



Low Slope Roofing Systems
The University of Wisconsin Madison

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Building codes applicable to roofing

presented by

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Some background

- The I-Codes are “model codes” developed by the International Code Council (ICC)
- Model codes serve as the technical basis for state or local code adoption
- The code provides the minimum legal requirements for building construction...and operation
- The code is enforced by the “authority having jurisdiction” (AHJ)
- The code can also provide a basis for construction claims-related litigation

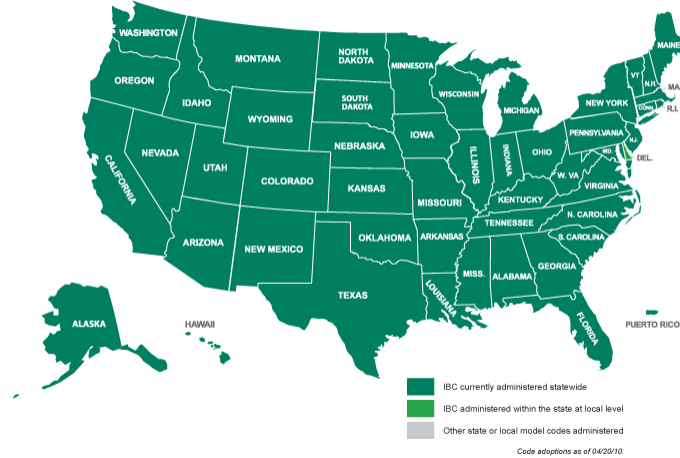


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Code adoption

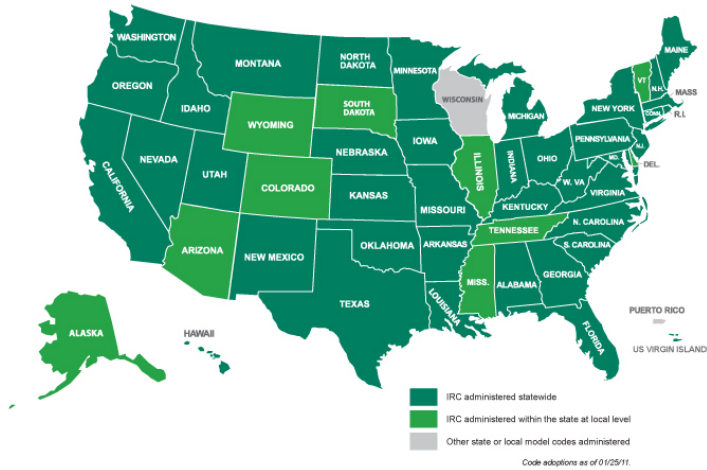
INTERNATIONAL BUILDING CODE ADOPTION MAP

The IBC is in use or adopted in 50 states, the District of Columbia, the U.S. Virgin Islands, NYC, Guam and the Northern Marianas Islands.



INTERNATIONAL RESIDENTIAL CODE ADOPTION MAP

The IRC is in use or adopted in 49 states, the District of Columbia and the U.S. Virgin Islands



Code enforcement

- AHJ's code official
- Construction litigation



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Legal considerations

“In most states, a building code violation is considered to be evidence of negligence. In some situations, a building code violation may be considered *negligence per se*...”

--Stephen M. Phillips
Hendrick, Phillips, Salzman & Flatt



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Who is responsible for compliance?

- The building owner
- And, everyone else involved



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AIA General Conditions

AIA A201 – General Conditions of The Contract for Construction

Article 3 Contractor

3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by and made known to the Contractor as a request for information in such a form as the Architect may require.



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AIA General Conditions

AIA A201 – General Conditions of The Contract for Construction

3.2.4 ...If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay the costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages ...for nonconformities of the Contract Documents to... codes...



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International Building Code, 2012 Edition (IBC 2012)



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International Building Code, 2012 Edition

101.2 Scope. The provisions of this code shall apply to the construction, *alteration*, relocation, enlargement, replacement, *repair*, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures.

Exception: Detached one- and two-family *dwelling*s and multiple single-family *dwelling*s (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*.



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International Building Code, 2012 Edition

Specific roofing-related requirements

- Ch. 12-Interior Environment (attic ventilation)
- Ch. 13-Energy Efficiency (thermal insulation)
- Ch. 15-Roof Assemblies and Rooftop Structures
- Ch. 16-Structural Design (design loads)
- Ch. 22-Steel (structural metal panel roofing)
- Ch. 24-Glass and Glazing (skylights)
- Ch. 26-Plastic (foam plastic insulation)
- Ch. 35-Referenced Standards



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Ch. 15-Roof Assemblies and Rooftop Structures

International Building Code, 2012 Edition

SECTION 1501

GENERAL

1501.1 Scope. The provisions of this chapter shall govern the design, materials, construction and quality of roof assemblies and rooftop structures.

