathing and shower room floor finish materials shall have a smooth, hard, nonabsorbent surface. The intersections of such floors with walls shall have a smooth, hard, nonabsorbent vertical base that extends upward onto the walls not less than 4 6 inches (~~±02~~ 153 mm).

[Add new Section 1211 as follows:]

SECTION 1211 **SURROUNDING MATERIALS**

1211 Surrounding materials. Floor and wall base materials shall comply with the requirements of this section.

1211.1 Floors and Wall Base Finish Materials. Floors and wall base materials shall have a smooth, hard, nonabsorbent surface that extends upward onto the walls at least 6 inches (153 mm) in the following spaces.

1. Kitchens in other than dwelling units
2. Laundry rooms
3. Spa areas
4. Rooms with hose bibbs or hose connected-outlets
5. Classrooms in Group E occupancies

1211.2 Hallways in Group E. Floors in hallways of Group E occupancies shall have a smooth, hard, nonabsorbent surface. The smooth, hard, nonabsorbent surface shall extend upward on walls and partitions to a height of not less than 4 feet (1219 mm) above the floor.

C1210.2.1 Floors and wall bases [MR]. The presence of moisture is part of normal operation and routine maintenance in toilet, bathing and shower room areas regardless of occupancy. This change extends the requirements of the code for toilet, bathing and shower rooms in dwelling units. In addition the height of the base materials is increased from 4 to 6 inches to better insure materials adversely affected by moisture are protected where located in close proximity to the floor.

SECTION 1211 **SURROUNDING MATERIALS**

C1211.1 Floors and Wall Base Finish Materials [MR]. In addition to toilet, bathroom and shower areas, the potential for water damage to is similar in kitchens, laundry rooms, spa areas, and rooms with hose bibbs and hose connected-outlets. This change extends the requirements from the IBC for floors and base wall finish materials as modified in Section 1210 to these locations.

Floors in hallways and classrooms of educational occupancies also benefit from smooth, hard, non-absorptive floor and base wall material finishes. Floor surfaces in educational buildings experience a high degree of use and abuse on a daily basis from the occupants and are frequently wetted during routine maintenance operations. Not only is it important that materials used for walls and floors be resistant to moisture damage or bases of walls to protect substrate materials for moisture damage, the smooth, hard non-absorbent surfaces facilitate cleaning and maintenance operations and reduce the amount of cleaning materials required.

C1211.1 Hallways in Group E. [MR]. Like floors, the walls and partitions of hallways in educational buildings are subject to use and abuse on a daily basis and frequent wetting during routine maintenance operations. This modification extends the protection concepts of the IBC for toilet and bathroom areas to hallways of educational buildings. Although not in these requirements for sustainable buildings the use of smooth, hard nonabsorptive surfaces for hallways and the floor area of other occupancies such health care can be equally beneficial.

SECTION 1212 THERMAL COMFORT

[Add new Section 1212 as follows:]

1212 Thermal Comfort. The building shall be designed in accordance with Section 6.1 of ASHRAE Standard 55.

Exceptions:

1. Group F, H and S occupancies.
2. Spaces with special requirements for processes, activities, or contents that require a thermal environment outside that which humans find acceptable.
3. Spaces intentionally designed for human comfort and activities differing from the conditions assumed in ASHRAE 55.

CHAPTER 13 ENERGY EFFICIENCY

SECTION 1212 THERMAL COMFORT

C1212 Thermal Comfort [IQ]. Maintaining thermal conditions for occupant comfort and productivity is essential for sustainable buildings. The requirements of this section are similar to those in ASHRAE 189.1. Excluded from these requirements are factories, high hazard facilities and storage buildings because of the low occupant density that typically occurs in these types of structures. Too, these occupancy groups include cold storage, food processing and other functions that require environments that deviate from those necessary for occupant comfort. These exclusions for thermal environments differing from thermal requirements for occupant comfort are also applicable for such spaces within other occupancies. Other spaces that are excluded require thermal conditions for occupant comfort that are not consistent with the assumptions of ANSI/ASHRAE Standard 55 *Thermal Environmental Conditions for Human Occupancy* (ASHRAE 55) such as natatoriums, shower rooms and saunas.

CHAPTER 13 ENERGY EFFICIENCY

This chapter of the building code is used to regulate energy use in buildings and reduce energy consumption through energy conservation measures specified in the *International Energy Conservation Code* (IECC). The IECC, like most building code requirements however, specifies minimum requirements for buildings. Life cycle assessments of buildings have shown that environmental impacts related to operational energy continue to dramatically exceed those related to embodied energy. Though figures vary from building to building, studies suggest that over 80 percent of greenhouse gas emissions related to buildings is the result of heating, ventilation, and air conditioning (HVAC), water heating, lighting, entertainment and telecommunications. A smaller percentage, generally 10 to 20 percent, of energy is consumed in materials manufacturing and transport, construction, maintenance and demolition⁵. It is noteworthy that as reductions in operational energy, such as achieving net-zero energy buildings, are incorporated into building designs the percentage of environmental impacts due to embodied energy will increase. For sustainable buildings, the requirements for energy efficiency must be given extra

⁵Buildings and Climate Change: Summary for Decision-Makers United Nations Environment Programme, Division of Technology, Industry and Economics Sustainable Consumption & Production Branch, 15 Rue de Milan, 75441 Paris CEDEX 09, France, www.unep.fr/scp/sun, 2009, pg 10.

[Modify Section 1301 and add new Sections 1302 and 1303 as follows:]

SECTION 1301 GENERAL

1301.1 Scope. This section governs the design and construction of buildings for energy efficiency.

1301.1.1 Building Criteria. Buildings shall be designed and constructed in accordance with the *International Energy Conservation Code* requirements of this Chapter and one of the following.

1. The mandatory requirements, Chapter 3 and Appendix G of ANSI/ASHRAE/IES 90.1 (ASHRAE 90.1) and demonstrate a cost savings for non-renewable energy that is equal to or more than 10% of the baseline building using Appendix G.
2. Chapter 2 and Section C407, of the *International Energy Conservation Code*, provided the cost for non-renewable energy is equal to or less than 75% of the building energy costs for the standard reference design building.
3. The requirements of Chapters 3 and 7 of ANSI/ASHRAE/USGBC/IES 189.1 (ASHRAE 189.1).

attention beyond minimum levels. Thus these modifications to Chapter 13 of the IBC introduce additional requirements to raise the level of energy conservation for the sustainable buildings.

SECTION 1301 GENERAL

C1301.1.1 Building Criteria. [EC] The requirements in this section are revised to allow three alternatives to achieve appropriate minimum levels of energy conservation in sustainable buildings. Different percentages of energy conservation or energy cost savings are applied to each of the alternatives with the intention of achieving similar energy conservation for sustainable buildings designed and constructed using this document. As with any energy code or standard, actual energy performance will differ from calculated energy conservation or costs savings. This is true because design assumptions made regarding operations and climate cannot precisely predict actual conditions.

The first alternative allows compliance to be determined using ANSI/ASHRAE/IES Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, (ASHRAE 90.1) which is referenced in the *International Energy Conservation Code* (IECC). The designer is required to use ASHRAE 90.1, Appendix G *Performance Rating Method* to evaluate design alternatives. To demonstrate that energy conservation is consistent with expectations for sustainable buildings, the calculated non-renewable energy costs of the proposed design are required to be at least 10% less than those for the base-line building.

The second alternative allows the user to demonstrate improved energy conservation by using Section C407 Total Building Performance of the *International Energy Conservation Code* (IECC). To demonstrate compliance with this document, the calculated non-renewable energy cost savings for the proposed building are required to be at least 25% less than those for the standard reference design.

The third alternative allows the designer to determine compliance with the energy conservation requirements of this document by using ANSI/ASHRAE/

1301.1.2 Mandatory criteria. The requirements in Section 1302 shall apply. Where requirements of Section 1302 differ from the requirements in the referenced standards or codes the more stringent of the requirements shall apply.

SECTION 1302 MANDATORY CRITERIA

1302.1 General. The building shall comply with the requirements of the following items.

1. There shall be a minimum fenestration area providing daylighting by skylights or other toplighting for large enclosed spaces in accordance with the requirements of ASHRAE 189.1 Section 8.3.4 or Section 8.5.1.
2. Lighting systems shall be provided with controls in accordance with the requirements of the ASHRAE 189.1 Section 7.4.6.
3. Group R-1 buildings with more than 50 guest rooms shall be provided with HVAC and light control features in accordance with the requirements of ASHRAE 189.1 Section 7.4.3.9.
4. Building projects shall contain automatic systems such as demand-limiting or load shifting in accordance with the requirements of the ASHRAE 189.1 Section 7.4.5.1.
5. Lighting, appliances and equipment installed prior to the issuance of the certificate of occupancy and within the scope of the applicable Energy Star Program shall meet the requirements of ASHRAE 189.1 Sections 7.4.7.3.a, 7.4.7.3.b, 7.4.7.3.e, 7.4.7.3.f, and 7.4.7.3.g.
6. Commercial refrigerators, freezers and clothes washers shall meet the requirements of ASHRAE 189.1 Section 7.4.7.4.

USGBC/IES Standard 189.1 *Standard for the Design of High Performance Green Buildings Except Low-Rise Residential Buildings* (ASHRAE 189.1) Chapter 7, *Energy Efficiency*. Since ASHRAE 189.1 is structured to provide energy conserving measures that exceed those of ASHRAE 90.1 or the IECC there are no additional criteria modifying the energy efficiency requirements of ASHRAE 189.1.

C1301.1.2 Mandatory criteria. [EC] Simply meeting an energy conservation target for the building design does not address all of the design considerations for energy efficiency in sustainable buildings. Additional criteria are described in Section 1302.

SECTION 1302 MANDATORY CRITERIA

1302.1 General. The energy efficiency aspects of lighting, controls, demand-limiting or load shifting, equipment efficiency and monitoring energy performance are important for sustainable buildings.

The use of skylights to provide light to interior spaces can substantially reduce lighting energy loads. The first item introduces additional requirements to use outside light through skylights to provide lighting in the interior occupied spaces of the building. This reduces dependence on artificial light for these interior occupied spaces. Where skylights are employed to introduce light into the interior of buildings, lighting controls must also be present to automatically reduce or increase the artificial lighting levels based on the available natural light coming through the skylights.

Too often lights remain on in unoccupied spaces even when the lights aren't required for security or other purposes. Lights remain on simply because the occupant neglected to turn them off when vacating a room. To help assure that energy is not uselessly consumed when areas are not required to be lit, this item requires the use of occupant sensors to control the operation of lights within the building. These sensors have the ability to switch lighting circuits off when the space is unoccupied. Additional automatic controls are required to regulate artificial light in spaces with exterior vertical fenestration (e.g. windows) so the light levels are reduced when natural light is available to illuminate the occupied spaces. Finally, automatic controls capable of programming are required for exterior lighting. These controls allow the outside lighting to be turned off at set times during periods of daylight and to reduce lighting levels during non-peak hours of operation. Exceptions are

7. Buildings shall be provided with energy monitoring systems in accordance with the requirements of the ASHRAE 189.1 Section 7.3.3.

included to insure that safe levels of lighting are maintained where necessary.

Considerable energy savings can be achieved by controlling the heating and air-conditioning in vacant guest rooms in lodging facilities. Like the above discussion on lighting controls, this item addresses not only lighting but also the heating and cooling systems for hotel and motel guest rooms. These controls turn off the lights and reduce or increase the temperature settings so the heating or cooling system does not maintain temperatures at unnecessary levels while the room is vacant. While appropriate for all hotels and motels, the requirements are only mandatory for hotel and motel properties that have at least 50 guest rooms due to the pay-back periods for these controls.

Spikes in electrical energy consumption may require the use of less efficient back-up electric generating units to meet demand. To address energy conservation on this larger scale, the fourth item requires automatic systems in the building that shift energy loads of the building to off-peak hours or initiate load reduction during peak energy demand times. Spikes in space conditioning may also reduce the operating efficiency of the cooling plant for the building. On-site standby power generating systems are not permitted to be used to compensate for the demand limits or load shifting, as this would defeat the intended purpose of this requirement.

Improving the efficiency of lighting, appliances, and equipment has been demonstrated to dramatically reduce the energy demand. The U.S. Environmental Protection Agency (EPA) *Energy Star* program⁶ has shown itself to be a useful means for improving energy efficiency in buildings by utilizing more energy efficient appliances, equipment and lighting. This fifth item makes it mandatory to only use appliances, equipment, and lighting systems with the *Energy Star* label. While it is recommended that all appliances, equipment, and lighting systems be *Energy Star* compliant, only those installed prior to the issuance of the certificate of occupancy can be realistically regulated by the building code department. Typically this will be limited to fixed appliances; heating, ventilating and air-conditioning equipment; water heating equipment; dishwashers; laundry equipment; lighting fixtures; and food service equipment. Other appliances and equipment, including computers, televisions, copiers, and battery charges, should be compliant with *Energy Star*, but are outside the purview of the typical building code department and thus not included these requirements.

Consistent with the previous items, there are energy saving opportunities specifically related to commercial refrigera-

⁶Information on the EPA *Energy Star* may be obtained at www.energystar.gov/about/

tors and freezers as reflected in item six. Uncovered, open refrigerated display cases are prohibited. This item also sets the minimum efficiencies and maximum lighting loads for commercial refrigerators and freezers and minimum efficiencies for commercial clothes washers.

Monitoring energy performance is also crucial for evaluating the efficiencies of appliances, equipment, and lighting systems; assuring items are operating properly; and identifying areas for enhanced improvements over the life of the building. Only when building owners and operators can monitor energy use in their buildings are they able to effectively prioritize and incorporate energy saving features into the decision stream for building improvements. Item seven requires that the building be equipped with an energy monitoring system capable of collecting data on energy consumption from all sources supplying the building systems, storing the data, and then have the capability to transmit the data to a designated data system for processing. Many alternative green or sustainability codes and standards set requirements on frequency of data collection during continued operation of the building. The criteria herein do not address ongoing monitoring as that is typically preferred in owner manuals or other contract documents and not the building code.

1302.2 Fenestration. Fenestration for buildings shall comply with the following requirements.

1302.2.1 Fenestration Area Limitations. The vertical fenestration area (not including opaque doors) shall not exceed the values in Table 1302.1 for the gross above grade wall area of the building thermal envelope.

C1302.2 Fenestration. [EC] The contribution to the energy load of a building due to the thermal transmittance and solar heat gain of fenestrations is typically more significant than that of other building envelope components. Improvements in energy conservation can often be achieved by varying the amount, orientation, and properties of fenestration. This section sets requirements for fenestration in an effort to improve overall building energy performance as compared with minimum requirements of the energy code.

C1302.2.1 Fenestration Area Limits. [EC] While it is unrealistic to eliminate fenestrations from a building, limiting the area can significantly improve the building's energy performance. For example, ASHRAE 90.1 provides maximum values for coefficient of thermal transmittance (U-factor) for building envelope components. The disparity between the energy criteria for opaque walls compared to windows is shown in the table below.

**TABLE 1302.1
MAXIMUM FENESTRATION AREA**

Occupancy Group	Maximum Fenestration Area as Percent of Gross Above Grade Wall Area
A-1, A-3, A-4, F, H, M, S	15%
A-2, E	18%
B, I, R	25%
U	No Requirement

Disparity of U-Factors for Building Walls and Fenestration¹

Climate Zone	Maximum U-Factor Wall Steel Framed	Maximum U-Factor Fenestration, Fixed Metal Framing	Percent of Difference
1	0.124	0.57	360
2	0.084	0.57	579
3	0.077	0.50	549
4	0.064	0.42	556
5	0.055	0.42	663
6	0.049	0.42	757
7	0.049	0.038	676
8	0.037	0.038	927

¹ Source: ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings

The energy loss through comparable square foot areas of windows with fixed metal frames versus opaque wall constructed of steel studs is shown to range from 360 to 927 percent. Other factors, such as solar heat gain, further contribute to the disparity. Minimum energy codes and standards currently have criteria for maximum area of fenestration ranging from 30 to 40%. For sustainable buildings in this document, the maximum area of vertical fenestration is further limited to improve overall energy performance of buildings for different occupancies. Though the areas shown are the maximum permitted for sustainable design the designer should consider using the smallest areas possible while still satisfying the design requirements. In order to realistically reflect typical design requirements the maximum limits vary by occupancy. At some facilities windows for visual connection to the exterior are eliminated and replaced by live video feed of exterior views from the building shown on monitors mounted internally to simulate the visual effects of windows. This could be a solution where optimal human interface with the exterior for comfort and productivity is not deemed adequate with the reduced amount of fenestration.

1302.2.2 Fenestration Orientation. The vertical fenestration area and SHGC shall satisfy the requirements of Section 7.4.2.8 of ASHRAE 189.1

Exceptions:

1. Buildings where the total fenestration area is less than 5% of the gross wall area.
2. Buildings in climate zones 7 and 8.

C1302.2.2 Fenestration orientation. [EC] Solar heat gain through east and west facing fenestrations contribute to the air-conditioning load of buildings more than south and north facing fenestrations. This is because the maximum solar radiation incidence on vertical surfaces of buildings occurs when the sun is low in the sky and shining on east-facing vertical surfaces in the morning and west-facing vertical surfaces in the afternoon. The sun is highest in the sky at mid-day and thus there is less direct solar radiation incidence on north-facing and south-facing vertical surfaces. At mid-day the majority of the solar radiation incidence tends to be on horizontal rather than vertical surfaces of the building, especially in the summer when solar radiation incidence has its largest effect on building energy performance. To reduce the energy load created by solar heat gain of east and west facing fenestrations this section requires that the area-adjusted combined solar heat gain coefficients for east and west facing fenestrations does not exceed the combined area-adjusted solar heat gain coefficient for north and south facing fenestrations. This approach permits the user to either relocate fenestration areas from east-facing and west-facing walls to north-facing or south-facing walls or to improve the solar heat gain coefficient of the east-facing and west-facing fenestrations.

There are two exceptions for the SHGC requirements offered in this document in addition to those specified in ASHRAE 189.1. The first exception applies where the total fenestration area of the building is less the 5% of the gross above-grade wall area. The impact on energy use due to fenestration, regardless of orientation, is already significantly reduced by the small amount of fenestration area. The second exception is for climates zones 7 and 8. In these climates the air-conditioning load due to environmental factors is less than in warmer climates. Too, the benefits of solar heat gain through fenestrations during the heating mode may more than offset the effects of solar gain during the cooling mode.

1302.2.3. Visible light transmittance. The visible light transmittance (VLT) shall meet one of the following:

1. shall be no less than 0.50 or
2. the VLT/SHGC shall be at least 1.20.

CHAPTER 14 EXTERIOR WALLS

SECTION 1403 PERFORMANCE REQUIREMENTS

[Add new Section 1403.8 as follows:]

1403.8 Landscaping Sprinklers. Landscaping sprinklers systems shall be designed to prevent the spray of water within 3 ft (914 mm) of a building.

SECTION 1405 INSTALLATION OF WALL COVERINGS

[Modify Section 1405.14 as follows:]

1405.14 Vinyl siding. Vinyl siding conforming to the requirements of this section and complying with ASTM D 3679 shall only be permitted on exterior walls of buildings

C1302.2.3 Visible light transmittance. [EC] Artificial lighting, as previously discussed in this Chapter, may consume considerable amounts of energy. Visible light through fenestrations can reduce the demand for artificial lighting. Criteria in this section provide two options to assure the fenestrations provide ample visible light. The first is intended to assure glazing properties provide a minimum level of visible light transmittance. The second allows the designer to appropriately balance the effects of visible light transmittance and solar heat gain into the building.

CHAPTER 14 EXTERIOR WALLS

Chapter 14 of the building code is used to specify the minimum requirements that the exterior walls of a building must meet. These requirements include safety from fire exposure as well as weather elements. The material added to Chapter 14 for sustainable buildings include requirements to address solar reflectance, improve the resistance to damage from hail, and improve fire resistance requirements. For more information on fire performance see the discussion at the beginning of Chapter 4 on ENHANCED FIRE SAFETY.”

Section 1403 PERFORMANCE REQUIREMENTS

C1403.8 Landscaping Sprinklers [IQ]. This provision has been added to minimize the wetting of exterior wall surfaces by landscaping sprinklers. The present code has no such provision. Where landscape sprinklers continuously wet exterior wall surfaces the risk of moisture infiltration is increased. This can lead to mold growth and deterioration of exterior wall components as well as creating an environment more suitable for infestations.

SECTION 1405 INSTALLATION OF WALL COVERINGS

C1405.14 VINYL SIDING [ER]. Vinyl siding is recognized in the building code as not being appropriate or re-

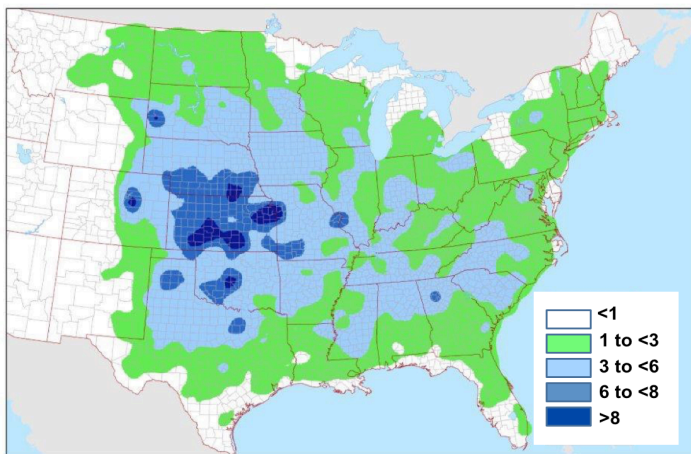
located in areas where $V_{nsd} - V_{ult}$ as determined in accordance with Section 1609.3.1 Figure 1609A, regardless of risk category, does not exceed 100 115 miles per hour (45 51 m/s) and the building height is less than or equal to 40 feet (12 192 mm) in Exposure C. Where construction is located in areas where $V_{nsd} - V_{ult}$ as determined in accordance with Section 1609.3.1 Figure 1609A, regardless of risk category, exceeds 100 115 miles per hour (45 51 m/s), or building heights are in excess of 40 feet (12 192 mm), tests or calculations indicating compliance with Chapter 16 shall be submitted vinyl siding shall be permitted on exterior walls when tested in accordance with ASTM D5206 using wind speed not less than the wind speed applicable for the building location. Vinyl siding shall be secured to the building so as to provide weather protection for the exterior walls of the building.

[Add new Section 1405.14.2 as follows:]

1405.14.2 Hail impact characteristics. Vinyl siding used in regions where hail exposure is Moderate or Severe, as determined in Figure 1405.1 shall be tested, classified, and labeled in accordance with UL 2218 or FM 4473. Moderate and Severe hail exposure regions are defined as:

(a) Moderate – Three but less than six hail reports per 100 square miles (259 square km).

(b) Severe - Six or more hail reports per 100 square miles (259 square km).



Source: Institute for Business and Home Safety

AVERAGE FREQUENCY OF HAIL (1-INCH OR LARGER) REPORTS PER 100 SQUARE MILES
FIGURE 1405.1

quiring special attachment in high wind areas. Sustainable buildings must be designed to more than these minimum requirements when sited in areas subject to high winds. Failure of the vinyl siding may result in additional damage to the remaining building envelope components and possibly other components and contents of the building. Thus these revisions limit the use of vinyl siding in high wind regions to reduce the risk of damage resulting in repair, removal, disposal and replacement. This helps ensure that the building envelope is not compromised improving the likelihood that the building to be available for use after a wind event. Alternatively, the exception allows vinyl siding to be used in high wind areas where testing demonstrates that specific vinyl siding systems could be effective.

C1405.14.2 Hail impact characteristics [ER]. Hail impact damage also results in considerable amounts of material being removed and disposed of annually. The building code does not currently have requirements for impact resistance of exterior wall finishes. The insurance industry in the United States recognizes the inability of vinyl siding to resist hail damage. These revisions also place limits of the use of vinyl siding in hail impact prone regions.

To assure that vinyl siding selected for use in areas of moderate or severe hail exposure have a demonstrated impact resistance, testing in accordance with nationally recognized standards is required. The exposure levels are based on a hail activity map provided by the Institute for Business and Home Safety.⁷ In this document moderate exposure is considered areas where the number of hail reports per 100 square miles is at least three but less than six. Severe exposure is considered to be where reports are more than six. The reporting is based on hail with a diameter of 1-inch or larger.

⁷ Source: <http://www.disastersafety.org/wp-content/uploads/hail-tornado-report.pdf>, last visited August 2014.

