



OCT. 13-15

**2021 I-codes: Challenges and Liability Risks
for Roofing Contractors**



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Prerequisites

- Intermediate- to advanced-level
- Some knowledge of code requirements
- General knowledge of 2018 I-codes
- Understand...I am the messenger
– “...don't shoot the messenger...”

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Code development process

The 2021 I-codes are the 8th edition

The 2021 I-codes present the code as originally published in 2000, with changes reflected in the 2003 through 2018 editions and further changes approved by the ICC Code Development Process through 2020. A new edition is promulgated every three years.

2018 Group A: IBC Building Fire, Building General and Plumbing Committees

2019 Group B: IBC Structural, IECC-Commercial, IECC-Residential Committees

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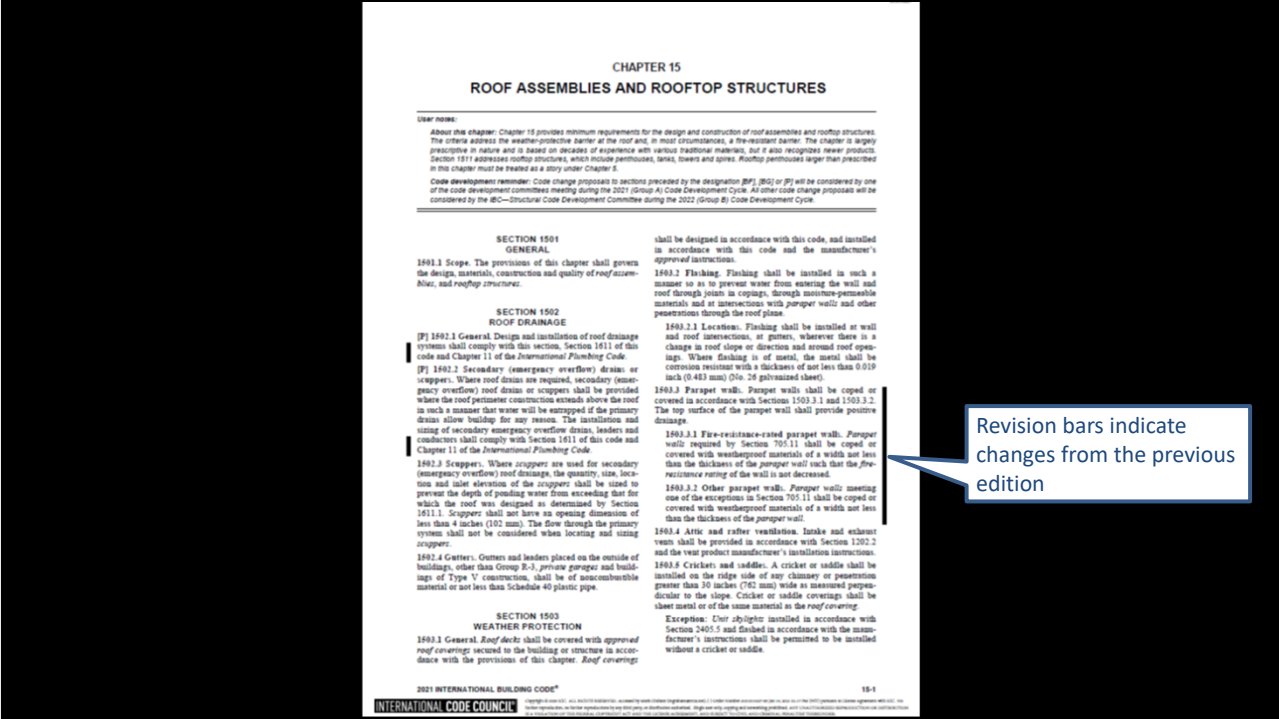
2021 I-codes



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Edge metal testing

Changes in IBC 2021, Section 1504-Performance Requirements

1504.6 Edge systems for low-slope roofs. Metal edge systems, except gutters and counterflashing, installed on built-up, modified bitumen and single-ply roof systems having a slope less than 2 units vertical in 12 units horizontal (2:12) 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 basic design *wind speed*, V, shall be determined from Figures 1609.3(1) through 1609.3(12) as applicable.

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Gutter testing

Changes in IBC 2021, Section 1504-Performance Requirements

1504.6 Edge systems for low-slope roofs. Metal edge systems, except gutters and counterflashing, installed on built-up, modified bitumen and single-ply roof systems having a slope less than 2 units vertical in 12 units horizontal (2:12) 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 basic design *wind speed*, V, shall be determined from Figures 1609.3(1) through 1609.3(12) as applicable.

1504.6.1 Gutter securement for low-slope roofs. Gutters that are used to secure the perimeter edge of the roof membrane on low-slope (less than 2:12 slope) built-up, modified bitumen, and single-ply roofs, shall be designed, constructed and installed to resist wind loads in accordance with Section 1609 and shall be tested in accordance with Test Methods G-1 and G-2 of SPRI GT-1.

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ANSI/SPRI GT-1

ANSI/SPRI GT-1
Test Standard for Gutter Systems
Approved May 28, 2016

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1.5 (PFI) Test Method 2

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1.7 Safety 2

Figure 2. Test Set-up for SPRI Test G-1

Figure 3. Test Set-up for SPRI Test G-2

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Westborough, MA 01581
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Disclaimer:
This standard is for use by architects, engineers, roofing contractors and building owners when designing, installing or evaluating a building's gutter system. SPRI, its members and employees do not warrant that this standard is proper and/or applicable under all conditions.

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Aggregate surfacing

Changes in IBC 2021, Section 1504-Performance Requirements

1504.9 Wind resistance of aggregate-surfaced roofs. Parapets shall be provided for aggregate surfaced roofs and shall comply with Table 1504.9.

TABLE 1504.9
MINIMUM REQUIRED PARAPET HEIGHT (INCHES) FOR AGGREGATE SURFACED ROOFS^{a, b, c}

AGGREGATE SIZE	MEAN ROOF HEIGHT (ft)	WIND EXPOSURE AND BASIC DESIGN WIND SPEED (MPH)																	
		Exposure B								Exposure C ^d									
		≤ 95	100	105	110	115	120	130	140	≤ 95	100	105	110	115	120	130	140	150	
ASTM D1863 (No. 7 or No. 67)	15	2	2	2	2	12	12	16	20	24	2	13	15	18	20	23	27	32	37
	20	2	2	2	2	12	14	18	22	26	12	15	17	19	22	24	29	34	39
	30	2	2	2	13	15	17	21	25	30	14	17	19	22	24	27	32	37	42
	50	12	12	14	16	18	21	25	30	35	17	19	22	25	28	30	36	41	47
	100	14	16	19	21	24	27	32	37	42	21	24	26	29	32	35	41	47	53
ASTM D1863 (No. 6)	15	2	2	2	2	12	12	12	15	18	2	2	2	13	15	17	22	26	30
	20	2	2	2	2	12	12	13	17	21	2	2	12	15	17	19	23	28	32
	30	2	2	2	2	12	12	16	20	24	2	12	14	17	19	21	26	31	35
	50	12	12	12	12	14	16	20	24	28	12	15	17	19	22	24	29	34	39
	100	12	12	14	16	19	21	26	30	35	16	18	21	24	26	29	34	39	45
	150	12	14	17	19	22	24	29	34	39	18	21	23	26	29	32	37	43	48

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.
a. Interpolation shall be permitted for mean roof height and parapet height.
b. Basic design wind speed, *V*, and wind exposure shall be determined in accordance with Section 1609.
c. Where the minimum required parapet height is indicated to be 2 inches (51 mm), a gravel stop shall be permitted and shall extend not less than 2 inches (51 mm) from the roof surface and not less than the height of the aggregate.
d. For Exposure D, add 8 inches (203 mm) to the parapet height required for Exposure C and the parapet height shall not be less than 12 inches (305 mm).

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Rooftop PV – Fire resistance

Changes in IBC 2021, Section 1505-Fire Classification

[BF] 1505.8 Building-integrated photovoltaic (BIPV) products. *BIPV products* installed as the roof covering shall be tested, *listed* and *labeled* for fire classification in accordance with Section 1505.1.

[BF] 1505.9 Rooftop mounted photovoltaic (PV) panel systems. Rooftop mounted *photovoltaic (PV) panel systems* shall be tested, *listed* and identified with a fire classification in accordance with UL 2703. Listed systems shall be installed in accordance with the manufacturer's installation instructions and their listing. The fire classification shall comply with Table 1505.1 based on the type of construction of the building.

1507.16.6 Material standards. *Photovoltaic shingles* shall be *listed* and labeled in accordance with UL 7103 or with both UL 61730-1 and UL 61730-2.

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Single-ply membrane roof systems

■ **1507.12 Single-ply roofing.** The installation of single-ply roofing shall comply with the provisions of this section.

■ **1507.12.1 Slope.** Single-ply membrane roofs shall have a design slope of not less than $\frac{1}{4}$ unit vertical in 12 units horizontal (2-percent slope) for drainage.

■ **1507.12.2 Material standards.** Single-ply roof coverings shall comply with the material standards in Table 1507.12.2.

**TABLE 1507.12.2
SINGLE-PLY ROOFING MATERIAL STANDARDS**

MATERIAL	MATERIAL STANDARD
Chlorosulfonated polyethylene (CSPE) or polyisobutylene (PIB)	ASTM D5019
Ethylene propylene diene monomer (EPDM)	ASTM D4637
Ketone Ethylene Ester (KEE)	ASTM D6754
Polyvinyl Chloride (PVC) or (PVC/KEE)	ASTM D4434
Thermoplastic polyolefin (TPO)	ASTM D6878

■ **1507.12.3 Ballasted low-slope roofs.** Ballasted low-slope roofs (roof slope < 2:12) shall be installed in accordance with this section and Section 1504.5. Stone used as *ballast* shall comply with ASTM D448 or ASTM D7655.

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SPF roof systems

1507.13 Sprayed polyurethane foam roofing. The installation of sprayed polyurethane foam roofing shall comply with the provisions of this section.

1507.13.1 Slope. Sprayed polyurethane foam roofs shall have a design slope of not less than $\frac{1}{4}$ unit vertical in 12 units horizontal (2-percent slope) for drainage.

