



ARMKO Industries, Inc.
February 13, 2023
San Antonio, TX

Roofing market conditions update and roofing-related provisions of the 2021 I-codes




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1

Market conditions and forecast

2



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ARMA Releases 2022 Q4 Report on Asphalt Roofing Product Shipments


2020: 161,416,435
2019: 146,605,438
2018: 143,453,436
2017: 151,098,256

Shipments (squares)	Q4 2022	Q4 2021	% Change	YTD 2022	YTD 2021	% Change
Shingles – U.S. (including individual shingles)	29,865,538	37,014,634	-19.3%	157,749,481	169,188,143	-6.8%
BUR base, ply, and mineral cap sheets – U.S. (not including saturated felts)	1,398,161	1,344,956	4.0%	7,055,363	6,587,255	7.1%
Modified Bitumen – U.S.	8,040,453	8,930,779	-10.0%	38,996,142	39,805,747	-2.0%
Shingles – Canada (including Individual shingles)	1,569,610	2,917,763	-46.2%	12,109,765	14,215,825	-14.8%

About ARMA:
The Asphalt Roofing Manufacturers Association (ARMA) is a trade association representing North America's asphalt roofing manufacturing companies and their raw material suppliers. The association includes the majority of North American manufacturers of asphalt shingles and asphalt low slope roof membrane systems. Committed to advances in the asphalt roofing industry, ARMA is proud of the role it plays in promoting asphalt roofing to those in the building industry and to the public.

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3



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4



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5



FOR IMMEDIATE RELEASE

For more information, contact: Linda King, SPRI Managing Director
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SPRI reports strong recovery in 2022.

WALTHAM, MA—May 31, 2022—The Single-Ply Roofing Industry (SPRI), representing North American manufacturers in commercial roofing manufacturing, education, and innovation, today announced that the U.S. Single Ply roofing industry saw a 12.2% increase in 2021 roof membrane shipments as reported by SPRI Membership. Despite the many challenges faced in the supply chain, 2021 showed a strong increase from the 2020 reported 4.1% decline in shipments, according to statistics compiled by SPRI.

invaluable, proprietary report tracking these key industry product shipments.

In 2021, the thermoset segment saw 7.5% growth over the prior year, thermoplastic saw 14% and modified bitumen 9.7% growth.


year. SPRI members and the entire roofing industry faced many obstacles to increased production including labor, transportation, raw materials, uneven demand, and were not immune to these challenges. As we moved into 2022, members saw strong shipment performance in the first quarter showing a 16.8% increase in year-over-year shipments," said Brad Van Dam, SPRI President.

Regionally, year-to-year shipments increased 20% in the North East US. The South saw 13.5 % growth, followed by the North Central at 10.7% and the West at 6%.

volume nationally.

Together, SPRI members develop industry standards, sponsor research, publish informative guidelines and publications for the commercial roofing industry, and continue to advance roofing technology.

6



Polyiso Industry Reports 7.5% Increase in Product Shipments for 2021

Arlington, VA, April 7, 2022 – The Polyisocyanurate Insulation Manufacturers Association (PIMA) announces that for the year ending December 31, 2021, polyisocyanurate (polyiso) product shipments increased 7.5 percent year-over-year as measured in board feet. Over the past five years (2017-2021), total polyiso product shipments have increased by more than 22 percent.

as well as in the existing building stock. This is creating more opportunities for the use of polyiso insulation in projects that result in significant energy savings, including retrofit projects like roof replacements.”

PIMA gathers shipment data for polyiso products produced in the United States and Canada by the participating manufacturing members of the Association. The shipment information is collected and reported in the aggregate by an independent third party, Association Research, Inc., and reflects products used for roofs, walls, cover boards and other applications.

###

About PIMA
 For more than 30 years, the Polyisocyanurate Insulation Manufacturers Association (PIMA) has served as the voice of the rigid polyiso industry, proactively advocating for safe, cost-effective, sustainable, and energy-efficient construction. Organized in 1987, PIMA is an association of polyiso manufacturers and industry suppliers. Polyiso is one of North America’s most widely-used and cost-effective insulation products. To learn more, visit www.polyiso.org.


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7

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81% report increasing labor costs, with the average labor costs increasing 17%. On average, the workforce is constructed of 62% full-time employees, 29% subcontractors, and 9% part-time employees.

1. **Stability.** Although new technologies have entered the roofing industry, the core business is extraordinarily stable. New properties will need roofs. Roofs will wear out and need to be replaced. Contractors will utilize qualified crews to install roofing. Properties will as a result be protected from the weather.
2. **Growth.** Two major factors fuel future progress. Over time, the expanding U.S. economy based on productivity and increased population drives industry revenues. Additionally, the trend of more severe weather results in even more roof repairs and replacements.
3. **Large.** The U.S. roofing industry is estimated to be more than \$55 billion and growing.
4. **Profitable.** The industry’s average return on assets is estimated at 8% and average return on equity of about 20%! For perspective, that means investor profits double every 3.5 years!
5. **Fragmented.** The 15 largest roofing companies represent less than 5% of total U.S. industry sales! In most industries, the 10% largest companies represent over 50% of the market share.

[Link](#)

8



9



10

Some Q4 results...

Market Index Survey for Reroofing

- 78%: Inquiries are equal to or greater than 2022
- 72%: Contracts are equal to or greater than 2022
- Indices (50 is the baseline):
 - Inquiries:
 - 43.8: Steep slope
 - 58.6: Low slope
 - 57.7: Combined
 - Contracts:
 - 43.3: Steep slope
 - 58.9: Low slope
 - 53.8: Combined

11

Some comments...

- Interest rates and economic uncertainty are hampering the industry, particularly the steep-slope/residential segment
- Supply chain/product availability issues and material/product pricing have stabilized... with few exceptions
- Transportation/trucking is a major issue
- The worker shortage is serious... and limiting industry growth
- Contractors are warehousing far more materials/products
- Regulatory issues are of increasing concern... and cost.
- Local/regional high-wind and hail events are wildcards
- Global events and politics are an unknown... and a concern

12

Questions
Market conditions and forecast

13

Roofing-related provisions in the 2021 I-codes

14

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)
- Code enforcement occurs at the time of installation and occupancy/use
- The code can also provide a basis for construction claims-related litigation



15

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.

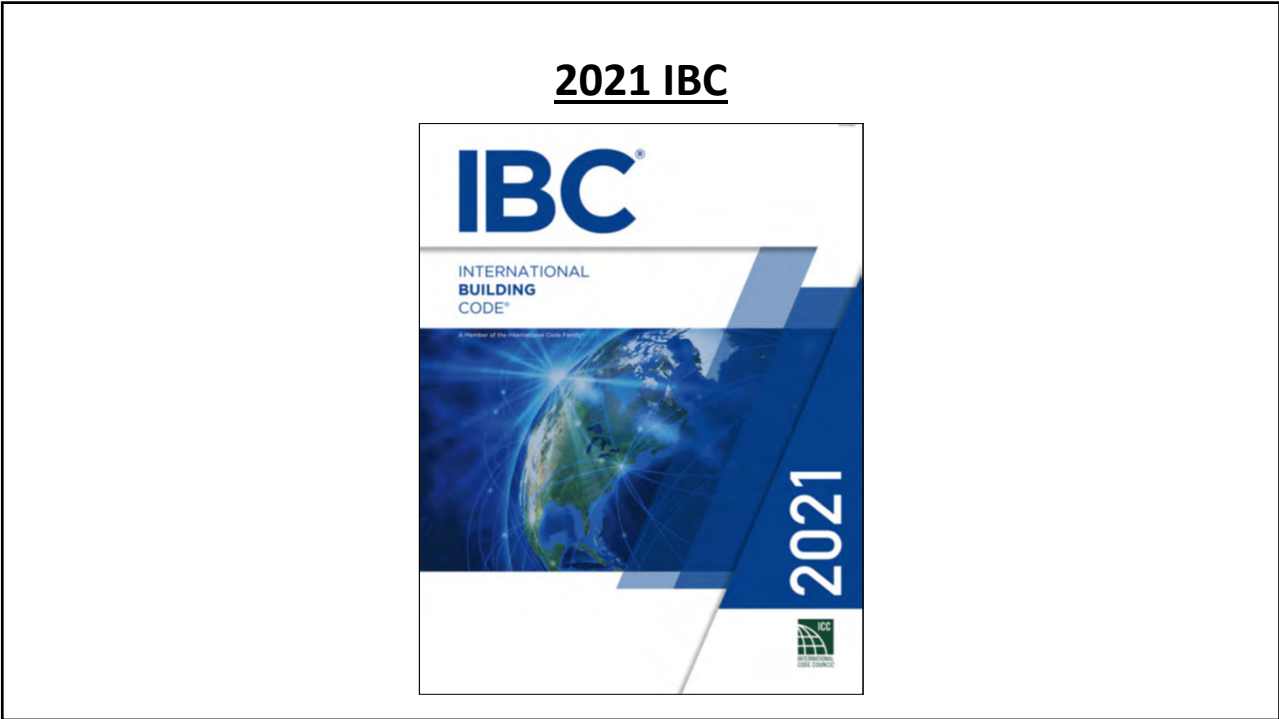
2018 Group A: IBC Building Fire, Building General and Plumbing Committees