Building code requirements for vegetative roof systems and rooftop PV are in Ch. 15



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Ch. 15-Roof Assemblies and Rooftop Structures

International Building Code, 2012 Edition

- Sec. 1501-Scope
- Sec. 1502-Definitions
- Sec. 1503-Weather Protection
- Sec. 1504-Performance Requirements (wind)
- Sec. 1505-Fire Classification
- Sec. 1506-Materials
- Sec. 1507-Requirements for Roof Coverings
- Sec. 1508-Roof Insulation
- Sec. 1509-Rooftop Structures
- Sec. 1510-Reroofing



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Roofing-related building code provisions addressed in this presentation

- Reroofing
- Prescriptive requirements
- Fire resistance
- Wind-uplift resistance
- Alternate approval



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Sec. 1510-Reroofing

International Building Code, 2012 Edition

1510.1 General. Materials and methods of application used for recovering or replacing an existing roof covering shall comply with the requirements of Chapter 15.

Exception: Reroofing shall not be required to meet the minimum design slope requirement of one-quarter unit vertical in 12 units horizontal (2-percent slope) in Section 1507 for roofs that provide positive roof drainage.



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Sec. 1510-Reroofing

International Building Code, 2012 Edition

1510.3 Recovering versus replacement. New roof coverings shall not be installed without first removing all existing layers of roof coverings down to the roof deck where any of the following conditions occur:

1. Where the existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.
2. Where the existing roof covering is wood shake, slate, clay, cement or asbestos-cement tile.
3. Where the existing roof has two or more applications of any type of roof covering.

Exceptions:...



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Prescriptive requirements



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Sec. 1503-Weather Protection

International Building Code, 2012 Edition

1503.6 Crickets and saddles. A cricket or saddle shall be installed on the ridge side of any chimney or penetration greater than 30 inches (762 mm) wide as measured perpendicular to the slope. Cricket or saddle coverings shall be sheet metal or of the same material as the roof covering.

Exception: Unit skylights installed in accordance with Section 2405.5 and flashed in accordance with the manufacturer's instructions shall be permitted to be installed without a cricket or saddle.

Unit skylights need to comply with
AAMA/WDMA/CSA 101/I.S./A440



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Sec. 1506-Materials

International Building Code, 2012 Edition

1506.1 Scope. The requirements set forth in this section shall apply to the application of roof-covering materials specified herein. Roof coverings shall be applied in accordance with this chapter and the manufacturer's installation instructions. Installation of roof coverings shall comply with the applicable provisions of Section 1507.



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Sec. 1507-Requirements for Roof Coverings

International Building Code, 2012 Edition

- Asphalt shingles
- Clay & concrete tile
- Metal roof panels
- Metal roof shingles
- Roll roofing
- Slate shingles
- Wood shingles
- Wood shakes
- Built-up roofs
- Modified bitumen roofs
- Thermoset single-ply roofs
- Thermoplastic single-ply roofs
- SPF roofs
- Liquid-applied roofing
- Roof gardens/landscaped roofs
- Photovoltaic modules/shingles



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Fire resistance

Classification of exterior fire resistance:

Class A: Severe fire-test exposure

Class B: Moderate fire-test exposure

Class C: Light-fire test exposure



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Sec. 1505-Fire Classification

International Building Code, 2012 Edition

1505.1 General. Roof assemblies shall be divided into the classes defined below. Class A, B and C roof assemblies and roof coverings required to be listed by this section shall be tested in accordance with ASTM E 108 or UL 790. In addition, fire-retardant-treated wood roof coverings shall be tested in accordance with ASTM D 2898. The minimum roof coverings installed on buildings shall comply with Table 1505.1 based on the type of construction of the building.

Exception: Skylights and sloped glazing that comply with Chapter 24 or Section 2610.



Sec. 1505-Fire Classification

International Building Code, 2012 Edition

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

IA	IB	IIA	IIB	IIIA	IIIB	IV	VA	VB
B	B	B	C ^c	B	C ^c	B	B	C ^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. Nonclassified 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 in height 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.



Sec. 1505-Fire Classification

International Building Code, 2012 Edition

1505.2 Class A roof assemblies. Class A roof assemblies are those that are effective against severe fire test exposure. Class A roof assemblies and roof coverings shall be *listed* and identified as Class A by an *approved* testing agency. Class A roof assemblies shall be permitted for use in buildings or structures of all types of construction.