1507.13.2 Material standards. Spray-applied polyurethane foam insulation shall comply with ASTM C1029 Type III or IV or ASTM D7425.

1507.13.3 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 1507.13.3 shall be applied not less than 2 hours nor more than 72 hours following the application of the foam.

**TABLE 1507.13.3
PROTECTIVE COATING MATERIAL STANDARDS**

MATERIAL	STANDARD
Acrylic coating	ASTM D6083
Silicone coating	ASTM D6694
Moisture-cured polyurethane coating	ASTM D6947

1507.13.4 Foam plastics. Foam plastic materials and installation shall comply with Chapter 26.

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Liquid-applied membrane roof systems

Changes in IBC 2021, Section 1507.14-Liquid-applied Roofing

1507.14 Liquid-applied roofing. The installation of liquid-applied roofing shall comply with the provisions of this section.

1507.14.1 Slope. Liquid-applied roofing shall have a design slope of not less than $\frac{1}{4}$ unit vertical in 12 units horizontal (2-percent slope).

1507.14.2 Material standards. Liquid-applied roofing shall comply with ASTM C836, ASTM C957 or ASTM D3468. ■

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Roof coatings

Changes in IBC 2021, Section 1509-Roof Coatings (new)

SECTION 1509 ROOF COATINGS

1509.1 General. The installation of a *roof coating* on a *roof covering* shall comply with the requirements of Section 1505 and this section.

1509.2 Material standards. Roof coating materials shall comply with the standards in Table 1509.2.

**TABLE 1509.2
ROOF COATING MATERIAL STANDARDS**

MATERIAL	STANDARD
Acrylic coating	ASTM D6083
Asphaltic emulsion coating	ASTM D1227
Asphalt coating	ASTM D2823
Asphalt roof coating	ASTM D4479
Aluminum-pigmented asphalt coating	ASTM D2824
Silicone coating	ASTM D6694
Moisture-cured polyurethane coating	ASTM D6947

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Reroofing

Changes in IBC 2021, Section 1512-Reroofing

1512.2 Roof replacement. *Roof replacement* shall include the removal of all existing layers of *roof assembly* materials down to the *roof deck*.

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Reroofing

Changes to IBC 2021, Section 1512-Reroofing

1512.4 Reinstallation of materials. Existing slate, clay or cement tile shall be permitted for reinstallation, except that damaged, cracked or broken slate or tile shall not be reinstalled. Existing vent flashing, metal edgings, drain outlets, collars and metal counterflashings shall not be reinstalled where rusted, damaged or deteriorated. Existing *ballast* that is damaged, cracked or broken shall not be reinstalled. Existing aggregate surfacing materials from built-up roofs shall not be reinstalled.

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Roof zones

Changes in IBC 2021, Section 1603-Construction Documents

CHAPTER 16
STRUCTURAL DESIGN

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. Basic design *wind speed*, V , miles per hour and *allowable stress design wind speed*, V_{asd} , as determined in accordance with Section 1609.3.1.
2. *Risk category*.
3. Wind exposure. Applicable wind direction if more than one wind exposure is utilized.
4. Applicable internal pressure coefficient.
5. Design wind pressures and their applicable zones with dimensions to be used for exterior component and cladding materials not specifically designed by the *registered design professional* responsible for the design of the structure, pounds per square foot (kN/m^2).

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Attic ventilation

Changes in IBC 2021, Section 1203-Unvented Attics and Unvented Enclosed Rafter Spaces

5.2.7. The roof slope shall be greater than or equal to 3 units vertical in 12 units horizontal (3:12).

5.2.8. Where only air-permeable insulation is used, it shall be installed directly below the structural roof sheathing, on top the attic floor, or on top of the ceiling.

5.2.9. Where only air-permeable insulation is used and is installed directly below the structural roof sheathing, air shall be supplied at a flow rate greater than or equal to 50 cubic feet per minute (23.6 L/s) per 1,000 square feet (93 m²) of ceiling.

5.3. The air shall be supplied from ductwork providing supply air to the occupiable space when the conditioning system is operating. Alternatively, the air shall be supplied by a supply fan when the conditioning system is operating. Where preformed insulation board is used as the air-impermeable insulation layer, it shall be sealed at the perimeter of each individual sheet interior surface to form a continuous layer.

Exceptions:

1. Section 1202.3 does not apply to special use structures or enclosures such as swimming pool enclosures, data processing centers, hospitals or art galleries.
2. Section 1202.3 does not apply to enclosures in Climate Zones 5 through 8 that are humidified beyond 35 percent during the three coldest months.

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2021 IRC

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IRC's applicability

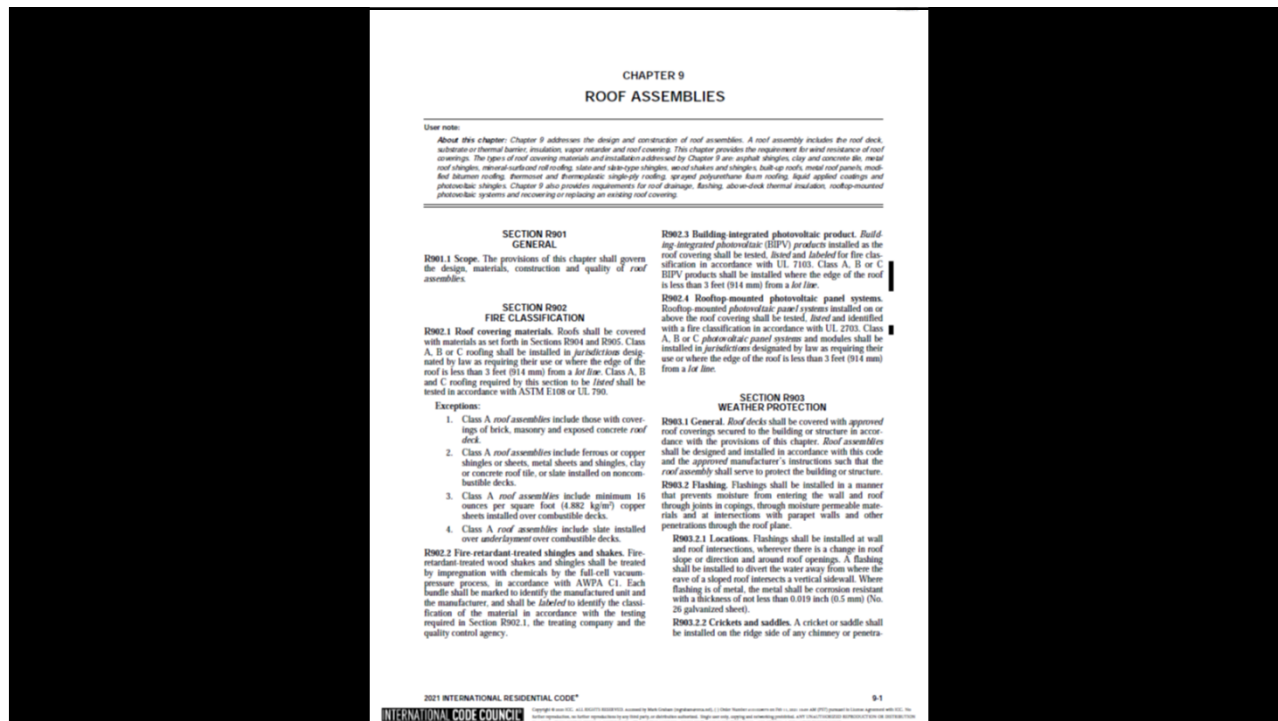
When does IRC apply vs. IBC?

R101.2 Scope. The provisions of this code shall apply to the construction, *alteration*, movement, enlargement, replacement, *repair*, equipment, use and occupancy, location, removal and demolition of detached one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height with a separate means of egress and their *accessory structures* not more than three stories above *grade plane* in height.

Exception: The following shall be permitted to be constructed in accordance with this code where provided with an automatic sprinkler system complying with Section P2904:

1. Live/work units located in townhouses and complying with the requirements of Section 508.5 of the *International Building Code*.
2. Owner-occupied *lodging houses* with five or fewer guestrooms.
3. A care facility with five or fewer persons receiving custodial care within a *dwelling unit*.
4. A care facility with five or fewer persons receiving medical care within a *dwelling unit*.
5. A care facility for five or fewer persons receiving care that are within a single-family dwelling.

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Rooftop PV – Fire resistance

Changes in IRC 2021, Section R902-Fire Classification

R902.3 Building-integrated photovoltaic product. *Building-integrated photovoltaic (BIPV) products* installed as the roof covering shall be tested, *listed* and *labeled* for fire classification in accordance with UL 7103. Class A, B or C BIPV products shall be installed where the edge of the roof is less than 3 feet (914 mm) from a *lot line*.

R902.4 Rooftop-mounted photovoltaic panel systems. Rooftop-mounted *photovoltaic panel systems* installed on or above the roof covering shall be tested, *listed* and identified with a fire classification in accordance with UL 2703. Class A, B or C *photovoltaic panel systems* and modules shall be installed in *jurisdictions* designated by law as requiring their use or where the edge of the roof is less than 3 feet (914 mm) from a *lot line*.

R905.16.4 Material standards. *Photovoltaic shingles* shall be *listed* and *labeled* in accordance with UL 7103 or with both UL 61730-1 and UL 61730-2.

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Steep-slope underlayment

Change in IRC 2021, Section R905-Requirements for Roof Coverings

R905.1.1 Underlayment. *Underlayment* for asphalt shingles, clay and concrete tile, *metal roof shingles*, mineral-surfaced roll roofing, slate and slate-type shingles, wood shingles, wood shakes, *metal roof panels* and *photovoltaic shingles* shall conform to the applicable standards listed in this chapter. *Underlayment* materials required to comply with ASTM D226, D1970, D4869 and D6757 shall bear a *label* indicating compliance to the standard designation and, if applicable, type classification indicated in Table R905.1.1(1). *Underlayment* shall be applied in accordance with Table R905.1.1(2). *Underlayment* shall be attached in accordance with Table R905.1.1(3).