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

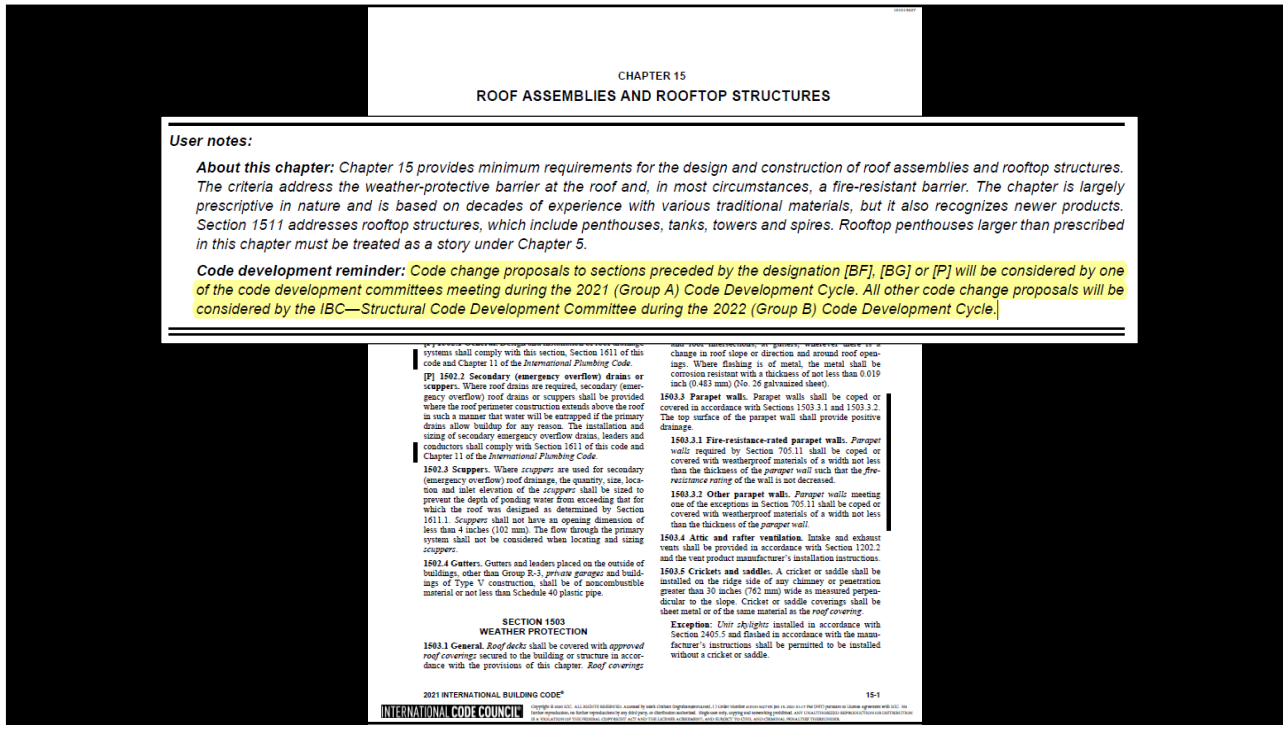
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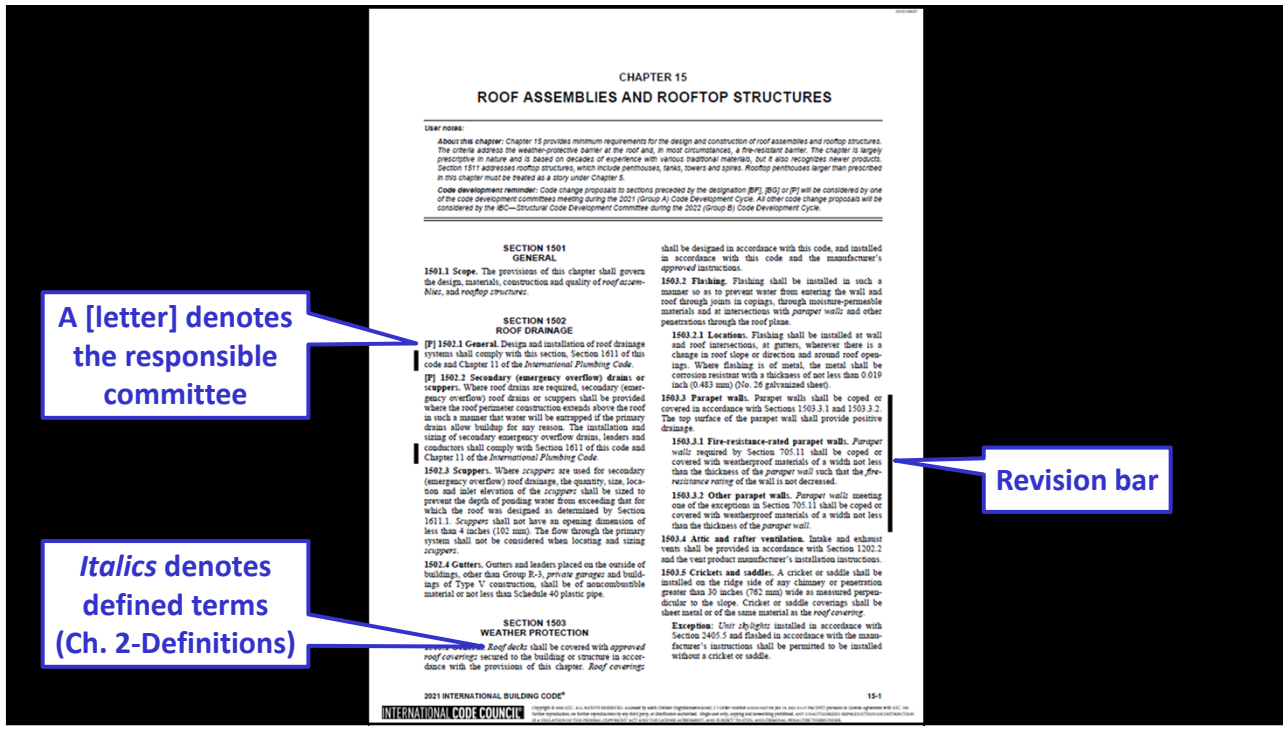
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18



19



20

ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

SECTION 1504
PERFORMANCE REQUIREMENTS

**SECTION 1504
PERFORMANCE REQUIREMENTS**

1504.1 Wind resistance of roofs. Roof decks and roof coverings shall be designed for wind loads in accordance with Chapter 16 and Sections 1504.2, 1504.3 and 1504.4.

ASCE 7-16

required classification in Table 1504.2

1504.3 Wind resistance of clay and concrete tile. Wind loads on clay and concrete tile roof coverings shall be in accordance with Section 1609.5.

1504.3.1 Testing. Testing of concrete and clay roof tiles shall be in accordance with Sections 1504.3.1.1, 1504.3.1.2 and 1504.3.1.3.

1504.3.1.1 Overturning resistance. Concrete and clay roof tiles shall be tested to determine their resistance to overturning due to wind in accordance with Chapter 15 and either SBCCI SSTD 11 or ASTM C1568.

1504.3.1.2 Wind tunnel testing. Where concrete and clay roof tiles do not satisfy the limitations in Chapter 16 for rigid tile, a wind tunnel test shall be used to determine the wind characteristics of the concrete or clay tile roof covering in accordance with Chapter 15 and either SBCCI SSTD 11 or ASTM C1569.

1504.3.1.3 Air permeability testing. The lift coefficient for concrete and clay tile shall be 0.2 or shall be determined in accordance with SBCCI SSTD 11 or ASTM C1570.

1504.4 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 1609.5.2. The wind load on the roof covering shall be permitted to be determined using allowable stress design.