Exceptions:

1. Class A roof assemblies include those with coverings of brick, masonry or an exposed concrete roof deck.
2. Class A roof assemblies also include ferrous or copper shingles or sheets, metal sheets and shingles, clay or concrete roof tile or slate installed on noncombustible decks or ferrous, copper or metal sheets installed without a roof deck on noncombustible framing.
3. Class A roof assemblies include 16 oz/sq. ft. (0.0416 kg/m²) copper sheets installed over combustible decks.



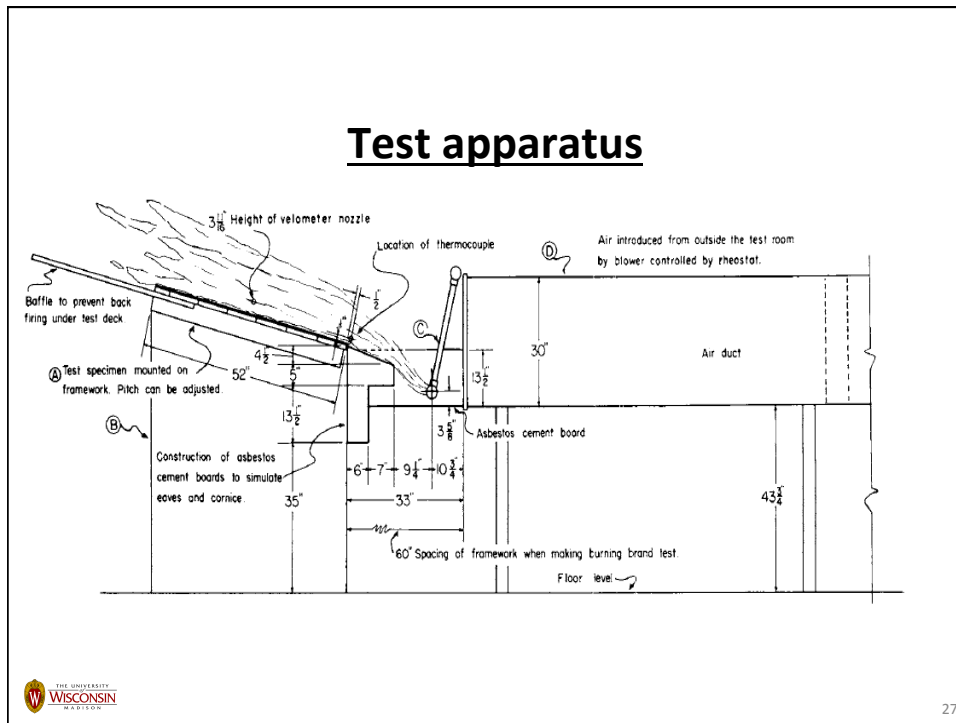
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ASTM E108 or UL 790 testing

- Spread of flame test (all roof deck types)
- Burning brand test (combustible roof decks)
- Intermittent flame test (combustible roof decks)
- Flying brand test
- Rain test
- Weathering test

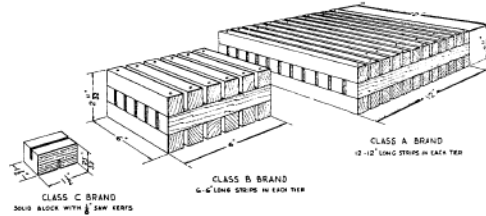


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- ### Spread of flame test
- Test specimen sizes:
 - Class A: 8 ft. long x 40 in. wide
 - Class B: 9 ft. long x 40 in. wide
 - Class C: 13 ft. long x 40 in. wide
 - 10 minute duration
 - Pass/fail criteria:
 - No lateral flame spread to edges of test specimen
 - Maximum up-slope flame spread:
 - Class A: 6 ft.
 - Class B: 8 ft.
 - Class C: 13 ft.
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Burning brand test



- Brand class/size:
 - Class A brand (12" x 12" x 2-11/32")
 - Class B brand (6" x 6" x 2-11/32")
 - Class C - 20 brands (1-1/2" x 1-1/2" x 25/32" each)
- 1-1/2 hr. duration
- Pass/fail: Sustained flaming on the bottomside of the roof deck