Exceptions:

1. As an alternative, self-adhering polymer-modified bitumen underlayment bearing a label indicating compliance with ASTM D1970
2. As an alternative, a minimum 4-inch-wide (102 mm) strip of self-adhering polymer-modified bitumen membrane bearing a *label* indicating compliance with ASTM D1970, installed in accordance with the *manufacturer's installation instructions* for the deck material, shall be applied over all joints in the roof decking. An *approved underlayment* complying with Table R905.1.1(1) for the applicable roof covering for areas where wind design is not required in accordance with Figure R301.2.1.1 shall be applied over the entire roof over the 4-inch-wide (102 mm) membrane strips. Underlayment shall be applied in accordance with Table R905.1.1(2) using the application requirements for areas where wind design is not required in accordance with Figure R301.2.1.1. Underlayment shall be attached in accordance with Table R905.1.1(3).

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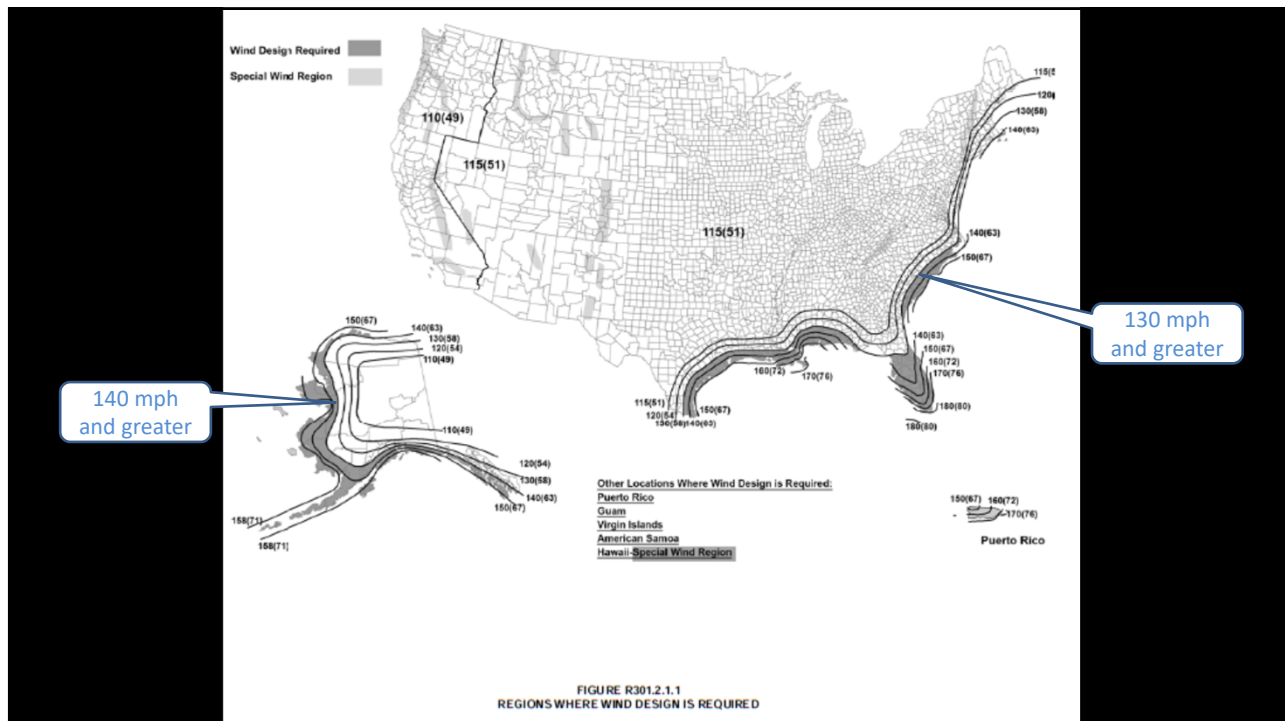
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**TABLE R905.1.1(1)
UNDERLAYMENT TYPES**

ROOF COVERING	SECTION	AREAS WHERE WIND DESIGN IS NOT REQUIRED IN ACCORDANCE WITH FIGURE R301.2.1.1	AREAS WHERE WIND DESIGN IS REQUIRED IN ACCORDANCE WITH FIGURE R301.2.1.1
Asphalt shingles	R905.2	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV ASTM D6757	ASTM D226 Type II ASTM D4869 Type III or Type IV
Clay and concrete tile	R905.3	ASTM D226 Type II ASTM D2626 Type I ASTM D6380 Class M mineral-surfaced roll roofing	ASTM D226 Type II
Metal roof shingles	R905.4	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type III or Type IV
Mineral-surfaced roll roofing	R905.5	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type III or Type IV
Slate and slate-type shingles	R905.6	ASTM D226 Type I ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type III or Type IV
Wood shingles	R905.7	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type III or Type IV
Wood shakes	R905.8	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type III or Type IV
Metal panels	R905.10	Manufacturer's instructions	ASTM D226 Type II ASTM D4869 Type III or Type IV
Photovoltaic shingles	R905.16	ASTM D4869 Type I, II, III or IV ASTM D6757	ASTM D4869 Type III or Type IV

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Clay and concrete tile

Changes in IRC 2021, Section R905.3-Clay and Concrete Tile

R905.3 Clay and concrete tile. The installation of clay and concrete tile shall comply with the provisions of this section.

R905.3.1 Deck requirements. Concrete and clay tile shall be installed only over solid sheathing.

Exception: Spaced lumber sheathing in accordance with Section R803.1 shall be permitted in *Seismic Design Categories A, B and C.*

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Metal shingles

Changes in IRC 2021, Section R905.4-Metal Roof Shingles

R905.4.4.1 Wind resistance of metal roof shingles. *Metal roof shingles* applied to a solid or closely fitted deck shall be tested in accordance with ASTM D3161, FM 4474, UL 580 or UL 1897. *Metal roof shingles* tested in accordance with ASTM D3161 shall meet the classification requirements of Table R905.4.4.1 for the appropriate maximum basic wind speed and the metal shingle packaging shall bear a *label* to indicate compliance with ASTM D3161 and the required classification in Table R905.2.4.1.

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TABLE R905.4.4.1
CLASSIFICATION OF STEEP SLOPE METAL ROOF SHINGLES TESTED IN ACCORDANCE WITH ASTM D3161

MAXIMUM ULTIMATE DESIGN WIND SPEED, V_{ult} FROM FIGURE R301.2(2) (mph)	MAXIMUM BASIC WIND SPEED, V_{ASD} FROM TABLE R301.2.1.3 (mph)	ASTM D3161 SHINGLE CLASSIFICATION
110	85	A, D or F
116	90	A, D or F
129	100	A, D or F
142	110	F
155	120	F
168	130	F
181	140	F
194	150	F

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Wood shingles and shakes

Changes in IRC 2021, Section R905.7-Wood Shingles and Section R905.8-Wood Shakes

TABLE R905.7.5(2)
NAIL REQUIREMENTS FOR
WOOD SHAKES AND WOOD SHINGLES

PRODUCT TYPE	NAIL TYPE, MINIMUM LENGTH AND SHANK DIAMETER (inches)
Shakes	
18" straight-split	5d box 1 ³ / ₄ " × 0.080
18" and 24" handsplit and resawn	6d box 2" × 0.099
24" taper-split	5d box 1 ³ / ₄ " × 0.080
18" and 24" tapersawn	6d box 2" × 0.099
Shingles	
16" and 18"	3d box 1 ¹ / ₄ " × 0.076
24"	4d box 1 ¹ / ₂ " × 0.076

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PV shingles – Wind resistance

Changes in IRC 2021, Section R905.16-Photovoltaic Shingles

R905.16.6 Wind resistance. *Photovoltaic shingles* shall comply with the classification requirements of Table R905.16.6 for the appropriate maximum basic wind speed.

**TABLE R905.16.6
CLASSIFICATION OF PHOTOVOLTAIC SHINGLES**

MAXIMUM ULTIMATE DESIGN WIND SPEED, V_{ult} , FROM FIGURE R301.2(2) (mph)	MAXIMUM BASIC WIND SPEED, V_{ASD} , FROM TABLE R301.2.1.3 (mph)	UL 7103 SHINGLE CLASSIFICATION
110	85	A, D or F
116	90	A, D or F
129	100	A, D or F
142	110	F
155	120	F
168	130	F
181	140	F
194	150	F

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Unvented attics

Changes in IRC 2021, Section R806.5-Unvented Attics and Enclosed Rafter Spaces

ROOF-CEILING CONSTRUCTION

**SECTION R806
CEILING FINISHES**

R806.1 Ceiling installation. Ceilings shall be installed in accordance with the requirements for interior wall finishes as provided in Sections R702.1 through R702.6.

**SECTION R806
ROOF VENTILATION**

R806.1 Ventilation required. Unvented attics and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters shall have cross ventilation for each separate space by ventilating openings protected against the entrance of rain or snow. Ventilating openings shall have a least dimension of $\frac{1}{8}$ inch (3.2 mm) minimum and $\frac{1}{4}$ inch (6.4 mm) maximum. Ventilating openings having a least dimension larger than $\frac{1}{8}$ inch (3.2 mm) shall be provided with corrosion-resistant wire cloth screening, hardware cloth, perforated rigid or insular material with openings having a least dimension of $\frac{1}{8}$ inch (3.2 mm) minimum and $\frac{1}{4}$ inch (6.4 mm) maximum. Openings in roof framing members shall conform to the requirements of Section R802.2. Required ventilating openings shall open directly to the outside air and shall be protected to prevent the entry of birds, rodents, snakes and other similar creatures.

R806.2 Minimum vent area. The minimum net free ventilating area shall be $\frac{1}{150}$ of the area of the vented space.

Exception: The minimum net free ventilation area shall be $\frac{1}{150}$ of the vented space provided both of the following conditions are met:

1. In Climate Zones 6, 7 and 8, a Class I or II vapor retarder is installed on the warm or winter side of the ceiling.
2. Not less than 40 percent and not more than 50 percent of the required ventilating area is provided by ventilators located in the upper portion of the attic or rafter space. Upper ventilators shall be located not more than 3 feet (914 mm) below the ridge or highest point of the space, measured vertically. The balance of the required ventilation provided shall be located in the bottom one-third of the attic space. Where the location of wall or roof framing members conflicts with the installation of upper ventilation, ventilation more than 12 feet (3658 mm) below the ridge or highest point of the space shall be provided.