1504.4.1 Other roof systems. Built-up, modified bitumen, fully adhered or mechanically attached single-ply roof systems, metal panel roof systems applied to a solid or closely fitted deck and other types of membrane roof coverings shall be tested in accordance with FM 4474, UL 580 or UL 1897.

1504.5 Ballasted low-slope single-ply roof systems. Ballasted low-slope (roof slope < 2:12) single-ply roof system coverings installed in accordance with Section 1507.12 shall be designed in accordance with ANSI/SPRI RP-4.

1897. Metal roof shingles tested in accordance with ASTM D3161 shall meet the classification requirements of Table 1504.2 for the appropriate maximum basic wind speed and the metal shingle rock guard shall bear a label

TABLE 1504.2
CLASSIFICATION OF STEEP SLOPE ROOF SHINGLES

MAXIMUM BASIC WIND SPEED, V, FROM FIGURES 1609.3(1)–(8) OR ASCE 7(9)(II)	MAXIMUM ALLOWABLE TEST SPEED, V _{TEST} , FROM THE		
110	85		
115	90		
120	100		
142	110		
155	120		
168	135		
181	140	H	F
194	150	H	F

For 12, 1 foot = 304.8 mm; 1 mph = 0.447 m/s.
 H The windward calculation contained in ASTM D7158 assumes Exposure Category B or C and building height of 60 feet or less. Additional calculations are required for conditions outside of these assumptions.

15-2

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21

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.

22

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.

23

ANSI/SPRI GT-1

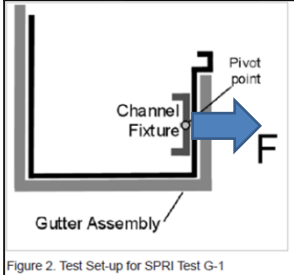
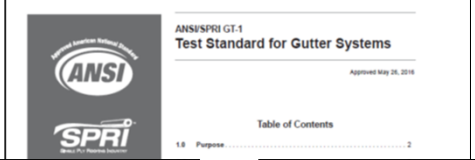


Figure 2. Test Set-up for SPRI Test G-1

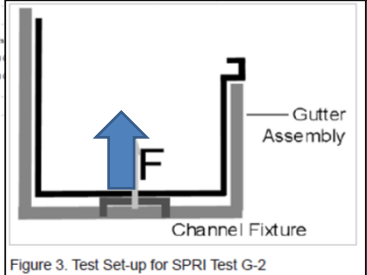


Figure 3. Test Set-up for SPRI Test G-2

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Disclaimer
This standard is for use by architects, engineers, roofing contractors and building services when designing, testing 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.

[Link to access GT-1](#)

24

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	150	≤ 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)	150	17	19	22	25	27	30	36	41	46	23	26	29	32	35	38	44	50	56
	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).

25

ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

1504.5 Ballasted low-slope single-ply roof systems. Ballasted low-slope (roof slope ≤ 2:12) single-ply roof system coverings installed in accordance with Section 1507.12 shall be designed in accordance with AISI SPSR1-20-4 coverings that are subject to cyclical flexural response due to wind loads shall not demonstrate any significant loss of tensile strength for unreinforced membranes or breaking strength for reinforced membranes when tested as herein required.

SECTION 1505 FIRE CLASSIFICATION

[BF] 1505.1 General. Roof assemblies shall be divided into the classes defined in this section. Class A, B and C roof assemblies and roof coverings required to be listed by this section shall be tested in accordance with ASTM E108 or UL 790. In addition, *fire-retardant-treated wood* roof coverings shall be tested in accordance with ASTM D2898. 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.

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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26

[BF] 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 non-combustible decks or ferrous, copper or metal sheets installed without a roof deck on noncombustible framing.
3. Class A roof assemblies include minimum 16 ounce per square foot (0.0416 kg/m²) copper sheets installed over combustible decks.
4. Class A roof assemblies include slate installed over ASTM D226, Type II underlayment over combustible decks.

27

**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 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 constructed in accordance with Section 1505.7.

28

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.

29

ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

TABLE 1505.1
MINIMUM ROOF COVERING
CLASSIFICATION FOR TYPES OF CONSTRUCTION^a

Type	Type I		Type II		Type III		Type IV		Type V	
	A	B	A	B	A	B	A	B	A	B
1	B	B	C	B	C	B	B	B	C	C

^a Unless otherwise required in accordance with the International Wildland Urban Interface Building Code, the fire district in accordance with Appendix D.

^b Nonclassified roof coverings shall be permitted on buildings of Group R-1 and Group U occupancies, when there is a minimum fire separation distance of 6 feet measured from the leading edge of the roof to the nearest fire-rated wall or fire-rated door and having not more than 0.005 square feet of projected roof area and when used as 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 new means of egress, shall be permitted to have roof No. 1 cedar or redwood shakes and No. 1 shingles constructed in accordance with Section 1507.7.

[BF] 1506.2 Class A roof assemblies. Class A roof assemblies are those that are effective against severe fire test exposures. 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:

- Class A roof assemblies include those with coverings of brick, masonry or an exposed concrete roof deck.
- 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.
- Class A roof assemblies include minimum 16 ounces per square foot (0.5416 kg/m²) copper sheets installed over combustible decks.
- Class A roof assemblies include slate installed over ASTM D2124, Type II underlayment over combustible decks.

[BF] 1506.3 Class B roof assemblies. Class B roof assemblies are those that are effective against moderate fire-test exposures. Class B roof assemblies and roof coverings shall be *listed* and identified as Class B by an approved testing agency.

[BF] 1506.4 Class C roof assemblies. Class C roof assemblies are those that are effective against light fire-test exposures. Class C roof assemblies and roof coverings shall be *listed* and identified as Class C by an approved testing agency.

[BF] 1506.5 Nonclassified roofing. Nonclassified roofing is approved material that is not *listed* as a Class A, B or C roof covering.

[BF] 1506.6 Fire-retardant-treated wood shingles and shakes. Fire-retardant-treated wood shingles and shakes shall be treated by impregnation with chemicals by the full-cell vacuum-pressure process, in accordance with AWPA C1. Each bundle shall be marked to identify the manufacturer and the manufacturer, and shall be *labeled* to identify the classification of the material in accordance with the testing required in Section 1505.1, the testing company and the quality control agency.

[BF] 1506.7 Special purpose roofs. Special purpose wood shingle or wood shake roofing shall conform to the grading and application requirements of Sections 1507.8 or 1507.9. In addition, an underlayment of 1/2-inch (12.7 mm) Type X water-resistant gypsum backing board or gypsum sheathing shall be placed under minimum nominal 1/2-inch-thick (12.7 mm) wood structural panel solid sheathing or 1-inch (25 mm) nominal spaced sheathing.

[BF] 1506.8 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] 1506.9 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.

[BF] 1506.10 Landscaped roofs. Landscaped roofs shall comply with Sections 1505.1 and 1507.15 and shall be installed in accordance with ANSI SPRI VF-1.