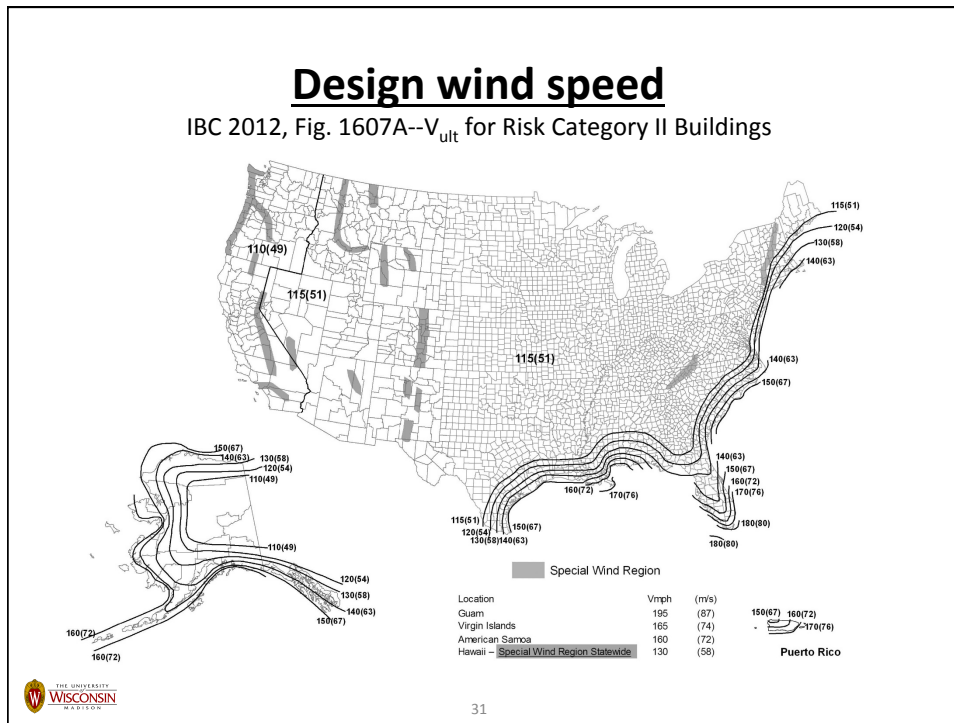


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Wind-uplift resistance



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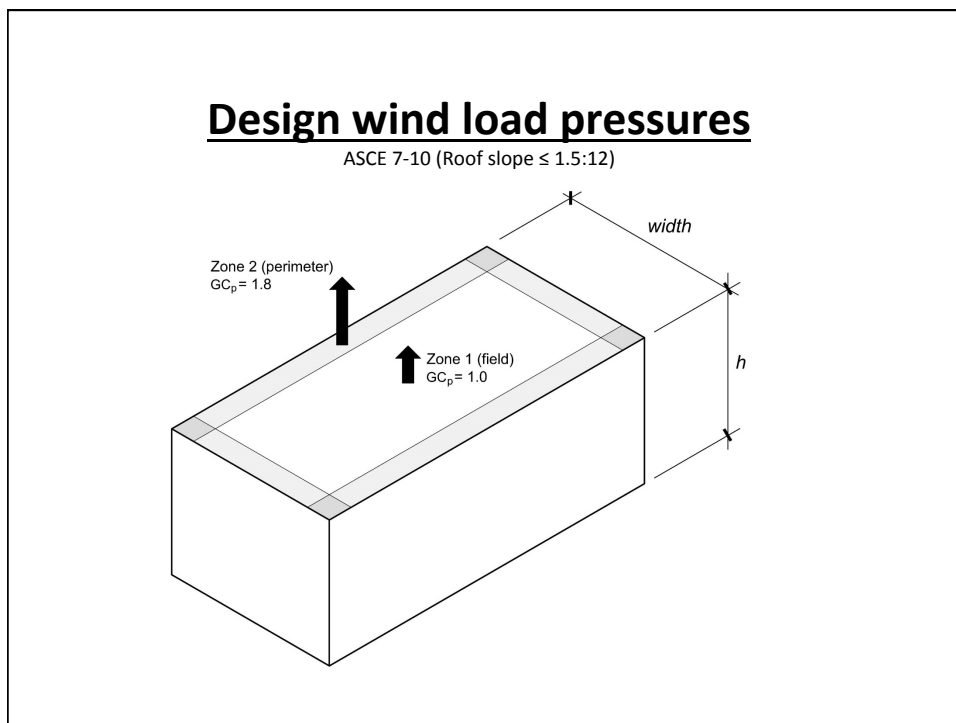
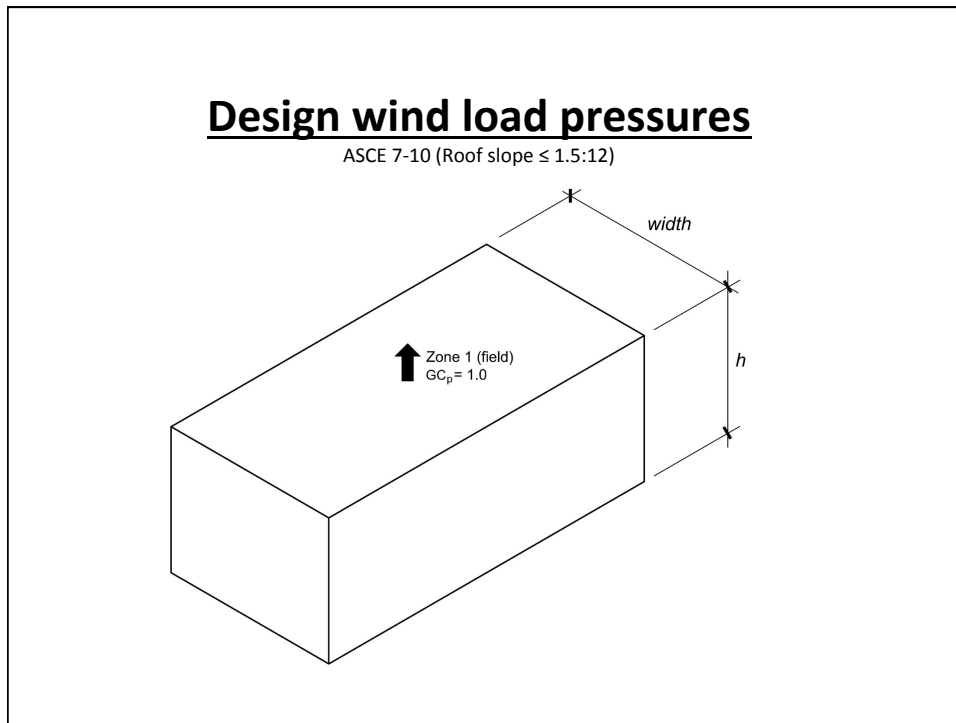
Sec. 1504-Performance Requirements