**SECTION 1406
COMBUSTIBLE MATERIALS ON THE
EXTERIOR SIDE OF EXTERIOR WALLS**

[Modify Section 1406.2 as follows:]

1406.2 Combustible exterior wall coverings. Combustible exterior wall coverings shall comply with this section.

1. Combustible exterior wall coverings other than those covered by Items 2, 3 or 4 shall comply with Sections 1406.2.1 through 1406.2.3.
2. Combustible exterior wall coverings installed on exterior walls where the fire separation distance is 5 feet (1524 mm) or less shall not be permitted.
3. Vinyl siding and exterior insulation and finish systems installed on exterior walls where the fire separation distance is 30 feet (9144 mm) or less shall not be permitted.
4. Plastics other than vinyl siding and exterior insulation finish systems shall comply with Chapter 26.

Exception: Plastics complying with Chapter 26.

(No change to remainder of section)

**SECTION 1408
EXTERIOR INSULATION AND
FINISH SYSTEMS (EIFS)**

**SECTION 1406
COMBUSTIBLE MATERIALS ON THE
EXTERIOR SIDE OF EXTERIOR WALLS**

C1406.2 Combustible exterior wall coverings [ER]. Combustible materials on the exterior of walls increase the risk of fire spread between buildings. Materials with low melting points may not only contribute to fire spread but are also susceptible to damage. Neither of these outcomes is consistent with the concept of sustainability.

1. This item retains the building code requirements addressing combustible exterior wall coverings where the fire separation distance exceeds 5 feet. Additional criteria are included in Item 2 where the distance is 5 feet or less and Item 3 for materials with low melting points.
2. Where the fire separation distance between buildings is less than 5 feet the possibility of fire spread and damage to the exterior wall coverings of adjacent buildings is increased significantly. The changes to this section prohibit combustible materials or coverings on buildings with less than 5 feet of fire separation.
3. Besides the increased risk of fire spread, materials with low melting points are susceptible to irreparable damage due to radiant heat exposure where in close proximity to adjacent buildings. The use of such materials as exterior wall covering is further limited to sites where the building has a fire separation distance of at least 30 feet. The 30 feet distance is provided as a minimum code requirement but actual fire incidences have thoroughly ruined combustible exterior wall covering where the distances between buildings exceeded 100 feet.
4. This item retains the building code requirements for plastics on the exterior other than vinyl siding and EIFS.

**SECTION 1408
EXTERIOR INSULATION AND
FINISH SYSTEMS (EIFS)**

Sustainable buildings must be designed to more than minimum requirements of the building code when sited in high wind or hail impact prone areas. Failure of the EIFS may result in additional damage to the remaining building en-

velope components and possibly other components and contents of the building. Thus revisions to this section limit the use of EIFS to reduce the risk of damage resulting in repair, removal, disposal and replacement. This helps ensure that the building envelope is not compromised allowing the building to be available for use after an event.

[Modify Section 1408.2 as follows:]

1408.2 Performance characteristics. EIFS shall be constructed such that it in accordance with this section.

1408.2.1 General characteristics. EIFS shall meet the performance characteristics required in ASTM E2568.

1408.2.2 Hail impact characteristics. EIFS used in regions where hail exposure is Moderate or Severe, as determined in Figure 1405.1 shall be tested, classified, and labeled in accordance with UL 2218 or FM 4473. Moderate and Severe hail exposure regions are defined as:

(a) Moderate – Three but less than six hail reports per 100 square miles (259 km²).

(b) Severe - Six or more hail reports per 100 square miles (259 km²).

[Add new Section 1408.3.1 as follows:]

1408.3.1 High wind regions. Exterior insulation and finish systems (EIFS) conforming to the requirements of Chapter 26 shall be permitted on exterior walls of buildings complying with all of the following:

1. The building is located outside areas where V_{ult} as determined in accordance with Figure 1609A, regardless of risk category, is less than 115 mph (51 m/s).
2. The building is located in areas where the wind speed is less than 250 mph (98 m/s) according to Figure 304.2(1) of ICC/NSSA 500.

C1408.2 Performance characteristics. [ER] Hail impact damage, wind damage and damage from wind borne debris result in considerable amounts of material being removed and disposed of annually. The building code does not currently have requirements for impact resistance of exterior wall finishes. The insurance industry in the United States recognizes the inability of EIFS to resist hail damage. The revision to this section limits the use of EIFS in hail impact and high wind prone regions.

C1408.2.1 General characteristics [ER]. No changes to the requirements of the code are made with regard to the general characteristics of EIFS.

C1408.2.2 Hail impact characteristics [ER]. To assure that EIFS systems selected for use in areas of moderate or severe hail exposure have a demonstrated impact resistance, testing in accordance with nationally recognized standards is required. The exposure levels are based on a hail activity map provided by the Institute for Business and Home Safety.⁸ In this document moderate exposure is considered areas where the number of hail reports per 100 square miles is at least three but less than six. Severe exposure is considered to be where reports are more than six. The reporting is based on hail with a diameter of 1-inch or larger.

C1408.3.1 High wind regions [ER]. The building code has requirements for wind resistance of exterior and insulation finish systems (EIFS). These revisions restrict the use of EIFS in high wind regions to reduce the risk of damage.

⁸ Source: <http://www.disastersafety.org/wp-content/uploads/hail-tornado-report.pdf>, last visited August 2014.

SECTION 1410
SOLAR REFLECTANCE INDEX

[Add new Section 1410 as follows:]

SECTION 1410
SOLAR REFLECTANCE INDEX

1410.1 General. The provisions of this section shall govern the solar reflectance index (SRI) of exterior wall coverings.

1410.2 Opaque above ground exterior walls. All opaque portions of exterior walls above ground having an orientation in accordance with 1410.2.1 shall have a solar reflectance index (SRI) of not less than 29 as determined in accordance 1410.2.2.

Exceptions:

1. Exterior walls in Climate Zones 4, 5, 6, 7, and 8 as determined by Section 301 of the IECC
2. Exterior walls having a heat capacity greater than or equal to 5 Btu/ft² • °F (103 kJ/m² • °K).
3. Exterior walls where the overall thermal resistance is 20% or greater than otherwise required by the code.
4. Architectural trim and features that cover less than or equal to 10% of the exterior wall surface area.
5. Exterior walls that are at least 75% shaded by building projections, man-made structures, existing buildings, topography, or plantings. Shade coverage shall be calculated on the summer solstice at 10:00 am and 3:00 pm.

C1410.1 General [EC]. The color of exterior surfaces may dramatically affect the heat gain in buildings. The solar reflectance of dark exterior wall surfaces receiving a significant amount of solar radiation incidence will contribute to surface temperature increases. Due to the larger temperature differential between outside and inside the demand for cooling will be increased. Increased energy consumption for cooling due to exterior surfaces of low density materials that are dark in color is inconsistent with the basic premise of sustainable buildings.

C1410.2 Opaque Above Grade Exterior Walls [EC]. Where the potential for heat gain resulting from solar radiation incidence is large, exterior opaque walls are required to have a solar reflectance of not less than 29 to reduce the need for the increased cooling. There are five conditions where exterior wall SRI does not substantially impact the cooling load because the heat gain is not significant.

1. In cooler climates the contribution of solar radiation incidence to heat gain through the exterior wall does not provide a significant increase in cooling load. Further the walls warmed by solar radiation incidence may reduce heating loads. Exterior walls in cooler regions (Climate Zones 4, 5, 6, 7, and 8) are exempted from the SRI requirement.
2. Mass walls absorb and delay heat gains into the interior of buildings. Where there is sufficient mass the effects of solar radiation incidence are diminished. This exception excludes walls with a heat capacity more than 5 Btu/ft² • °F (103 kJ/m² • °K) in from the SRI requirement. Most concrete or masonry with a thickness of 2-1/2 inches (64 mm) or more will satisfy the requirements of this exception.
3. An alternative method for reducing the cooling load due to heat gain through exterior walls is to increase the amount of thermal resistance insulation in the wall. This exception excludes walls where the overall thermal resistance is 20% or greater than otherwise required by the code thus negating the need for the SRI requirement.
4. As a practical matter, small portions of the wall that have an SRI less than 29 are not likely to substantially contribute to the overall reduction in the heat gain through exterior walls, but are often necessary to achieve a desirable appearance. This exception acknowledges this and thus allows up to 10% of the exterior wall surface area to be architectural trim.
5. Shading has been shown to reduce the effects of heat gain on a building. Viable shading techniques include using building projections, man-made

1410.2.1 Orientation. Exterior opaque walls with an orientation measured perpendicularly to compass directions between and including NE (45°) and SE (135°) and between and including SW (225°) and NW (315°).

1410.2.2 Solar Reflectance Index. The solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 for medium wind speed. The SRI shall be based on the thermal emittance determined in accordance with ASTM E408 or C1371 and solar reflectance as determined in accordance with ASTM E1918 or C1549.

CHAPTER 15 ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

SECTION 1503 WEATHER PROTECTION

[Add new Section 1503.1.1 as follows:]

1503.1.1 Protection in special wind regions. Secondary water protection shall be provided for all roofs in regions where the design wind speed, V_{ult} , determined in accordance with 1609.1.1 and Figure 1609A, regardless of risk category, is 130 miles per hour (58 m/s) or greater.

Exception: Roof systems directly applied to concrete decks.

structures, existing buildings, topography, or plantings. Where shading is provided for 75% or more of the exterior wall during peak heat gain periods the SRI requirement is exempted

C1410.2.1 Orientation [EC]. Peak heat gains typically occur during the morning on east facing walls and in the afternoon on west facing walls when the sun is low in the sky. North facing and south facing vertical surfaces receive minimal direct solar radiation incidence. Thus it is important that east and west facing walls have an SRI of 29 or more.

C1410.2.2 Solar Reflectance Index [EC]. This section cites the appropriate standards for determining the solar reflectance index (SRI).

CHAPTER 15 ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

SECTION 1503 WEATHER PROTECTION

C1503.1.1 Protection in special wind regions [ER]. Roofs of sustainable buildings should have redundant weather protection systems when sited in areas subject to high winds. Secondary protection is typically provided by using water resistant tape on all joints of roof sheathing materials or impervious insulation boards under the roof covering system. This ensures that if the primary weather protection system is compromised the buildings will be available for use after these types of events. Further this protection minimizes damage to the building, its interior, and its contents. Thus the need for repairs and the removal, disposal and replacement of materials is reduced which is consistent with the basic premise of sustainability. The modifications to Section 1503.1.1 require building roofs to be provided with secondary water protection to minimize water damage to the interior due to potential damage to roof systems from wind or wind-borne debris.

[Modify Section 1503.4.3 and add new Section 1503.4.4 as follows:]

1503.4.3 Gutters. Gutters and leaders placed on the outside of buildings, other than Group R-3, private garages and buildings of Type V construction, shall be of noncombustible material or a minimum of Schedule 40 plastic pipe. Gutter attachment shall be designed and detailed for design wind speeds determined in 1609.1.1.

1503.4.4 Roof drain protection. All roof drains on low-slope roofs located in severe exposure areas in Figure 1904.2 shall have heating strips (heat trace) installed around them to prevent blockage of the drains by ice or ice dams.

**SECTION 1504
PERFORMANCE REQUIREMENTS**

[Modify Section 1504.3 as follows:]

1504.3 Wind resistance of nonballasted roofs. Roof coverings installed on roofs in accordance with Section 1507 that are mechanically attached or adhered to the roof deck shall be designed to resist the design wind load pressures for components and cladding in accordance with Section 1609.

Roof coverings and their attachments installed on low-sloped (roof slope < 2:12) roofs in accordance with Section 1507 shall meet the design and installation requirements of ANSI/SPRI WD-1 or FM 1-28 and 1-29. Low slope roof systems shall be tested in accordance with FM 4450, FM 4470, FM 4471, FM 4474, UL580, or UL 1897.

(No change to Sections 1504.3.1 and 1504.3.2)

[Modify Section 1504.4 as follows:]

1504.4 Ballasted low-slope roof systems. Ballasted low-slope (roof slope < 2:12) single-ply roof system coverings installed in accordance with Sections 1507.12 and 1507.13 shall be designed in accordance with Section 1504.8 and one of the following:

1. ANSI/SPRI RP-4, or
2. FM 1-29.

[Modify Section 1504.5 as follows:]

1504.5 Edge securement for low-slope roofs. Low-slope

C1503.4.3 Gutters [ER]. Where gutters are installed they provide an important function: collecting water from roof surfaces and directing it away of the building. In high wind regions maintaining these appurtenances is critical. This revision requires the gutter attachment to be based on the design wind speed for sustainable buildings in high wind regions.

C1503.4.4 Roof drain protection [ER]. Sustainable buildings must be designed to more than the minimum when sited in areas subject to severe freezing exposure conditions. The modifications to Section 1503.4.4 require the building roof drain system minimize the effects freezing that may direct water past the drain system and allow water into the building resulting in damage to the interior of the building and its contents.

**SECTION 1504
PERFORMANCE REQUIREMENTS**

[Modify Section 1504.3 as follows:]

C1504.3 Wind resistance of nonballasted roofs [ER]. Loss history observed by the Institute for Business and Home Safety (IBHS) indicates that low sloped roofs are more susceptible to damage in high wind regions. The loss of roof coverings not only compromises the building envelope but the coverings themselves may become wind driven projectiles resulting in other damage to the building or to adjacent buildings. Such damage is inconsistent with sustainable design which should include features to reduce the risk of damage resulting in repair, removal, disposal and replacement. Thus criteria are provided to strengthen the attachment of roof coverings in high wind areas.

C1504.4 Ballasted low-slope roof systems [ER]. The code already sets criteria for the design of ballasted low sloped roof systems. Loss history observed by the Institute for Business and Home Safety (IBHS) has shown that compliance with FM Loss Prevention Data Sheet 1-29 results in comparable or improved performance to that deemed acceptable in the current code. This modification provides an alternative method to satisfy the intent of the code.

C1504.5 Edge securement for low-slope roofs [ER]. The

built-up, modified bitumen and single-ply roof system metal edge securement, except gutters, shall be designed and installed for wind loads in accordance with Chapter 16 and tested for resistance in accordance with ANSI/SPRI ES-1 or FM 4435. ~~except~~ The design wind speed shall be 20 mph (9 m/s) plus the V_{ult} wind speed shall be determined from Figure 1609A, 1609B or 1609C as applicable.

code already sets criteria for the design and installation of edge securement for low sloped roof systems. Loss history observed by the Institute for Business and Home Safety (IBHS) has shown that compliance with FM 4435 results in comparable or improved performance. The first modification to this section provides an alternative method to satisfy the intent of the code. Further modification is made to this section to increase the wind speeds used to determine performance of the attachments for the edges. Failure of the edge securement permits roof coverings or portions thereof to be lifted off the building. Resulting damage is inconsistent with sustainable design which should include features to reduce the risk of damage resulting in repair, removal, disposal and replacement.

**SECTION 1505
FIRE CLASSIFICATION**

**SECTION 1505
FIRE CLASSIFICATION**

[Modify Section 1505.1 by deleting Footnotes (b) & (c) from Table 1505.1 as follows:]

1505.1 General. Roof assemblies shall.....*(No change to text)*.....with Table 1505.1 based on the type of construction of the building.

C1505.1 General [ER]. Modifications to Table 601 prohibit the use of Type IIB, IIIB and VB construction. Changes to Table 1505.1 MINIMUM ROOF COVERING CLASSIFICATION FOR TYPES OF CONSTRUCTION reflect that prohibition. Table 1505.1 is further modified by elimination the footnote related to non-classified roofing which becomes prohibited in modifications to Section 1505.5.

**TABLE 1505.1^{a, b}
MINIMUM ROOF COVERING CLASSIFICATION
FOR TYPES OF CONSTRUCTION**

IA	IB	IIA	IIIB	IIIA	IIIB	IV	VA	VB
B	B	B	€ ^c	B	€ ^c	B	B	€ ^c

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

- a. Unless otherwise required in accordance with the *International Wildland-Urban Interface Code* or due to the location of the building within a fire district in accordance with Appendix D.
- b. ~~Non-classified roof coverings shall be permitted on buildings of Group R-3 and Group U occupancies, where there is a minimum fire separation distance of 6 feet measured from the leading edge of the roof.~~
- c. ~~Buildings that are not more than two stories above grade plane and having not more than 6,000 square feet of projected roof area and where there is a minimum 10-foot fire-separation distance from the leading edge of the roof to a lot line on all sides of the building, except for street fronts or public ways, shall be permitted to have roofs of No. 1 cedar or redwood shakes and No. 1 shingles.~~

[Delete Section 1505.5 as follows:]

1505.5 Nonclassified roofing. Nonclassified roofing is *approved material that is not listed* as a Class A, B or C roof covering.

C1505.5 Nonclassified roofing [ER]. Ignition of exterior components of buildings is a common failure mode in wildland fire exposures and can further propagate of fires. Because of this the use of non-classified roofs is prohibited in areas likely to experience wildland fires (e.g. hot, dry regions). By deleting Section 1505.5, Section 1505.8 of this document then requires all sustainable buildings to have roof coverings with a minimum Class A fire classification.

[Add new Section 1505.8 as follows:]

1505.8 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.

**SECTION 1507
REQUIREMENTS FOR ROOF COVERINGS**

[Add new Section 1507.1.1 as follows:]

1507.1.1 Roof coverings subject to hail exposure. Roof coverings used in regions where hail exposure is Moderate or Severe, as determined in accordance with Section 1405.14.2 and Figure 1405.1, shall be tested, classified, and labeled in accordance with FM 4473 or UL 2218. Hail exposure regions in Figure 1405.1 shall be as follows:

(a) **Moderate** – Three but less than six hail reports per 100 square miles (259 square km).

(b) **Severe** - Six or more hail reports per 100 square miles (259 square km).

[Add new Section 1507.1.2 as follows:]

1507.1.2 Roof solar reflectance index. Roof coverings for roofs in Climate Zones 1, 2 and 3 shall be provided with solar reflectance indices in accordance with the requirements of Sections 5.3.2.3 and 5.3.2.4 of ASHRAE 189.1.

Exception: Up to 10% of the opaque roof area used for architectural and serviceability features.

C1505.8 Roofs in warm and dry climates [ER]. Wildland fires are more prone to occur in dry climates. Thus all sustainable buildings in dry climate areas are required to have roof coverings with a minimum Class A fire classification to minimize risk of damage resulting in repair, removal, disposal and replacement. This requirement for minimum Class A roofs prohibits the use of No. 1 shakes or shingles. Adequate fire protection requires concealed spaces in roofing systems to be firestopped.

**SECTION 1507
REQUIREMENTS FOR ROOF COVERINGS**

C1507.1.1 Roof coverings subject to hail exposure [ER] Consistent with limitations in Sections 1405.14.2 and 1408.2.2 placed on exterior wall coverings in regions of moderate and severe hail exposure, these changes include additional protection of roofs from hail damage. These requirements increase the likelihood that roof coverings in moderate and severe exposures will continue to protect the building after an event and minimize the need to replace the roof.

To assure that roof coverings selected for use in areas of moderate or severe hail exposure have a demonstrated impact resistance, this section requires coverings to be tested in accordance with nationally recognized standards. The exposure levels are based on a hail activity map provided by the Institute for Business and Home Safety (IBHS).⁹ In this document moderate exposure is considered areas where the number of hail reports per 100 square miles is at least three but less than six. Severe exposure is considered to be where reports are more than six. The reporting is based on hail with a diameter of 1-inch or larger.

C1507.1.2 Roof solar reflectance index [EC]. The temperature gradient through roof systems where the exterior surfaces are light in color is less than that for darker roofs. The use of lighter roof colors can result in significant reductions in air conditioning loads. Air conditioning loads tend to be large climate zones 1, 2 and 3 as defined in the *International Energy Conservation Code* (IECC). The surface temperature is also dependent on the slope of the roof. Low-sloped roofs (i.e. roof slopes < 2-1/2:12) have more stringent requirements since they are more susceptible to direct sunlight. The energy conservation benefits related to roof solar reflectance are addressed in ASHRAE 189.1. This document includes an exception for portions of the roof that are intended for use by maintenance personnel.

The use of higher solar reflectance indices may not only pro-

⁹ Source: <http://www.disastersafety.org/wp-content/uploads/hail-tornado-report.pdf>, last visited August 2014.

SECTION 1512 RAINWATER MANAGEMENT

[Add new Section 1512.1 as follows:]

1512.1 General. Where a rainwater harvesting system is incorporated into the building all components, including those used for collection, conveyance and storage, shall meet the following requirements.

1. All rainwater harvesting systems shall be designed and installed in accordance with the *International Plumbing Code*.
2. Design and installation of rainwater harvesting systems and components shall not result in damage or deterioration of other building components.

CHAPTER 16 STRUCTURAL DESIGN

vide sustainability related to energy conservation but can also reduce urban heat island effects¹⁰. Therefore it may be beneficial to use lighter colored surfaces in other climate zones.

SECTION 1512 RAINWATER MANAGEMENT

C1512.1 General [WC]. Reusing rainwater is an effective alternative to using potable water for irrigation and graywater systems. However, rainwater harvesting systems are not suitable in all locations. In some instances there are insufficient amounts of rainfall to justify incorporating a system into the building design. In addition, some state and local authorities have restrictions on rainwater harvesting.

This new section has two requirements that are applicable where rainwater harvesting systems are installed.

1. The system must be designed and installed in accordance with the *International Plumbing Code* to insure that all applicable components meet minimum health and safety requirements.
2. Consideration should also be given to make sure the performance and function of other building components are not compromised by the rainwater harvesting system. If damage or deterioration to other building components occurs, the subsequent repairs and the removal, disposal and replacement of materials is not consistent with the basic premise of sustainability.

CHAPTER 16 STRUCTURAL DESIGN

Enhanced resilience is a key component of sustainable buildings to reduce the need for repair and the removal, disposal and replacement of materials when disasters occur. Modifying structural design loads can significantly increase resiliency. The revisions in this chapter are intended to achieve a level of enhanced resilience consistent with the recommendations of insurers in the United States. This is accomplished by addressing snow, wind, flood, seismic and ice loads.

While the provisions in this Chapter primarily address minimum loads due to commonly occurring natural disasters, further augmentation of these and other loads may be necessary to achieve a the desired level of sustainability. The results of the basic load combinations in the code may

¹⁰ Heat Island Group, Building Technology and Urban Systems Department, Environmental Energy Technologies Division, Berkeley Lab, www.heatisland.lbl.gov/coolscience/cool-science-cool-roofs. last visited August 2014.

**SECTION 1604
GENERAL DESIGN REQUIREMENTS**

[Modify Section 1604.5 by adding new Section 1604.5.2 and Table 1604.5.2 as follows:]

1604.5 Risk category. Each building and structure shall be assigned a *risk category* in accordance with Table 1604.5. Where a referenced standard specifies an occupancy category, the *risk category* shall not be taken as lower than the occupancy category specified therein.

1604.5.1 Multiple occupancies. Where a building or structure is occupied by two or more occupancies..... *(No change to text)*..... having a higher *risk category*, both portions shall be assigned to the higher *risk category*.

1604.5.2 Importance factors by risk categories.
The minimum design loads for buildings shall be based on the Importance Factors in Table 1604.5.2

not adequately provide for desired of enhanced resiliency for simultaneous events. Thus, modification of factors used in load combination equations should be considered to address the occurrence of multiple hazards or generally increase overall resiliency.

**SECTION 1604
GENERAL DESIGN REQUIREMENTS**

C1604.5.2 Importance factors by risk categories [ER]. Structural design loads are determined using appropriate importance factors assigned for the risk category of the structure. Risk Category I is defined in the code as structures where the risk to human life is low, such as agricultural, temporary, and minor storage facilities. Risk Category II is defined as buildings not otherwise classified and thus most buildings fall into this category. Risk Category III is defined as structures where there may be a substantial threat to human life. For most buildings in this category the criteria are based on occupancy load. Buildings are classified as Risk Category III when occupant loads exceed the values below:

Occupancy and Use Group		Occupancy Load
A	Assembly	300
E	K through 12th grade	250
B	Educational above 12th grade	500
I-2	Resident care without surgery or emergency care	50
I-3	Correctional and detention facilities, prisons and jails	5
Any other occupancy		5000

Risk Category III also includes public utility facilities and buildings containing quantities of toxic or explosive materi-

als. When toxic and explosive materials exceed the allowable amounts per control area as addressed in the *International Fire Code* (IFC) within structures not included in Risk Category IV, the building is designated Risk Category III.

Risk Category IV includes hospitals with emergency and surgery treatment facilities; fire, rescue and police stations; ambulance and emergency vehicle garages; emergency shelters and operation centers; power generation stations; buildings containing large amounts of toxic materials; aviation control facilities and hangars for emergency aircraft; critical national defense facilities; and water storage and pumping stations necessary for fire suppression.