**SECTION 1506
MATERIALS**

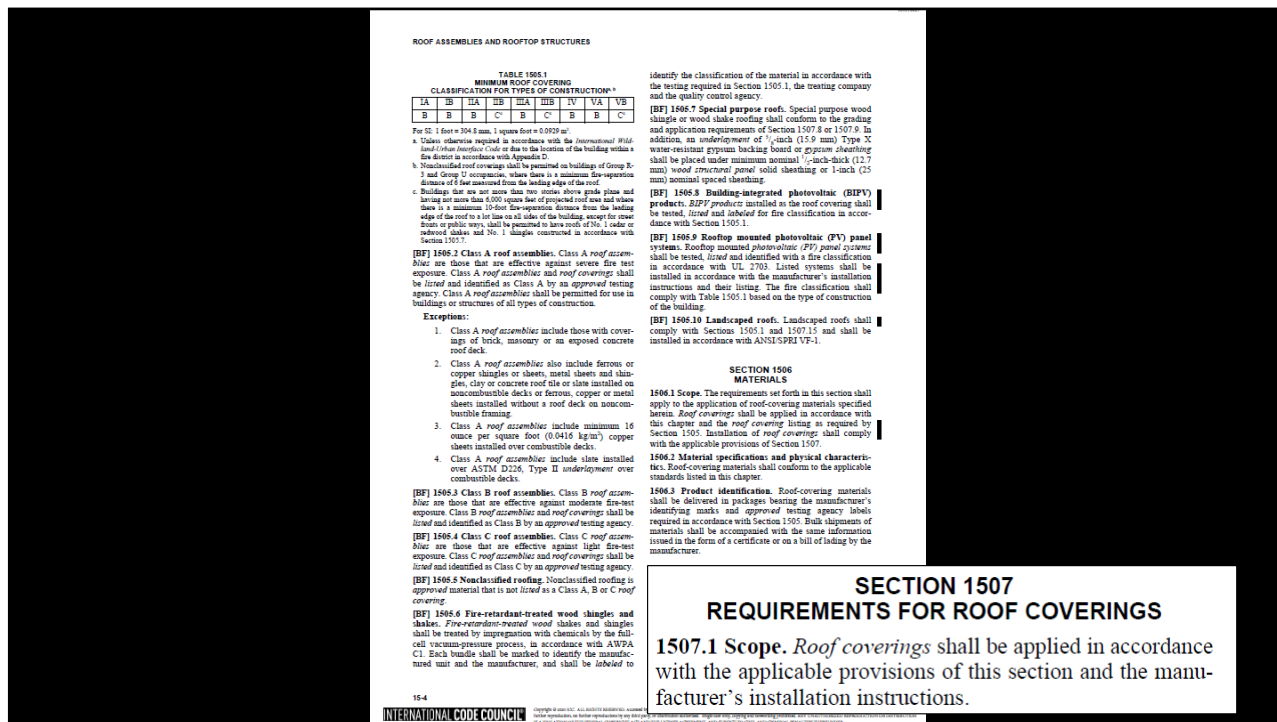
1506.1 Scope. The requirements set forth in this section shall apply to the application of roof-covering materials specified herein. *Roof coverings* shall be applied in accordance with this chapter and the *roof covering* listing as required by Section 1505. Installation of *roof coverings* shall comply with the applicable provisions of Section 1507.

SECTION 1507
REQUIREMENTS FOR ROOF COVERINGS

1507.1 Scope. *Roof coverings* shall be applied in accordance with the applicable provisions of this section and the manufacturer’s installation instructions.

1507.1.1 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

30



31

Roof system types

Prescriptive requirement in Section 1507

- Asphalt shingles
- Modified bitumen roofing
- Clay and concrete tile
- Single-ply roofing
- Metal panels
- Spray polyurethane foam
- Metal shingles
- Liquid-applied roofing
- Mineral-surfaced roll roofing
- Vegetative roofs, roof gardens and landscaped roofs
- Slate shingles
- Photovoltaic shingles
- Wood shingles
- Building-integrated photovoltaic roof panels
- Wood shakes
- Built-up roofs

32

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.

33

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.

34

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 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.

35

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

36

ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

**SECTION 1511
REROOFING**

1511.1 General. Materials and methods of application used for recovering or replacing an existing roof covering shall comply with the requirements of Chapter 15.

Exceptions:

1. *Roof replacement* or *roof recover* of existing low-slope roof coverings 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.
2. Recovering or replacing an existing roof covering shall not be required to meet the requirement for secondary (emergency overflow) drains or scuppers in Section 1503.4 for roofs that provide for positive roof drainage. For the purposes of this exception, existing secondary drainage or scupper systems required in accordance with this code shall not be removed unless they are replaced by secondary drains or scuppers designed and installed in accordance with Section 1503.4.

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INTERNATIONAL CODE COUNCIL

37

1511.3 Roof replacement. *Roof replacement* shall include the removal of all existing layers of roof coverings down to the roof deck.

Exception: Where the existing roof assembly includes an ice barrier membrane that is adhered to the roof deck, the existing ice barrier membrane shall be permitted to remain in place and covered with an additional layer of ice barrier membrane in accordance with Section 1507.

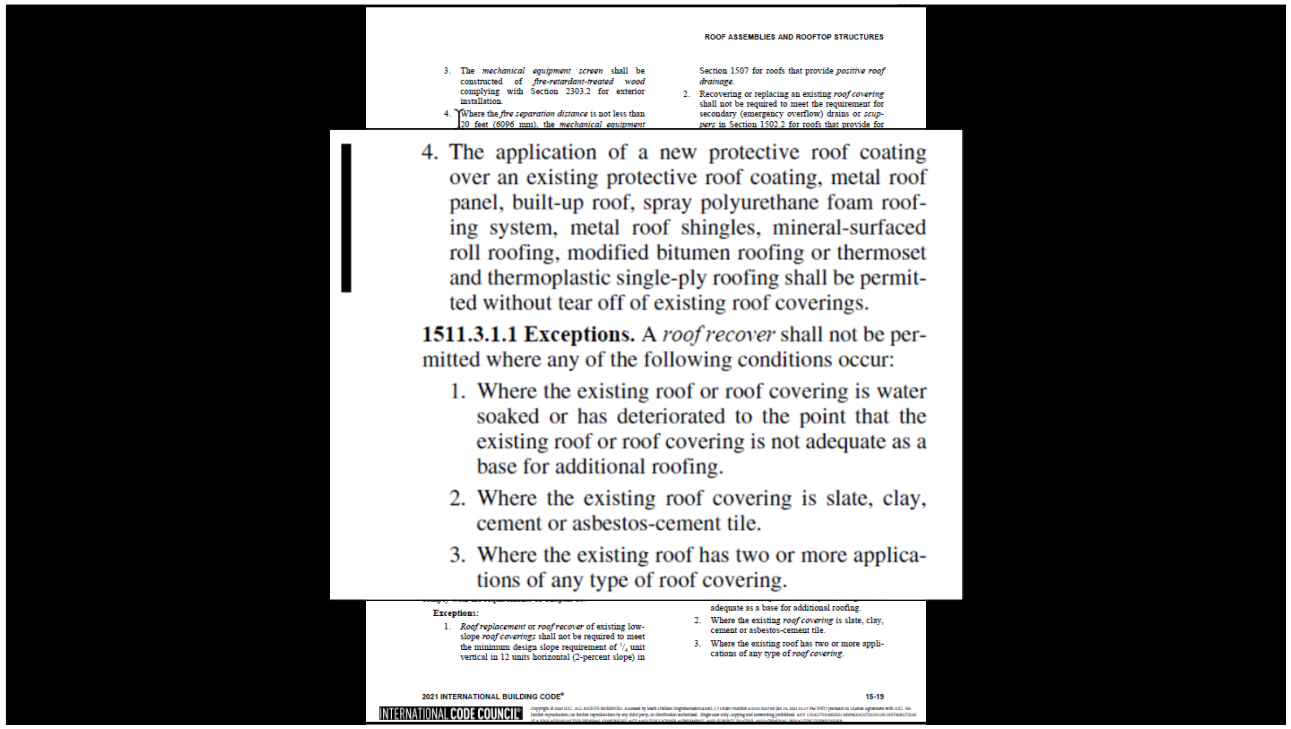
1511.3.1 Roof recover. The installation of a new roof covering over an existing roof covering shall be permitted where any of the following conditions occur:

1. Where the new roof covering is installed in accordance with the roof covering manufacturer's approved instructions.
2. Complete and separate roofing systems, such as standing-seam metal roof panel systems, that are designed to transmit the roof loads directly to the building's structural system and that do not rely on existing roofs and roof coverings for support, shall not require the removal of existing roof coverings.
3. Metal panel, metal shingle and concrete and clay tile roof coverings shall be permitted to be installed over existing wood shake roofs when applied in accordance with Section 1511.4.