R806.3 Vast and insulation clearance. Where vapor or certain vents are installed, blocking, bridging and insulation shall not block the free flow of air. Not less than a 3 inch (76 mm) space shall be provided between the insulation and the roof sheathing and at the location of the vent.

R806.4 Installation and weather protection. Ventilators shall be installed in accordance with manufacturer's instructions. Installation of ventilators in roof systems shall be in accordance with the requirements of Section R905.16a.

size of ventilators in wall systems shall be in accordance with the requirements of Section R702.1.

R806.5 Unvented attic and unvented enclosed rafter assemblies. Unvented attic and unvented enclosed rafter assemblies created by ceilings that are applied directly to the underside of the roof framing members and structural roof sheathing applied directly to the top of the roof framing members, shall be permitted where all the following conditions are met:

1. The unvented attic space is completely within the building thermal envelope.
2. Interior Class I vapor retarders are not installed on the ceiling and (one floor) or the unvented attic assembly or on the ceiling side of the unvented enclosed rafter framing assembly.
3. Where wood shingles or shakes are used, a minimum $\frac{1}{8}$ inch (3.2 mm) vented airspace separates the shingles or shakes and the roofing underlayment above the structural sheathing.
4. In Climate Zones 5, 6, 7 and 8, any air-impermeable insulation shall be a Class II vapor retarder or shall have a Class II vapor retarder coating or covering in direct contact with the underside of the insulation.
5. Insulation shall comply with Item 5.1.2 and Item 5.1.3.

5.1. Item 5.1.2, 5.1.3 or 5.1.4 shall be met, depending on the air permeability of the insulation directly above the structural roof sheathing.

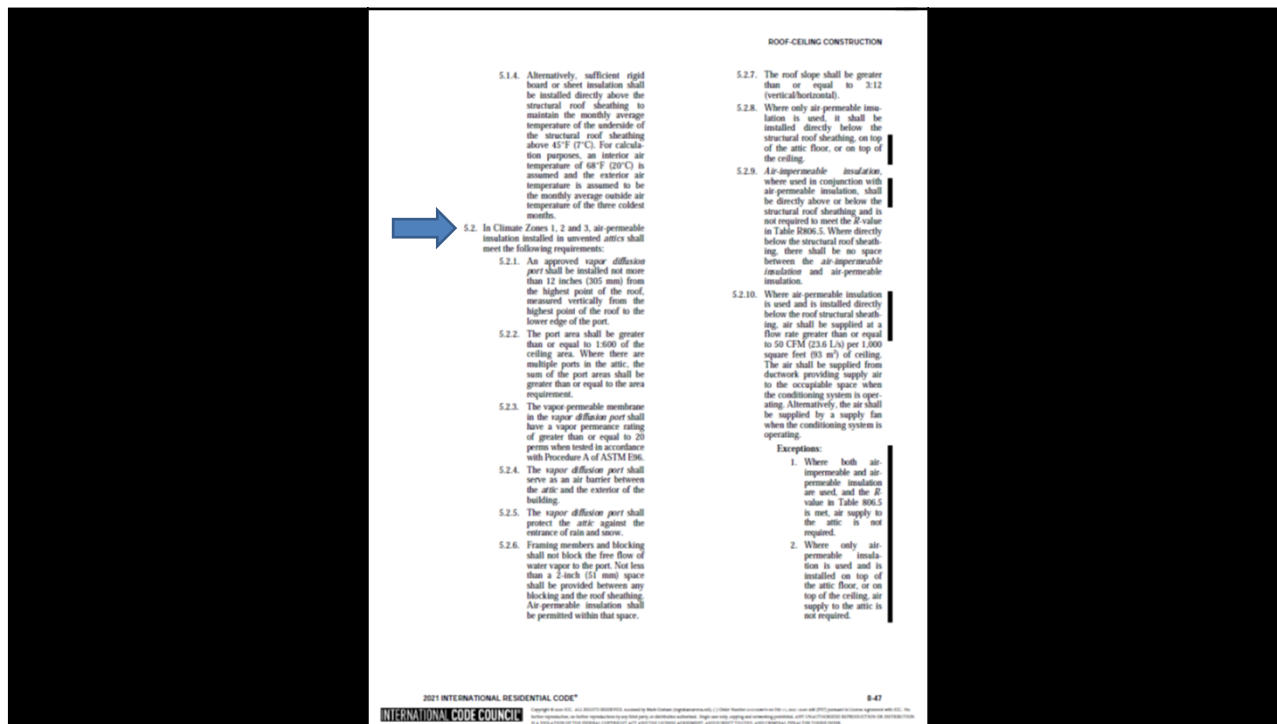
5.1.1. Where only air-impermeable insulation is provided, it shall be applied in direct contact with the underside of the structural roof sheathing.

5.1.2. Where air-permeable insulation is installed directly below the structural sheathing, rigid board or sheet insulation shall be installed directly above the structural roof sheathing in accordance with the R-values in Table R806.5 for condensation control.

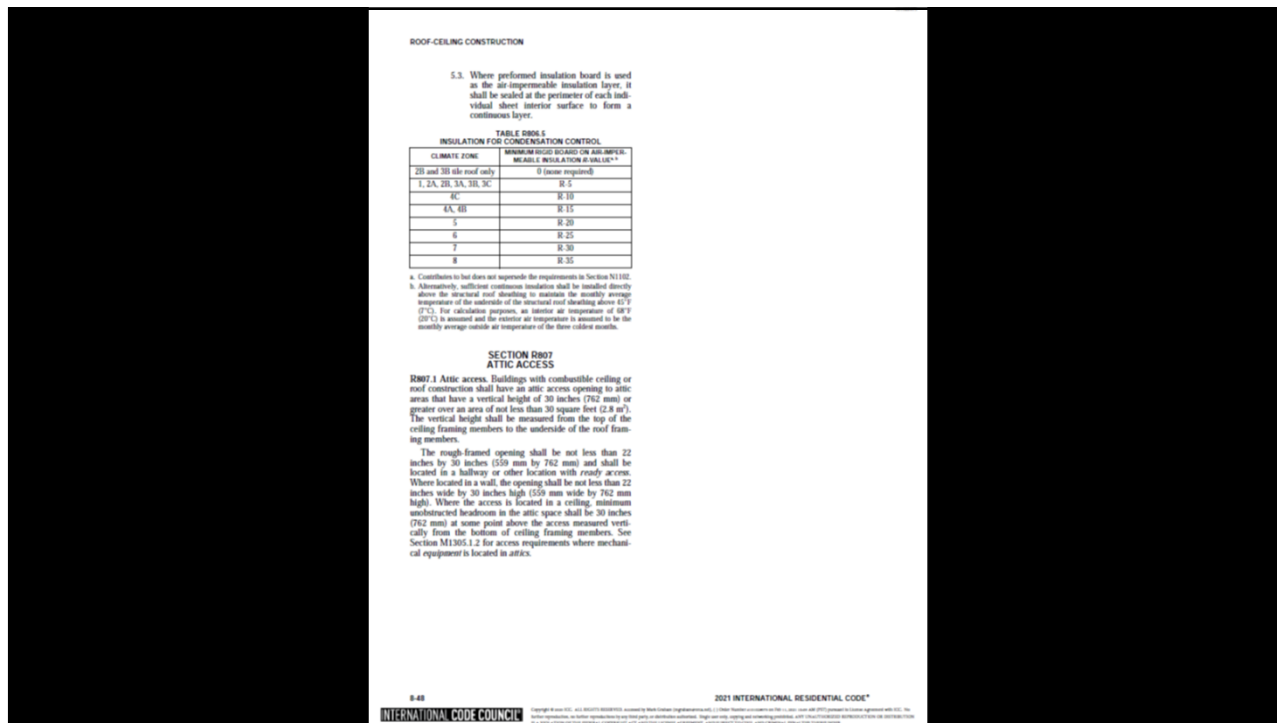
5.1.3. Where both air-impermeable and air-permeable insulation are provided, the air-impermeable insulation shall be applied in direct contact with the underside of the structural roof sheathing in accordance with Item 5.1.1 and shall be in accordance with the R-values in Table R806.5 for condensation control. The air-permeable insulation shall be installed directly under the air-impermeable insulation.

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2. These that do not require conditioned space.

C402.1.1 Greenhouse areas that are enclosed shall comply with all of the building envelope requirements.

1. Enclosure shall comply with Section C402.1.3.4.
2. Interior finish shall comply with Section C402.1.3.4.
3. Fenestration shall comply with Section C402.1.3.4.

TABLE C402.1.1.1 Thermal Envelope Maximum U-factor

Component	Maximum U-factor
Roof/ceiling assembly	0.15
Walls	0.15
Floors	0.15
Glazing	0.30
Doors	0.30
Skylights	0.30
Vertical glazing	0.30

C402.1.1.1.1 Thermal Envelope Maximum U-factor

1. Area opaque and less than 1,500 square feet.
2. Area intended to be occupied equipment work per square foot for business occupancy.
3. Have a heating or cooling load (BTU/hr/ft²) equivalent that is not greater than 100.
4. Have an average U-factor of 0.200 in Climate Zone 1 and 0.150 in Climate Zone 2.
5. Comply with the maximum U-factor.

C402.1.1.1.2 Thermal Envelope Maximum U-factor

Insulation shall comply with the maximum U-factor based on the table. For opaque roof envelope intended to be conditioned space, the U-factor shall be not less than that specified in Table C402.1.1.1.1. Where cavity insulation is installed in the roof/ceiling assembly, the U-factor shall be not less than that specified in Table C402.1.1.1.1.1.

C402.1.4.1 Roof/ceiling assembly. The maximum roof/ceiling assembly U-factor shall not exceed that specified in Table C402.1.4 based on construction materials used in the roof/ceiling assembly.

C402.1.4.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a maximum roof/ceiling assembly U-factor calculation, the sloped roof insulation R-value contribution to that calculation shall use the average thickness in inches (mm) along with the material R-value-per-inch (per-mm) solely for U-factor compliance as prescribed in Section C402.1.4.

C402.1.4.1.2 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly U-factor of the roof/ceiling construction.