While not addressed in the code or the modifications presented in this document, jurisdictions should also consider classifying facilities essential to community recovery and continuity following disasters into Risk Categories III or IV. This may be applicable to facilities that employ or house large numbers of individuals. This can be especially important in smaller communities where residents directly or indirectly rely on a few large employers, or businesses rely primarily on local residents.

The Structural Engineering Institute of the American Society of Civil Engineers *Minimum Design Loads for Buildings and Other Structures* (ASCE/SEI 7) utilizes importance factors as a means to increase design loads for structures used as critical and essential facilities (Risk Categories III and IV). Following this premise further modifications to these importance factors are made to achieve enhanced resiliency for all buildings regardless of risk category.

**TABLE 1604.5.2
IMPORTANCE FACTORS BY RISK CATEGORY**

Risk Category From Table 1604.5	Snow Importance Factor,	Ice Importance Factor,	Wind Importance Factor,	Seismic Importance Factor,	
	I_s	I_i	I_w	I_e	
				0.2 spectral response	
				0.40 g or greater	
I	0.95	0.95	1.20	1.00	1.20
II	1.20	1.20	1.20	1.00	1.20
III	1.25	1.40	1.15	1.25	1.40
IV	1.30	1.40	1.15	1.50	1.65

For critical and essential occupancies the importance factors in the IBC increase design loads by 10 to 50% as compared to the design loads required for general occupancies (Risk Category II). In this code, a similar increase is applied for all buildings where the intent of the design is to achieve a minimum level of enhanced resilience. This is consistent with the basic concepts of sustainable buildings. For sustainable

[Add new Section 1604.11 as follows:]

1604.11 Seismic design categories C, D, E and F. Where the *seismic design category* is determined to be C, D, E or F in accordance with Section 1613.3.5, the building shall be designed by a *registered design professional*.

buildings designed using this document the values chosen as importance factors in Table 1604.5.2 provide a simple method for reaching load requirements for sustainable design. The percentage used to develop the revised Importance Factors in Table 1604.5.2 were adjusted so that the numerical values could be expressed to the nearest five hundredths.

The modifications for each loading condition are discussed in the relevant section for the various loads (i.e. Snow, wind, seismic, ice).

C1604.11 Seismic design categories C, D, E and F [ER]. There are many factors influencing the performance of building subjected to earthquake loads. The prescriptive requirements in the code provide direction on design of elements and components of a building for seismic events. However, a fuller understanding of the complex interactions of the building structure and components during a ground motion event is required to further minimize damage. This is especially important for larger seismic exposures. And, while the code does not require all buildings to be designed by a registered design professional, a design professional provides this additional understanding. The result is less components that require repair or the removal, disposal and replacement of materials when disasters occur, consistent with the concept of sustainability. This change requires buildings assigned to Seismic Design Category (SDC) of C, D, E or F, to be designed by a registered design professional.

Requiring design by a registered design professional is in addition to the increased seismic importance factor as modified in Table 1604.5.2 Importance Factors By Risk Category. Compared to other natural disasters where life safety is often provided by evacuation or seeking shelter, life safety for earthquakes requires a greater degree of collapse avoidance because there is limited or no opportunity to seek shelter or evacuate. Since enhanced collapse avoidance is already integrated into seismic design, the importance factor is only increased where the potential for a large earthquake and a greater amount of property damage may be expected. The potential for large seismic events is considered where the spectral response is greater than 0.40g.

**SECTION 1608
SNOW LOADS**

[Modify Section 1608.2 as follows:]

1608.2 Ground snow loads. The ground snow loads to be used in determining the design snow loads for roofs shall be determined in accordance with ASCE 7 or Figure 1608.2 for the contiguous United States and Table 1608.2 for Alaska. The Snow Importance Factor, I_s , shall be determined from Table 1604.5.2. Site-specific case studies shall

**SECTION 1608
SNOW LOADS**

C1608.2 Ground snow loads [ER]. Sustainable buildings should be expected to withstand higher snow loads than the minimum prescribed by the building code. This change to Section 1608.2 directs the designer to new Table 1604.5.2 for modified importance factors which are applied to snow loads. The snow load importance factor for Risk Category I is maintained at 0.95 but increased to 1.20, 1.25, and 1.30

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*.

SECTION 1609 WIND LOADS

[Modify Section 1609.1.1 as follows:]

1609.1.1 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 Wind Importance Factor, I_w , shall be determined from Table 1604.5.2. 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.

(No change to Exceptions 1-6 or remainder of section)

SECTION 1612 FLOOD LOADS

[Modify Section 1612.4 as follows:]

for Risk Categories II, III, and IV, respectively.

SECTION 1609 WIND LOADS

C1609.1.1 Determination of wind loads [ER]. Sustainable buildings should be expected to withstand higher wind loads than the minimum prescribed by the building code. This change to Section 1609.1.1 directs the designer to new Table 1604.5.2 for modified importance factors which are applied to wind loads. The increase in importance factors for Risk Category III and IV buildings is less than the increase for the importance factors for Risk Category I and II buildings. Although there is less of an increase in importance factor the result is a similar increase in loads because of the higher wind speeds on the map used for Risk Category III and IV buildings.

SECTION 1612 FLOOD LOADS

Floods not only cause damage to structures they also have the potential to disrupt occupancy and use. Floodwaters not only cause moisture damage but they also contain contaminants. Contaminated materials typically must be disposed of in landfills or incinerated. Minimizing the damage is necessary for sustainable buildings to reduce cleansing, repair or removal, disposal and replacement of materials. The current code does require flood resistant materials to be used for supporting habitable floor spaces so habitable floor spaces above that point are most susceptible to damage. Raising floor elevations has the greatest potential for reducing damage to habitable spaces due to flood waters.

There are numerous high water marks that have been recorded on buildings indicating flood levels from past events. Often these marks are higher than the flood eleva-

1612.4 Design and construction. The design and construction of buildings and structures located in *flood hazard areas*, including flood hazard areas subject to high-velocity wave action, shall be in accordance with Chapter 5 of ASCE 7 and with ASCE 24 and the following requirements.

1. **Floor elevation.** Floors required by ASCE 24 to be built above the base flood elevations shall have the floor and their lowest horizontal supporting members not less 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. the 500-year flood, if known.
2. **Flood protective works.** Buildings designed and constructed in accordance with ASCE 24 shall not consider levees and floodwalls for providing flood protection during the design flood.
3. **Protection of mechanical, plumbing and electrical systems.** Mechanical, plumbing and electrical systems, including plumbing fixtures and utility connections, shall comply with the following:
 - a. All components shall be elevated above the

tion established by minimum code requirements. Where such marks exist it would be beneficial for local authorities to use them in setting base flood elevations. However, since these marks may not exist in all jurisdictions or may have preceded the installation of dams for flood control, the changes presented in this section are based on flood maps. History continues to show that actual flood levels repeatedly exceed base flood elevations provided on many flood maps. The recurring cleansing, repair or removal, disposal and replacement of materials are not consistent with the concept of sustainable buildings. This further emphasizes the need for raising the lowest habitable floor to a level higher than base flood elevation.

Design flood elevations tend to be based on historical data. For coastal areas and other areas that are predicted to experience effects of rising sea levels due to climate change, the recommendation in this document may be conservative. Federal agencies^{11, 12} predict sea levels will rise more than 3 feet by the year 2100. Since buildings, especially sustainable buildings should have a design service life of at least 75 years, additional consideration of higher base flood elevations and freeboards should be considered for structures located in areas that are predicted to be impacted by rising sea levels.

C1612.4 Design and construction [ER]. Sustainable buildings are expected to perform better in areas subject to flooding. The changes to this section add two important provisions that raise the floor elevation of habitable spaces and add provisions for protection of mechanical, plumbing and electrical systems.

1. In all flood hazard areas the habitable floor elevations are established as the highest elevation based on four commonly known flood design criteria.
2. Recent floods have resulted in breaching or overtopping of levees and floodwalls. This change prohibits considering levees and floodwalls as protective works for buildings. Thus the habitable floor elevation will be determined based on flood design criteria regardless of the presence of levees and floodwalls.
3. The potential for water to enter and contaminate components of the mechanical, plumbing and electrical systems can result in significant expenditures for cleaning, repairing or removing and replacing elements. Problems related to flood water may not just be limited to damaging the components themselves. For example contaminated mechanical equipment and ducts compromise indoor air quality and health; plumbing fixtures, water supplies and waste disposal systems can be rendered

¹¹ *Vital Signs of the Planet: Sea Level* <http://climate.nasa.gov/vital-signs/sea-level/> National Aeronautic and Space Administration, last visited August 2014.

¹² *Climate Change: Global Sea Level* <http://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level>, National Oceanic and Atmospheric Administration (NOAA) last visited August 2014.

design flood elevation.

Exception: Electrical systems, equipment and components, and heating, ventilating, air conditioning, and plumbing appliances, plumbing fixtures, duct systems and other service equipment shall be permitted to be located below the design flood elevation provided that all elements are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy. Electrical wiring systems shall be permitted to be located below the design flood elevation provided they conform to the provisions of NFPA70.

- b. Where break away wall systems are required, vertical runs extending below the lowest habitable floor shall be protected by columns or other structural elements that are not part of any break away wall system and shall not be connected to any break away elements.

SECTION 1613 EARTHQUAKE LOADS

[Modify Section 1613.1 as follows:]

1613.1 Scope. Every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motions in accordance with ASCE 7, excluding Chapter 14 and Appendix 11A. The *seismic design category* for a structure is permitted to be determined in accordance with Section 1613 or ASCE 7. The Seismic Importance Factor, I_e , shall be determined from Table 1604.5.2.

unusable; and electrical systems can be shorted leading to fires. Thus locating these system components below the design flood elevation is prohibited unless they are designed and constructed such that flood water cannot enter or accumulate in any components. To further preserve integrity of the mechanical, plumbing and electrical systems, attachment to elements intended to be sacrificed during floods is prohibited.

SECTION 1613 EARTHQUAKE LOADS

C1613.1 Scope [ER]. Sustainable buildings should be expected to withstand higher seismic loads than the minimum prescribed by the building code. This change to Section 1613.1 directs the designer to new Table 1604.5.2 for modified importance factors which are applied to seismic loads. The understanding in the design community of the effects of seismic loads on buildings has improved dramatically over the past decades and is reflected in the minimum structural design criteria of the IBC. These improvements stem from the fact that there is little advance notice to occupants of buildings when an earthquake is about to occur. In addition, the mapping of ground motion has improved to better reflect the potential severity of seismic events. Although intended primarily to improve life safety, the resultant structural design for collapse avoidance already provides a significant increase in resiliency. For this reason the importance factors are only increased where the severity of the seismic event is potentially high.

1613.1.1 Near fault sites. Buildings are not permitted on sites where the ground surface has the known potential to rupture at the structure due to ground motion. Determination shall be based on fault zones (areas subject to severe ground dislocations) that have been established and mapped.

C1613.1.1 Near fault sites [ER]. Buildings built near known earthquake fault zones have been documented to be at high risk to damage when a seismic event occurs. This change is intended to reduce damage to the buildings which in turn reduces the need for repair or the removal, disposal and replacement of materials when disasters occur. The provisions for sustainable buildings prohibit buildings from being sited where earthquake fault zones have been mapped and have the known potential to rupture the ground surface.

**SECTION 1614
ATMOSPHERIC ICE LOADS**

[Modify Section 1614.1 as follows:]

1614.1 General. Ice-sensitive structures shall be designed for atmospheric ice loads in accordance with Chapter 10 of ASCE 7 using the Ice Importance Factor, I_i , in Table 1604.5.2.

**SECTION 1614
ATMOSPHERIC ICE LOADS**

C1614.1 General [ER]. Sustainable buildings should be expected to withstand thicker ice accumulations than the minimum prescribed by the building code. This change to Section 1614.1 directs the designer to new Table 1604.5.2 for modified importance factors which are applied to atmospheric ice loads. The atmospheric ice importance factors become 0.95, 1.20, 1.40, and 1.40 for Risk Categories I, II, III and IV, respectively.

**CHAPTER 17
SPECIAL INSPECTIONS AND TESTS**

[No modifications to Chapter 17.]

**CHAPTER 18
SOILS AND FOUNDATIONS**

**SECTION 1809
SHALLOW FOUNDATIONS**

[Modify Section 1809.5 and add new Section 1809.5.1 as follows:]

1809.5 Frost protection. Except where otherwise protected from frost, foundations and other permanent supports of buildings and structures shall be protected from frost by one or more of the following methods:

1. Extending below the frost line of the locality;
2. Constructing in accordance with ASCE 32 and Section 1809.5.1; or
3. Erecting on solid rock.

(No change to Exceptions 1 through 3)

Shallow foundations shall not bear on frozen soil unless such frozen condition is of a permanent character.

**CHAPTER 18
SOILS AND FOUNDATIONS**

**SECTION 1809
SHALLOW FOUNDATIONS**

1809.5 Frost Protection [ER]. Traditional foundation systems extend below the frost-line to reduce the potential for damage due to heave or repeated freeze thaw exposure. The code permits foundations that are protected from frost heave to be built to elevations above the frost line. Care must be taken to ensure the integrity of these frost protected shallow foundations (FPSF) systems. These systems rely on maintaining an interior temperature in the buildings, adequate drainage, perimeter thermal resistance insulation or combinations of these. Should any components of the FPSF system be compromised the protection to the foundation is no longer provided. Damage due to foundation failure is usually not limited to the foundation, but also may result in considerable damage to building components supported by the foundation or otherwise relying on successful foundation performance. This results in repair or the removal, disposal and replacement of materials which is not consistent with the premise of sustainability.

Drainage and thermal insulation systems are near surface components around the perimeter of the building. Their near surface location makes them susceptible to damage when the soils near the building are disrupted due to landscaping, excavations or root migrations. For sustainable buildings placards are required to alert the owner that a FPSF system has been used for the building and alerts them that caution needs to be exercised when considering landscaping or other excavations near the building.

FPSF systems using thermal insulation also rely on maintaining appropriate interior temperatures. These systems may not be suitable for sustainable buildings. Maintaining temperatures within buildings that are seasonally occupied or otherwise subjected to vacancies, including foreclosures, waste energy. While the minimum interior temperature that must be maintained is dependent on the specific features of the FPSF system, generally the interior temperature should not be permitted to be less than the 45° F specified. A label is required on the electrical panel to alert the owner that the heat is not to be turned off in such buildings.

1809.5.1 Foundations constructed using ASCE 32. All buildings using foundation walls, piers and other permanent supports in accordance with ASCE 32 shall be marked in accordance with all of the following.

1. A placard in accordance with the following shall be attached to the building on the front of the structure in the vicinity of the front entrance and in a visible location.

1.1 Building placards shall be 8 inches high by 24 inches long (203 mm by 610 mm) in size with a white background, black letters and a black border. The letters and border shall be easily visible and readable at 10 feet (3048 mm).

1.2 The placard shall state: *“This building uses insulation materials to protect the foundation from frost heave. Do not disturb any earth within 3 feet of the building without determining the extent of the insulation protection.”*

2. A label shall be affixed to the inside of the main electrical panel with the following statement: *“This building uses insulation materials to protect the foundation from frost heave. Do not shut off power to the building or reduce the interior temperature to the building below 45 °F (7 °C) without determining the impact to the foundation protection.”*

[Add new Section 1811 as follows:]

SECTION 1811 **FOUNDATIONS IN COASTAL ZONES**

1811.1 Coastal A Zone. Foundations located in Coastal A Zones determined in accordance with Section 1612.4 shall be designed for the same requirements as foundations located in Coastal V Zones.

C1809.5.1 Foundations constructed using ASCE 32. [ER] Frost protected shallow foundations (FPSF) are commonly viewed as a strategy to minimize excavation and materials required for foundation walls. However, FPSF should be avoided for sustainable buildings because of the extensive damage should a FPSF system fail. Also, in locations where excavation to frost line is deep enough to have a significant savings on excavation and materials, a conventional foundation system would typically be converted into a basement or lower level living space. Such spaces provide additional usable storage or living space and a protected location for mechanical and plumbing system components that facilitates access for routine maintenance and replacement over the life of the building. If these benefits are not considered justification to avoid the use of FPSF systems in sustainable buildings, then there should be adequate notification to owners, landscapers, renovators and even lending institutions in the event of foreclosure that disruption of the perimeter insulation or failure to maintain adequate minimum interior temperatures may cause considerable damage to the structure. The modifications provided in this section require placards and labels to help assure proper notification.

SECTION 1811 **FOUNDATIONS IN COASTAL ZONES**

C1811.1 Coastal Zones [ER]. Buildings built in coastal areas are required to be evaluated for impact from flood loads by Section 1612 of the code. This evaluation also requires the building site be assigned a zone classification based on the exposure to flooding. In coastal areas these zones

**CHAPTER 19
CONCRETE**

[No modifications to Chapter 19.]

**CHAPTER 20
ALUMINUM**

[No modifications to Chapter 20.]

**CHAPTER 21
MASONRY**

[No modifications to Chapter 21.]

**CHAPTER 22
STEEL**

[No modifications to Chapter 22.]

**CHAPTER 23
WOOD**

**SECTION 2304
GENERAL CONSTRUCTION
REQUIREMENTS**

are identified as Coastal Zone A and Coastal Zone V with Coastal Zone V noted as locations where buildings are at very high risk from wave action or high velocity water while in Coastal Zone A the risk is currently attributed to rising waters. Recent disasters have shown that many buildings located in Coastal Zone A are also subjected to wave and high velocity water resulting in damage. The necessary repair or the removal, disposal and replacement of materials are not consistent with the premise of sustainability. For sustainable buildings the foundation in Coastal Zone A areas must be designed to the same requirements as buildings sited in Coastal Zone V. This requirement improves the robustness of the structure and reduces the risk from flood damage to the building.

**CHAPTER 19
CONCRETE**

**CHAPTER 20
ALUMINUM**

**CHAPTER 21
MASONRY**

**CHAPTER 22
STEEL**

**CHAPTER 23
WOOD**

**SECTION 2304
GENERAL CONSTRUCTION
REQUIREMENTS**

Disasters in high wind areas have shown that there needs to be more rigid support of roofing and siding materials and better attachment of sheathing. The damage due to the loss of sheathing or roofing and siding materials is threefold. First there is the damage to the structure itself. Secondly, the building envelope is compromised resulting in further wind and water damage to the building. And thirdly, the detached materials may become wind-borne projectiles that cause damage to adjacent structures. The resulting repair or the removal, disposal and replacement of materials are not consistent with the premise of sustainability.

The modifications to Section 1609.1.2.2 establish increased wind loads for sustainable buildings. Consistent with those higher wind loads, the following provisions specify stiffer deflection criteria and a more robust fastening system for wood structural sheathing in the high wind regions

[Modify Section 2304.7.2 and add new Section 2304.7.2.1 as follows:]

2304.7.2 Structural roof sheathing. Structural roof sheathing shall be designed in accordance with the general provisions of this code and the special provisions in this section.

Except as required in Section 2304.7.2.1, roof sheathing conforming to the provisions of Table 2304.7(1), 2304.7(2), 2304.7(3) or 2304.7(5) shall be deemed to meet the requirements of this section. Wood structural panel roof sheathing shall be bonded by exterior glue.

2304.7.2.1 Special wind regions. In Wind Zones 3 or 4 determined in accordance with Section 1609.1.2.2 structural roof sheathing panels shall be rated for maximum deflection between supports of L/160 when subjected to a uniform live load of 100 pounds per square foot (488 kg/m²).

C2304.7.2.1 Special wind regions [ER]. Disasters in high wind areas have shown that more rigid sheathing provides better support for the roofing and siding materials. The result is a more robust building and improved substrate for the attachment of roofing and siding materials.

[Add new Section 2304.9.1.1 as follows:]

2304.9 Connections and fasteners. Connectors and fasteners shall comply with the applicable provisions of Sections 2304.9.1 through 2304.9.7.

2304.9.1 Fastener requirements. Connections for wood members shall be designed in accordance with the appropriate methodology in Section 2301.2. The number and size of fasteners connecting wood members shall not be less than that set forth in Table 2304.9.1.

2304.9.1.1 Sheathing attachment in special wind regions. In Wind Zones 3 or 4 determined in accordance with Section 1609.1.2.2 connections and fasteners of structural roof sheathing panels shall be designed to provide panel resistance uplift with a minimum factor of safety of 2.0 based on a design wind pressure using terrain Exposure C.

C2304.9.1.1 Sheathing attachment in special wind regions [ER]. Disasters in high wind areas have shown that strengthened fastening reduces the likelihood of detachment of the sheathing. The provisions require more robust connection and fastening systems be provided to resist uplift of wood structural sheathing.

[Add new Section 2309 as follows:]

SECTION 2309
ENDANGERED SPECIES

2309.1 Endangered species. Wood products shall not be produced from endangered species.

SECTION 2309
ENDANGERED SPECIES

C2309.1 Endangered species [MR]. When wood is used in sustainable buildings it is important to be sure the wood is

Exception: Wood products bearing a label identifying compliance with the CITES.

CHAPTER 24 GLASS AND GLAZING

[No modifications to Chapter 24.]

CHAPTER 25 GYPSUM BOARD AND PLASTER

[No modifications to Chapter 25.]

CHAPTER 26 PLASTIC

SECTION 2603 FOAM PLASTIC INSULATION

[Modify Section 2603.3 as follows:]

2603.3 Surface-burning characteristics. Unless otherwise(No change to text).....stock for the flame spread index and smoke-developed indexes.

Exceptions:

1. Smoke-developed index for interior trim as provided for in Section 2604.2.
2. In cold storage buildings, ice plants, food

not obtained from protected or endangered species. This requirement was added to bring attention to the code user of the need for proper documentation of the wood product and its place of origin.

CHAPTER 24 GLASS AND GLAZING

CHAPTER 25 GYPSUM BOARD AND PLASTER

CHAPTER 26 PLASTIC

The building code recognizes that plastic building components represent an increased fire hazard and regulates their use accordingly. Typical requirements limit the flame spread, size and frequency. Deviations from these minimum requirements that are reliant on the performance of sprinklers are not consistent with the basic premise of sustainable buildings. See ENHANCED FIRE SAFETY at the beginning of Chapter 4.

SECTION 2603 FOAM PLASTIC INSULATION

C2603.3 Surface-burning characteristics [ER]. Increased thickness of foam plastics for cold storage rooms and buildings simply because sprinklers are present is not permitted.

plants, food processing rooms and similar areas, foam plastic insulation where tested in a thickness of 4 inches (102 mm) shall be permitted in a thickness up to 10 inches (254 mm) where the building is equipped throughout with an automatic fire sprinkler system in accordance with Section 903.3.1.1. ~~The approved automatic sprinkler system shall be provided in both the room and that part of the building in which the room is located.~~

(No change to Items 3 through 5)

SECTION 2608 LIGHT-TRANSMITTING PLASTIC GLAZING

[Modify Section 2608.2 as follows:]

2608.2 Buildings of other types of construction. Openings.....(*No change to text*).....and all of the following:

1. The aggregate area of.....(*No change to text*).....the vertical dimension of a single pane shall not exceed 4 feet (1219 mm).

Exception: ~~Where an automatic sprinkler system is provided throughout in accordance with Section 903.3.1.1, the area of allowable glazing shall be increased to a maximum of 50 percent of the wall face of the story in which it is installed with no limit on the maximum dimension or area of a single pane of glazing.~~

2. Approved flame barriers.....(*No change to text*).....located in adjacent stories.

Exception: ~~Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.~~

3. Light-transmitting plastics.....(*No change to text*).....above grade level.

Exception: ~~Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.~~

SECTION 2609 LIGHT-TRANSMITTING PLASTIC ROOF PANELS

SECTION 2608 LIGHT-TRANSMITTING PLASTIC GLAZING

C2608.2 Buildings of other types of construction [ER]. Modifications to the minimum requirements of the building code for light transmitting plastics in building exterior walls simply because sprinklers are present are not permitted.

1. Increasing the area based on the presence of sprinklers is not permitted.
2. Eliminating the flame barrier between glazed units based on the presence of sprinklers is not permitted.
3. Allowing glazed units to be placed over 75 feet above grade level based on the presence of sprinklers is not permitted.

SECTION 2609 LIGHT-TRANSMITTING PLASTIC ROOF PANELS

Modifications to the minimum requirements of the building code for light transmitting plastics in building roofs

[Modify Sections 2609.1 and 2609.2 as follows:]

2609.1 General. Light-transmitting plastic roof panels(No change to text).....any one of the following conditions:

1. ~~The building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.~~

(No change to Items 2 and 3)

2609.2 Separation. Individual roof panels shall be separated from each other by a distance of not less than 4 feet (1219 mm) measured in a horizontal plane.