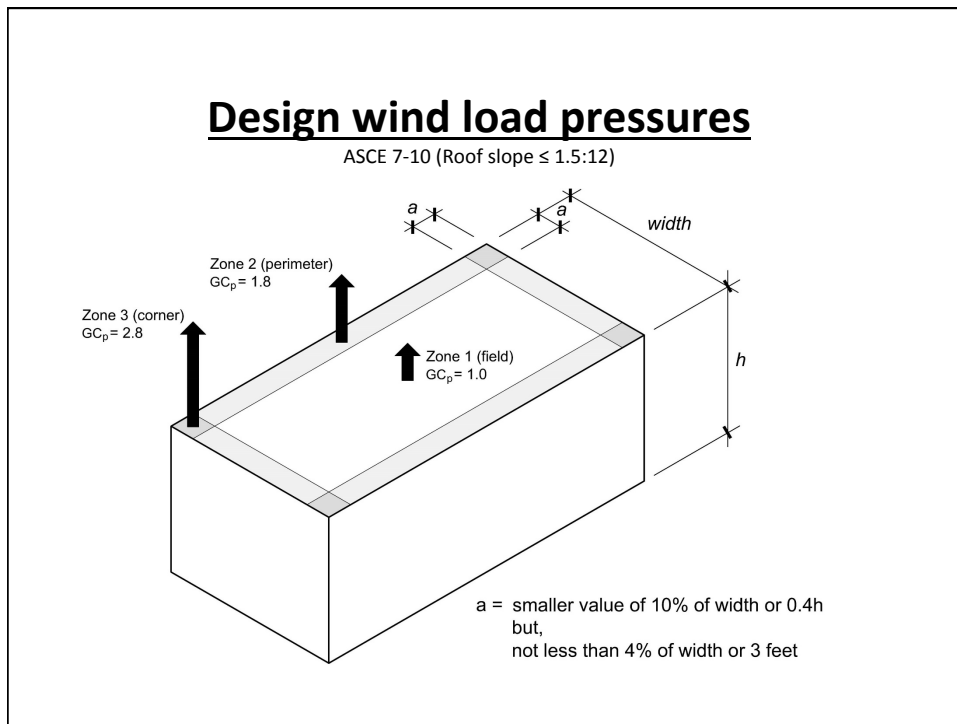
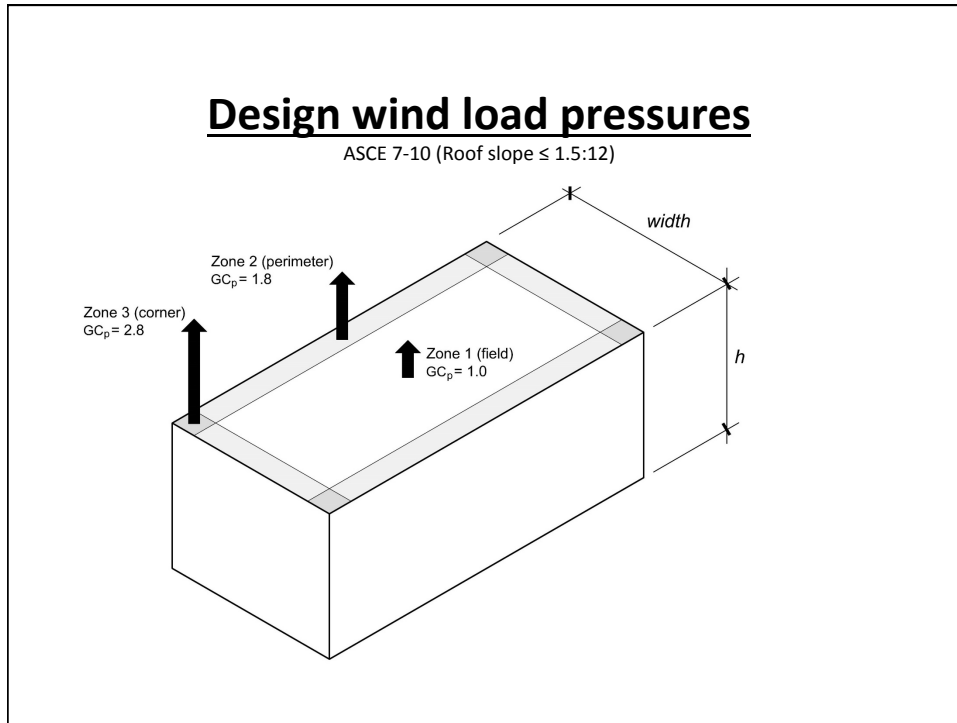
International Building Code, 2012 Edition