C402.1.4.1.3 Joints staggered. Continuous insulation board shall be installed in not less than two layers, and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.

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C402.2 Specific building thermal envelope insulation requirements. Insulation in building thermal envelope opaque assemblies shall comply with Sections C402.2.1 through C402.2.7 and Table C402.1.3.

C402.2.1 Roof assembly. The minimum thermal resistance (R-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly.

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
0.15	6.67	0.15	6.67
0.20	5.00	0.20	5.00
0.25	4.00	0.25	4.00
0.30	3.33	0.30	3.33
0.35	2.86	0.35	2.86
0.40	2.50	0.40	2.50

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies (continued)

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
0.45	2.22	0.45	2.22
0.50	2.00	0.50	2.00
0.55	1.82	0.55	1.82
0.60	1.67	0.60	1.67
0.65	1.54	0.65	1.54
0.70	1.43	0.70	1.43
0.75	1.33	0.75	1.33
0.80	1.25	0.80	1.25
0.85	1.18	0.85	1.18
0.90	1.11	0.90	1.11
0.95	1.05	0.95	1.05
1.00	1.00	1.00	1.00

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies (continued)

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
1.05	0.95	1.05	0.95
1.10	0.91	1.10	0.91
1.15	0.87	1.15	0.87
1.20	0.83	1.20	0.83
1.25	0.80	1.25	0.80
1.30	0.77	1.30	0.77
1.35	0.74	1.35	0.74
1.40	0.71	1.40	0.71
1.45	0.69	1.45	0.69
1.50	0.67	1.50	0.67
1.55	0.65	1.55	0.65
1.60	0.63	1.60	0.63
1.65	0.61	1.65	0.61
1.70	0.60	1.70	0.60
1.75	0.58	1.75	0.58
1.80	0.57	1.80	0.57
1.85	0.56	1.85	0.56
1.90	0.55	1.90	0.55
1.95	0.54	1.95	0.54
2.00	0.53	2.00	0.53

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies (continued)

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
2.05	0.52	2.05	0.52
2.10	0.51	2.10	0.51
2.15	0.50	2.15	0.50
2.20	0.49	2.20	0.49
2.25	0.48	2.25	0.48
2.30	0.47	2.30	0.47
2.35	0.46	2.35	0.46
2.40	0.46	2.40	0.46
2.45	0.45	2.45	0.45
2.50	0.45	2.50	0.45
2.55	0.44	2.55	0.44
2.60	0.44	2.60	0.44
2.65	0.43	2.65	0.43
2.70	0.43	2.70	0.43
2.75	0.43	2.75	0.43
2.80	0.42	2.80	0.42
2.85	0.42	2.85	0.42
2.90	0.42	2.90	0.42
2.95	0.41	2.95	0.41
3.00	0.41	3.00	0.41

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies (continued)

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
3.05	0.41	3.05	0.41
3.10	0.40	3.10	0.40
3.15	0.40	3.15	0.40
3.20	0.40	3.20	0.40
3.25	0.39	3.25	0.39
3.30	0.39	3.30	0.39
3.35	0.39	3.35	0.39
3.40	0.38	3.40	0.38
3.45	0.38	3.45	0.38
3.50	0.38	3.50	0.38
3.55	0.38	3.55	0.38
3.60	0.37	3.60	0.37
3.65	0.37	3.65	0.37
3.70	0.37	3.70	0.37
3.75	0.37	3.75	0.37
3.80	0.36	3.80	0.36
3.85	0.36	3.85	0.36
3.90	0.36	3.90	0.36
3.95	0.36	3.95	0.36
4.00	0.35	4.00	0.35

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies (continued)

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
4.05	0.35	4.05	0.35
4.10	0.35	4.10	0.35
4.15	0.34	4.15	0.34
4.20	0.34	4.20	0.34
4.25	0.34	4.25	0.34
4.30	0.34	4.30	0.34
4.35	0.34	4.35	0.34
4.40	0.33	4.40	0.33
4.45	0.33	4.45	0.33
4.50	0.33	4.50	0.33
4.55	0.33	4.55	0.33
4.60	0.33	4.60	0.33
4.65	0.32	4.65	0.32
4.70	0.32	4.70	0.32
4.75	0.32	4.75	0.32
4.80	0.32	4.80	0.32
4.85	0.32	4.85	0.32
4.90	0.31	4.90	0.31
4.95	0.31	4.95	0.31
5.00	0.31	5.00	0.31

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies (continued)

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
5.05	0.31	5.05	0.31
5.10	0.31	5.10	0.31
5.15	0.30	5.15	0.30
5.20	0.30	5.20	0.30
5.25	0.30	5.25	0.30
5.30	0.30	5.30	0.30
5.35	0.30	5.35	0.30
5.40	0.30	5.40	0.30
5.45	0.29	5.45	0.29
5.50	0.29	5.50	0.29
5.55	0.29	5.55	0.29
5.60	0.29	5.60	0.29
5.65	0.29	5.65	0.29
5.70	0.28	5.70	0.28
5.75	0.28	5.75	0.28
5.80	0.28	5.80	0.28
5.85	0.28	5.85	0.28
5.90	0.28	5.90	0.28
5.95	0.28	5.95	0.28
6.00	0.27	6.00	0.27

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies (continued)

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
6.05	0.27	6.05	0.27
6.10	0.27	6.10	0.27
6.15	0.27	6.15	0.27
6.20	0.27	6.20	0.27
6.25	0.26	6.25	0.26
6.30	0.26	6.30	0.26
6.35	0.26	6.35	0.26
6.40	0.26	6.40	0.26
6.45	0.26	6.45	0.26
6.50	0.26	6.50	0.26
6.55	0.25	6.55	0.25
6.60	0.25	6.60	0.25
6.65	0.25	6.65	0.25
6.70	0.25	6.70	0.25
6.75	0.25	6.75	0.25
6.80	0.25	6.80	0.25
6.85	0.24	6.85	0.24
6.90	0.24	6.90	0.24
6.95	0.24	6.95	0.24
7.00	0.24	7.00	0.24

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies (continued)

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
7.05	0.24	7.05	0.24
7.10	0.23	7.10	0.23
7.15	0.23	7.15	0.23
7.20	0.23	7.20	0.23
7.25	0.23	7.25	0.23
7.30	0.23	7.30	0.23
7.35	0.23	7.35	0.23
7.40	0.22	7.40	0.22
7.45	0.22	7.45	0.22
7.50	0.22	7.50	0.22
7.55	0.22	7.55	0.22
7.60	0.22	7.60	0.22
7.65	0.22	7.65	0.22
7.70	0.21	7.70	0.21
7.75	0.21	7.75	0.21
7.80	0.21	7.80	0.21
7.85	0.21	7.85	0.21
7.90	0.21	7.90	0.21
7.95	0.21	7.95	0.21
8.00	0.20	8.00	0.20

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies (continued)

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
8.05	0.20	8.05	0.20
8.10	0.20	8.10	0.20
8.15	0.20	8.15	0.20
8.20	0.20	8.20	0.20
8.25	0.19	8.25	0.19
8.30	0.19	8.30	0.19
8.35	0.19	8.35	0.19
8.40	0.19	8.40	0.19
8.45	0.19	8.45	0.19
8.50	0.19	8.50	0.19
8.55	0.18	8.55	0.18
8.60	0.18	8.60	0.18
8.65	0.18	8.65	0.18
8.70	0.18	8.70	0.18
8.75	0.18	8.75	0.18
8.80	0.18	8.80	0.18
8.85	0.17	8.85	0.17
8.90	0.17	8.90	0.17
8.95	0.17	8.95	0.17
9.00	0.17	9.00	0.17

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies (continued)

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
9.05	0.17	9.05	0.17
9.10	0.16	9.10	0.16
9.15	0.16	9.15	0.16
9.20	0.16	9.20	0.16
9.25	0.16	9.25	0.16
9.30	0.16	9.30	0.16
9.35	0.15	9.35	0.15
9.40	0.15	9.40	0.15
9.45	0.15	9.45	0.15
9.50	0.15	9.50	0.15
9.55	0.15	9.55	0.15
9.60	0.14	9.60	0.14
9.65	0.14	9.65	0.14
9.70	0.14	9.70	0.14
9.75	0.14	9.75	0.14
9.80	0.14	9.80	0.14
9.85	0.14	9.85	0.14
9.90	0.13	9.90	0.13
9.95	0.13	9.95	0.13
10.00	0.13	10.00	0.13

TABLE C402.1.3 Thermal Resistance of Cold Formed Steel Wall Assemblies (continued)

Minimum U-factor (per inch)	Minimum R-value (per inch)	Minimum U-factor (per inch)	Minimum R-value (per inch)
10.05	0.13	10.05	0.13
10.10	0.12	10.10	0.12
10.15	0.12	10.15	0.12
10.20	0.12	10.20	0.12
10.25	0.12	10.25	0.12
10.30	0.12	10.30	0.12
10.35	0.11	10.35	

**TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD^a**

CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings ^b	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-25 + R-11 + R-11 LS	R-25 + R-11 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-60	R-60	R-60	R-60
Floors																
Walls, below grade																
Floors																
Slab-on-grade floors																

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 48.8 kg/m², 1 pound per cubic foot = 16 kg/m³.
 ci = Continuous Insulation, NR = No Requirement, LS = Linear System.
 a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA 90.1 Appendix A.
 b. Where using R-value compliance method, a thermal spacer block shall be provided, otherwise use the U-factor compliance method in Table C402.1.4.
 c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.04 Btu-in-h-°F.
 d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
 e. "Mass floors" shall be in accordance with Section C402.2.3.
 f. "Mass walls" shall be in accordance with Section C402.2.2.
 g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

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C402.2.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a roof/ceiling assembly R-value calculation, the sloped roof insulation R-value contribution to that calculation shall use the average thickness in inches (mm) along with the material R-value-per-inch (per-mm) solely for R-value compliance as prescribed in Section 402.1.3.

C402.2.1.2 Minimum thickness, lowest point. The minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be not less than 1 inch (25 mm).

C402.2.1.3 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (R-value) of roof insulation in roof/ceiling construction.

C402.2.1.4 Joints staggered. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.

“...average thickness...”