Exceptions:

1. ~~The separation between roof panels is not required in a building equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.~~

(No change to Exception 2)

[Modify Section 2609.4 as follows:]

2609.4 Area limitations. Roof panels shall be limited in area and the aggregate area of panels shall be limited by a percentage of the floor area of the room or space sheltered in accordance with Table 2609.4.

Exceptions:

1. ~~The area limitations of Table 2609.4 shall be permitted to be increased by 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.~~

(No change to Items 2 through 4)

**SECTION 2610
LIGHT-TRANSMITTING PLASTIC SKYLIGHT
GLAZING**

[Modify Sections 2610.4, 2610.5 and 2610.6 as follows:]

simply because sprinklers are present are not permitted.

C2609.1 General [ER]. Light transmitting panels should not be permitted in roof assemblies simply due to the presence of sprinklers.

C2609.2 Separation [ER]. The distance between light transmitting panels should not be permitted to be decreased in roof assemblies simply due to the presence of sprinklers.

C2609.4 Area limitations [ER]. The area of light transmitting panels should not be permitted to be increased in roof assemblies simply due to the presence of sprinklers.

**SECTION 2610
LIGHT-TRANSMITTING PLASTIC
SKYLIGHT GLAZING**

Modifications to the minimum requirements of the building code for light transmitting plastic skylight glazing in building roofs simply because sprinklers are present are not permitted.

2610.4 Maximum area of skylights. Each skylight shall have a maximum area within the curb of 100 square feet (9.3 m²).

Exception: ~~The area limitation shall not apply where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or the building is equipped with smoke and heat vents in accordance with Section 910.~~

2610.5 Aggregate area of skylights. The aggregate area.....(No change to text).....materials are utilized.

Exception: ~~The aggregate area limitations of light-transmitting plastic skylights shall be increased 100 percent beyond the limitations set forth in this section where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or the building is equipped with smoke and heat vents in accordance with Section 910.~~

2610.6 Separation. Skylights shall be separated from each other by a distance of not less than 4 feet (1219 mm) measured in a horizontal plane.

Exceptions:

- ~~1. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.~~

(No change to Exception 2)

CHAPTER 27 ELECTRICAL

[Add new Section 2703 as follows:]

SECTION 2703 ELECTRICAL OUTLETS AND RECEPTACLES

2703.1 Type. Electrical outlets and receptacles shall not have push-in type connections located on the back of the outlet or receptacle.

2703.2 Installation. Connections between the electrical conductors' and the outlet or receptacle shall be made with

2610.4 Maximum area of skylights [ER]. The area of light transmitting plastic skylight glazing should not be permitted to be increased in roof assemblies simply due to the presence of sprinklers.

2610.5 Aggregate area of skylights [ER]. The aggregate area of light transmitting plastic skylight glazing should not be permitted to be increased in roof assemblies simply due to the presence of sprinklers.

2610.6 Separation [ER]. The distance between light transmitting plastic skylight glazing should not be permitted to be decreased in roof assemblies simply due to the presence of sprinklers.

CHAPTER 27 ELECTRICAL

Electrical fires due to shorts or surges tend to occur in concealed spaces resulting in considerable fire damage before detection. The resultant repair or the removal, disposal and replacement of materials due to structure fire are not consistent with the premise of sustainability.

SECTION 2703 ELECTRICAL OUTLETS AND RECEPTACLES

C2703.1 Type [ER]. This modification is intended to insure more secure connections at electrical receptacles.

C2703.2 Installation [ER]. This modification is intended to insure more secure connections at electrical receptacles.

screw-wired connections in accordance with the manufacturer's installation requirements.

[Add new Section 2704 as follows:]

SECTION 2704
SURGE PROTECTION

2704.1 Electrical Service. Electrical services shall be protected with a minimum of 80 kA surge protection installed in accordance with NFPA 70 and the manufacturers' installation instructions.

CHAPTER 28
MECHANICAL

[No modifications to Chapter 28.]

CHAPTER 29
PLUMBING

[Add new Section 2903 as follows:]

SECTION 2903
FLOOR DRAINS

2903.1 Floor drains. Where a water supply is provided to faucets with hose bibbs or hose-connected outlets the room shall be provided a floor drain located to drain the entire floor area.

Exception. In laundry rooms where the only hose connections supply the washing machine and a the washing machine is protected by a drain pan connected to the sanitary drainage system of the building.

SECTION 2704
SURGE PROTECTION

C2704.1 Electrical Service [ER]. This modification provides increased surge protection for the electrical service to sustainable buildings. This protection is especially important where there are abrupt changes to the electrical service the building whether due to disasters or intermittent power fluctuations. These minimum criteria are consistent with those of the Institute for Business and Home Safety¹³.

CHAPTER 28
MECHANICAL

CHAPTER 29
PLUMBING

SECTION 2903
FLOOR DRAINS

Water is essential to humans however it can also be one of the more challenging elements for sustainable buildings. When water is not properly contained within a building it can result in significant damage. Moisture damage can jeopardize a material's ability to provide its intended function which may be in the form of deterioration, dimensional changes, or degradation of thermal, acoustical or other properties. The damage may not be limited to the direct moisture effects to organic materials but also may result in the growth of mold and mildew. The resulted cleaning, repair, or the removal, disposal and replacement of materials are not consistent with the premise of sustainability. The modifications to 2903 and 2904 are intended to reduce the risk of water damage.

C2903.1 Floor drains [MR]. In rooms where hose connections are installed the potential for inadvertent release of large quantities of water exist. This tends to be serious when related to hose or connector failures. To reduce the impact from the water release these provisions require a floor drain in rooms with hose bibbs or hose connected outlets. Assur-

¹³Fortified.....for Safer Living Builders Guide, Institute for Business and Home Safety, 2008

2903.2 Public toilet rooms, janitors closets and utility rooms. Where floor drains are required in public toilet rooms, janitors closets and utility rooms, the drain outlet shall not be less than 3 inches (76 mm) in diameter.

[Add new Sections 2904 as follows:]

SECTION 2904 FREEZE PROTECTION

2904.1 Water pipe protection from freezing. In severe exposure areas in Figure 1904.2 water, soil and waste pipes shall not be exposed to freezing temperatures. Pipes shall not be concealed in exterior walls, or installed in attics or crawl spaces. Providing freeze protection using insulation or heat shall not be permitted.

[Add new Section 2905 as follows:]

SECTION 2905 BUILDING WATER CONSERVATION

2905.1 Building water conservation. All plumbing fixtures, food service operations, appliances and special water using devices used in the building shall be in accordance with the requirements of Section 6.3.2 of ASHRAE 189.1.

[Add new Section 2906 as follows:]

SECTION 2906 WATER METERING

2906.1 Water metering. The domestic water supply system shall be equipped with measurement and remote commu-

ing adequate drainage of water also reduces the propagation of mold and mildew growth.

The exception recognizes that drain pans connected to an appropriate drainage system are deemed to provide adequate protection from water spills and leakage related to washing machines.

C2903.2 Public toilet rooms, janitors closets and utility rooms [MR]. Public toilet rooms, janitor closets and utility rooms are often exposed to water during use. This change insures that drains of increased size are provided in these spaces to further reduce the risk of damage to the room enclosure from water.

SECTION 2904 FREEZE PROTECTION

C2904.1 Water pipe protection from freezing [MR]. Water pipes located in areas subject to freezing are subject to rupture and can cause water damage to buildings. This provision prohibits locating the water piping in wall cavities or unheated spaces if the building is located in areas subject to continuous freezing conditions. The International Plumbing Code (IPC) permits the use of insulation or heat or a combination of both to protect pipes located in areas subject to freezing. This is not recommended for sustainable buildings in freezing climates unless adequate safeguards are provided to prevent freezing during power outages.

SECTION 2905 BUILDING WATER CONSERVATION

C2905.1 Building water conservation [WC]. Water is a precious commodity and in the built environment there are extra precautions that can be taken in the management of water use in the building. The addition of this section is intended to specify the requirements that must be followed in a sustainable building to ensure that water is used in the most efficient manner possible. The provisions include additional requirements for water using plumbing fixtures, food service equipment, and appliances. In addition there are provisions to assist the code user in the use of ornamental water using fixtures such as fountains, pools, and spas.

SECTION 2906 WATER METERING

C2906.1 Water metering [WC]. Water use management is important for the operation of sustainable buildings. Consumption must be known in order to introduce a man-

nication devices to permit monitoring in accordance with Section 6.3.3 of ASHRAE 189.1.

CHAPTER 30 ELEVATORS AND CONVEYING SYSTEMS

SECTION 3004 HOISTWAY VENTING

[Modify Section 3004.1 as follows:]

3004.1 Vents required. Hoistways of elevators and dumb-waiters penetrating more than three stories shall be provided with a means for venting smoke and hot gases to the outer air in case of fire.

Exceptions:

1. ~~In occupancies of other than Groups R-1, R-2, I-1, I-2 and similar occupancies with overnight sleeping units, venting of hoistways is not required where the building is equipped throughout with an approved automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.~~

(No change to Exceptions 2 through 4)

[Add new Section 3009 as follows:]

SECTION 3009 ENERGY SAVINGS

agement plan. These provisions require that the building water supply system be equipped to monitor potable and reclaimed water use.

Criteria for monitoring of water usage in buildings are addressed in ANSI/ASHRAE/USGBC/IES Standard 189.1, *Standard for the Design of High Performance Green Buildings Except Low-rise Residential Buildings* (ASHRAE 189.1). ASHRAE 189.1 contains provisions that go beyond the current responsibility of most building departments addressing items and setting criteria that are applicable after the issuance of the Certificate of Occupancy (CO) for the building. Such standard requirements are useful to assure proper operation of buildings but are not necessarily appropriate for building code requirements even for sustainable buildings. Thus this document limits the requirements of ASHRAE 189.1 to those that assure the building is equipped for monitoring water use prior to the issuance of the CO.

CHAPTER 30 ELEVATORS AND CONVEYING SYSTEMS

SECTION 3004 HOISTWAY VENTING

3004.1 Vents required [ER]. The building code requires vents to be installed on hoistways of elevators to vent smoke and hot gases to the outside in the event of a fire within the shaft. The code also permits the vent to be eliminated if the building is sprinklered. The presence of sprinklers does not negate the need to vent smoke and hot gases from the hoistways. If unvented, smoke and hot gases may accumulate in the hoistway and migrate to other floors. This change eliminates the exception to venting for sprinklers. See discussion on ENHANCED FIRE SAFETY at the beginning of Chapter 4.

SECTION 3009 ENERGY SAVINGS

Continuous operation of equipment and lighting for elevators, escalators and other conveying systems when not in use unnecessarily consumes energy. This is not consistent

3009.1 Elevators. Elevators shall comply with the lighting, ventilation power and standby mode provisions of Section 10.4.3 of ASHRAE 90.1.

3009.2 Conveying systems. Escalators and moving walkways shall be equipped with the capability to slow down or stop when detectors indicate no traffic within the previous 5 minutes.

CHAPTER 31 SPECIAL CONSTRUCTION

[No modifications to Chapter 31.]

CHAPTER 32 ENCHROACHMENTS INTO THE PUBLIC RIGHT-OF-WAY

[No modifications to Chapter 32.]

CHAPTER 33 SAFEGUARDS DURING CONSTRUCTION

[Add new Section 3314 as follows:]

SECTION 3314 **MOISTURE CONTROL**

3314.1 General. Control of moisture in materials during construction shall be implemented in accordance with this section.

with the basic premise of sustainable buildings. The changes in this section reduce energy use for elevators and other conveying systems.

3009.1 Elevators [EC]. ANSI/ASHRAE/IES Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings* (ASHRAE 90.1) is referenced here since it has provisions to reduce energy use for elevators if they remain unoccupied for at least 15 minutes. It also has provisions that set maximum levels for lighting and ventilation fan power.

3009.2 Conveying systems [EC]. Escalators that run continuously without riders waste energy. To save energy, this section requires escalators in sustainable buildings to be equipped with motion detectors to slow down or stop after 5 minutes of inactive use by pedestrians.

CHAPTER 33 SAFEGUARDS DURING CONSTRUCTION

SECTION 3314 **MOISTURE CONTROL**

C3314.1 General [IQ]. The presence of moisture may have deleterious effects on the performance of some building materials. This is generally addressed in referenced standards governing the materials being incorporated into the building. The effects of moisture may not only be limited to the performance of the building materials but may also negatively impact the interior environment. Two requirements are added to the code to address moisture control.

3314.1.1 Storage, handling and installation. Materials susceptible to damage from moisture exposure shall be protected from moisture during storage, handling and installation in accordance with referenced standards. Where referenced standards do not address moisture protection then the manufacturer's recommendations shall be followed.

3314.1.2 Mold or mildew on material. Organic materials with visible biological growth shall not be installed on or in the building. Where visible biological growth appears on organic materials after installation but prior to issuance of a certificate of occupancy, such materials shall be cleaned and dried or removed and replaced.

[Add new Section 3315 as follows:]

SECTION 3315 INDOOR AIR QUALITY

3315.1 General. Indoor Air Quality (IAQ) provisions during and following construction shall be implemented in accordance with ASHRAE 189.1 Section 10.3.1.4.

CHAPTER 34 EXISTING STRUCTURES

[No modifications to Chapter 34.]

CHAPTER 35 REFERENCED STANDARDS

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in Section 102.4.

C3314.1.1 Storage, handling and installation [IQ]. For many materials referenced standards address moisture protection. However, referenced standards may not address the storage, handling and installation of all materials. Where these provisions are absent this section requires protection be provided in accordance with manufacturer's recommendations.

C3314.1.1.2 Mold or mildew on materials [IQ]. Mold or mildew may begin growing on the exposed surfaces of organic materials prior to installation. The mold may continue to grow and become a health hazard for the occupants if introduced into the built environment. Where organic materials are installed before the moisture has been reduced to acceptable levels mold and mildew may propagate even after installation. This section requires organic materials with visible signs of biological growth to either be cleaned and dried, or removed and replaced. Where cleaning and drying is used to remove mold and mildew from wood framing, drying the wood to a moisture content of 19 percent is consistent with the requirements for incorporating wood framing into structures in Chapter 23.

SECTION 3315 INDOOR AIR QUALITY

3315.1 General [IQ]. Mechanical systems in sustainable buildings should have a complete cleanout prior to being placed into service. If this is not done, airborne foreign matter may be introduced into the built environment resulting in poor indoor air quality. To minimize the effect of newly functioning HVAC equipment, this section has been added to the code to specify requirements to operate the system in a manner necessary to "flush out" undesirable particulates from the duct system and air handlers before the system is placed into operation with building occupants present.

CHAPTER 34 EXISTING STRUCTURES

CHAPTER 35 REFERENCED STANDARDS

This document is based on numerous technical resources that have been developed or are in the process of technical review for use in other building regulations and standards for sustainable buildings or to improve energy efficiency. Notably, because they are in many different forums, they are not available in a single source location. That is one of the purposes of a code amended by these requirements. It is a compilation of these scattered requirements in one document. The additions to Chapter 35 identify the other

[The following standards are in addition to those in the IBC. Underlining has been omitted for clarity:]

sources of material used in whole or part to provide for the regulatory application of this code.

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 1791 Tullie Circle NE, Atlanta, GA 30329, United States 1-404-636-8400;	
Standard reference number	Title	Referenced in code section number
ASHRAE/IES Standard 90.1-2010	Energy Standard for Buildings Except Low-Rise Residential Buildings	1303.1.1.1, 3009.01
ASHRAE Standard 62.1-2007 2010	Ventilation for Acceptable Indoor Air Quality	1203.1
ASHRAE/USGB/IES Standard 189.1-2009-2011	Standard for the Design of High Performance Green Buildings Except Low-Rise Residential Buildings	809, 1203.1, 1203.5, 1204.2, 1301.1.1, 1302.1, 1302.2, 1302.2.2, 1507.17, 2906.1,
ASTM	ASTM International 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959	
Standard reference number	Title	Referenced in code section number
C1371-04a (2010e)	Standard Test Method for Determining Emittance Materials Near Room Temperature Using Portable Emmissometers	1410.2.2
C1549-09	Standard Test Method for Determining Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer	1410.2.2
E408-13	Standard Test Method for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques	1410.2.2
E413-10	Classification for Rating Sound Insulation	1207.2
E1332-10a	Standard Classification for Rating Outdoor-Indoor Sound Attenuation	1207.2
E1918-06	Standard Test Method for Determining Solar Reflectance of Horizontal and Low-sloped surfaces in the Field.	1410.2.2
E1980- 11	Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces	1410.2.2
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora International Environment House 11 Chemin des Anémones, CH-1219 Châtelaine, Geneva, Switzerland	
Standard reference number	Title	Referenced in code section number
CITES 1973, amended 1979 and 1983	Convention on International Trade in Endangered Species of Wild Fauna and Flora	2309.1
FM	Factory Mutual Global Research Standards Laboratories Department 1301 Atwood Avenue, P.O. Box 7500, Johnston, RI 0291	
Standard reference number	Title	Referenced in code section number
1-28, 2012	Wind Design	1504.3
1-29, 2010	Roof Deck Securement And Above-Deck Roof Components	1504.3, 1504.4
4435-13	Approval Standard for Edge Systems Used With Low Slope Roofing Systems	1504.5
4450-89	Approval Standard for Class 1 Insulated Steel Deck Roofs	1504.3
4470-12	Approval Standard for Single Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction	1504.3
4471-10	Approval Standard for Class 1 Panel Roofs	1504.3
4473-11	Test Standard for Impact Resistance testing of Rigid Roofing Materials by Impacting with Freezer Ice Balls	1408.3.2.2, 1507.1.1
4474-11	American national Standard for Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or negative Differential Pressures	1504.3
UL	Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, IL 60062	
Standard reference number	Title	Referenced in code section number
UL 2218-10	Impact Resistance of Prepared Roof Covering Materials.	1405.14.2 1408.2.2 1507.1.1

**APPENDIX A
EMPLOYEE QUALIFICATIONS**

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

[No modifications to Appendix A]

**APPENDIX B
BOARD OF APPEALS**

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

[No modifications to Appendix B]

**APPENDIX C
GROUP U—AGRICULTURAL BUILDINGS**

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

[No modifications to Appendix C]

**APPENDIX D
FIRE DISTRICTS**

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

[No modifications to Appendix D]

**APPENDIX E
SUPPLEMENTARY ACCESSIBILITY
REQUIREMENTS**

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

[No modifications to Appendix E]

**APPENDIX F
RODENTPROOFING**

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

**APPENDIX F
RODENTPROOFING**

[GA] Rodent infestation resistance is necessary to reduce the potential for damage and use of pesticides over the life of the

APPENDIX G FLOOD-RESISTANT CONSTRUCTION

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

[Modify Section G1001.6 as follows:]

G1001.6 Protection of mechanical, plumbing and electrical systems. Mechanical, plumbing and electrical systems, including plumbing fixtures and utility connections, shall be elevated ~~to or~~ above the design *flood* elevation. Vertical runs shall be protected by columns or other structural elements that are not part of any break away wall system and shall not be connected to any break away elements.

(No changes to the Exception)

APPENDIX H SIGNS

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

[No modifications to Appendix H]

building. Damage can significantly affect the performance of building materials. Plastics, wood and insulation are especially susceptible to rodent damage. In addition, the use of pesticides and other measures to eradicate infestations can have a negative impact on human health and comfort.

The amount of energy and resources required for repair and replacement when rodent infestations occur can be significant. To provide for increased safety to occupants and minimize damage, buildings should be designed and constructed in a manner that at least satisfies the requirements of the Appendix F. The use of Appendix F remains optional in the IBC and thus will not be required in many jurisdictions. While these requirements only become mandatory if a jurisdiction includes Appendix F within the ordinance for code adoption, a sustainable building should not be readily susceptible to rodent infestations. Following the Appendix F criteria should be a prerequisite for sustainable buildings regardless of mandatory code language.

APPENDIX G FLOOD-RESISTANT CONSTRUCTION

[GA] Floods are destructive and result in costly cleaning, repairing or removal and replacement of building components. As discussed in the commentary to Section 1612, Flood Loads, sustainable building should not be readily susceptible to flood damage. The criteria of Appendix G complement the new provisions set forth in Section 1612. While the use of Appendix G remains optional in the IBC and thus will not be required in many jurisdictions, the criteria of Appendix G should be a prerequisite for sustainable buildings regardless of mandatory code language.

CG1001.6 Protection of mechanical, plumbing and electrical systems [ER]. Mechanical, plumbing and electrical components attached to elements designed to break-a-way during flood conditions can be damaged and service disrupted. This section provides protection for those components and prohibits them from being attached to break-a-way elements of the building. Protecting these systems from damage and maintaining service is consistent with the premise of sustainable buildings.

APPENDIX I PATIO COVERS

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

[No modifications to Appendix I]

APPENDIX J GRADING

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

[No modifications to Appendix J]

APPENDIX K ADMINISTRATIVE PROVISIONS

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

[No modifications to Appendix K]

APPENDIX L EARTHQUAKE RECORDING INSTRUMENTATION

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

[No modifications to Appendix L]

APPENDIX M TSUNAMI-GENERATED FLOOD HAZARD

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

APPENDIX L EARTHQUAKE RECORDING INSTRUMENTATION

[GA] Appendix L requires seismic instrumentation in high seismic areas for buildings that are six or more stories. The requirements of the appendix facilitate the evaluation of the amount of damage corresponding to actual movements experienced in a seismic event. This is important to appropriately implement repair, or the removal, disposal and replacement of materials. Appendix L of the IBC is only applicable where specifically included by the adopting agency. In this document Appendix L remains optional, however the information to assess damage is important to the restoration and repair processes and should be a prerequisite for sustainable buildings regardless of mandatory code language.

APPENDIX M TSUNAMI-GENERATED FLOOD HAZARD

[GA] Appendix M sets minimum criteria for essential facilities and other buildings and structures that represent a substantial hazard to human life in the event of failure during a tsunami. This includes buildings such as hospitals, police stations, fire stations, emergency shelters and power generation stations. The requirements are only applicable in tsunami prone areas as identified by the applicable State agency or the National Oceanic and Atmospheric Adminis-

[No modifications to Appendix M]

[Add new Appendix N as follows:]

APPENDIX N
MATERIAL RESOURCE
MANAGEMENT

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance. This Appendix provides the minimum requirements for material resources. Upon adoption they shall become part of the requirements regulating building sites in conjunction with building code requirements for life safety, property protection, and safety to emergency responders for buildings and related structures.

tration (NOAA). The criteria enhance life safety and reduce the amount of repair, or the removal, disposal and replacement of materials when tsunamis occur. While these criteria remain optional, they are consistent with the premises of sustainability and should be incorporated in the design and construction of sustainable buildings regardless of mandatory code language.

APPENDIX N
MATERIAL RESOURCE
MANAGEMENT

[GA] This appendix is intended for adoption by state and local jurisdictions that desire to set minimum requirements for materials resources in their building code. Included in this Appendix are criteria for construction waste management and material resource management. While the provisions in this appendix are optional for code adoption, the concepts are consistent with the basic premises of sustainability regardless of mandatory code.

Also included are minimum levels of pollution prevention [See Section CN104 Pollution Prevention] related to extracting, harvesting, processing, and manufacturing materials, products, and assemblies intended for use in sustainable buildings. These provisions require compliance with federal rules and regulations of the United States as minimum levels related to environmental protection. Even though it is not uncommon for state and local jurisdictions to require materials and products in compliance with federal or more strict regulations, some individuals and organizations have suggested that the pollution prevention provisions of this Appendix may be interpreted as being in conflict with the intent of free trade agreements of the World Trade Organization (WTO), of which the United States is a member. Due to this possible interpretation, the information on material resources is intentionally limited to adoption as an appendix. In jurisdictions that may interpret these requirements as causing such a conflict, and therefore do not adopt this appendix, it is still recommended that design professionals consider the intent of these provisions in their construction documents, including, but not limited to their product specifications.

SECTION N101 **GENERAL**

N101.1 Scope. The provisions of this Appendix shall control the supplementary requirements for material resources used in the construction of sustainable buildings.

N101.2 Design. Technical requirements for items herein shall comply with this Appendix and this Code.

Exception: The material resource management criteria provided in Section N103 and pollution prevention criteria provided in Section N104 are not required where the design methodology includes a whole building life cycle assessment (LCA). The LCA shall as a minimum include all materials used in the building that are listed in N101.3.