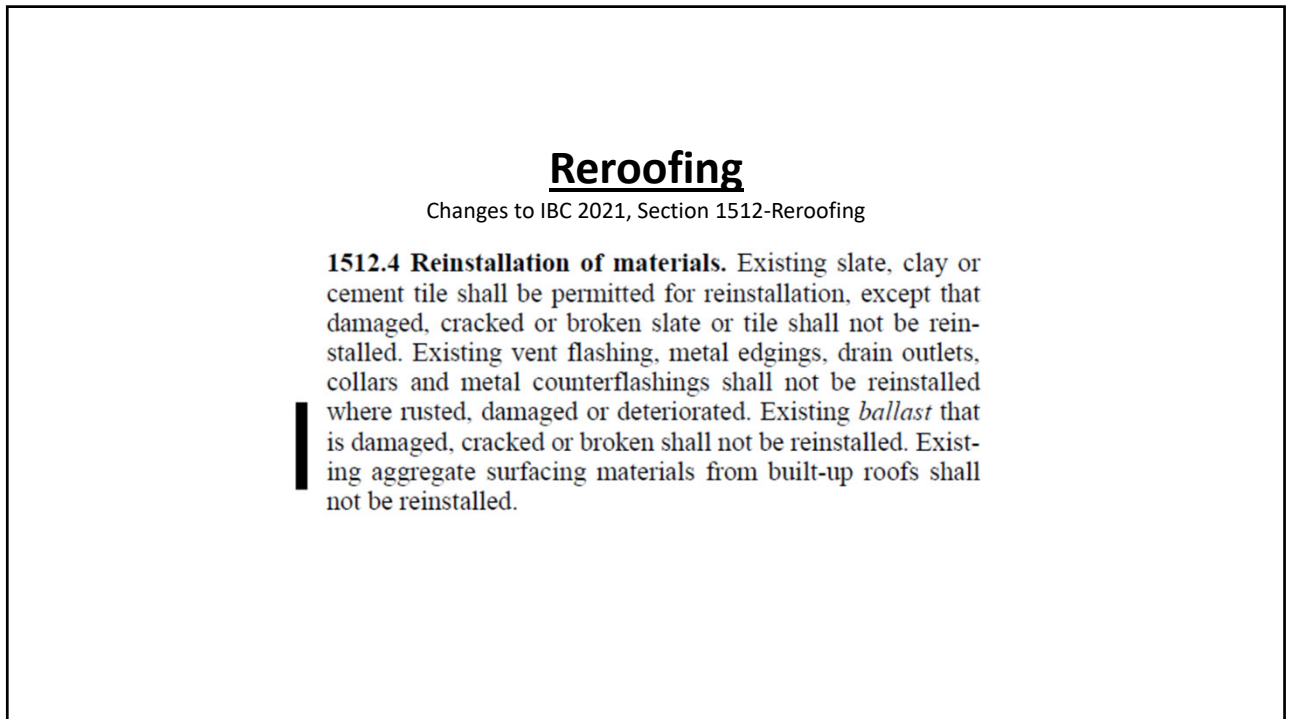
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38



39



40

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*, $V_{as,d}$, 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/m²).

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41

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.

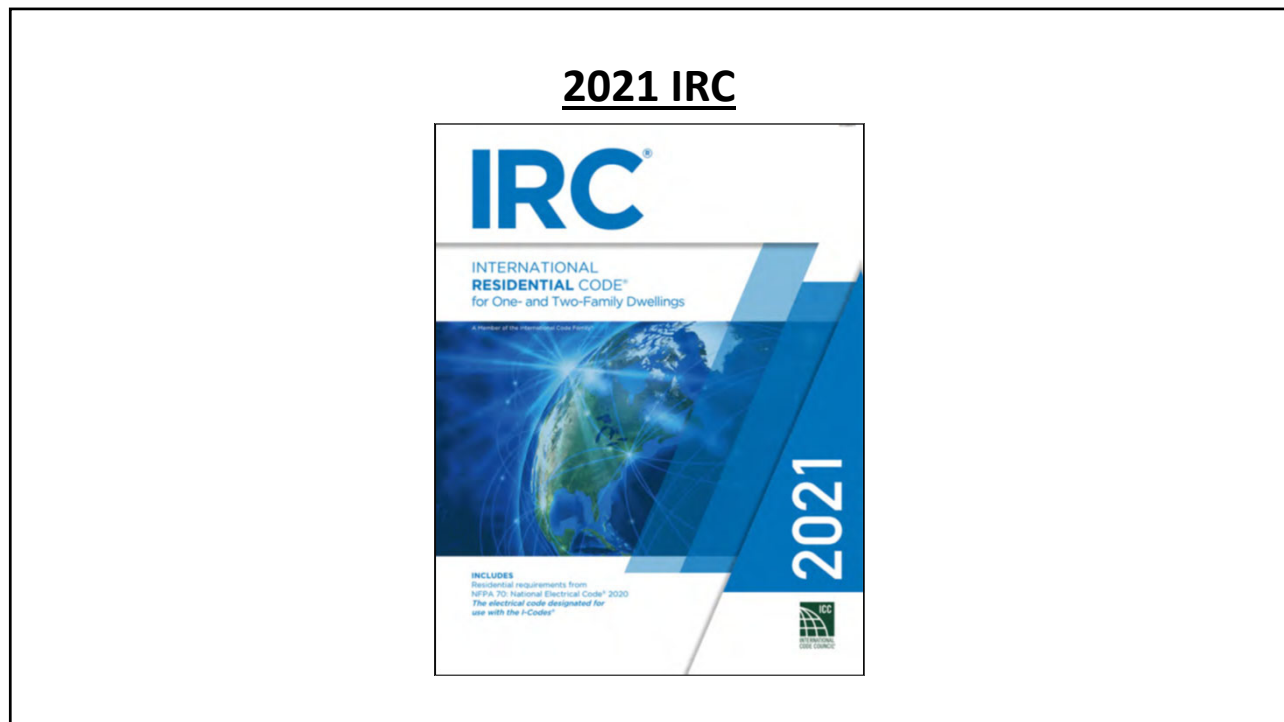
5.3. The air shall be supplied from ductwork providing supply air to the occupiable space when the conditioning system is operating. Alternatively, the air shall be supplied by a supply fan when the conditioning system is operating. Where preformed insulation board is used as the air-impermeable insulation 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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42



43

IRC's applicability

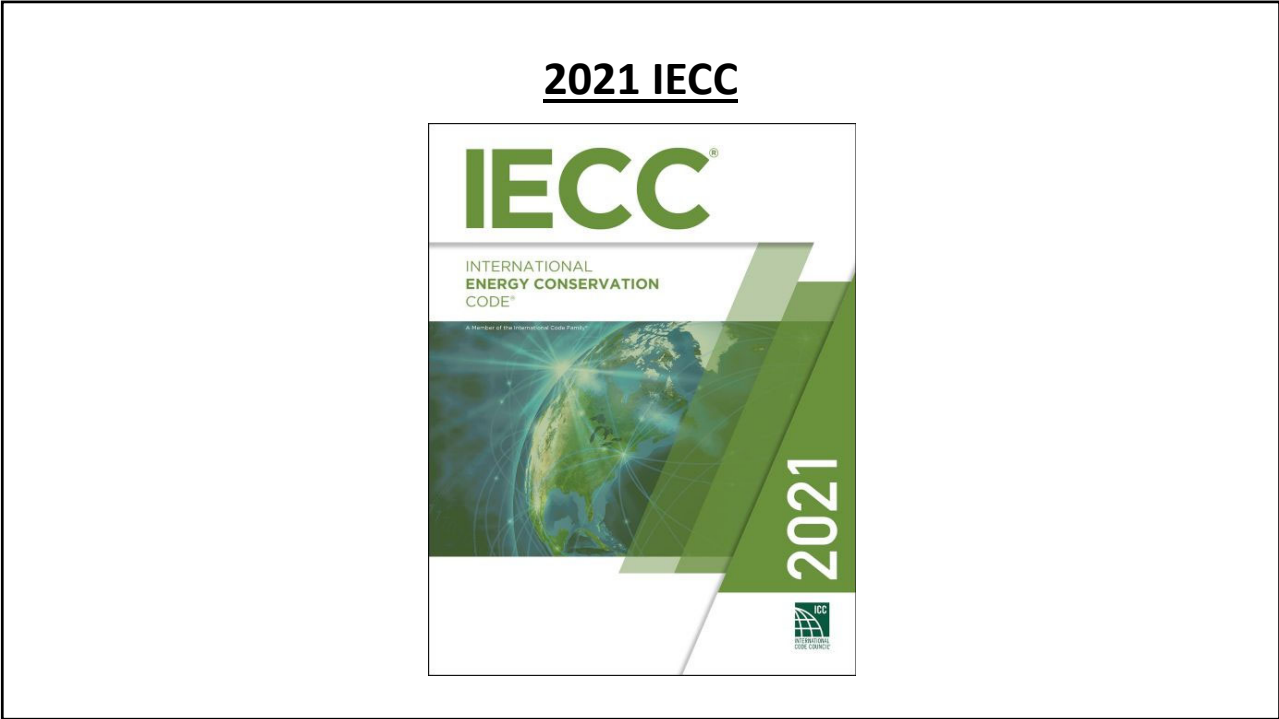
When does IRC apply vs. IBC?

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.