“...not less than 1 inch...”

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penetrator shall not be required to extend below the bottom of the framed slab and shall be continuous with the full slab insulation.

Exception: When the slab-on-grade floor is greater than 24 inches (610 mm) below the finished exterior grade, penetrator insulation is not required.

C402.5 Below-grade walls. The C-factor for the below-grade exterior walls shall be in accordance with Table C402.5.4. The E-value of the unconditioned unconditioned continuously within or on the below-grade exterior walls of the building envelope shall be in accordance with Table C402.5.3. The C-factor or E-value required shall extend to a depth of not less than 10 feet (3048 mm) below the grade finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below-grade wall, whichever is less.

C402.5.6 Insulation of radiant heating systems. Radiant heating systems, panels, and their associated components that are installed in unceiling or exterior assemblies shall be insulated to an R-value of not less than R-5 on all surfaces not facing the space being heated. Radiant heating systems panels that are installed in the building thermal envelope shall be separated from the exterior of the building or unconditioned or unheated spaces by not less than the R-value of insulation installed in the spaces assembly in which they are installed or the assembly shall comply with Section C402.5.4.

Exception: Rigid slabs on grade installed in accordance with Section C402.5.4.

C402.5.7 Airspaces. When the E-value of an airspace is used for compliance in accordance with Section C402.5, the airspace shall be enclosed in an unconditioned cavity constructed to minimize surface area and out of the enclosed airspace. Airflow shall be deemed unimpeded when the enclosed airspace is located on the exterior side of the construction or barrier and is bounded on all sides by building components.

Exception: The thermal resistance of airspaces located on the exterior side of the construction or barrier and adjacent to and behind the exterior wall-covering material shall be determined in accordance with ASTM C1363 modified with an surface emitting the bottom and ending the top of the airspace or an unconditioned cavity of not less than 70 mm (2.75 in.)

C402.5.8 Roof solar reflectance and thermal emittance. Low-sloped roofs shall have a solar reflectance and thermal emittance as specified in Table C402.5.3.

Exception: The following roofs and portions of roofs are exempt from the requirements of Table C402.5.3:

1. Portions of the roof that include or are covered by the following:
 - 1.1. Penetrator systems or components.
 - 1.2. Solar air or water-heating systems or components.
 - 1.3. Vegetative roofs or landscaped roofs.
 - 1.4. Above-roof decks or walkways.
 - 1.5. Skylights.
 - 1.6. HVAC systems and components, and other spaces directly connected above the roof.
2. Portions of the roof directly above the peak roof angle on the summer solstice by permanent features of the building or by permanent features of adjacent buildings.
3. Portions of roofs that are ballasted with a minimum stone ballast of 17 pounds per square foot (74 kg/m²) or 23 pcf (117 kg/m³) gravel.
4. Roofs where not less than 75 percent of the roof area is occupied with one or more of the exceptions in this section.

TABLE C402.5.3 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS^a

Minimum solar reflectance index (SRI) and 1-year typical thermal emittance of 0.75	Minimum roof solar reflectance index ^b (SRI)
0.55	0.55
0.60	0.60
0.65	0.65
0.70	0.70
0.75	0.75
0.80	0.80
0.85	0.85
0.90	0.90
0.95	0.95
1.00	1.00
1.05	1.05
1.10	1.10
1.15	1.15
1.20	1.20
1.25	1.25
1.30	1.30
1.35	1.35
1.40	1.40
1.45	1.45
1.50	1.50
1.55	1.55
1.60	1.60
1.65	1.65
1.70	1.70
1.75	1.75
1.80	1.80
1.85	1.85
1.90	1.90
1.95	1.95
2.00	2.00
2.05	2.05
2.10	2.10
2.15	2.15
2.20	2.20
2.25	2.25
2.30	2.30
2.35	2.35
2.40	2.40
2.45	2.45
2.50	2.50
2.55	2.55
2.60	2.60
2.65	2.65
2.70	2.70
2.75	2.75
2.80	2.80
2.85	2.85
2.90	2.90
2.95	2.95
3.00	3.00
3.05	3.05
3.10	3.10
3.15	3.15
3.20	3.20
3.25	3.25
3.30	3.30
3.35	3.35
3.40	3.40
3.45	3.45
3.50	3.50
3.55	3.55
3.60	3.60
3.65	3.65
3.70	3.70
3.75	3.75
3.80	3.80
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IECC 2021 Commercial – Air Retarders

COMMERCIAL ENERGY EFFICIENCY

are included in accordance with Section C402.5.4.2. Other than the portion of the building envelope that is not included in the assembly or any combination with Section C402.5.4.2.

Exception: If located in the air barrier or following:

1. The air barrier is not required.
2. Air is not included in the assembly or any combination with Section C402.5.4.2.
3. The air barrier is not required.
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TABLE C402.5.4 MAXIMUM AIR LEAKAGE RATES FOR PENETRATION ASSEMBLIES

PENETRATION ASSEMBLY	MINIMUM RATE (CFM/FT ²)	TEST PROCEDURE
Windows	0.30	
Sliding doors	0.30	
Swinging doors	0.30	ASTM E2878 or ASTM E2878-17
Partitions or other	0.30	
Curbs	0.30	
Roof penetrations	0.30	
Power-operated sliding doors	1.00	1.00
Power-operated sliding doors	1.00	1.00
Swinging doors	0.40	
Sliding doors	0.40	
High-speed doors	1.30	

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EXISTING BUILDINGS

C402.1.1, the addition shall comply with Section C402.1.3, C402.1.4 or C407.

2. Where an addition with vertical fenestration that results in a total building fenestration area greater than Section C402.1.1 or an addition that exceeds the fenestration area greater than that permitted by Section C402.1.1, the fenestration shall comply with Section C402.1.1 for the addition only.

3. Where an addition has vertical fenestration that results in a total building vertical fenestration area exceeding that permitted by Section C402.1.1.1, the addition shall comply with Section C402.1.1.2 or C407.

C402.1.2 Skylight area. Skylight shall comply with the following:

1. Where an addition has one skylight area that results in a total building fenestration area less than or equal to that permitted by Section C402.1.1, the addition shall comply with Section C402.1.1 or C407.
2. Where an addition has one skylight area that results in a total building skylight area greater than that permitted by Section C402.1.1 or where additions have skylight area greater than that permitted by Section C402.1.1, the skylight area shall comply with Section C402.1.1.2 for the addition only.
3. Where an addition has skylight area that results in a total building skylight area exceeding that permitted by Section C402.1.1, the addition shall comply with Section C402.1.1 or C407.

C402.3 Building mechanical systems. New mechanical systems and equipment that are part of the addition and serve the building heating, cooling and ventilation needs shall comply with Sections C402 and C405.

C402.3.4 Service water heating systems. New service water heating equipment, controls and service water heating piping shall comply with Section C404.

C402.3.5 Pools and inground permanently installed spas. New pools and inground permanently installed spas shall comply with Section C404.9.

C402.3.6 Lighting power and systems. New lighting systems that are installed as part of the addition shall comply with Sections C407 and C408.

C402.3.6.1 Interior lighting power. The total interior lighting power for the addition shall comply with Section C407.1.2 for the addition alone, or the existing building and the addition shall comply as a single building.

C402.3.6.2 Exterior lighting power. The total exterior lighting power for the addition shall comply with Section C407.1.2 for the addition alone, or the existing building and the addition shall comply as a single building.

**SECTION C503
ALTERATIONS**

C503.1 General. Alterations to any building or structure shall comply with the requirements of Section C503. Alterations shall be such that the existing building or structure is not less conforming to the provisions of this code than the existing building or structure was prior to the alterations.

Alterations to an existing building. Building systems or portions thereof shall continue to the provisions of this code in those provisions unless new construction without requiring the enclosed portions of the existing building or building systems to comply with this code. Alterations shall not create or result in hazardous conditions or overloaded existing building systems.

Exception: The following alterations need not comply with the requirements for new construction, provided that the energy use of the building is not increased:

1. Some windows installed over existing fenestration.
2. Surface-applied window films installed on existing single-pane fenestration assemblies including solar heat gain, provided that the code does not require the glazing or fenestration to be replaced.
3. Existing cooling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall or floor cavity is not exposed.
5. *Roof recover.*
6. *Attic barriers* shall not be required for *roof recover* and *roof replacement* where the alterations or repairs to the building do not include alterations, maintenance or repairs to the remainder of the building envelope.

C503.2.1 Roof replacement. Roof replacements shall comply with Section C402.1.3, C402.1.4, C402.1.5 or C407 where the existing roof assembly is part of the *building thermal envelope* and contains insulation entirely above the roof deck. In no case shall the R-value of the roof insulation be reduced or the U-factor of the roof assembly be increased as part of the *roof replacement*.

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IECC 2021 Residential -- Application

**CHAPTER 4 [RE]
RESIDENTIAL ENERGY EFFICIENCY**

NOTE:
About this chapter: Chapter 4 presents the paths and options for compliance with the energy efficiency provisions. Chapter 4 contains energy efficiency provisions for the building envelope, mechanical and water heating systems, lighting and additional efficiency requirements. A performance alternative, energy saving alternative, and tropical region alternative are also provided to allow for energy code compliance other than the prescriptive method.

3. For buildings complying with the Energy Rating Index alternative Section R401.2.3, the Energy Rating Index value shall be at least 1 percent better than the Energy Rating Index target specified in Table R405.1.

The options selected for compliance shall be identified in the certificate required by Section R401.3.

ENERG-1 Certificate. A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the fixture is located, a entry room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required label. The certificate shall indicate the following:

1. The predominant R-values of insulation installed in or on ceilings, walls, windows, foundation components such as slabs, basement walls, crawl space walls and floors and doors outside conditioned space.
2. U-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required duct system and building envelope air leakage testing performed on the building.
4. The types, sizes and efficiencies of heating, cooling and service water heating equipment. Where a pre-fabricated room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate "pre-fabricated room heater," "electric furnace" or "baseboard electric heater," as appropriate. An efficiency label shall be indicated for pre-fabricated room heaters, electric furnaces and electric baseboard heaters.
5. Where on-site photovoltaic panel systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R405, the Energy Rating Index score, both with and without

R401.2 Application. Residential buildings shall comply with Section R401.2.5 and either Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4.