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.

1504.3.1 Other roof systems. Roof systems with built-up, modified bitumen, fully adhered or mechanically attached single-ply through fastened metal panel roof systems, and other types of membrane roof coverings shall also be tested in accordance with FM 4474, UL 580 or UL 1897.







Design wind load pressures

International Building Code, 2012 Edition

SECTION 1603

CONSTRUCTION DOCUMENTS

1603.1 General. *Construction documents* shall show the size, section and relative locations of structural members with floor levels, column centers and offsets dimensioned. The design loads and other information pertinent to the structural design required by Sections 1603.1.1 through 1603.1.9 shall be indicated on the *construction documents*.

[continued...]



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1603.1.4 Wind design data. The following information related to wind loads shall be shown, regardless of whether wind loads govern the design of the lateral force resisting system of the structure:

1. Ultimate design wind speed, V_{ult} (*3-second gust*), miles per hour (km/hr) and nominal design wind speed, V_{asd} as determined in accordance with Section 1609.3.1.
2. *Risk category*.
3. Wind exposure. Where more than one wind exposure is utilized, the wind exposure and applicable wind direction shall be indicated.
4. The applicable internal pressure coefficient.
5. Components and cladding. The design wind pressures in terms of psf (kN/m²) to be used for the design of exterior component and cladding materials not specifically designed by the *registered design professional*.



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Roof Wind Designer is intended to provide users with an easy-to-use means for determining roof systems' design wind loads for many commonly encountered building types that are subject to building code compliance.

Design-wind loads are derived using the American Society of Civil Engineers (ASCE) Standard ASCE 7, "Minimum Design Loads for Buildings and Other Structures." This standard is a widely recognized consensus standard and is referenced in and serves as the technical basis for wind load determination in the International Building Code and NFPA 5000: Building Construction and Safety Code. Roof Wind Designer allows users to choose between the 2005 or 2010 editions of ASCE 7. Roof Wind Designer uses Method 1—Simplified Method, 2005 edition, and the Envelope Procedure, Part 2: Low-rise Buildings (Simplified) of Chapter 30, 2010 edition. For a more detailed explanation of the two editions, please [click here](#).