N101.3 Materials. The provisions of Sections N103 through N105 are applicable to materials within the scope of the following chapters of this Code:

N101.3.1 Chapter 8 Interior Finishes,

N101.3.2 Chapter 9 Fire Protection – Pipes only,

N101.3.3 Chapter 14 Exterior Walls,

SECTION N101 **GENERAL**

CN101.1 Scope [MR]. Today, it is generally recognized that building operations have the most significant impact on the environment. Building product selection based on occupancy, intended use, design, construction, serviceability, and community impact typically accounts for about 5 percent of the total environmental impact of a building. The relative environmental impact of building products will tend to become more significant as building design, construction, and operations continue to conserve more energy and water. Thus, it is appropriate to have provisions related to material resources incorporated into the design of sustainable buildings.

There are various levels and capabilities related to sustainable practices for extracting or harvesting, processing and manufacturing materials and products. This appendix is offered to set a minimum level of practices suitable for materials used in sustainable buildings.

CN101.2 Design [MR]. As important as they may be, it is inappropriate for sustainability requirements to conflict with code provisions regarding life safety, property protection and the welfare of the general public. This section requires that the more stringent provisions of this appendix or the building code shall apply in the design and construction of sustainable buildings.

The exception permits the use of more sophisticated methods of determining the environmental impacts of building products achieved by incorporating whole building life cycle assessment into the design process. Such assessments typically compare initial project designs to alternative designs incorporating products that have less negative impact on the environment. These detailed analyses are preferable to the more prescriptive approach contained in this document for identifying and giving credit for environmental benefits of products. Only a prescriptive approach is provided in this appendix because the required information for sophisticated assessments is not currently available for many products; the more detailed approach is beyond the capability of some design firms; sophisticated analysis may not be cost justified for some projects; and appropriate standardized requirements for comparing base-case buildings to alternative designs may still require further refinement.

CN101.3 Materials [MR]. All building materials have some degree of environmental impact. Building materials identified in this Section tend to have the most significant overall impact simply because they constitute the majority of the products, components, and systems of the building. While the provisions are applicable to all components of most building systems; only the wiring and conduit materials are included for electrical systems, ductwork included

N101.3.4 Chapter 15 Roof Assemblies and Rooftop Structures,

N101.3.5 Chapter 19 Concrete,

N101.3.6 Chapter 20 Aluminum,

N101.3.7 Chapter 21 Masonry,

N101.3.8 Chapter 22 Steel,

N101.3.9 Chapter 23 Wood,

N101.3.10 Chapter 24 Glass and Glazing,

N101.3.11 Chapter 25 Gypsum Wallboard and Plaster,

N101.3.12 Chapter 26 Plastic,

N101.3.13 Chapter 27 Electrical – Wiring and conduit only,

N101.3.14 Chapter 28 Mechanical Systems – Ductwork only,

N101.3.15 Chapter 29 Plumbing Systems - Pipes only.

N101.4 Calculations. All calculations within this appendix are intended to be aggregate of all materials, components, and systems identified in Section N101.3.

SECTION N102 **DEFINITIONS**

N102.1 General. The following words and terms shall, for the purpose of this appendix and as used elsewhere in this Code, have the meanings shown herein..

BIO-BASED. Material that complies with the minimum bio-based content of 7 CFR Part 2902; contains the “USDA Certified Bio-based Product” label; or are composed of solid wood, engineered wood, bamboo, wool, cotton, cork, agricultural fibers, or other bio-based materials.

BIO-BASED WOOD. Wood material obtained from sources proven legal and which practice sustainable (environmentally preferable) forest management as verified through accredited, independent, third-party certification bodies. Wood materials and products include, but are not limited to, structural framing and general dimensional framing, flooring, sub-flooring, wood doors and finishes. Acceptable forest management certification bodies are those with principles, criteria, and standards developed using ISO/IEC Guide 59 or TBT.

INDIGENOUS. Material that is regionally extracted or harvested, processed, and manufactured.

MATERIAL. Ingredient, product, component, or system that constitutes all or a portion of an element incorporated

for mechanical systems, and pipes included for plumbing and automatic sprinkler systems.

These limitations for electrical, mechanical, plumbing and automatic sprinkler systems are permitted to avoid conflicts with the sustainability benefits provided by specific components such as controls, fixtures, and equipment. This allows for more informed decisions regarding the environmental impact for such components and systems. For example, improvements in and availability of specific equipment efficiencies for HVAC or flow rates for plumbing fixtures may have more significant impact on overall building performance than can be obtained by satisfying the material resource requirements.

in the building during construction.

MINIMIZATION THROUGH DESIGN. *Material that is eliminated, reduced or replaced through sustainable building design practices.*

MINIMIZATION THROUGH MANUFACTURE. *Material that is eliminated, reduced, or replaced through sustainable manufacturing practices.*

POST-CONSUMER RECYCLED CONTENT. *Material containing recycled content where recycled content has been used in previous construction or has otherwise been provided to manufacturers or assemblers after use by consumers.*

PRE-CONSUMER RECYCLED CONTENT. *Material containing recycled content where recycled content consists of materials or products diverted from the waste stream or are by-products from manufacturing or fabrication processes or excess materials diverted from disposal.*

RECYCLABLE. *Material that may be recycled multiple times.*

REUSED. *Material that has been salvaged or refurbished.*

REUTILIZED. *Material that is re-worked, re-ground, or excess or scrap material capable of being returned as feedstock into the same process that generated the excess or scrap material.*

SECTION N103 MATERIAL RESOURCE MANAGEMENT

N103.1. Total material resource factor, MR_T . The total material resource factor, MR_T , shall comply with this section and all of the following.

1. The resource value for each individual building material shall be determined in accordance with Section N103.2.
2. MR_T shall be calculated using Equation N103.1.
3. MR_T shall be at least 0.55.
4. MR_T shall be calculated using the aggregate resource values of all *materials* identified in Section N101.3.
5. A single *material* in a specific application is only permitted to be used as one resource value in Equation N103-1.

$$\underline{MR_T} = \frac{[\underline{\Sigma R_B} + \underline{\Sigma R_C} + \underline{\Sigma R_D} + \underline{\Sigma R_I} + \underline{\Sigma R_M} + 1.5 \underline{\Sigma R_O} + \underline{\Sigma R_R} + 2.0 \underline{\Sigma R_U}]}{\underline{V_T}} \quad \text{(Equation N103-1)}$$

Where:

MR_T = Total material resource factor.

R_B = Bio-based resource value expressed in dollars.

R_C = Recyclable resource value expressed in dollars.

R_D = Minimization through design resource value expressed in dollars.

R_I = Indigenous resource value expressed in dollars as determined in Section N103.1.1.

R_M = Minimization through manufacture resource value expressed in dollars. The R_M shall not include recycled content.

R_O = Post-consumer recycled content resource value expressed in dollars.

R_R = Pre-consumer recycled content resource value expressed in dollars as determined in Section N103.1.2.

R_U = Reused resource value expressed in dollars.

V_T = Total dollar value of *materials*.

SECTION N103 MATERIAL RESOURCE MANAGEMENT

CN103.1 Total material resource factor, MR_T [MR]. Managing material resources is a common method for recognizing the sustainability attributes of building products. Bio-based materials, recyclable materials, minimization of materials through design, indigenous materials, minimization of materials through manufacture, post- and pre-consumer recycled content, and reused materials are typically used to reduce negative environmental impacts. This section uses a total materials resource factor, MR_T , to account for the sustainability attributes of building products.

The concept of this approach is consistent with approaches used in other documents addressing sustainability attributes of products. This approach requires an inventory of materials and products used in the building combined with a quantification of sustainable attributes that may be assigned to each material or product. More refined approaches may be developed in the future, but there continues to be difficulties in tracking and obtaining information necessary for many of these more refined and sophisticated approaches. As previously discussed in CN101.2, the use of

life cycle assessment models based on environmental product declarations is preferable.

Dollar value - Some documents addressing materials resources permit evaluations using weight, volume, or cost. The provisions within this document are restricted to the weighted average dollar value of materials. Basing the material resource factor on dollar value overcomes inequities that result when weight or volume are used. This is especially important for smaller projects. For example, where locally available concrete satisfies the criteria for being an indigenous product and is used for the foundation system and slab-on-ground, the concrete itself may have adequate volume or weight to satisfy the materials resource management criteria for the entire project. This is clearly not consistent with the basic premise of sustainability. Using dollar value is the only approach for determining the total material resource factor that encourages the use of materials with sustainable attributes throughout the entire project. Alternatively, a more appropriate but potentially more complex approach might be to satisfy specific material resource targets for each component of the building separately. Such an approach would strive to reach targets for foundation systems, above grade opaque walls, fenestration systems, roof/ceiling assemblies, plumbing systems, etc. and could then be appropriately addressed using volume, weight or cost, whichever is the most appropriate measure for the respective systems.

It should be noted that while using dollar value is preferable to using weight or volume for the reasons stated, dollar value, too, may not provide sufficient detailed information to adequately account for differences in use and fabrication. For example, there are significant differences in the dollar value per amount of material depending whether steel is provided as concrete reinforcing, hot-rolled structural members, cold-formed framing, or door frames. The fabrication costs of steel door frames dramatically shifts the weighting of recycled content toward recycled steel used in door frames and may not be the most appropriate way to influence environmental impacts for sustainable buildings. Again the exception in Section N101.2 permits more sophisticated analyses using whole building life cycle assessment (LCA).

There is a benefit to using materials with sustainable attributes in any project. However, for sustainable buildings these materials should constitute over half of the dollar value of all materials incorporated into the design. Thus the dollar value of building materials with sustainability attributes is set to be at least 55% of the total dollar value for all building materials used on the project.

Aggregate material – The sustainability attributes of any material used in the building should be appropriately considered. The total material resource factor used in this approach accomplishes this by; 1) weighting the sustainability attributes of each material, and 2) evaluating all contributions as an aggregate of all materials used in the building. Each resource value is based on the summation of dollar values for all materials contributing to a specific sustainable attribute. For example, the bio-based resource value may include the contributions of oriented strand board (OSB), dimensional lumber, glue laminated members and bamboo flooring.

The sustainability attributes of some materials are far more significant than those of others. For example, hot-rolled structural steel may have a 90% recycled content and 100% of the concrete may be indigenous. Whereas, the dollar value of fly ash used as a supplementary cementitious material may be relatively insignificant. Thus it is recommended that the user first consider materials with large sustainable attributes to satisfy the requirements rather than starting with a rigorous evaluation of the sustainability attributes of every product in the project.

Double dipping – Though some materials may provide multiple sustainable attributes, the intent is to have as many materials with sustainable attributes as possible incorporated into a sustainable building. Concrete for a floor slab may qualify as recyclable and indigenous but is not permitted to be counted as satisfying more than one sustainability attribute. Similarly hot-rolled structural steel may have 90% recycled content but is also a 100% recyclable. The contribution of the hot-rolled structural steel is maximized by using it as the resource value for recyclable content.

Bio-based materials - Bio-based materials and wood products are defined in the definitions section of this document. The use of bio-based materials is generally recognized as providing sustainability attributes to the building. Any portion of a material, product, component or system that is constituted of bio-based materials and wood products as defined in this document may be considered in determining the total material resource factor material. The resource value for bio-based materials, R_b , is determined using the material content method provided in Section N103.2.1

Recyclable content - The ability to readily recycle building materials after their initial intended use is a sustainable attribute for many building materials. For example most steel, concrete and masonry may be collected after a project is demolished or deconstructed and recycled. For steel this may be returned to a steel manufacturing process to produce new steel products. For concrete and masonry the materials are most commonly crushed and used as aggregate, typically as base materials. Crushed concrete may also be suitable as aggregate to produce new concrete or concrete products. A concrete or concrete product producer should be consulted prior to specifying crushed concrete as aggregate for new concrete. Depending on prior applications crushed concrete may contain foreign materials detrimental to the intended performance in the new application. Generally, the best application for crushed recycled concrete will be as base material or gravel fill. Where projects are deconstructed, salvaged masonry units may be re-used for other projects as discussed later in this section. The resource value for recyclable materials, R_c , is determined by using the material content method provided in Section N103.2.1

Minimization through design. One of the least recognized, but most significant methods to make projects more sustainable is through the elimination, substitution or reduction in the amount of materials necessary to satisfy the occupancy and use requirements of the building. This category of sustainable attributes accounts for design practices that reduce the amount of materials required to satisfy the project requirements. The resource value for eliminating materials through the design process, R_d , is determined using the materials minimization method provided in Section N103.2.2.

For example, consider that an initial design called for the installation of a ceramic tile floor over a concrete floor slab. Changing the concrete floor to a decorative concrete floor can eliminate the ceramic tile, setting bed materials, and grout. In this example, the decorative concrete is considered as the alternative. The decorative concrete requires pigmenting, polishing,

and sealing; none of which would be applied to the concrete floor slab under the ceramic tile. The resource value for minimization through design would be determined as the dollar value of the tile, adhesive, and grout minus the dollar value for pigments and sealers required to achieve the desired concrete finish.

Another example is the use of exposed columns. Concrete columns inherently have structural fire resistance and do not require additional treatments to satisfy the fire protection requirements in the building code. Unlike other columns wrapping concrete columns with framing elements and gypsum wall board is primarily for aesthetic purposes. Thus, where exposed concrete columns are acceptable for the intended aesthetic requirements of the project, the use of wallboard and/or furring or studs can be eliminated. Since there is no additional cost associated with the concrete column, the entire dollar value of the column enclosure system eliminated from the project may be used to determine the minimization through design resource value, R_D . Although not a significant benefit on a column by column basis, leaving columns exposed increases usable floor area which in and of itself is an additional sustainable attribute.

Now consider the use of normal strength and high strength concrete. Assume that the normal strength concrete has a total cementitious material content of 500 lbs. per cu.yd. (297 kg/m³) and the high strength concrete has a total cementitious content of 650 lbs. per cu.yd. (386 kg/m³). Intuitively, and consistent with some prescriptive approaches to sustainability, one would assume the high strength concrete is less sustainable due to the increased dosage of cementitious material. Consider an application where a building has a three-by-three bay configuration, is 20-stories in height, and has a clear-height of 12 feet (3658 mm) per story. For the normal strength concrete the column size is determined to be 30-in. by 30-in (762 mm by 762 mm). For the high strength concrete the column size is determined to be 20-in by 20-in (508 mm by 508 mm). The total volume of all 320 concrete columns designed with normal weight concrete is 889 cu. yd (680 m³). while the total volume for the high strength concrete columns is 395 cu. yds (302 m³). Although there is a higher dosage of cementitious materials in the high strength concrete the total amount of cementitious materials in the high strength concrete building, 128 tons (116,120 kg), is over 40% less than the amount of cement required for the building with columns constructed using normal weight concrete, 222 tons (201,395 kg). The amount of aggregate used in the building with high strength concrete columns is 55% less than that required in the building designed using normal strength concrete for the columns. Thus for determining the dollar value for the resource value for material minimization through design, R_D , would be the reduction in the dollar value of the total volume normal weight concrete minus the additional costs for increasing the dosage of cementitious materials. For this particular example, there are additional benefits related to sustainability. The dead load of the concrete columns is reduced by 55%, 933 tons (846,403 kg) thus the size of the foundation system may also be reduced resulting in a further reduction in concrete used. Too, the total usable floor area is increased by more than 1100 square feet (102 m²) while maintaining the same overall building footprint. This means the occupiable space is increased while the site disturbance remains the same.

Indigenous. See discussion under Section CN103.1.1, Indigenous Material.

Minimization through manufacture. Minimizing materials by altering the product at the point of production can provide significant benefits related to sustainability by eliminating, substituting or reducing the amount of product required or by reducing negative environmental impacts of the material used as ingredients within a product. The resource value for eliminating materials through manufacture, R_M is determined using the materials minimization method provided in Section N103.2.2.

Depending on the specific project requirements and manufacturing techniques, there may be methods to provide products that are more sustainable. Consideration of this approach for improving the sustainability of the materials often requires detailed coordination between the design team and the manufacturer to appropriately consider the project requirements and the capabilities of the manufacturing facility. Often what may be achievable in one facility may not work in another facility producing the same type of product due to differences in manufacturing processes and available raw materials.

For example, at some cement manufacturing facilities, up to five percent of portland cement may be limestone that is inter-ground with the portland cement and still satisfy the product specification requirements for portland cement. Five percent of the portland cement, which tends to be the most expensive ingredient in concrete, may be replaced with limestone that is introduced into the normal cement klinker grinding process. For some projects a portland-limestone cement, containing up to 15% inter-ground limestone, may be used in lieu of 100% portland cement to produce concrete that satisfies the project requirements. These replacements of portland cement using limestone are only practical when inter-ground at the cement manufacturing facility designed to accommodate the process and normally producing a portland cement that is capable of satisfying the product specifications with the inclusion of inter-ground limestone.

Post-consumer content. Converting disposed consumer products and packaging into building products encourages society to continue practices that may not truly be sustainable. This strategy simply provides a solution to an existing problem in a throw-away

society rather than encouraging innovation of more sustainable consumer products and packaging. However, the reality is that this socially accepted practice of recycling has become the norm instead of disposal into landfills. Thus the sustainable benefits for incorporating post-consumer products and packaging into building products are provided for in Equation N103.1. A common application of post-consumer recycling is the use of recycled plastic in the manufacture of carpet.

The post-consumer content resource value, R_o , is determined using the material content method provided in Section N103.2.1. Because this attribute is responsive to such a widely and socially accepted practice, this attribute represented by R_o is multiplied by a factor of 1.5 when calculating the total material resource factor, MR_T .

Pre consumer content – Pre-consumer content is waste or by-products from one industry or process. Flyash from electric power generation is commonly considered pre-consumer content. The sustainability attribute is recognized when the pre-consumer content is incorporated into building materials in lieu of being disposed in landfills. Typically, these pre-consumer recycled materials replace virgin raw materials required to produce a product. Thus, pre-consumer recycled content resource value, R_R , is best determined using Section N103.2.2, Material minimization method.

The use of pre-consumer content materials must be adequately evaluated to determine the effects on overall performance of the building material and the benefits to sustainability. For example, consider the use of flyash in concrete:

1. Only Class C flyash has cementitious properties. Class C flyash is used as a supplementary cementitious material in concrete and commonly replaces a portion of portland cement required. For determining the resource value for pre-consumer recycled content, R_R , the material minimization method is probably the most appropriate method. The resource value would be determined by subtracting the costs associated with processing the flyash from the cost of the portland cement that is replaced by using the Class C flyash.

Class F flyash has no significant cementitious properties. If Class F flyash is used in concrete the primary function in the concrete is replacement of fine aggregate. Thus, the sustainability attribute is essentially limited to landfill avoidance, and is probably best determined using the material content method in Section N103.2.1, Material content method. In this instance the dollar value of the flyash subtracted from the dollar values of the fine aggregate is divided by the total dollar value of cost of the concrete would be used to modify the total dollar value of the concrete.

2. Most flyash available for use in building materials is a by-product from burning coal to generate electric power. Due to stringent emission requirements at power plants flyash may contain unburned coal and other materials that may have deleterious effects on the performance of the concrete. The environmental impacts of processing the flyash, if necessary, and transporting the flyash may not provide any sustainability benefit as compared to simply using traditional cementitious materials.
3. Flyash may only be available in certain regions. In many regions of the United States electric power is generated using natural gas or nuclear fuel or the power is provided from hydro-electric facilities and thus flyash is not readily available. The cost of transporting flyash long distances may not provide any sustainability benefit as compared to simply using traditional hydraulic cements or alternative cementitious materials, such as slag cement.

Reused materials – Reusing materials is clearly one of the most sustainable practices that may be implemented for the design and construction of buildings. Some materials may be reused without any significant modifications. However many materials may need to be modified or otherwise adapted in order to satisfy the requirements for the project. The resource value for reusing materials, R_U , will most commonly be determined using the material minimization method where the costs of modifying the material are subtracted from the dollar value of new materials that would have been used on the project using the calculation provided in Section N103.2.2.

One example might be the reuse of doors from a building that is being deconstructed. The original finish may need to be removed and a new finished applied to satisfy the project requirements. The cost of obtaining and refinishing the reused doors would be subtracted from the dollar value of new doors.

Another example is the reuse of brick. Some brick may be reused, but in order to be reused, it is most likely that old mortar must be removed from the head and bedding surfaces. Prior to reusing brick, the brick should be evaluated to assure that

N103.1.1 Indigenous material. The indigenous resource value, R_i , shall be the cost of indigenous materials satisfying one of the following.

- 1) **Distance to project.** Any material harvested or extracted; processed; and manufactured within a 500 mile (805 km) radius of the project site.
- 2) **Equivalent distance.** Any material harvested or extracted; processed; and manufactured at locations such that the equivalent distance, D_e , as determined using Equation N103-2 does not exceed 500 miles (805 km).

the mortar bond achieved with reused brick will satisfy the performance requirements for the project. The material resource value for reused brick would be the dollar value of new brick minus the cost of making salvaged brick suitable for reuse.

CN103.1.1 Indigenous [MR]. There are multiple sustainability attributes related to the use of regional or indigenous products. The two most significant benefits tend to be reductions in energy required to transport goods and support of the local economy. The most common approach for addressing this concept is to simply limit the distance between the source of the products and the project. This is accomplished by specifying a maximum radius from the project. A 500 mile (805 km) radius from the project is used to identify the boundaries for which a product may be considered regional or indigenous. In most other documents addressing indigenous products, lower fuel consumption and reductions in emissions achieved by using more efficient methods of transportation is accounted for with a single multiplier regardless of the transportation method. The single multiplier is used to increase the distance that products may be transported using more fuel efficient transportation methods. However a study conducted at Iowa State University for the U.S. Department of Agriculture¹⁴ indicated that there is a substantial difference in the fuel efficiency expressed in miles per ton depending on the method of transport and the transportation route. While somewhat more complex than a single multiplier, an equation is provided to better account for specific fuel efficiencies of various transportation methods and routes. This approach uses constants that reflect fuel efficiencies for transport by rail, barges on inland waterways and cargo ships. The most significant differences related to transportation routes are whether the railroad crosses or does not cross the Rocky Mountains and whether barge transportation using inland waterways is upstream or downstream. These variations are also provided for in the equation. The equation is also more accurate than a constant multiplier because it requires consideration of all forms of transport used to get the product from the supplier to the project. Rarely will rail, barge, or cargo ship be used for the entire route. There will typically be a portion of the route that still required transportation by truck. The use of this equation is highly recommended because a single multiplier cannot account for combinations of transportation methods or fuel efficiencies related to methods and routes.

The resource value, R_i , for indigenous materials should be determined using the material content method provided in Section N103.2.1. This method

¹⁴ Estimates of Total Fuel Consumption in Transporting Grain from Iowa to Major Grain Countries by Alternative Modes and Routes, C.P. Baumel, C.R. Hurburghl, and T. Lee, Iowa University, Ames, IA, 20008.

$$D_E = D_{TT} + F_{RR} D_{RR} + F_{IB} D_{IB} + F_{DW} D_{CS} \quad \text{(Equation N103-2)}$$

- D_E = Equivalent distance, in miles (km), as determined for the proposed transportation route
- D_{TT} = Distance *materials* are transported using truck over proposed transportation route, in miles (km).
- F_{RR} = Fuel efficiency factor for transport by railroad shall be as follows:
 $F_{RR} = 0.30$ where transportation route does not cross the Rocky Mountains.
 $F_{RR} = 0.43$ where transportation route crosses the Rocky Mountains.
- D_{RR} = Distance *materials* are transported using railroad over proposed transportation route, in miles (km).
- F_{IB} = Fuel efficiency factor for transport by barge on inland waterway shall be as follows:
 $F_{IB} = 0.88$ where primary direction of transportation route is upstream.
 $F_{IB} = 0.17$ where primary direction of transportation route is downstream.
- D_{IB} = Distance *materials* are transported via inland waterways using barge over proposed transportation route, in miles (km).
- F_{DW} = Fuel efficiency factor for transport by cargo ship shall be based on the dead weight (dwt) of the shipping vessel as follows:
 $F_{DW} = 0.33$ where dwt is $\leq 50,000$ tons (45,400,000 kg).
 $F_{DW} = 0.27$ where dwt is $> 50,000$ tons (45,400,000 kg) and $\leq 70,000$ tons (63,500,000 kg).
 $F_{DW} = 0.22$ where dwt $> 70,000$ tons (63,500,000 kg) and $\leq 100,000$ tons (90,700,000 kg).
 $F_{DW} = 0.18$ where dwt $> 100,000$ tons (90,700,000 kg).
- D_{CS} = Distance *materials* are transported using a cargo ship over proposed transportation route, in miles (km).

N103.2 Determination and use of resource values. Each resource value shall be determined in accordance with Section N103.2.1 or N103.2.2.

is recommended because some portions of a product may not qualify as being indigenous.