Exception: Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5.

R401.2.1 Prescriptive Compliance Option. The Prescriptive Compliance Option requires compliance with Sections R401 through R404.

R401.2.2 Total Building Performance Option. The Total Building Performance Option requires compliance with Section R405.

R401.2.3 Energy Rating Index Option. The Energy Rating Index (ERI) Option requires compliance with Section R406.

R401.2.4 Tropical Climate Region Option. The Tropical Climate Region Option requires compliance with Section R407.

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IECC 2021 Residential -- Attics

RESIDENTIAL ENERGY EFFICIENCY

R602.2.1 Ceilings with attic spaces. Where Section R602.1.3 requires R-49 insulation to the ceiling or attic, installing R-38 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for R-49 insulation whenever the full height of uncompressed R-38 insulation extends over the wall top plane at the eaves. Where Section R602.1.3 requires R-60 insulation to the ceiling, installing R-49 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-60 insulation whenever the full height of uncompressed R-49 insulation extends over the wall top plane at the eaves. This reduction shall not apply to the insulation and fasteners criteria in Section R602.1.1 and the Total UA alternative in Section R602.1.5.

R602.2.2 Ceilings without attics. Where Section R602.1.3 requires insulation R-value greater than R-30 in the unconditioned space above a ceiling and below the structural roof deck, and the depth of the roof-ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation R-value for such roof-ceiling assemblies shall be R-30. Insulation shall extend over the top of the wall plane to the outer edge of such plane and shall not be compressed. This reduction of insulation from the requirements of Section R602.1.3 shall be limited to 500 square feet (46 m²) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the Total UA alternative in Section R602.1.5.

R602.2.3 Eave baffles. For air-permeable insulation in raftered attics, a baffle shall be installed adjacent to rafters and eave vents. Baffles shall maintain a net free area opening equal to or greater than the size of the vent. The baffles shall extend over the top of the attic insulation. The baffles shall be permitted to be any solid material. The baffles shall be installed on the outer edge of the exterior wall top plane so as to provide maximum space for attic insulation coverage over the top plane. Where rafter ventilation is not continuous, baffles shall be installed continuously to prevent variations air in the eave soffit from bypassing the baffle.

R602.2.4 Access hatches and doors. Access hatches and doors from conditioned to unconditioned spaces such as attics and crawl spaces shall be installed to the same R-value required by Table R602.1.3 for the wall or ceiling in which they are installed.

Exceptions:

1. Vertical doors providing access from conditioned spaces to unconditioned spaces that comply with the distribution requirements of Table R602.1.3 based on the applicable climate zone specified in Chapter 3.
2. Horizontal pull-down, roll-up access hatches in ceiling assemblies that provide access from conditioned to unconditioned spaces in Climate Zones 3 through 4 shall not be required to comply with the insulation level of the surrounding surface provided the hatch meets all of the following:
 1. The average U-factor of the hatch shall be less than or equal to 0.45 U₀ or have an average insulation R-value of R-10 or greater.
 2. Not less than 75 percent of the panel area shall have an insulation R-value of R-13 or greater.
 3. The net area of the framed opening shall be less than or equal to 13.3 square feet (1.23 m²).
 4. The perimeter of the hatch edge shall be weatherstripped.

The reduction shall not apply to the total UA alternative in Section R602.1.5.

R602.2.4.1 Access hatches and door insulation installation and retention. Vertical or horizontal access hatches and doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped. Access that prevents damage or compressing the insulation shall be provided in all equipment. Where loose-fill insulation is installed, a wood-framed or equivalent baffle or restraint, or dam shall be installed to prevent the loose-fill insulation from spilling into the living spaces, from higher to lower sections of the attic and from attic covering conditioned spaces to unconditioned spaces. The baffle or restraint shall provide a permanent means of maintaining the installed R-value of the loose-fill insulation.

R602.2.5 Mason walls. Mason walls where used as a component of the building thermal envelope shall be one of the following:

1. Above-ground walls of concrete block, concrete, reinforced concrete form, masonry cavity brick (not face brick), stone, compressed earth block, rammed earth, solid timber, mass timber or solid logs.
2. Any wall having a test capacity greater than or equal to 8 lbs/ft² (121 kPa/m²).

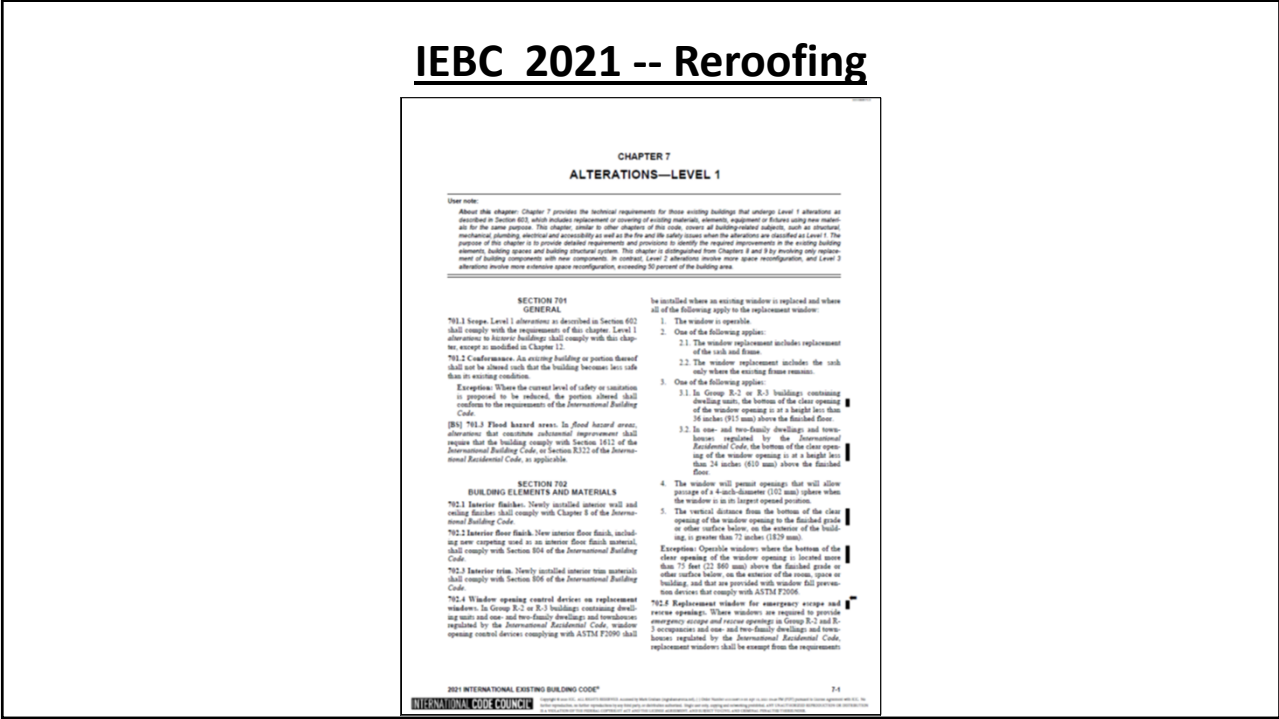
R602.2.6 Steel frame ceilings, walls and floors. Steel-frame ceilings, walls, and floors shall comply with the insulation requirements of Table R602.1.2 or the U-factor requirement of Table R602.1.3. The calculation of the U-factor for a steel-frame assembly shall use a series-parallel path calculation method.

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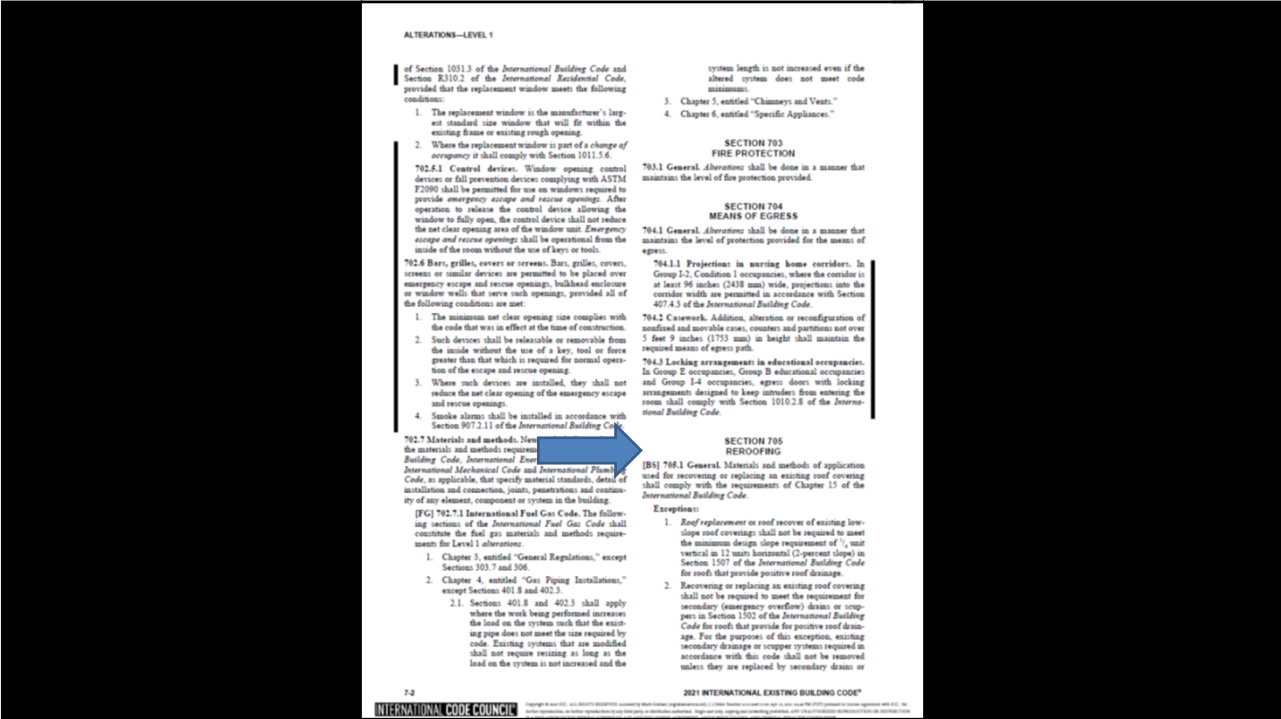
ICC is changing its development process for future editions of the IECC to their standard development process.