Also, Roof Wind Designer determines roof systems' minimum recommended design wind-resistance loads, which are derived from the building's design wind loads, taking into consideration a safety factor in reliance of ASTM D6630, "Standard Guide for Low Slope Insulated Roof Membrane Assembly Performance." Using these minimum recommended design wind-resistance loads, users can select appropriate wind resistance classified roof systems.

Roof Wind Designer has been developed and is maintained by the National Roofing Contractors Association (NRCA), with the support of the Midwest Roofing Contractors Association (MRCA) and the North/East Roofing Contractors Association (NERCA). Currently, this application is available at no cost.

Questions regarding Roof Wind Designer can be directed to the [Contact Us](#) page.

To register for a new account [click here](#). If you already have an account, [click here](#) to login.





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Sec. 1504-Performance Requirements

International Building Code, 2012 Edition

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.

1504.3.1 Other roof systems. Roof systems with built-up, modified bitumen, fully adhered or mechanically attached single-ply through fastened metal panel roof systems, and other types of membrane roof coverings shall also be tested in accordance with FM 4474, UL 580 or UL 1897.



Wind uplift test methods

FM Approvals (FM)

FM 4474:

- Class 60 (30 psf field)
- Class 90 (45 psf field)
- Class 120 (60 psf field)
- Class 150 (75 psf field)
- Class 180 (90 psf field)
- and on, and on....

Underwriters Laboratories (UL)

UL 580 and UL 1897:

- Class 30 (30 psf)
- Class 60 (60 psf)
- Class 90 (90 psf)

Wind uplift testing at and certification by FM or UL is not required by the Code



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Sec. 1504-Performance Requirements

International Building Code, 2012 Edition

1504.3.2 Metal panel roof systems. Metal panel roof systems through fastened or standing seam shall be tested in accordance with UL 580 or ASTM E 1592.

Exception: Metal roofs constructed of cold-formed steel, where the roof deck acts as the roof covering and provides both weather protection and support for structural loads, shall be permitted to be designed and tested in accordance with the applicable referenced structural design standard in Section 2210.1.



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Sec. 1504-Performance Requirements

International Building Code, 2012 Edition

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 ANSI/SPRI RP-4.

ANSI/SPRI RP-4 is available on SPRI's website: www.spri.org



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Sec. 1504-Performance Requirements

International Building Code, 2012 Edition

1504.5 Edge securement for low-slope roofs. Low-slope 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 Test Methods RE-1, RE-2 and RE-3 of ANSI/SPRI ES-1, except V_{ult} wind speed shall be determined from Figure 1609A, 1609B, or 1609C as applicable.

ANSI/SPRI ES-1 is available on SPRI's website: www.spri.org



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Sec. 1504-Performance Requirements

International Building Code, 2012 Edition

1504.8 Aggregate. Aggregate used as surfacing for roof coverings and aggregate, gravel or stone used as ballast shall not be used on the roof of a building located in a hurricane-prone region as defined in Section 202, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site.

[Continued...]



**TABLE 1504.8
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR
BUILDINGS WITH AGGREGATE ON THE ROOF IN AREAS
OUTSIDE A HURRICANE-PRONE REGION**

NOMINAL DESIGN WIND SPEED, V_{wd} (mph) ^{b, d}	MAXIMUM MEAN ROOF HEIGHT (ft) ^{a, c}		
	Exposure category		
	B	C	D
85	170	60	30
90	110	35	15
95	75	20	NP
100	55	15	NP
105	40	NP	NP
110	30	NP	NP
115	20	NP	NP
120	15	NP	NP
Greater than 120	NP	NP	NP

For SI: 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.

- a. Mean roof height as defined in ASCE 7.
- b. For intermediate values of V_{wd} , the height associated with the next higher value of V_{wd} shall be used, or direct interpolation is permitted.
- c. NP = gravel and stone not permitted for any roof height.
- d. V_{wd} shall be determined in accordance with Section 1609.3.1.



SPF roof systems

IBC 2012, Section 1507.14.3--Application

1507.14.3 Application. Foamed-in-place roof insulation shall be installed in accordance with the manufacturer's instructions. A liquid-applied protective coating that complies with Table 1507.14.3 shall be applied no less than 2 hours nor more than 72 hours following the application of the foam.

**TABLE 1507.14.3
PROTECTIVE COATING MATERIAL STANDARDS**

MATERIAL	STANDARD
Acrylic coating	ASTM D 6083
Silicone coating	ASTM D 6694
Moisture-cured polyurethane coating	ASTM D 6947



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Alternate approval

IBC 2012, Sec. 104.11

104.11 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.