The resource value, R_p , for indigenous materials should be determined using the material content method provided in Section N103.2.1. This method is recommended because some portions of a product may not qualify as being indigenous.

CN103.2 Determination and use of resource values, [MR] Some products may inherently satisfy the criteria for multiple resource values. Consistent with Section N103.1, each material is limited to satisfying only one portion of the equation used to determine the total material resource factor, MR_p . This is intentional to help assure that the majority of products used in sustainable buildings possess some sustainability attributes. While these criteria place a restriction on considering multiple sustainability attributes provided by a single product, the designer should place a preference on products that provide multiple sustainability attributes.

This section provides two methods to determine the resource values for the sustainable attributes of building products. Previous discussion suggested suitable methods for determining each resource value. The user however should determine which method optimizes recognition of a building product's sustainable attributes.

N103.2.1 Material content method. Where qualifying materials are a constituent of the building product the resource value for that building material shall be determined using the Equation N103-3.

$$\underline{R_n} = \underline{FP_{QM}} \times \underline{V_t} \quad \text{(Equation N103-3)}$$

Where:

- R_n = Resource value for respective *material* resource, expressed in dollars.
- FP_{QM} = Fractional portion of qualifying material used.
- V_t = Total dollar value of the respective building *material*

N103.2.2 Material minimization method. Where qualifying materials eliminate, substitute or reduce the use of materials, the resource value shall be determined using the Equation N103-4.:

$$\underline{R_m} = \underline{V_s - V_M} \quad \text{(Equation N103-4)}$$

Where:

- R_m = Minimization resource value for *minimization through design or minimization through manufacture*, expressed in dollars.
- V_s = Dollar value of material eliminated, substituted, or reduced.

CN103.2.1 Material content method. [MR] Many approaches intended to achieve enhanced levels sustainability set minimum acceptable thresholds for the portion of the building material that satisfies specific sustainability attributes. For example, some sustainability practices set a minimum post-consumer content for a building material to be at least 25% in order for that building material to qualify as having post-consumer recycled content. The requirements of this section deviate from this approach and allow consideration of the sustainability attributes based on a proportion of total content. While this allows building materials with lower levels of qualifying material content to be considered; more importantly, it places a higher value on building materials that have qualifying material contents above a minimum threshold level.

For a building material having a dollar value of \$10.00 per unit and consisting of 70% recycled content, using the material content method for a 1000 units results in a material resource factor shown below. The dollar value calculated using the material content method is the value applied in the calculation to determine the total material resource factor.

Fractional Portion of Qualifying Material	X	Total Dollar Value of Building Product
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$$0.70 \times 1000 \text{ units} \times \$10.00/\text{unit} = \$7,000.00$$

The dollar value calculated using the material content method is the value applied in the calculation to determine the total material resource factor.

CN103.2.2 Material elimination method. [MR] Elimination, substitution, and reductions of materials may often provide significant sustainability benefits for a project. These eliminations, substitutions, and reductions may occur at the manufacturing or processing facility or through project design. However, modifications are often required where one material is used to eliminate, substitute, or reduce the use of another material. The material elimination method is used to provide a means to offset the costs, if any, required to modify qualifying materials.

For example, consider a building material being eliminated costs \$20.00 per unit. A viable substitution requires modifications to become a qualifying material. The cost of modifications is \$5.00 per unit. Using the material elimination method and

$\frac{V_m}{m}$ = Dollar value of modifications made to qualifying materials.

SECTION N104 POLLUTION PREVENTION

N104.1 General. At least 90% of all building materials used in the building, based on dollar value, shall be in accordance with this section.

N104.2 Pollution Prevention. The minimum criteria for extracting or harvesting, processing and manufacturing to safeguard the environment shall be:

- 1) **Clean Air** - 40 CFR Parts 50-99,

considering 1,000 units are used in the building, the resource value is determined to be:

Dollar Value of Material Eliminated, Substituted, or Replaced	–	Dollar Value of Modifications to Qualifying Material
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$$\$20.00 \times 1000 = \$20,000 \quad - \quad (\$5.00 \times 1000) = \$15000.00$$

SECTION N104 POLLUTION PREVENTION

Pollution prevention has served as the impetus that led to the development of sustainable practices for building design and construction. In the United States this resulted in federal, state and local government regulations. While some countries may have more stringent criteria others may have far less stringent or no criteria. It is important in the design and construction of sustainable buildings to minimize the use of building materials extracted or harvested, and processed and manufactured in a fashion that adhere to some prescribed minimum. This section sets the rules and regulations of the United States as that prescribed minimum. As minimums, these requirements do not supersede other jurisdictional criteria.

CN104.1 General. [MR]. It is important for all building materials used in sustainable buildings to be extracted or harvested, and processed and manufactured using methods that reduce pollution. Unfortunately there may be instances where some products necessary to satisfy specific project requirements may not be compliant with these minimum criteria. Thus this section allows up to 10% of the building materials to be nonconforming.

CN104.2 Pollution Prevention [MR]. Processes for extracting or harvesting, and processing and manufacturing materials in the United States must adhere to the regulations listed in this section. It would be inappropriate to consider building materials that do not satisfy these criteria for use in a sustainable building. This section sets minimum criteria to avoid the use of materials extracted or harvested, and processed and manufactured in compliance with less stringent rules and regulations.

In addition to minimizing the amount of pollution these provisions discourage the use of imported materials where extracting or harvesting, processing, or manufacturing products are less environmentally friendly. This helps assure that sustainable buildings minimize negative environmental impacts globally.

1. **Clean Air.** Specifies that the minimum require-

- 2) Clean Water - 40 CFR Parts 100-149,
- 3) Conservation - 40 CFR Parts 239-282,
- 4) Noise Control - 40 CFR Parts 201-211.

N104.3 Acceptance. A letter from the manufacturer or design professional certifying compliance with this section shall be submitted to the *building official* for approval.

**SECTION N105
CONSTRUCTION WASTE MANAGEMENT**

N105.1 Diversion. Construction waste shall be diverted from landfills or incineration in accordance with the requirements of the ASHRAE 189.1 Section 9.3.1.

ments for air pollution prevention related to extracting or harvesting, processing, and manufacturing materials, components, or systems are in accordance with the United States of America Clean Air Act.

- 2. **Clean Water.** Specifies that the minimum requirements for water pollution prevention related to extracting or harvesting, processing, and manufacturing materials, components, or systems are in accordance with the United States of America Clean Water Act and Amendments.
- 3. **Conservation.** Specifies that the minimum requirements for resource conservation related to extracting or harvesting, processing, and manufacturing materials, components, or systems are in accordance with the United States of America Resource Conservation and Recovery Act.
- 4. **Noise Control.** Specifies that the minimum requirements for noise control related to extracting or harvesting, processing, and manufacturing materials, components, or systems are in accordance with the United States of America Noise Control Act.

CN104.2 Acceptance [MR]. Compliance with these criteria must be demonstrated to the building official. The supplier or manufacturer may provide a letter of compliance stating the facilities involved in extracting or harvesting, processing, and manufacturing are operating with a legal permit within the United States. Alternatively, a letter from the architect or engineer of record stating that the building materials, components, and systems specified are compliant can be submitted. These methods of acceptance are consistent with the methods of acceptance typically used for compliance with building product specification standards.

**SECTION N105
CONSTRUCTION WASTE MANAGEMENT**

CN105.1 Diversion [MR]. Sustainable construction practices should limit the amount of waste that is disposed of in landfills or through incineration. This section sets the minimum levels for diverting excess and waste materials in accordance with ASHRAE 189.1. These provisions indirectly encourage placing a preference on materials that generate less construction waste over those materials that routinely generate large volumes of construction waste. This is an important aspect regarding the design and construction of sustainable buildings that is difficult to address in code requirements. However, material selection should consider the environmental costs of collecting and transporting construction waste. Rather than collecting and transporting waste it is preferable to specify materials that generate little or no waste.

SECTION N106
REFERENCES

<u>ASHRAE</u>	American Society of Heating, Refrigerating and Air-Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329, USA	
Standard reference number	Title	Referenced in code section number
189.1-11	Standard for the Design of High-Performance Green Buildings, Except Low-Rise Residential Buildings	N105.1
<u>GPO</u>	United States Government Printing Office 732 North Capitol St. NW Washington, DC 20401 USA	
Standard reference number	Title	Referenced in code section number
40 CFR Parts 50-99	United States Code of Federal Regulations Title 40 Protection of the Environment, Chapter I, Environmental Protection Agency, Subchapter C Air Programs	N104.2
40 CFR Parts 100-149	United States Code of Federal Regulations Title 40 Protection of the Environment, Chapter I, Environmental Protection Agency, Subchapter D Water Programs	N104.2
40 CFR Parts 239-282	United States Code of Federal Regulations Title 40 Protection of the Environment, Chapter I, Environmental Protection Agency, Subchapter I Solid Wastes	N104.2
40 CFR Parts 201-211	United States Code of Federal Regulations Title 40 Protection of the Environment, Chapter I, Environmental Protection Agency, Subchapter G Noise Abatement Programs	N104.2
<u>ISO</u>	International Organization for Standardization (ISO) 1, ch. de la Voie-Creuse, Case postale 56 CH-1211 Geneva 20, Switzerland	
Standard reference number	Title	Referenced in code section number
ISO/IEC Guide 59-94	Code of Good Practice for Standardization	N102
<u>USDA</u>	United States Department of Agriculture Office of Energy Policy and New Uses Room 361, Reporters Building, 300 Seventh Street, SW Washington, DC 20024, USA	
Standard reference number	Title	Referenced in code section number
7 CFR Part 2902-06	Guidelines for Designating Bio-based Products for Federal Procurement	N102
<u>WTO</u>	World Trade Organization (WTO) Centre William Rappard, Rue de Lausanne 154, CH-1211 Geneva 21, Switzerland.	
Standard reference number	Title	Referenced in code section number
TBT	Technical Barriers to Trade Agreement Annex 3 Code of Good Practice for the Preparation, Adoption and Application of Standards	N102

[Add new Appendix O as follows:]

APPENDIX O **SITWORK**

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

This Appendix provides the minimum requirements for site development. Upon adoption they shall become part of the requirements for regulating building sites in conjunction with building code requirements for life safety, property protection, or safety to emergency responders as related to buildings and related structures.

SECTION O101 **GENERAL**

O101.1 Scope. The provisions of this Appendix shall apply to sitework.

SECTION O102 **DEFINITIONS**

O102.1 General. The following words and terms shall, for the purpose of this appendix and as used elsewhere in this Code, have the meanings shown herein.

EFFECTIVE SHADE COVERAGE. The arithmetic mean of the shade coverage calculated on the summer solstice at 10 a.m., 12:00 p.m., and 3:00 p.m.

SOLAR REFLECTANCE. A measure of the ability of a material's surface to reflect sunlight—including the visible, infrared, and ultraviolet wavelengths—on a scale of 0 to 1. Solar reflectance is also called "albedo."

SECTION O103 **PAVEMENTS FOR VEHICULAR TRAFFIC**

O103.1 General. Pavements intended for vehicular traffic shall be in accordance with the requirements of this section.

APPENDIX O **SITWORK**

[GA] Sitework may have significant impacts on the environment and are thus included in most codes, standards and guides addressing sustainable development, design, and construction. While the provisions in this appendix are optional for code adoption, the concepts are consistent with the basic premises of sustainability regardless of mandatory code language. This Appendix is intended for adoption by state and local jurisdictions that recognize site development as a significant component of sustainable construction. The applications and construction governed by these provisions tend not to be within the purview of most building code departments because they are not typically regarded as a priority nor considered to pertain to life safety, property protection, or safety to emergency responders to the same extent as minimum requirements for buildings and other occupiable structures. This Appendix may require involvement of other officials or special training of officials for appropriate enforcement.

SECTION O101 **GENERAL**

CO101.1 Scope [SD]. Sitework may result in significant negative environmental impacts, especially related to serviceability, heat island effects, stormwater management and lighting requirements. The provisions of this Appendix are intended to apply to sitework of sustainable buildings. The intent of this Appendix is to ensure a minimum amount of safety, environmental protection, and serviceability consistent with the basic premise of sustainability

SECTION O103 **PAVEMENTS FOR VEHICULAR TRAFFIC**

¹⁴American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331, 2008

¹⁵Asphalt Institute, 2696 Research Park Drive, Lexington, KY 40511-8480

Exception: The provisions of this section are not applicable to parking garages.

O103.1.1 Portland cement concrete pavements.

Portland cement concrete pavements shall comply with all of the following:

1. Portland cement concrete pavements shall be in accordance with ACI 330.1.
2. Portland cement concrete pavement thickness shall be a minimum of 4.0 in. (102 mm).
3. An aggregate base is not required for portland cement concrete pavements.

CO103.1 General [SD]. While all hardscapes should comply with appropriate provisions addressing their environmental impacts, this Section is limited to minimum prescriptive requirements for pavements intended for vehicular traffic. It is generally accepted that the composition of paving materials and thickness of pavement elements have the most significant impact on serviceability.

General criteria for the composition of paving materials are often dictated by specific site conditions. Thus, in addition to the standard specifications referenced in this Code, standard industry practice should also be followed. Portland cement concrete pavement recommendations are provided in concrete industry publications.¹⁵ Asphalt concrete pavement recommendations are provided by the Asphalt Institute^{16, 17, 18, 19}

Regardless of the composition of pavement material, pavement thickness is a crucial element to assure a minimum level of serviceability. The respective industries have established recommendations for minimum thickness. The criteria provided in this Appendix are consistent with these recommended thicknesses used of each pavement type and assume good or excellent soil conditions are in place. Where such soil conditions do not exist, the references above may be used to determine appropriate pavement thicknesses.

Some paving systems are not addressed in this document simply because referenceable standards are not available for all construction types and systems. For example, interlocking clay masonry pavers may satisfy the intent of sustainable design and construction, but the lack of a standard developed through a qualified standards development process prohibit the criteria from being referenced in the building code. However, standard industry practice for interlocking clay masonry²⁰ should be considered appropriate and submitted to the building code official for approval. *ASCE T&DI 58-10 Standard Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways* addresses interlocking concrete pavers. These criteria may be supplemented with industry information.²¹

Pavements for parking garages are exempt from the criteria of this Appendix because parking structures are addressed in the body of the code.

CO103.1.1 Portland cement concrete pavements [SD]. Minimum requirements for concrete are pro-

¹⁵ *ACI 330R-08 Guide for the Design and Construction of Concrete Parking Lots*, American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331, 2008.

¹⁶ *A Basic Asphalt Emulsion Manual (MS-19)*, Asphalt Institute, 2696 Research Park Drive, Lexington, KY 40511-8480, 2008

¹⁷ *Model Construction Specification for Asphalt Concrete and Other Plant-Mix Types, (MS-22)* Asphalt Institute, 2696 Research Park Drive, Lexington, KY 40511-8480, 1984,

¹⁸ *Construction of Hot Mix Asphalt Pavements, (MS-22)* Asphalt Institute, 2696 Research Park Drive, Lexington, KY 40511-8480, 2001

¹⁹ *Full Depth Asphalt Pavement for Parking Lots Service Stations and Driveways (IS-91)* Asphalt Institute, 2696 Research Park Drive, Lexington, KY 40511-8480, 1994

²⁰ *Technical Notes for Brick Construction, 14 Series*, Brick Industry Association, 1850 Centennial Park Drive, Suite 301, Reston, VA 20191, <http://www.gobrick.com/Technical-Notes>, last visited August 2014.

²¹ *Tech Spec 18: Construction of Permeable Interlocking Concrete Pavement Systems*, Interlocking Concrete Pavement Institute, 14801 Murdock Street Suite 230, Chantilly, VA 20151

O103.1.2 Asphalt concrete surface on asphalt concrete base. Asphalt concrete pavement shall comply with all of the following:

1. The asphalt concrete surface layer thickness shall be a minimum of 1 in. (25 mm).
2. A tack coat produced of emulsified asphalt shall be applied between the asphalt concrete base and the asphalt concrete surface layer.
3. The thickness of asphalt concrete base shall be a minimum of 3 in. (76 mm).

vided by the American Concrete Institute publication ACI 330.1²² Thus, the only additional requirement is for minimum thickness of the pavement. A base is not required for concrete pavements to satisfy the performance and serviceability criteria for most projects. However, an untreated aggregate base is typically installed to facilitate construction. The minimum thickness of the concrete pavement is provided to ensure a minimum level of serviceability. Selection of the actual thickness of concrete pavement and additional criteria that may be useful in the design and construction, although not written in mandatory language, may be obtained from American Concrete Institute²³

CO103.1.2 Asphalt concrete surface on asphalt concrete base [SD]. Criteria for minimum thicknesses of asphalt concrete surface layers and bases are provided to ensure minimum serviceability consistent with the basic premise of sustainability. The criteria provided here are minimum requirements for asphalt concrete pavements for Traffic Class I, described as parking lots, driveways, light traffic residential streets, and light traffic farm roads. The actual thickness should be determined in accordance recommendations and requirements provide by the Asphalt Institute.²⁴ There are a variety of asphalt concrete mix designs that may be used. These variations include the types of emulsifying agents, aggregates, and type of mix (hot, warm, and cold). Only Type I mix designs are provided in the Appendix. There may be advantages of using alternative mixes, but these need to be evaluated on a case-by-case basis and obtain specific approval by the authorized official. In some instances alternative mix designs, such as warm and cold mix asphalt concrete, may be considered more environmentally from a materials standpoint. However, the Asphalt Institute²⁵ advises that “plant mixing is required for high quality, dense graded Type I emulsified asphalt mixes in order to obtain the controls necessary for uniform blending of aggregate, emulsified asphalt, and in some cases water during the mixing process.” The use of high quality materials is consistent with the basic premise of sustainability as they help ensure an

²²ACI 330.1 *Specifications for Unreinforced Concrete Parking Lots*, American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331, 2014

²³*Asphalt Pavement Thickness Design (IS-181)*, Asphalt Institute, 2696 Research Park Drive Lexington, KY 40511-8480, 1983.

²⁴*Asphalt Pavement Thickness Design (IS-181)*, Asphalt Institute, 2696 Research Park Drive Lexington, KY 40511-8480, 1983.

²⁵*Asphalt Pavement Thickness Design (IS-181)*, Asphalt Institute, 2696 Research Park Drive Lexington, KY 40511-8480, 1983, pg 5.”

O103.1.3 Asphalt concrete surface on untreated aggregate base. Asphalt concrete pavement surfaces on untreated aggregate bases shall comply with all of the following:

1. The asphalt concrete surface layer thickness shall be a minimum of 1 in. (25 mm).
2. A tack coat produced of emulsified asphalt shall be applied between the asphalt concrete base and the asphalt concrete surface layer.
3. An asphalt concrete base having a minimum thickness of 2 in. (51 mm) shall be provided.
4. The thickness of the untreated aggregate base shall be a minimum of 4 in. (102 mm).
5. The aggregate for the untreated aggregate base shall comply with ASTM D2940.

O103.1.4 Interlocking concrete pavements on untreated aggregate base. Interlocking concrete pavements subject to vehicular traffic shall be designed in accordance with ASCE/T&DI 58 and all of the following:

1. Concrete paving unit thickness shall be a minimum of 3-1/8 inch (79 mm).
2. Concrete paving units conforming to ASTM C936.
3. The thickness of the untreated aggregate base shall be a minimum of 4 in. (102 mm).
4. The aggregate for untreated aggregate bases shall comply with ASTM D2940.

O103.1.5 Pervious concrete pavements. Pervious pavements shall comply with all of the following:

1. Pervious pavements shall be in accordance with ACI 522.1.

appropriate level of durability and serviceability. Consistent with industry standards a tack coat of emulsified asphalt needs to be provided between the asphalt concrete surface layer and the asphalt concrete base.

CO103.1.3 Asphalt concrete surface on untreated aggregate base [SD]. Asphalt concrete over untreated aggregate base consist of three layers; 1) asphalt concrete surface layer; 2) asphalt concrete base and 3) untreated aggregate base. The discussion about the criteria for the asphalt concrete surface layer, asphalt concrete base and tack coat is provided in Section CO103.1.2. Unlike asphalt surface over asphalt concrete base this system also requires an untreated aggregate base. The thickness of the base and type of aggregate are crucial to assure minimum levels of serviceability and sustainability. Thus minimum thickness and standard specification for the aggregate base material are provided.

CO103.1.4 Interlocking concrete pavements on untreated aggregate base [SD]. For interlocking concrete pavements serviceability is a function of the thicknesses and types of both the paving units and aggregate. Thus minimum thicknesses and standard specifications for these components are provided. In addition to the concrete paver units and untreated base standard industry practice as identified in previous discussion (See Section CO103.1) typically requires a thin leveling bed of fine aggregate installed between the untreated aggregate base and the paver units and for fine aggregate to be vibrated into joints between paving units to interlock the paving system.

CO103.1.5 Pervious concrete pavements [SD]. For pervious pavements to be considered sustainable it is generally accepted that there should be a minimum percolation rate. The serviceability of pervious pavements requires compliance with standard industry practice. This section sets the

2. Pervious pavements shall have a minimum percolation rate of 2 gal. per minute per square foot (100 L/min-m²).

SECTION O104 **HEAT ISLAND EFFECT**

O104.1 General. Methods addressed in this section are required to mitigate heat island effects for hardscapes.

Exceptions:

1. Covered parking areas.
2. Parking garages.z

minimum percolation rate and requires the pervious concrete pavements to satisfy a standard specification. While there are other types of pervious pavements, only the concrete pervious pavement system has an industry standard specification written in mandatory language suitable for code adoption. Alternative pervious pavements may be suitable for the project, but these need to be evaluated on a case-by-case basis and specific approval obtained from the authorized official.

The design of pervious pavements should not be based on the porosity of the paving material. Porosity may or may not be related to the ability of water to percolate through the pavement system. For example, aerated cellular concrete is extremely porous, so much so that it floats. However, the interstitial relationship of pores within the aerated cellular concrete is such that most pores are closed and are not conducive to the percolation of water. The percentage of pores or porosity does not reflect the size, distribution or connectivity of pores or the role of the pores in achieving an acceptable level of percolation to qualify as pervious pavement.

SECTION O104 **HEAT ISLAND EFFECT**

CO104.1 General [SD]. Mitigating heat island effects can provide substantial sustainability benefits. Studies²⁶ show that there are significant benefits of using cool pavements. The most significant benefit of cool pavements is that they lower outside air temperatures. This allows reductions in energy use and emissions for air conditioning buildings. The reflectivity of cool pavements also saves energy by reducing the need for electric street lighting at night. Cool pavements also: reduce heat and smog related illnesses; increase comfort for pedestrians; improve driver safety due to increased reflectance and visibility at night; reduce negative environmental impacts of smog; reduce power plant emissions; improve quality of runoff water; and slow climate change. “Assuming a 0.15 increase in reflectance is realized by switching to lighter pavement option, cool pavements would ‘offset’ approximately 0.5 tonnes of CO₂ per 10 square meters (100 square feet) or 300 tonnes of CO₂ per lane mile (1.6 kilometers) of highway.”²⁷

Primarily, heat island mitigation lowers ambient temperatures surrounding the building. Since most of the energy load of commercial buildings is internal gain dominated, lowering the outside ambient air temperature can dramati-

²⁶*Cool Science: Cool Pavement*, Heat Island Group, Building Technology and Urban Systems Department, Environmental Energy Technologies Division, Berkeley Lab, <http://heatisland.lbl.gov/coolscience/cool-science-cool-pavements>, last visited August 2014.

²⁷Cool roofs and Cool Pavement Toolkit, Global Cool Cities Alliance, http://www.coolroof-toolkit.org/wp-content/pdfs/CoolRoofToolkit_Full.pdf, last visited August 2014.

O104.2 Solar reflectance index, SRI. The SRI shall be determined in accordance with ASTM E1980 for medium wind speed. The SRI shall be based on the thermal emittance determined in accordance with ASTM E408 or C1371 and solar reflectance determined in accordance with ASTM E1918 or C1549.

Exception: Concrete surfaces without added color pigments shall be considered to have a SRI value of 35.

O104.3 Heat island mitigation methods. Heat island mitigation methods in Sections O104.3.1, O104.3.2 and O104.3.3, either individually or in any combination, shall apply to at least 50% of all paved surfaces.

Exception: Where all paved surfaces have a minimum solar reflectance index (SRI) of 18.

O104.3.1 Shading. The portion of the sitework to be considered shaded shall be calculated as the arithmetic mean of the shade coverage at 10 a.m., 12:00 p.m., and 3:00 p.m. standard time on the summer solstice. Shading shall be provided in accordance with Sections O104.3.1.1 and O104.3.1.2.

cally reduce the energy required to cool the building. In addition to requiring reflective roofs, the use of light colored or shaded hardscapes helps to optimize heat island mitigation. This section sets minimum criteria for the amount and types of permissible heat island mitigation strategies.