44



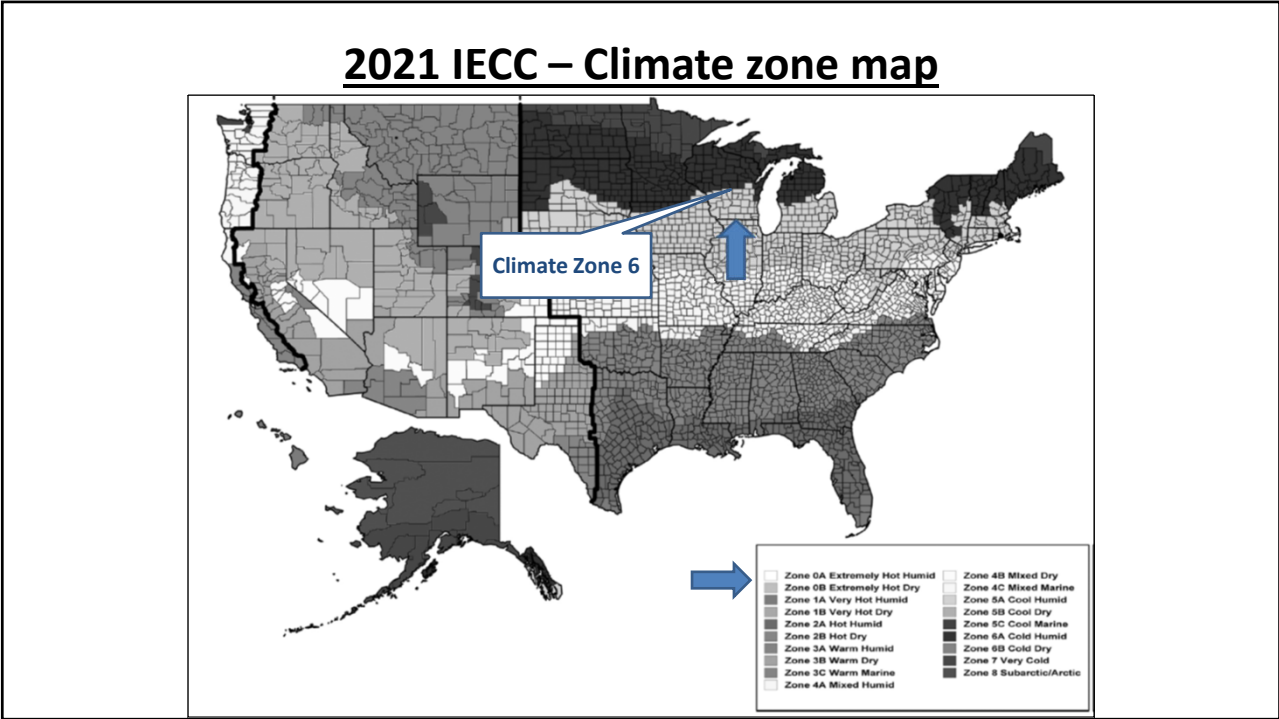
45

TABLE OF CONTENTS

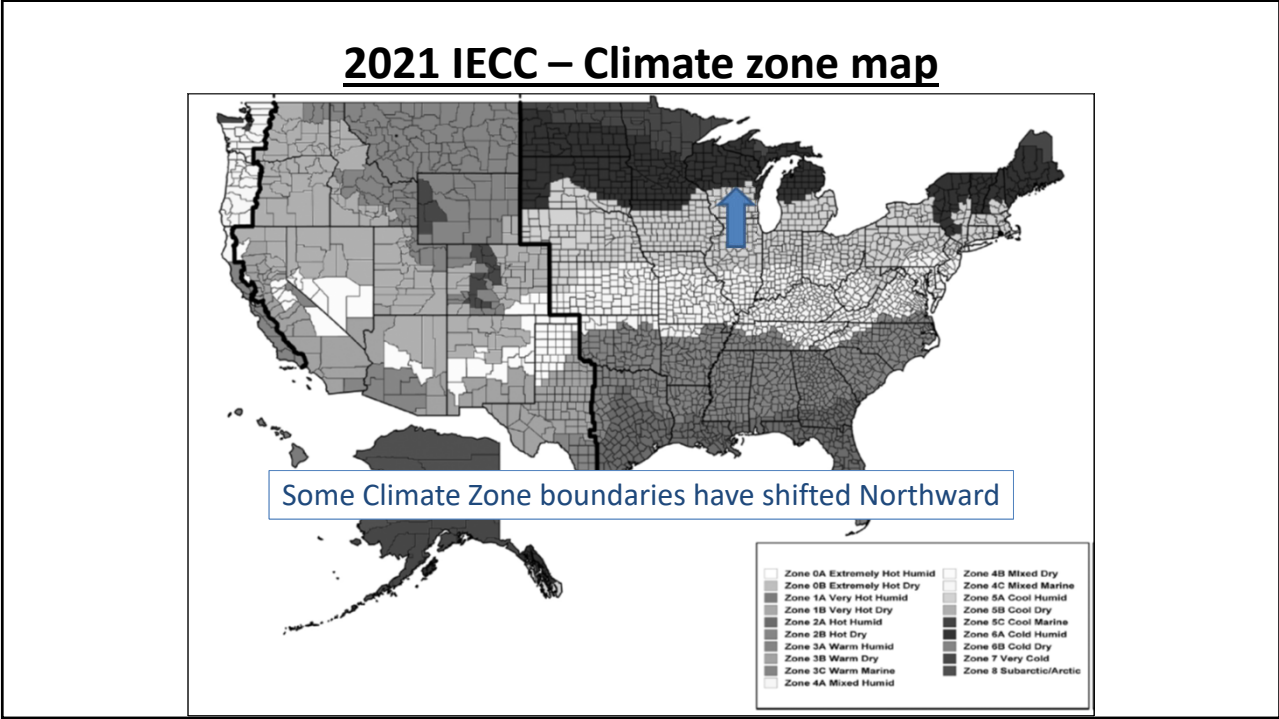
<i>IECC—COMMERCIAL PROVISIONS</i> C-4	<i>IECC—RESIDENTIAL PROVISIONS</i> R-4
CHAPTER 1 SCOPE AND ADMINISTRATION C1-1	CHAPTER 1 SCOPE AND ADMINISTRATION R1-1
CHAPTER 2 DEFINITIONS C2-1	CHAPTER 2 DEFINITIONS R2-1
CHAPTER 3 GENERAL REQUIREMENTS C3-1	CHAPTER 3 GENERAL REQUIREMENTS R3-1
CHAPTER 4 COMMERCIAL ENERGY EFFICIENCY C4-1	CHAPTER 4 RESIDENTIAL ENERGY EFFICIENCY R4-1
CHAPTER 5 EXISTING BUILDINGS C5-1	CHAPTER 5 EXISTING BUILDINGS R5-1
CHAPTER 6 REFERENCED STANDARDS C6-1	CHAPTER 6 REFERENCED STANDARDS R6-1
APPENDIX CA BOARD OF APPEALS—COMMERCIAL APPENDIX CA-1	APPENDIX RA BOARD OF APPEALS—RESIDENTIAL APPENDIX RA-1
APPENDIX CB SOLAR-READY ZONE—COMMERCIAL APPENDIX CB-1	APPENDIX RB SOLAR-READY PROVISIONS—DETACHED ONE- AND TWO-FAMILY DWELLINGS AND TOWNHOUSES APPENDIX RB-1
APPENDIX CC ZERO ENERGY COMMERCIAL BUILDING PROVISIONS APPENDIX CC-1	APPENDIX RC ZERO ENERGY RESIDENTIAL BUILDING PROVISIONS APPENDIX RC-1
INDEX INDEX C-1	INDEX INDEX R-1