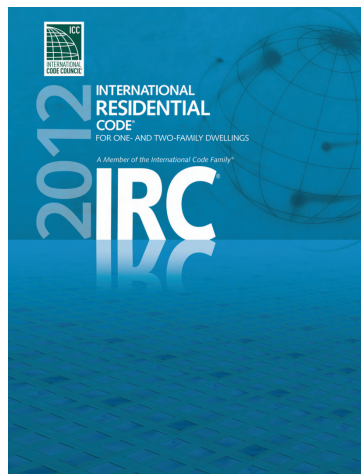
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104.11.1 Research reports. Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources.

104.11.2 Tests. Whenever there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the building official shall have the authority to require tests as evidence of compliance to be made at no expense to the jurisdiction. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the building official shall approve the testing procedures. Tests shall be performed by an approved agency. Reports of such tests shall be retained by the building official for the period required for retention of public records.



International Residential Code, 2012 Edition (IRC 2012)



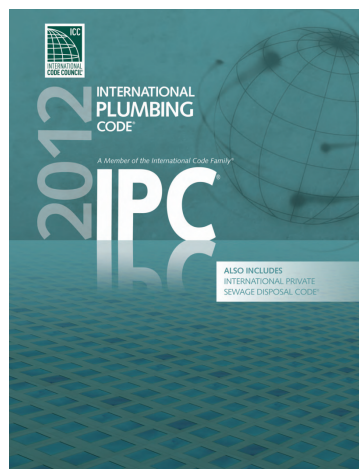
International Residential Code, 2012 Edition

- Chapter 9-Roof Assemblies
- Similar to IBC 2012, Chapter 15
- Required fire classification by local ordinance
- More prescriptive-based language



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International Plumbing Code, 2012 Edition (IPC 2012)



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International Plumbing Code, 2012 Edition

Roof drain, drain piping, scupper, gutter and
downspout sizing is dictated by the
International Plumbing Code.

IPC Chapter 11-Storm Drainage



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***International Fire Code,
2012 Edition (IFC 2012)***



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International Fire Code, 2012 Edition

Fire safety during roofing operations, and rooftop PV and vegetative roof systems are dictated by the *International Fire Code*.

- IFC Sec. 303-Kettles (e.g., ≥ 20 ft.)
- IFC Sec. 3317-Safeguarding Roofing Operations
- IFC Sec. 605.11-Solar Photovoltaic Power Systems
- IFC Sec. 317-Rooftop Gardens and Landscaped Roofs



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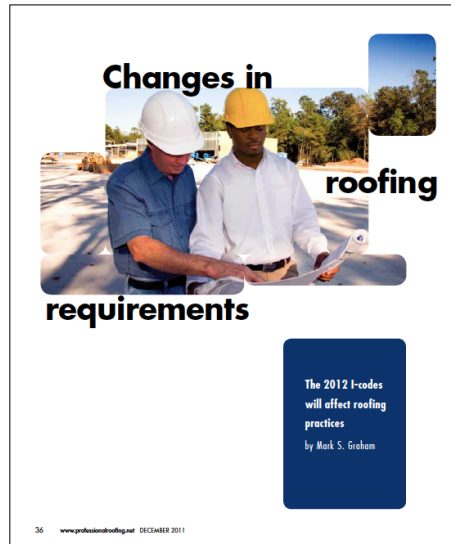
In summary

- Be knowledgeable of applicable codes
- Watch for state/local modifications
- Comply with the applicable codes
- Building/Residential Code
- Plumbing Code
- Fire Code



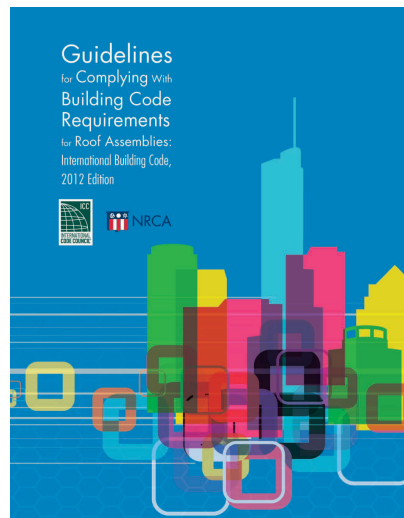
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Professional Roofing, December 2011



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Building Codes Manual (2012 Codes)



- Based on 2012 I-codes:
 - IBC 2012
 - IRC 2012
 - IECC 2012
 - IPC 2012
 - IFC 2012
- Includes roofing-related code text and NRCA commentary on each section
- Co-branded with ICC; NRCA promotes to industry and ICC promotes to code officials



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