The top surfaces of covered parking areas and parking garages are considered roofs of buildings. As such these are exempted here since they are addressed in Section 1507.17, Roof solar reflectance index, of the Code.

CO104.2 Solar reflectance index, SRI [SD]. Standard test methods have been developed to assure material surfaces will provide the amount of solar reflectance necessary to adequately contribute to heat island mitigation. This section requires materials to be tested accordingly. When measured, in-place concrete without added color pigments consistently has an SRI of 35 or more. Such concrete is exempted from testing to establish an SRI of at least 29 required in Section O104.3.2 Solid pavements.

CO104.3 Heat island mitigation methods [SD]. The most widely used heat island mitigation strategies are shading and surface reflectance. This section requires that a minimum amount of hardscape surface area be shaded, have a minimum solar reflectance index or some combination. Where the minimum SRI for the total paved surfaces is sufficiently high, shading or more stringent reflectance criteria are not required. The exception presumes that if all pavements on site have an SRI that is nearly 60% of that required for half of the site pavement, then the net heat island mitigation effect will be about the same.

CO104.3.1 Shading [SD]. Preventing solar radiation incidence on sitework is an effective method to minimize heat island effects. While shade coverage will vary over the course of the year, the peak solar radiation incidence on horizontal surfaces will occur at noon on the summer solstice. Surface temperature of horizontal sitework results from the combination of ambient temperature and solar radiation incidence. Notable rises in surface temperatures above ambient temperature typically begin after 10:00 a.m. Similarly, surface temperatures begin to fall below ambient temperature after 3:00 p.m. In order to obtain the best representation of the required shade coverage during the hottest portions of the day the shaded area is calculated as the arithmetic mean of the three times noted. It is only the time period during which horizontal surface temperatures are higher than ambient air temperatures that is important with regard to heat island mitigation.

Computer model techniques are available to calculate the required shade coverage for heat island

O104.3.1.1 Plantings. Plantings that are native and adapted plants shall be permitted as shading. Shade calculations shall be based on anticipated growth within five years after the certificate of occupancy is issued. Trees selected shall be capable of having a 15 ft (4.6 m) minimum crown radius within five years of issuance of the final certificate of occupancy. Selection and location of plantings shall be such that root growth does not have deleterious effects on the hardscapes or the building foundation and the requirements of Section 101.4.7, Wildland fires, are satisfied.

O104.3.1.2 Structures. Permanent structures on the building site or campus, or topography shall be permitted to provide shading to the site.

O104.3.2 Solid pavements. Solid pavement surfaces with a minimum initial solar reflectance index (SRI) of 29.

mitigation. These programs tend to produce more accurate and comprehensive results than those determined by using an arithmetic mean. The use of such modeling techniques requires approval from the official having authority.

Plantings and structures are the two common methods of providing shading on sites and have been included in these provisions. However, plantings used for shading have limited life spans and are susceptible to disease and weather effects (i.e. wind damage, lightning strikes, hail, snow and ice damage, etc.) that can substantially alter the amount of shading provided over the life of the plantings. Too, structures adjacent to the project may be demolished or otherwise altered in a way that reduces the amount of shading that is provided over the life of the project. Thus, shading tends not to provide the consistent long term heat island mitigation as compared to the use of reflective surfaces on pavements.

CO104.3.1.1 Plantings [SD]. To assure adequate amounts of shading minimum criteria regarding the size and age of trees is required. In addition, the selection and location of the plantings are limited to places where the deleterious effects on the building and sitework are avoided. This includes satisfying the criteria for urban-wildland interface because plantings in close proximity of the building increase the hazard risk due to wildland fires. When considering potential deleterious effects of plantings near the building it is important to assure that any exterior foundation insulation systems remain intact, including insulation that projects horizontally from the building.

CO104.3.1.2 Structures [SD]. Shading may be provided by topographical features or nearby structures. To minimize the potential to lose the effects of shading from structures that are removed from adjacent sites, shading from structures is limited to permanent structures on the building site or campus.

CO104.3.2 Solid pavements [SD]. Reflective surfaces are a means to limit increases to ambient air temperatures as a result of increases in surface temperatures from solar radiation incidence. This section sets a minimum solar reflectance index (SRI) for pavement surfaces to be considered as contributing to mitigation of heat island effects. Periodic cleaning of paving surfaces may be required to maintain an acceptable SRI.

O104.3.3 Pervious pavements. Pervious pavements including open grid paving systems with a minimum percolation rate of 2 gal per minute per square foot (100 L/min/m²).

SECTION O105 STORMWATER

O105.1 General. Stormwater management shall satisfy the criteria of this section as determined for the volume of rainfall in the design rainfall event. The design rainfall event shall not be less than the 95th percentile rainfall event.

O105.1.1 Retention. The water retention system shall have a capacity equal to the volume of water collected over the entire site from the design rainfall event.

CO104.3.3 Pervious pavements [SD]. Many pervious pavement systems do not satisfy the solar reflectance index (SRI) criteria however, these systems are specifically cited amongst heat island mitigation methods because of their sustainability attributes related to water retention. This provision, regardless of the pervious pavement's SRI, is intended to encourage the use of pavement systems that retain a minimum amount of water. Pervious pavements also provide environmental and cooling benefits by supporting evapo-transpiration. Most concrete pervious pavements and many open grid paving systems that satisfy the water retention criteria will also satisfy the SRI criteria.

SECTION O105 STORMWATER

CO105.1 General [SD]. Stormwater management systems are considered sustainable practices when they maintain 1) water quality that is equal to or better and 2) water release rates off the site that are equal to or less than those that existed prior to development. The first part of this section defines the volume of rainfall that must be considered in the storm water management system. The remainder sets criteria for retention and release of water.

CO105.1.1 Retention [SD]. There are numerous strategies that may be employed individually or in combination to retain water on the site. The most commonly used approaches include properly designed retention ponds, pervious pavements systems and cisterns. Cisterns are often employed to provide water for sanitation or irrigation systems. Satisfying the criteria for percolation rates of pervious pavements in Section O103.1.5 may or may not result in adequate water retention. Where intended for water retention, the pervious pavement must be designed to provide adequate storage of water and satisfy the criteria of Section O103.1.5. Pervious pavements designed as water retention systems may also serve as parking areas or drives. This can dramatically reduce the amount of the site that is devoted to impervious pavements used for parking areas and drives and ponds used for water retention.

Persons, and especially younger individuals, have been known to drown in retention ponds containing water that have not been gated. The frequency of drownings has prompted many jurisdictions to require retention and detention ponds to be gated. Pervious pavements designed for water retention are far safer than retention ponds. Nor do they require the additional construction and materials necessary to achieve an acceptable level of security. The savings in construction cost and materials are an added sustainable benefit.

O105.1.2 Discharge. Stormwater discharged from the site shall satisfy the following:

- 1) The rate, volume, and duration of water discharged shall not exceed pre-development values.
- 2) The quality of the water discharged shall not be less than the quality of the pre-development water.

O105.2 Sealants. The use of coal tar as a pavement sealant is prohibited.

SECTION O106 **SITE LIGHTING**

O106.1. General. Lighting requirements for hardscape areas intended for vehicular and pedestrian traffic shall comply with the provisions in Section 5.3.3 of ASHRAE 189.1 and this section.

Exception: Lighting provided for security and access shall meet the minimum lighting levels in accordance with IESNA RP-33.

O106.2 Low light and unlit parking areas. Parking areas where lighting levels do not meet the minimum lighting requirements of IESNA RP-33 shall be permitted in accordance with this section and approved by the code official.

O106.2.1 Restricted access. During periods when

CO105.1.2 Discharge [SD]. To satisfy the intent of sustainability the criteria of this section limit the rate, volume, duration and quality to pre-development conditions.

CO105.2 Sealants [SD]. The Environmental Protection Agency (EPA) recognizes coal tar as a carcinogenic. This section prohibits the use of coal tar, historically used as a sealer to preserve and extend the life of asphalt pavements, to avoid entry into the watershed. Asphalt emulsifiers, not so categorized, are commonly used as alternative to coal tar. Alternatively, paving systems that do not require such sealers as a part of routine maintenance may be more suitable for sustainable projects.

SECTION O106 **SITE LIGHTING**

CO106.1 General [EC]. Conserving energy and avoiding light pollution that may result from exterior lighting are both important considerations for the development of sustainable sites. Excessive lighting not only wastes energy but when inappropriately directed or reflected can have a negative impact on ecosystems and can be an annoyance. This section requires compliance with the energy conservation requirements of ASHRAE 90.1, as referenced in ASHRAE 189.1. In addition, it also requires compliance with the back light and glare as well as the uplighting effect of luminaires in ASHRAE 189.1.

Generally efforts to conserve energy and avoid light pollution include not only reducing lighting power but also lumens. Reduction in lumens may create conditions that are contrary to the intent of the code. To avoid creating potentially unsafe areas, lighting levels are required to meet minimum requirements for security and access.

CO106.2 Low light and unlit parking areas [EC]. One strategy to reduce energy required for exterior lighting is to permit some parking areas of the site to have reduced lighting levels or remain unlit. Safety and security however should not be jeopardized for the sake of energy conservation. Since the lighting levels in these parking areas may be below the levels required for use, safety, and security, such areas must be approved by the code official.

CO106.2.1 Restricted access [EC]. Low light and unlit parking areas pose an increased risk with regard to safety and security. The intent of this section is to require some

lighting levels do not meet the minimum requirements, access shall be restricted by physical barriers.

O106.3 Surface classification. Surfaces of all lighted parking area and drives shall have a road surface classification of R1 in accordance with Section 2.3 of IES RP-8.

O106.4 Light trespass. Light trespass restrictions shall be in accordance with the lighting zones specified in Table O106 (1).

form of physical barrier such as fences and locked gates to reduce the likelihood that unauthorized persons will enter these parking areas at times where lighting is reduced below minimum levels for safety and security.

CO106.3 Surface classification [EC]. Less power for lighting is required to achieve the desired amount of lumens where the mode of visible light reflectance from surfaces is mostly diffuse and less spectral. The Illuminating Engineers Society (IES) recognizes the mode of reflectance through road surface classifications. In IES Standard RP-8 the designation R1 is used for surfaces where the mode of reflectance is mostly diffuse. The R1 classification includes asphalt surfaces with at least 12% of the aggregates being artificial brightener aggregates and portland cement concrete surfaces. In addition to these R1 surfaces, any surface demonstrating similar photometric properties should be considered acceptable. Generally a material with a specific scaling factor of 0.09 as determined by the overall “lightness” of the pavement should satisfy the intent of this section. The scaling factor may be determined by laboratory or field measurement²⁸.

CO106.4 Light trespass [EC]. Light trespass tends to illuminate spaces that are not required to be lit. This is clearly a waste of energy that is not consistent with the basic premise of sustainability. In addition, light trespass can be detrimental to nocturnal animal habitats and be an annoyance to occupants on adjacent properties. This section sets limits for the amount of artificial light that may fall on adjacent properties thereby helping to optimize the energy required for lighting systems.

In order to control the amount of light trespass criteria for maximum illumination at and beyond site boundaries and maximum fixture lumens are specified in Table O106(1). The permissible amount of light trespass is conditional based on the land use of the adjacent property. Where adjacent properties are considered to be dark (i.e. LZ 1), the permissible light trespass is less and where the adjacent properties are bright (LZ 4) the permissible light trespass is greater. These are maximum permissible levels of light trespass. Good sustainable practices should strive to minimize the amount of light trespass as much as possible while still satisfying the project requirements.

²⁸International Commission on Illumination, CIE Report 30.2, *Calculation and Measurement of Luminance and Illuminance in Road Lighting*, Commission, Internationale de l’Eclairage, Vienna, Austria, 1982

**TABLE O106(1)
MAXIMUM ILLUMINANCE PERMITTED FOR LIGHT TRESPASS**

Land Use on Each Property Adjacent To The Site	Maximum Illuminance			Maximum Fixture Lumens Emitted at an angle of 90 Degrees or more from Nadir
	Maximum Vertical and Horizontal Footcandles at Site Boundary	Beyond Site Boundary		
		Maximum Horizontal Footcandles	Distance Beyond Site Boundary In feet	
Lighting Zone 1 (LZ 1) Population density 200 people or less/sq mi (2.59 km ²), such as rural residential areas, parks and agricultural areas	0.01	Not Permitted		
Lighting Zone 2 (LZ 2) Population density of more than 200 but less than 3000 people/sq mi (2.59 km ²), such as suburban 1 & 2-family dwellings areas	0.10	0.01	10	2%
Lighting Zone 3 (LZ 3) Population density of 3000 or more people/sq mi (2.59 km ²), such as commercial or industrial sites, or multi-family residential areas	0.20	0.01	15	5%
Lighting Zone 4 (LZ 4) Areas where light trespass exceeding the requirements for LZ3 is approved by the code official, such as entertainment centers or automobile dealerships	0.60	0.01	15	10%

Source: *New Construction and Major Renovation US Green Building Council*

**SECTION 0107
REFERENCES**

<u>ACI</u>	American Concrete Institute 38800 Country Club Dr. Farmington Hills, MI 48331 USA	
Standard reference number	Title	Referenced in code section number
330.1-03	Specification for Unreinforced Concrete Parking Lots	O103.1.1
522.1-13	Specification for Pervious Concrete Pavement	O103.1.5
<u>ASCE</u>	American Society of Civil Engineers Transportation and Development Institute (T&DI) 1801 Alexander Bell Drive Reston, VA 20191-4400	
Standard reference number	Title	Referenced in code section number
58-10	Standard Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways.O103.1.4	O103.1.4
<u>ASHRAE</u>	American Society of Heating, Refrigerating and Air-Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329 USA	
Standard reference number	Title	Referenced in code section number
189.1-11	Standard for the Design of High-Performance Green Buildings, Except Low-Rise Residential Buildings	O106.1
<u>ASTM</u>	ASTM International 100 Barr Harbor Drive West Conshohocken, PA 19428-2959 USA	
Standard reference number	Title	Referenced in code section number
C936-13	Standard Specification for Solid Concrete Interlocking Paving Units	O103.1.4
C1371-04a	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emisometers	O104.2
C1549-09	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer	O104.2
D2940-09	Standard Specification for Graded Aggregate Material for Bases and Subbases for Highways and Airports	O103.1.3, O103.1.4
E408-13	Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques	O104.2
E1918-06	Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.	O104.2
E1980-11	Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces	O104.2
<u>IES</u>	Illuminating Engineering Society formerly the Illuminating Engineering Society of North America (IESNA) 120 Wall Street, Floor 17 New York, NY 10005-4001 USA	
Standard reference number	Title	Referenced in code section number
RP 33-99	Recommended Practice Manual: Lighting for Exterior Environments	O106.1, O106.2
RP 8-00	Roadway Lighting (Reaffirmed 2005)	O106.3
<u>USGBC</u>	U.S. Green Building Council 1800 Massachusetts Ave, N.W. Suite 300 Washington, DC 20036 USA	
Standard reference number	Title	Referenced in code section number
Version 2.2 - 07	New Construction and Major Renovation, Reference Guide	Table O106(1)

[Add new Appendix P as follows:]

APPENDIX P **RADON MITIGATION**

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

This Appendix is intended for adoption in jurisdictions where radon migration into buildings has been determined to be at levels that warrant radon mitigation strategies.

SECTION P101 **RADON RESISTANT CONSTRUCTION**

P101.1 General. Buildings having the use and occupancy classifications of Group A, B, E, I or R Residential shall comply with the requirements in this section where located in areas of High and Moderate Radon Potential (Zone 1 and 2), as determined by Figure AF101 of the *International Residential Code*.

Exception: Group A occupancies that are not enclosed or identified as not posing a health hazard due to infrequent occupancy and approved by the code official.

P101.2 Radon mitigation alternatives. Radon mitigation shall be provided in accordance with one of the following:

1. Chapter 2 of EPA 625-R-92-016.
2. Appendix F of the IRC.
3. Section P101.3.

APPENDIX P **RADON MITIGATION**

[GA] Studies reported by the EPA show that high concentrations of radon can have detrimental health effects on humans including risk of cancer²⁹. Buildings are permitted to be located in areas where there is the presence of radon gas in the soils. In such locations interior radon levels may be sufficiently elevated to have an impact on the health of building occupants unless mitigated. Adverse effects on the health of occupants reduce comfort and productivity which is inconsistent with the premise of sustainability. The addition of Appendix P is intended to bring to the attention of the building code user the need to determine if the area where the building will be sited is prone to radon migration into the building and to implement strategies to protect the building. The minimum requirements for radon mitigation should be considered in the design and construction of sustainable buildings located where elevated radon levels are present in soils regardless of whether the authority having jurisdiction adopts this Appendix.

SECTION P101 **RADON RESISTANT CONSTRUCTION**

CP101.1 General [IQ]. The provisions are targeted to those types of buildings and locations where the exposure presents the greatest risk to the occupants. Occupancies such as residences, schools, offices, hospitals and restaurants located in high or moderate radon potential regions tend to be most at risk. However, the criteria in this appendix may also be appropriate for other occupancies or locations. This section identifies the most susceptible use groups and locations.

CP101.2 Radon mitigation alternatives [IQ]. Radon mitigation practices that have proven to be successful include those published by the Environmental Protection Agency and the International Code Council. These practices, although effective, are based on radon levels in the soils. Thus they tend to emphasize active sub-slab depressurization systems regardless of measured radon levels within the interior space of the building. Since they are proven practices they are included in this appendix as two acceptable options. Elevated radon levels in the soil do not necessarily mean there will be elevated levels within the living spaces. Accurate measurement of interior radon levels can only be made after completion of the building. Thus the third option offered is to install a passive sub-slab depressurization

²⁹Residential Radon and Risk of Lung Cancer: A Combined Analysis of 7 North American Case-control Studies, D. Krewski, JH Lubin, JM Zeilinski, M Alavanja, VS Catalan, RW Field, et al., Epidemiology, March 2005.

P101.3 Minimum radon mitigation requirements. Install radon mitigation components in accordance with all of the following:

1. Install a continuous minimum 4-in (102 mm) layer of clean aggregate under the slab.
2. Install a radon suction pit that is a minimum 4-ft by 4-ft by 8-in deep (1219 mm by 1219 mm by 203 mm deep) consisting of clean aggregate under the slab.
3. Where sub-slab walls restrict air flow, install a radon suction pit in each area separated by sub-slab walls.
4. Install a minimum 3-in (76 mm) diameter vent pipe from the radon suction pit to the outdoors.
5. Vent pipe termination shall be located no less than 10 ft (3048 mm) from all entrances, air intakes, operable windows, and exterior public access areas.
6. A portion of each vent pipe shall be accessible and configured to accommodate the installation of a fan.
7. An electrical circuit terminating in an *approved* box shall be provided within six feet (1829 mm) of the location designated for each fan.
8. Seal major radon entry routes.

system with the capability to be readily modified for active depressurization should it be determined more aggressive mitigation strategies are required. If measured radon levels are high enough to be considered a health risk an active system can be installed.

CP101.3 Minimum radon mitigation requirements. This section sets the minimum requirements for a passive sub-slab depressurization system that can be readily converted to become an active sub-slab depressurization system. The key components include: unobstructed sub-slab airflow with a suction pit; properly installed ventilation pipe; an electrical outlet in the vicinity where a fan could be installed; and properly sealing of cracks and joints where radon can enter the building.

SECTION P102 **REFERENCES**

<u>EPA</u>	<u>Environmental Protection Agency</u> Ariel Rios Building 1200 Pennsylvania Avenue, N.W. Washington, DC 20460 USA	
<u>Standard reference number</u>	<u>Title</u>	<u>Referenced in code section number</u>
625-R-92-016-94	Guide to Radon Prevention in the Design and Construction of Schools and Other Large Buildings, 3rd Printing with Addendum	P101.2
<u>ICC</u>	<u>International Code Council</u> 4051 West Flossmoor Road Country Club hills, IL 60478-5795 USA	
<u>Standard reference number</u>	<u>Title</u>	<u>Referenced in code section number</u>
IRC-12	International Residential Code	P101.1, P101.2

[Add new Appendix Q as follows:]

APPENDIX Q
SITE SELECTION

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

This Appendix provides the minimum requirements for selection of sites for site development. Upon adoption they shall become part of the requirements for regulating building sites in conjunction with building code requirements for life safety, property protection, or safety to emergency responders as related to buildings and related structures.

SECTION Q101
GENERAL

Q101.1 Scope. The provisions of this Appendix shall apply to site selection.

SECTION Q102
DEFINITIONS

Q102.1 General. The following words and terms shall, for

APPENDIX Q
SITE SELECTION

[GA] This Appendix is intended for adoption by jurisdictions that desire to restrict site development through their building code. This Appendix is optional because most jurisdictions find that provisions related to site selection are more suitable as modifications to zoning and land use regulations. Too, the provisions in this Appendix that are applicable to redevelopment, while consistent with sustainability practices, may be more stringent than appropriate for revitalization of communities. For example, it may not be feasible to sustainably redevelopment a site that was previously row homes in a densely developed urban area because of the difficulties in achieving the minimum criteria for restoring portions of the site to predevelopment conditions. However, while the provisions in this appendix are optional for code adoption, the concepts are consistent with the basic premises of sustainability regardless of mandatory code language

SECTION Q101
GENERAL

CQ101.1 Scope [SD]. Protection of farmland, flood plains, threatened and endangered species habitats, wetlands, bodies of water, parklands, and preserves is a natural extension of sustainable practices. This section makes restrictions on site development mandatory where this Appendix is adopted.

the purpose of this Appendix, have the meanings shown herein. Refer to Chapter 2 for general definitions.

DEVELOPMENT. Any man-made change to improved or unimproved real estate, including but not limited to, buildings or other structures, temporary or permanent storage of materials, and sitework.

SECTION Q103 GENERAL LAND USE

Q103.1 General. Development shall not be permitted on portions of sites classified in Items 1 through 7 as follows:

1. Prime farmland. Prime farmland as defined in 7 CFR 400-699.

2. Flood plains. Previously undeveloped land with an elevation lower than 5 ft (1524 mm) above the elevation of the 100-year flood as defined by the NFIP.

Exception: Buildings constructed in accordance with Section 1612 Flood Loads of this Code and where the floors required by ASCE 24 to be built above the base flood elevations have the floor and their lowest horizontal supporting members not less the higher of the following:

- a. design flood elevation,
- b. base flood elevation plus 5 feet, or
- c. advisory base flood elevation plus 5 feet, or
- d. the 500-year flood, if known.

3. Threatened or endangered species habitat. Land identified as habitat for any species defined in 16 CFR, Parts 1531-1544 or state threatened or endangered species list.

4. Wetlands. Wetlands as defined by 40 CFR, Parts 230-233, 40 CFR, Part 22 and isolated wetlands or areas of special concern identified by the state or local authority having jurisdiction.

5. Land adjacent to wetlands. Land within 100 ft (30.5 m) of wetland or within setback distances from wetlands as defined by the state or local authority having jurisdiction, whichever is larger.

SECTION Q103 GENERAL LAND USE

CQ103.1 General [SD]. Sustainable development requires careful consideration of any negative environmental impact to: prime farmland, wetlands, flood plains, bodies of water and the habitats of threatened or endangered species. Criterion in this section restricts development in these areas.

There are a few exceptions to these prohibitions on development. In some instances development along waterways is instrumental to the economic welfare of the community. In those circumstances development is permitted in flood plains as long as the project is designed to meet strict criteria to minimize damage from flooding. This is especially important for communities that want to reutilize areas in their downtowns that are classified as flood plains.

Two exceptions apply to parks and preserves. Parkland may be developed as long as the total amount of parkland remains the same or is increased. This should take into consideration that replacing one park with another may have undesirable effects on the neighborhood that may be losing their park. The second exception permits park authorities to build on parklands and in preserves as required to satisfy the needs of the community

6. Land adjacent to bodies of water. Land within 50 ft (15.2 m) of a body of water defined as seas, lakes, rivers, streams and tributaries which support or could support fish for recreational or industrial use in 33 CFR, Part 328.

7. Parks and preserves. Land which prior to acquisition was public parkland.

Exceptions:

1. Public parkland may be acquired and used for development if land of equal or greater value as parkland is accepted in trade by the public landowner.
2. Park authority projects.

SECTION Q104
HABITAT PROTECTION

Q104.1 Greenfields. On greenfield sites and portions of previously developed sites that were undisturbed, limit construction disturbance so as not to exceed the distances provided in Table Q104 (1).

Q104.2 Previously developed sites. Restore or protect 50% of the site area excluding the building footprint with native or adaptive vegetation.