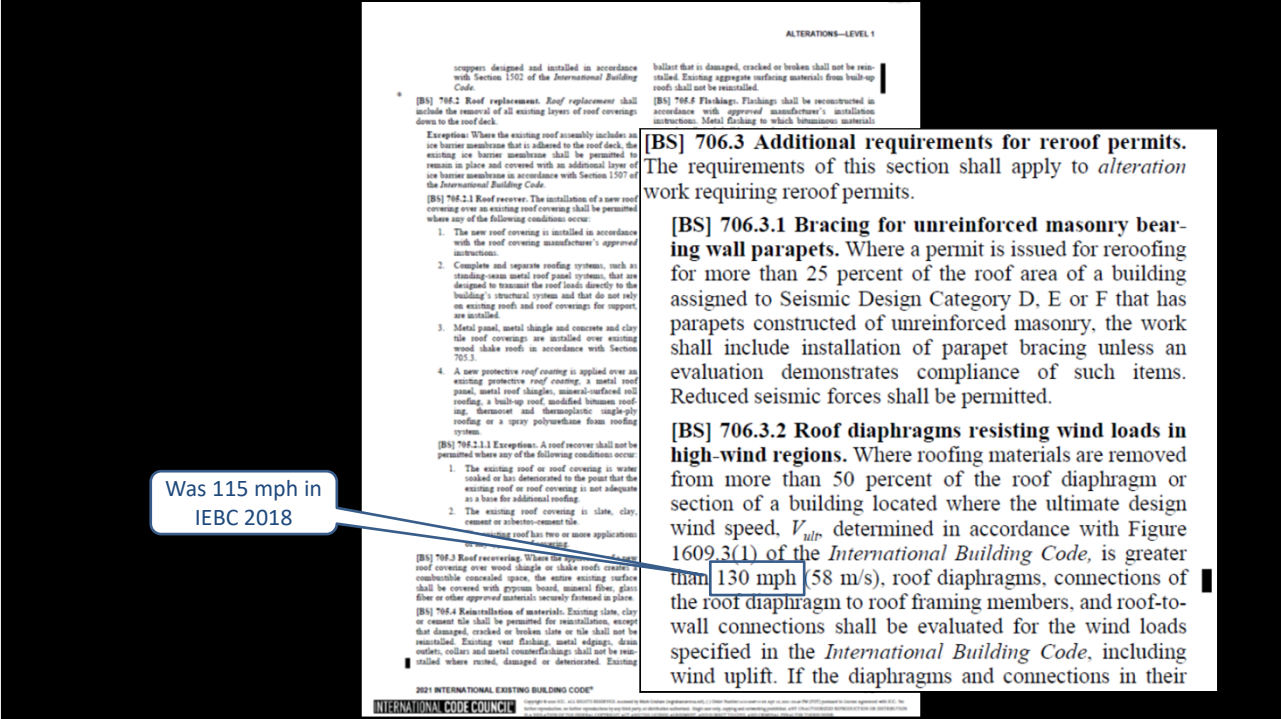
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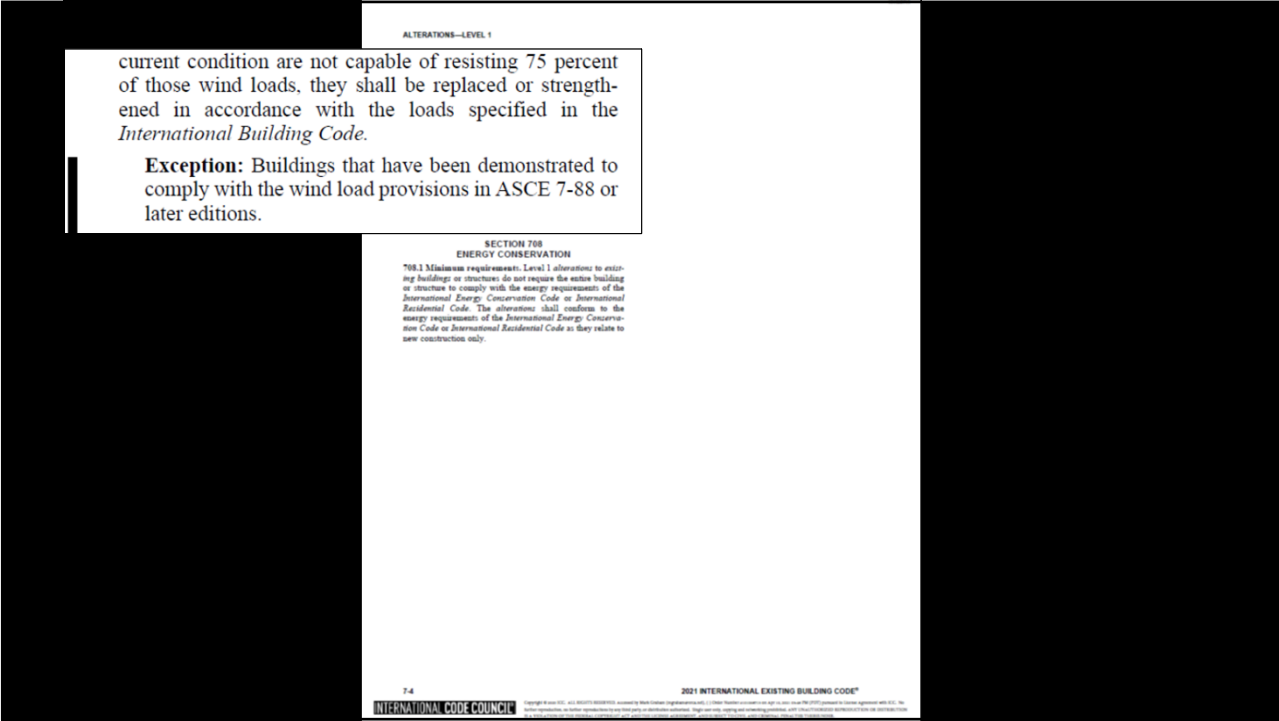
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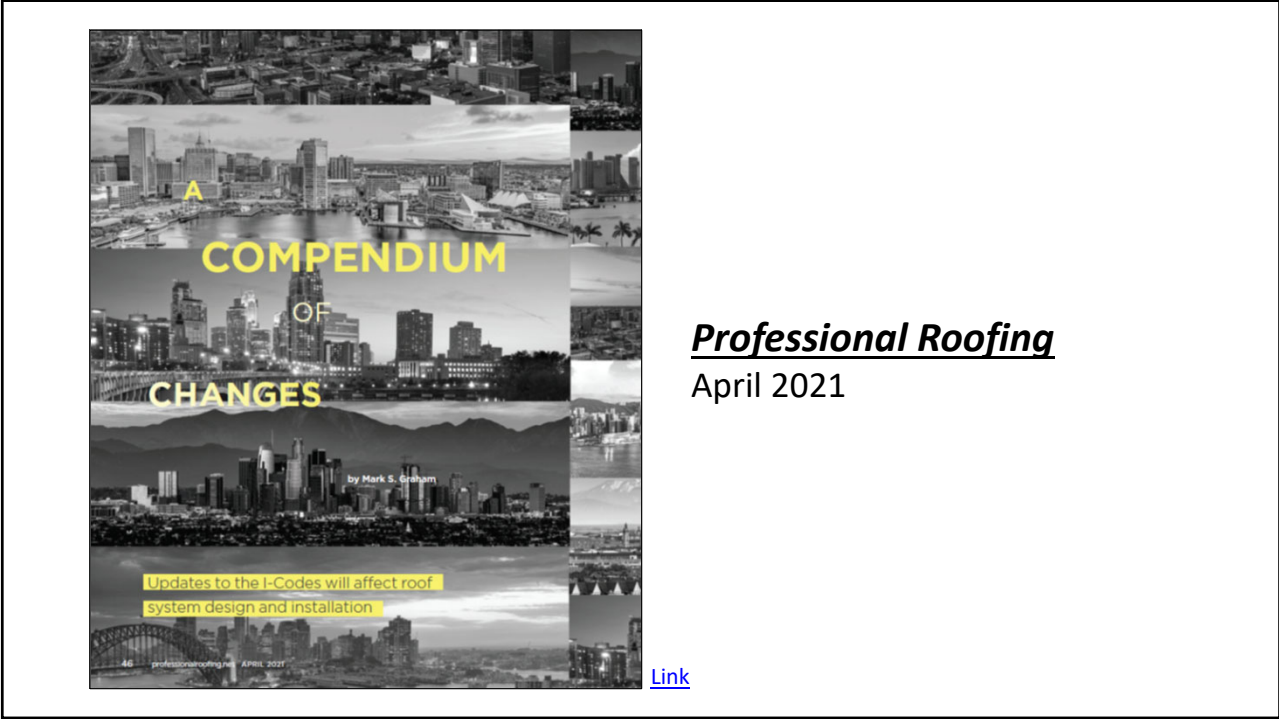
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Be aware whether and, if so, when your state and local jurisdictions will be adopting the 2021 I-codes

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ICC codes accessible online

codes.iccsafe.org

The screenshot displays the ICC codes website interface. At the top, there is a navigation bar with links for 'Find Codes', 'Premium Features', and 'Premium for Teams'. A search bar is present with the text 'Search I-Codes Books'. Below the navigation, a banner for 'I-Codes Building Codes' features a 'Premium Complete' offer. The main content area shows a grid of eight 2021 code books: IBC (International Building Code), IRC (International Residential Code), IFC (International Fire Code), IFGC (International Fuel Gas Code), IMC (International Mechanical Code), IPC (International Plumbing Code), IEBC (International Existing Building Code), and IECC (International Energy Conservation Code). Each book cover includes the year '2021' and the ICC logo. A sidebar on the left lists various categories like 'Collections', 'Commentaries', and 'Standards'. On the right, there is a 'Bundle and Save' section for the '2012 International Codes, Designer Collection' and an 'Info' section about the ICC and I-Codes.

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