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INTERNATIONAL CODE COUNCIL

46



47



48

GENERAL REQUIREMENTS

TABLE C301.1—continued
CLIMATE ZONES, MOISTURE REGIMES, AND WARM HUMID DESIGNATIONS BY STATE, COUNTY AND TERRITORY*

UNITED STATES—continued		WEST VIRGINIA (continued)	
4A Jefferson	4A Kanawha	6A Boone	6A Boone
4A Lewis	4A Lincoln	6A Cabnet	6A Cabnet
4A Logan	4A Mingo	6A Clay	6A Clay
4A Marion	4A Boone	6A Columbia	6A Columbia
4A Marshall	4A Boone	6A Crawford	6A Crawford
4A Mason	4A Boone	6A Dine	6A Dine
4A McDowell	4A Boone	6A Dodge	6A Dodge
4A Mercer	4A Boone	6A Door	6A Door
4A Mineral	4A Boone	6A Douglas	6A Douglas
4A Mingo	4A Boone	6A Drum	6A Drum
4A Monongalia	4A Boone	6A Elm Creek	6A Elm Creek
4A Monroe	4A Boone	6A Florence	6A Florence
4A Morgan	4A Boone	6A Fond du Lac	6A Fond du Lac
4A Nicholas	4A Boone	6A Forest	6A Forest
4A Ohio	4A Boone	6A Grant	6A Grant
4A Pendleton	4A Boone	6A Green	6A Green
4A Pleasants	4A Boone	6A Green Lake	6A Green Lake
4A Pocahontas	4A Boone	6A Inez	6A Inez
4A Putnam	4A Boone	6A Iowa	6A Iowa
4A Raleigh	4A Boone	6A Jackson	6A Jackson
4A Randolph	4A Boone	6A Jefferson	6A Jefferson
4A Richwood	4A Boone	6A Kanawha	6A Kanawha
4A Boone	4A Boone	6A Kenesaw	6A Kenesaw
4A Summers	4A Boone	6A Ewerwasaw	6A Ewerwasaw
4A Taylor	4A Boone	6A La Crosse	6A La Crosse
4A Tucker	4A Boone	6A Lafayette	6A Lafayette
4A Tyler	4A Boone	6A Langlade	6A Langlade
4A Upshur	4A Boone	6A Lincoln	6A Lincoln
4A Wayne	4A Boone	6A Manitowish	6A Manitowish
4A Webster	4A Boone	6A Manitowoc	6A Manitowoc
4A West	4A Boone	6A Marquette	6A Marquette
4A Wood	4A Boone	6A Menominee	6A Menominee
4A Wyoming	4A Boone	6A Milwaukee	6A Milwaukee
6A Adams	6A Boone	6A Monroe	6A Monroe
6A Ashland	6A Boone	6A Oconto	6A Oconto
6A Barron	6A Boone	6A Oconto	6A Oconto
6A Bayfield	6A Boone	6A Oshkosh	6A Oshkosh
6A Brown	6A Boone	6A Outagamie	6A Outagamie
6A Burnett	6A Boone	6A Ozaukee	6A Ozaukee
6A Calumet	6A Boone	6A Pepin	6A Pepin
6A Chippewa	6A Boone	6A Pierce	6A Pierce
6A Clark	6A Boone	6A Polk	6A Polk
6A Columbia	6A Boone	6A Portage	6A Portage
6A Crawford	6A Boone		
6A Dine	6A Boone		
6A Dodge	6A Boone		
6A Door	6A Boone		
6A Douglas	6A Boone		
6A Drum	6A Boone		
6A Elm Creek	6A Boone		
6A Florence	6A Boone		
6A Fond du Lac	6A Boone		
6A Forest	6A Boone		
6A Grant	6A Boone		
6A Green	6A Boone		
6A Green Lake	6A Boone		
6A Inez	6A Boone		
6A Iowa	6A Boone		
6A Jackson	6A Boone		
6A Jefferson	6A Boone		
6A Kanawha	6A Boone		
6A Kenesaw	6A Boone		
6A Ewerwasaw	6A Boone		
6A La Crosse	6A Boone		
6A Lafayette	6A Boone		
6A Langlade	6A Boone		
6A Lincoln	6A Boone		
6A Manitowish	6A Boone		
6A Manitowoc	6A Boone		
6A Marquette	6A Boone		
6A Menominee	6A Boone		
6A Milwaukee	6A Boone		
6A Monroe	6A Boone		
6A Oconto	6A Boone		
6A Oshkosh	6A Boone		
6A Outagamie	6A Boone		
6A Ozaukee	6A Boone		
6A Pepin	6A Boone		
6A Pierce	6A Boone		
6A Polk	6A Boone		
6A Portage	6A Boone		

(continued)

2021 INTERNATIONAL ENERGY CONSERVATION CODE®

INTERNATIONAL CODE COUNCIL

IECC 2021
Climate Zone 5A

49

GENERAL REQUIREMENTS

TABLE C301.1—continued
CLIMATE ZONES, MOISTURE REGIMES, AND WARM HUMID DESIGNATIONS BY STATE, COUNTY AND TERRITORY*

3A San Saba*	3A Young	4C Clark	4A Gilmer	6A Adams
3B Schuylker	3B Zavala	5B Columbia	5A Grant	7 Ashland
3B Shackelford	UTAH	4C Cowditz	5A Gosnell	6A Barron
3A Shelby*	5B Beaver	6B Ferry	5A Hampshire	7 Bayfield
4B Sherman	6B Bon Elder	5B Franklin	5A Hancock	6A Barron
3A Smith*	6B Boone	5B Garfield	5A Harrison	6A Buffalo
3A Somervell*	6B Carls	5B Grant	4A Jackson	7 Burnett
2A Stan*	6B Duggett	4C Gray's Harbor	4A Jefferson	6A Calumet
3A Stephens*	5B Davis	4C Island	4A Kanawha	6A Chippewa
3B Stepling	5B Davis	4C Jefferson	5A Lewis	6A Clark
3B Stone	5B Davis	4C King	4A Lincoln	6A Columbia
3B Stone	5B Davis	4C Knap	4A Logan	6A Crawford
3B Sutton	5B Davis	5B Knott	5A Marion	6A Dine
4B Swisher	5B Grand	5B Klickitat	5A Marshall	6A Dodge
3A Tarrant*	5B Grant	4C Lewis	4A Mason	6A Door
3B Taylor	5B Grant	5B Lincoln	4A McDowell	7 Douglas
3B Terry	5B Grant	4C Mason	4A Mercer	6A Drum
3B Throckmorton	5B Grant	6B Okanogan	5A Mineral	6A Eau Claire
3A Tins*	6B Morgan	4C Pacific	4A Mingo	7 Florence
3B Tom Green	5B Paine	6B Pend Oreille	5A Monongalia	6A Fond du Lac
2A Travis*	6B Rich	4C Pierce	4A Monroe	7 Forest
2A Trinity*	5B Salt Lake	4C San Juan	4A Morgan	6A Grant
2A Tyler*	5B San Juan	4C Skagit	5A Nicholas	6A Green Lake
3A Upland*	5B Sevier	5B Skamania	5A Ohio	6A Inez
3B Upton	5B Sevier	4C Saosomith	5A Pendleton	6A Iowa
2B Uvalde	6B Summit	5B Spokane	4A Pleasants	7 Inez
2B Val Verde	5B Tarrant	6B Stevens	5A Pocahontas	6A Jackson
3A Van Zandt*	6B Tarrant	4C Tazewell	5A Putnam	6A Jefferson
2A Victoria*	5B Utah	4C Wahiakum	5A Raleigh	6A Jones
2A Walker*	6B Wainwright	4C Wharton	5A Randolph	6A Keweenaw
3B Walker	5B Walla Walla	5B Wharton	4A Rich	6A La Crosse
3A Wall	5B Wayne	5B Williams	4A Rouse	6A Lafayette
2A Washington*	5B Weber	5B Yakima	5A Sumner	7 Langlade
2B Webb	VERMONT	WEST VIRGINIA	5A Taylor	7 Lincoln
2B Wharton*	6A (all)	5A Barbour	5A Tucker	6A Manitowish
3B Wheeler	VIRGINIA	4A Berkeley	4A Tyler	6A Marquette
3A Wichita	4A (all)	4A Boone	5A Upshur	6A Manitowish
3B Wilber	WASHINGTON	4A Braxton	4A Wayne	6A Marquette
2A Wilkes*	5B Adams	5A Brooke	4A York	6A Manitowish
3B Williams*	5B Adams	4A Cabell	5A Wetzel	6A Milwaukee
2A Wilson*	5B Adams	4A Carter	4A Wirt	6A Monroe
3B Winkler	5B Adams	4A Clay	4A Wood	6A Oconto
3A Wise	5B Adams	5A Doddridge	4A Wyoming	7 Oconto
3A Wood*	4C Chatham	5A Fayette		6A Outagamie
4B York				

(continued)

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IECC 2018
Climate Zone 6A

IECC 2018

50

2021 IECC Commercial -- Application

CHAPTER 4 [CE]
COMMERCIAL ENERGY EFFICIENCY

C401.2 Application. Commercial buildings shall comply with Section C401.2.1 or C401.2.2.

C401.2.1 International Energy Conservation Code. Commercial buildings shall comply with one of the following:

- Prescriptive Compliance.** The Prescriptive Compliance option requires compliance with Sections C402 through C406 and Section C408. Dwelling units and sleeping units in Group R-2 buildings without systems serving multiple units shall be deemed to be in compliance with this chapter, provided that they comply with Section R-406.
- Total Building Performance.** The Total Building Performance option requires compliance with Section C407.