SECTION Q104
HABITAT PROTECTION

CQ104.1 Greenfields [SD]. It is important to consider preservation and protection of the natural environment on site when land disturbance is required for site development. This not only protects indigenous flora and fauna but also assist in maintaining other ecological site attributes such as those related to water cycles and micro-climates. This section limits the amount of disturbance that may occur when developing a site.

CQ104.2 Previously developed sites [SD]. One of the goals of sustainable redevelopment of sites is to restore some portion of the land back to a natural condition. This helps to reestablish and maintain the local ecosystem. To achieve this, a minimum amount of native and adaptive vegetation is required on a portion of the site.

**TABLE Q104 (1)
MAXIMUM DISTANCE OF DISTURBANCE^a**

<u>Distance in feet</u>	<u>Measured From</u>
40	<u>Building Perimeter</u>
25	<u>Pervious Pavements</u>
25	<u>Pervious Surfaces Other Than Pavements</u>
25	<u>Playing Fields</u>
40	<u>Retaining Walls Intended to Maximize Development Density</u>
15	<u>Retaining Walls and Other Hardscapes</u>
15	<u>Roadway Curbs</u>
25	<u>Stormwater Retention Facilities</u>
10	<u>Parking Surfaces</u>
10	<u>Patios</u>
15	<u>Utility Line (12 inches or more in diameter) Trenches</u>
10	<u>Utility Lines (less than 12 inches in diameter) Trenches</u>
10	<u>Walkways</u>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm

^aSource: *New Construction and Major Renovation Version 2.2 Reference Guide*

**SECTION Q105
OPEN SPACE**

Q105.1 General. Provide vegetated open space area, including vegetated roofs, that is not less than any of the following:

1. The minimum required by the local zoning ordinance, or
2. 20% of the total project site area, or
3. Total footprint of the building.

**SECTION Q105
OPEN SPACE**

CQ105.1 General [SD]. As previously discussed, maintaining naturally vegetated areas is a widely accepted practice for sustainable sites. Some provisions even require open spaces to be larger than those of the local zoning ordinance. Arbitrary percentage increases in area above those locally required may not reflect criteria for sustainable practices already integrated into those ordinances. For this reason the criteria in this section are limited to the current local zoning ordinance, a percentage of the total site or the building footprint. However, where the zoning ordinance has not been modified to reflect sustainable practices the designer should consider increasing the open space criteria of the zoning ordinance by at least 25%.

**SECTION Q106
REFERENCES**

<u>FEMA</u>		
Federal Emergency Management Agency 500 C Street SW Washington, DC 20472 USA		
Standard reference number	Title	Referenced in code section number
NFIP	National Flood Insurance Program (100 year flood elevation maps)	Q103.1
<u>GPO</u>		
United States Government Printing Office 732 North Capitol St. NW Washington, DC 20401USA		
Standard reference number	Title	Referenced in code section number
7 CFR, Parts 400-699	United States Code of Federal Regulations, Title 7 Agriculture, Volume 6, Parts 400-699	Q103.1
16 CFR, Parts 1531-1544	United States Code of Federal Regulations Title 16 Conservation, Chapter 35 Endangered Species, Parts 1531-1544	Q103.1
33 CFR, Part 328	United States Code of Federal Regulations Title 33 Navigation and Navigable Waters, Chapter II Corps of Engineers, Department of the Army, Department of Defense, Part 328 Definitions of Waters of the United States	Q103.1
40 CFR, Part 22	United States Code of Federal Regulations Title 40 Protection of the Environment, Chapter I Environmental Protection Agency, Part 22	Q103.1
40 CFR Part 136	United States Code of Federal Regulations Title 40 Protection of the Environment, Chapter I Environmental Protection Agency, Subchapter D Water Programs, Part 136 Guidelines Establishing Test Procedures for the Analysis of Pollutants	Q103.1
40 CFR, Parts 230-233	United States Code of Federal Regulations Title 40 Protection of the Environment, Chapter I Environmental Protection Agency, Parts 230-233	Q103.1
<u>USGBC</u>		
U.S. Green Building Council 1800 Massachusetts Ave, N.W. Suite 300 Washington, DC 20036 USA		
Standard reference number	Title	Referenced in code section number
Version 2.2-07	New Construction and Major Renovation Version 2.2 Reference Guide	Table Q104(1)

[Add new Appendix R as follows:]

APPENDIX R **ENHANCED SECURITY**

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

This Appendix provides the minimum requirements for enhanced security. Upon adoption they shall become part of the requirements for regulating building sites in conjunction with the building code requirements for life safety, property protection, or safety to emergency responders as related to buildings and related structures.

SECTION R101 **GENERAL**

R101.1 Scope. The provisions of this Appendix shall control the supplementary requirements for security and burglary resistance.

SECTION R102 **BLAST RESISTANCE**

R102.1 Design. Where buildings are required to resist blast loads they shall be designed in accordance with ASCE 59.

APPENDIX R **ENHANCED SECURITY**

[GA] This Appendix is intended for adoption by state and local jurisdictions that desire to require minimum security requirements for enhanced resistance from events that are not natural disasters, but often follow disasters. Satisfying the minimum security requirements is intended to increase occupant safety, comfort and productivity, and reduce disruption in business continuity. The concepts of this appendix are consistent with the basic premises of sustainability regardless of code adoption

SECTION R101 **GENERAL**

CR101.1 Scope [ER]. Any disruption in normal operations and activities resulting from manmade disasters is not consistent with the basic premise of sustainability. Sustainable buildings should be designed to minimize disruptions that jeopardize occupancy safety, comfort and productivity. In addition to the direct cost to repair damage and environmental impact from manmade disasters, the loss of goods and business continuity are also not consistent with sustainable practices. This appendix sets criteria to enhance security and reduce damage.

SECTION R102 **BLAST RESISTANCE**

CR102.1 Design [ER]. Damage to buildings due to manmade disasters tends to result in excessive amounts of repair and the removal, disposal and replacement of materials where buildings are not adequately designed and constructed to resist blasts. Manmade explosions may be the result of equipment or system failures, such as explosions related to gas leaks, or intentional explosions that are considered acts of terrorism. To minimize the negative impacts due to damage from explosions sustainable practices should include blast resistant design where buildings are determined to be at risk. ASCE 59 has been developed as minimum design criteria to minimize damage from blast. Where this appendix is adopted and the building is determined to be at risk, the minimum requirements of ASCE 59 are mandatory. One of the basic principles in ASCE 59 is to provide redundancy with alternate load paths so that the amount of damage is not disproportionate to the damage of the blast itself. Some findings suggest that damage from the terrorist event in the

SECTION R103 **FORCED ENTRY RESISTANCE**

R103.1 Exterior doors. The provisions of this section shall apply to all entry doors.

Exception: Garage doors and roller doors.

R103.1.1 Wood doors. Wood doors shall be solid core and have a minimum thickness of 1-3/4 inch (45 mm). Where dead bolts are present, wood doors shall have an escutcheon plate at the dead bolt.

Exception: Escutcheon plates are not required for wood doors with steel edges.

R103.1.2 Steel doors. Steel doors, frames, and hardware reinforcing shall meet the performance Level 3 (Extra Heavy Duty) requirements of SDI A250.8.

1995 bombing of the Alfred P. Murrah Federal Building in Oklahoma City, Oklahoma was disproportionate³⁰. An example of where damage from a natural gas explosion resulted in progressive collapse is the 1968 event at the Ronan Point Building in Newham London, UK³¹. Design and construction practices that minimize disproportionate damage or progressive collapse regardless of the event should be considered for any sustainable building. This concept is not limited to blasts but is also applicable for other hazardous events. See the commentary discussion of ENHANCED FIRE SAFETY at the beginning of Chapter 4.

SECTION R103 **FORCED ENTRY RESISTANCE**

Occupant productivity and comfort are key to the design and construction of sustainable facilities. Both can be highly dependent on the level of security provided. In addition, enhanced security increases the protection of property which reduces the amount of repair and the removal, disposal and replacement of building material and contents. Main features of enhanced security are those related to forced entry resistance. Criteria for doors and windows, consistent with the Institute for Business and Home Safety, are provided in this section³².

CR103.1 Exterior Doors [ES]. One of the primary areas where forced entry occurs in buildings is the exterior doors. The doors themselves must provide a minimum level of resistance, but it is also necessary to assure that the door frame will not be readily compromised. This section includes minimum criteria enhanced forced entry resistance applicable to common types of personnel entry doors. Garage and roller doors have unique characteristics that require special consideration for their specific applications and thus are not addressed here.

CR103.1.1 Wood Doors [ES]. The enhanced forced entry resistance for wood doors has been determined by the insurance industry to be related to the composition and thickness of the doors and the use of escutcheon plates. Steel edges on wooden doors are deemed to provide the same level of security as escutcheon plates.

CR103.1.2 Steel Doors [ES]. Steel door assemblies are rated with regard to forced entry resistance. The provisions in this section are consistent with the recommendations of the insurance industry

³⁰Best Practices for Reducing Potential for Progressive Collapse in Buildings, NISTIR 7396, National Institute of Science and Technology (NIST), February 2007

³¹Ibid, page 91

³²Fortified.....for Safer Living Builders Guide, Institute for Business and Home Safety, 2008

R103.1.3 Glass doors. Glass doors and portions of glazing in doors shall meet the requirements of performance level L3 of ASTM E2395.

R103.1.4 Deadbolts. Except where prohibited by the Code requirements for panic and fire exit hardware, install BHMA A156.5 Grade 1 deadbolt locks with a minimum 1 inch (25 mm) long throw at all exterior doors.

R103.1.4.1 Deadbolts and wood door frames. Reinforce wood door frames with a steel or aluminum reinforcing plate at each deadbolt lock strike plate. The strike plate shall be attached with a minimum of four 3-inch (76 mm) long screws to the reinforcing plate. The reinforcing plate shall extend at least 12 inches (305 mm) above and below the deadbolt lock location and be attached with a minimum of eight 3-inch (76 mm) long screws to the building wall framing.

R103.1.5 Hinge installation. For wood jambs, install hardwood shims at all hinge locations and every 2 feet (610 mm) on each jamb. Minimum 3-inch (76 mm) long screws shall be used to attach hinges and jambs at all shim locations.

R103.1.6 Bracing. For wood and steel stud construction, reinforce the walls on both door jambs with horizontal framing members for the three stud spaces next to the door opening. Bracing shall not be less than one bracing system at the height of all hinges, deadbolts, and latches. Each bracing system shall be installed within 3 inches (76 mm) measured vertically of all hinges, deadbolts, and latches

CR103.1.3 Glass Doors [ES]. Glass doors assemblies are rated with regard to forced entry resistance. The provisions in this section are consistent with the recommendations of the insurance industry.

CR103.1.4 Deadbolts [ES]. Dead bolts provide a much larger degree of forced entry resistance compared to conventional door latches. However, deadbolts can significantly impede egress in the event of an emergency. For enhanced security deadbolts should be used on all types of personnel entry doors not required to be equipped with panic or fire exit hardware.

CR103.1.4.1 Deadbolts and Wood Door Frames [ES]. It is important for the entire deadbolt assembly to have appropriate features for forced entry resistance. This section sets criteria for strike plates where wood door frames are used.

CR103.1.5 Hinge Installation [ES]. Where it is obvious that doors in wood frames include dead bolts, a forced entry strategy is to remove the door along with its frame. To resist this type of forced entry the door jambs need to be securely fastened. This is accomplished with the use of hardwood shims located at the hinges and closely spaced around the jamb. The use of minimum 3-inch screws reduces the likelihood that the door trim can be removed and the door frame detached from the wall or the hinges pried loose from the jamb.

CR103.1.6 Bracing [ES]. Not only is attachment of the door frame to the wall system important, there is also a need to prevent the wall framing members from being pried away from the door jamb. Horizontal stiffeners in wood and steel frame construction are used to further resist the removal of the door with its frame or to deflect the frame further than the dead bolt throw.

R103.2 Windows. Windows shall meet the requirements for Grade 20 in ASTM F588.

SECTION R104

SECURITY ALARMS AND MONITORING

R104.1 Security alarms. Buildings shall be equipped with security alarm systems that are capable of being monitored by a constantly attended central monitoring station. Security alarm systems and installations shall be in accordance with NFPA 731 and this section.

R104.1.1 Forced entry alarms. Install a security alarm system with contacts at all exterior doors, entry doors and operable windows within 8 feet (2438 mm) of grade level or elements of the building or site that are scalable.

Exception: Windows and doors serving areas not intended to be secured.

R104.1.2 Glass break alarms. Install glass break detectors for all areas with windows, glass doors and doors with glass located on the ground floor or within 8 feet (2438 mm) of building or site elements that are scalable. A minimum of one glass break detector shall be installed for each area with exterior fenestration and interior isolated by floor to ceiling walls or partitions

Exception: Windows and doors serving areas not intended to be secured.

CR103.2 Windows [ES]. Windows assemblies are rated with regard to forced entry resistance. The provisions in this section are consistent with the recommendations of the insurance industry.

SECTION R104

SECURITY ALARMS AND MONITORING

CR104.1 Security alarms [ES]. Security alarm systems deter forced entry and minimize the time during which vandalism or burglary can occur. Deterring damage reduces the amount of materials and resources required for repairs and removal, disposal, and replacement of building elements that are not repairable. Alarm systems are proven to reduce the extent of damage to building elements and loss of goods. In addition to the physical damage and losses, alarm systems also provide added comfort and enhance productivity of building occupants. Each of these benefits is consistent with the basic premise of sustainability and thus alarm systems should be considered for enhanced security. This section describes the specific criteria for security alarm and related security systems. The security alarm systems must be connected to central monitoring station that operates 24 hours per day, 7 days per week. Generally if there is a need for heightened security that is beyond the minimum requirements provided in this section, security specialist should be consulted.

CR104.1.1 Forced Entry Alarms. [ES] Forced entry alarms are activated when attempts are made to force doors or operable windows open. These are minimum requirements for the most accessible doors and operable windows to secured spaces. Where a building contains areas not required to be secured windows and exterior doors, including garage doors, need not be equipped with forced entry alarm systems. However the criteria still require forced entry alarms for doors and windows between secured and unsecured areas. A higher degree of security may warrant additional alarms such as for roof hatches and openings at higher elevations. Heightened security is beyond the scope of this Appendix and requires the services of security system professionals.

CR104.1.2 Glass Break Alarms [ES]. Glass break alarms are activated when the means to gain entry into the building is by breaking windows, glass doors, or glass panes in doors. Breaking glass may not activate the forced entry alarm. Thus, there is a need for redundancy by having both forced entry and glass break alarms. Like forced entry alarms, glass break alarms are not required for unsecured spaces but are required for glazed elements between secure and unsecure areas. Burglary related to this type of entry is commonly referred to as “smash and grab.” “Smash and grab” is most common in store fronts and there are special criteria for

R104.2 Strobe/audible alarm. The security alarm system shall be equipped with a strobe/audible alarm placed on the exterior of the building. The strobe/alarm device shall face the street or a more visible location and be located at least 8 feet (2438 mm) above the ground but not within 8 feet (2438 mm) of building or site elements that are scalable.

R104.3 Exterior lighting. Install outdoor security lighting to conform to the IES G-1.

SECTION R105 **MERCANTILE OCCUPANCIES**

R105.1 Storefronts. Glass storefronts shall be in accordance with the requirements of Section R105.1.1 or R105.1.2.

R105.1.1 Glass. Storefront glass shall meet the requirements for ballistic criteria HG4 and forced entry sequence of testing Class II of ASTM F1233.

R105.1.2 Shutters and grilles. Storefront glass area shall be protected with security shutters or grilles.

mercantile occupancies in section R105.

CR104.2 Strobe/Audible Alarm [ES]. Strobe lights and audible alarms draw attention to persons attempting to intrude the premises. These notifications tend to deter the continuation of such activity. In many instances the unauthorized entry is foiled before the arrival of individuals responding to notification from the central monitoring station.

CR104.3 Exterior Lighting [ES]. Efforts to conserve energy by reducing lighting levels should never be permitted less than the minimum levels of lighting required to assure safety to individuals and protection of property. Security lighting provides additional safeguards for individuals and reduces the amounts of repair and the removal, disposal and replacement of materials by deterring burglary or other damaging activities such as arson and vandalism. Both are consistent with the premise of sustainable design.

The lighting requirements provided in this section are the minimum recommended by the Institute for Business and Home Safety. Where this Appendix is adopted these requirements are intended to supersede any provisions on exterior lighting levels provided in others sections of this code.

SECTION R105 **MERCANTILE OCCUPANCIES**

CR105.1 Storefronts [ES]. In addition to typical security features required in this Appendix, mercantile occupancies must also be resistant to “smash and grab” theft. Resistance to building damage and the loss of goods is consistent with the basic premise of sustainability. These minimum requirements for storefronts are consistent with the recommendations of the Institute for Business and Home Safety for forced entry and impact resistance. These features are especially important where post disaster looting is likely to occur. While these provisions are included primarily to deter theft, they will also improve the ability of storefronts to resist impact from wind-borne debris in high wind regions.

CR105.1.1 Glass [ES]. For glazing to be secure they need to be resistant to impact. While the impact in most “smash and grabs” is caused by using heavy objects such as hammers, firearms may also be used to breach the glazing. The recommendations of the Institute for Business and Home Safety require glass to pass both ballistics resistance and forced entry testing but not the combination of both.

CR105.1.2 Shutters and Grilles [ES]. Shutters or grilles may be employed as an alternative to impact and ballistic resistant glazing assemblies.

R105.2 Bollards. Bollards designed and constructed to meet the requirements of an M30 Rating per ASTM F2656 shall be used to protect storefronts from vehicular impact.

Exception: Structures or elements designed to provide equivalent resistance to vehicular impact shall be permitted.

CR105.2 Bollards [ES]. Where “smash and grab” theft may be accomplished with a vehicle, bollards are required. This is consistent with the minimum forced entry resistance requirements recommended by the Institute for Business and Home Safety. Planters, walls or other physical barriers that provide the same or better protection from vehicles impacting storefronts are acceptable.

SECTION R106 REFERENCES

ASTM	American Society for Testing and Materials 100 Barr Harbor Drive West Conshohocken, PA 19428	
Standard reference number	Title	Referenced in code section number
E2395-06	Standard Specification for Voluntary Security Performance of Window and Door Assemblies with and without Glazing Impact	R103.1.3
F588-07	Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact	R103.2
F1233-07	Standard Test Method for Security Glazing Materials and Systems	R105.1.1
F2656-07	Standard Test Method for Vehicle Crash Testing of Perimeter Barriers	R105.2
ASCE	American Society of Civil Engineers (ASCE) Transportation and Development Institute (T&DI) 1801 Alexander Bell Drive Reston, VA 20191-4400	
Standard reference number	Title	Referenced in code section number
ASCE 59-11	Blast Protection of Buildings	R102.1
BHMA	Builders Hardware Manufacturers Association 355 Lexington Avenue, 15th floor New York, NY 10017	
Standard reference number	Title	Referenced in code section number
ANSI/BHMA A156.5-01	Standard for Auxiliary Locks and Associated Products.	R103.1.4
IES	Illuminating Engineering Society of North America 120 Wall Street, Floor 17 New York, NY 10005-4001	
Standard reference number	Title	Referenced in code section number
IESNA G-1-03	Guideline on Security Lighting for People, Property, and Public Spaces	R104.3
NFPA	National Fire Protection Association (NFPA) 1 Batterymarch Park Quincy, MA 02169-7471	
Standard reference number	Title	Referenced in code section number
NFPA 731-11	Standard for the Installation of Electronic Premises	R104.1
SDI	Steel Door Institute 30200 Detroit Road Westlake, Ohio 44145	
Standard reference number	Title	Referenced in code section number
ANSI/SDI A250.8	Standard Steel Doors and Frames	R103.1.2

ABOUT THE AUTHORS

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Stephen (Steve) Szoke is the Senior Director of Codes and Standards at the Portland Cement Association. Steve is a registered professional engineer and has achieved the recognition of Fellow of the American Society of Civil Engineers, Structural Engineering Institute, and American Concrete Institute (ACI). He is a Leadership in Energy and Environmental Design Accredited Professional and a Construction Specifications Institute Construction Document Technologist. Steve continued to be an advocate of improved energy conservation, sustainability, and enhanced resiliency since the 1970s. Steve directs the portland cement industry's programs related to national model building codes and referenced standards, focusing on International Code Council (ICC) and National Fire Protection Association codes and referenced standards and related documents.

With specific regard to energy conservation and sustainability, Steve has and continues to participate in environmental and energy conservation standards development, primarily through ASTM International committees E06 on Performance of Buildings and E60 on Sustainability and American Society for Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) committees 90.1 Energy Standard for Buildings Except Low-Rise Residential and 90.2 Energy Efficient Design of Low-Rise Residential Buildings. Steve is past chair and continues work on ACI/The Masonry Society Committee 122 on Energy Efficiency of Concrete and Masonry Systems. In his early career, he initiated efforts to incorporate thermal mass credits in the Council of American Building Code Officials *Model Energy Code*, and a form of these credits continue to be included in the ICC *International Energy Conservation Code* and ASHRAE standards. With the onset of codifying green construction criteria, Steve served as a member of the ICC committee that developed the first public review draft of the ICC *International Green Construction Code*. Steve has chaired the technical committee and board of direction and has become an honorary member of the Sustainable Building Industries Association. He provides industry leadership and coordination through his activities with the Masonry Alliance for Codes and Standards and the Alliance for Concrete Codes and Standards. Since his initial involvement in whole building concepts of construction in 1978, he has published numerous papers and articles on energy conservation and environmental aspects of building construction, continuing to encourage combined whole building, whole project, and community impact approaches to sustainable development.

With regard to enhanced resiliency, Steve is an advocate for more stringent building codes in efforts to offset the trend where standard of practice is becoming increasingly more synonymous with minimum building code requirements for life safety and resulting in increased property damage and losses due to disasters. Amongst his many committees and activities, he serves on ASTM E54 on Homeland Security Applications and ASTM E05 on Fire Standards; National Institute of Building Sciences Multi-Hazard Mitigation Council, Building Seismic Safety Council (BSSC) and BSSC Board of Direction; Structural Engineering Institute Board of Governors, Codes and Standards Activities Division Executive Committee; Multi-Hazard Mitigation Committee and Structural Fire Protection Committee; and ACI/TMS Committee 216 on Fire Resistance and Fire Protection of Structures. He was a presenting participant in the development U.S. Department of Homeland Security's national roadmap for resiliency. He has published several papers and articles on fire protection, code and standards development, and enhanced resiliency in effort to encourage combined whole building, whole project, and community impact approaches for building design and construction.

Steve initiated the concepts of combined sustainability and enhanced resiliency in the form of the *High Performance Building Requirement for Sustainability* which were published in 2008. He has continued his leadership and technical roles which resulted in subsequent revisions and updates including the improvements reflected in this version now referred to as *Code Amendments for Sustainability*.

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Stephen (Steve) Skalko is a registered professional engineer in Georgia in the disciplines of civil engineering and fire protection engineering. He has been involved in codes and standards for over thirty years first as a Building Official and Fire Marshal for a local government, then as a representative of the Portland Cement Association, and is now the principal of a consulting engineering firm that provides building and fire safety consulting services. He participates in codes and standards development through the International Code Council (ICC), the National Fire Protection Association (NFPA), the American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE), the American Society of Civil Engineers (ASCE) and American Society for Testing and Materials (ASTM).

As a former code official he served on the Southern Building Code Congress, International (SBCCI) Standard Building Code Development Committee and represented SBCCI on the CABO *One and Two Family Dwelling Code* (OTFDC) and the Model Energy Code (MEC) Development Committees. He also has served on the *International Energy Conservation Code* (IECC) Development Committee.

Other technical committee activities during his career have included serving on ICC Committees for Storm Shelters and Residential High Wind Construction; NFPA Technical Committees for Assembly Occupancies, Garages and Parking Structures, Industrial-Storage Occupancies, Structures, Construction & Materials and Exposure Fire Protection; ASHRAE Standing Standard Project Committees (SSPC) 90.1 and 90.2 for energy conservation of commercial and residential buildings, including Chair of both committees; ASTM standard development with ASTM E05 on Fire Standards and ASTM E06 on Performance of Buildings; and for ASCE serving on the committee responsible for development of ASCE 32, *Design and Construction of Frost-Protected Shallow Foundations*.

Steve participated in the initial development of *High Performance Building Requirement for Sustainability* in 2008. With his unique background as a building code official and fire marshal combined with his history of code development activities, he continued to provide guidance and technical content in the development of subsequent revisions and updates which have resulted in the improvements reflected in this *Code Amendments for Sustainability*.