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

C401.2.2 ASHRAE 90.1. Commercial buildings shall comply with the requirements of ANSI/ASHRAE/IESNA 90.1.

The energy efficiency provisions Chapter 4 contains by systems, lighting and additional efficiency requirements other than for the prescriptive method.

... if no average value for any component of envelope, the certificate shall indicate the average value when available. If the average is not available, the certificate shall list but apply to 10 percent or more of the total area.

SECTION C402 BUILDING ENVELOPE REQUIREMENTS

402.1 Thermal envelope assemblies. Building thermal envelope assemblies shall comply with the specific insulation values of Section C402.2 and the thermal mass of either the F-factor-based method of Section C402.1.3, the U-, C- and F-factor-based method of Section C402.1.4, or the component resistance alternative of Section C402.1.5.

402.2 Insulation values. Thermal envelope assemblies shall comply with the insulation values of Section C402.2.1 through C402.2.4.

402.3 Thermal mass. Thermal envelope assemblies shall comply with the thermal mass requirements of Section C402.3.1 through C402.3.4.

402.4 F-factor-based method. Thermal envelope assemblies shall comply with the F-factor-based method of Section C402.4.1 through C402.4.4.

402.5 U-, C- and F-factor-based method. Thermal envelope assemblies shall comply with the U-, C- and F-factor-based method of Section C402.5.1 through C402.5.4.

402.6 Component resistance alternative. Thermal envelope assemblies shall comply with the component resistance alternative of Section C402.6.1 through C402.6.4.

2021 INTERNATIONAL ENERGY CONSERVATION CODE® C41

INTERNATIONAL CODE COUNCIL

51

2021 IECC Commercial – U-factor Approach

COMMERCIAL ENERGY EFFICIENCY

... square foot (0.7 W/m²) of floor area for space conditioning purposes.

C402.1.1 Greenhouse areas that are not included in the building envelope.

- Greenhouse areas that are not included in the building envelope shall comply with Section C402.1.1.1 through C402.1.1.4.
- Greenhouse areas that are not included in the building envelope shall comply with Section C402.1.1.1 through C402.1.1.4.
- Greenhouse areas that are not included in the building envelope shall comply with Section C402.1.1.1 through C402.1.1.4.
- Greenhouse areas that are not included in the building envelope shall comply with Section C402.1.1.1 through C402.1.1.4.

TABLE PENETRATION RATIO

Component	Ratio
Vertical penetrations	0.01
Horizontal penetrations	0.02

C402.1.2 Equipment in the building envelope. Equipment in the building envelope shall comply with the following:

- Equipment shall be listed for use in the building envelope.
- Equipment shall be listed for use in the building envelope.
- Equipment shall be listed for use in the building envelope.
- Equipment shall be listed for use in the building envelope.

C402.1.3 Insulation method. Building envelopes shall comply with the insulation method of Section C402.1.3.1 through C402.1.3.4.

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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INTERNATIONAL CODE COUNCIL

52

2021 IECC Commercial – Tapered insulation

C402.1.4.2 Thermal resistance of cold-formed steel walls. U-factor of walls with cold-formed steel shall be determined in accordance with Equation 4.1:

$$U = 1/R_s + (R_{ci} - R_{ce}) \quad \text{(Equation 4.1)}$$

where:

- R_s = The cumulative R-value of the wall components along the path of heat transfer, excluding the cavity insulation and steel studs.
- R_{ci} = The effective R-value of the cavity insulation with steel studs as specified in Table C402.1.4.2.

COMMERCIAL ENERGY EFFICIENCY

FL/Df = FL Proposed - FL Table
 FL Proposed = Proposed F-value x Permissible length
 FL Table = F-value specified in Table C402.1.4 x Permissible length
 C = Sum of the (CA, Df) values for each distinct below-grade wall assembly type of the building thermal envelope.
 CA/Df = CA Proposed - CA Table
 CA Proposed = Proposed C-value x Area
 CA Table = (Maximum allowable C-factor specified in Table C402.1.4) x Area

When the proposed vertical glazing area is less than or equal to the maximum vertical glazing area allowed by Section C402.1.1, the value of D (Direct Vertical Glazing Value) shall be zero. Otherwise:

- D = (GA + UV) - (GA + U Wall), but not less than zero.
- DA = (Proposed Vertical Glazing Area) - (Vertical Glazing Area allowed by Section C402.1.1).
- UAV = Sum of the (UA Proposed) values for each opaque assembly of the exterior wall.
- UAV = Area-weighted average U-value of all above-grade wall assemblies.
- UAV = Sum of the (UA Proposed) values for each vertical glazing assembly.
- UV = UAV/total vertical glazing area.

When the proposed skylight area is less than or equal to the skylight area allowed by Section C402.1.1, the value of E (Excess Skylight Value) shall be zero. Otherwise:

- E = (EA + US) - (EA + U Roof), but not less than zero.
- EA = (Proposed Skylight Area) - (Allowable Skylight Area as specified in Section C402.1.1).
- U-Roof = Area-weighted average U-value of all roof assemblies.
- UAS = Sum of the (UA Proposed) values for each skylight assembly.
- US = UAS/total skylight area.

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.

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.

Prescriptive approach

53

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 LS	R-25 + 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
Walls, below grade																
Below-grade wall ^c	NR	NR	NR	NR	NR	NR	R-7.5ci	R-10ci	R-7.5ci	R-10ci	R-10ci	R-15ci	R-15ci	R-15ci	R-15ci	R-15ci
Floors																
Mass ^d	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-14.6ci	R-16.7ci	R-14.6ci	R-16.7ci	R-16.7ci	R-20.9ci	R-20.9ci	R-20.9ci	R-23ci	R-23ci
Joist framing	R-13	R-13	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-38	R-38	R-38	R-38	R-38	R-38
Slab-on-grade floors																
Unheated slabs	NR	NR	NR	NR	NR	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below	R-20 for 24" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below	R-25 for 48" below
Heated slabs ^e	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 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-5.3ci 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 augmented cores filled with material having a maximum thermal conductivity of 0.44 Btu-in/ft²-h-R.

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.

54

2021 IECC Commercial – Tapered insulation

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.

C402.2.3 Floors. E-value or area assembly: over or shall be as follows:

“Main floor” where used as a component of the thermal envelope of a building shall provide one of the following weights:

1. 15 pounds per square foot (71 kg/m²) of floor surface area.
2. 27 pounds per square foot (122 kg/m²) of floor surface area where the structural member is not more than 120 inches (3048 mm) wide.

Exemptions:

1. The floor must (a) be a concrete slab on grade that meets or exceeds the minimum E-value in Table C402.1.3 for “Main Floor” or “Roof, Drains and Other” values for “Walls, above grade” and extends from the bottom to the top of all perimeter floor framing or floor assembly members;
2. Insulation applied to the underside of concrete floor slabs shall be permitted in an average of not more than 1 inch (25 mm) where it turns up and is in contact with the underside of the floor under walls associated with the building thermal envelope.

C402.2.4 Slabs on grade. The minimum thermal resistance (R-value) of the insulation for unheated or heated slab-on-grade floors designed in accordance with the E-value method of Section C402.1.3 shall be as specified in Table C402.1.3.

C402.2.4.1 Insulation installation. Where installed, the perimeter insulation shall extend downwards from the top of the slab for the minimum distance shown in the table or to the top of the footing, which ever is less, or downwards to not less than the bottom of the slab and then horizontally to the exterior or exterior face of the wall. Insulation extending over from the building shall be permitted by concrete or by not less than 10 inches (254 mm) of soil. Where installed, full slab insulation shall be continuous under the entire area of the slab-on-grade floor, except for structural columns and service penetrations. Insulation required at the heated slab perimeter shall not be required to extend below the bottom of the heated slab and shall be continuous with the full slab insulation.

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

C402.2.5 Below grade walls. The C-factor for the below-grade exterior walls shall be in accordance with Table C402.1.4. The E-value of the insulating material installed continuously outside or on the below-grade exterior walls of the building envelope shall be in accordance with Table C402.1.3. The C-factor or E-value required shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space indicated by the below-grade wall, whichever is less.

C402.2.6 Foundation of radiant heating systems. Radiant heating system panels, and their associated components that are installed in interior or exterior assemblies, shall be installed to an E-value of not less than R-5.0 on all surfaces not facing the space being heated. Radiant heating system panels that are installed in the building thermal envelope shall be separated from the exterior of the building or unconditioned or exempt spaces by not less than the E-value of insulation installed in the space assembly in which they are installed or the assembly shall comply with Section C402.1.4.

Exception: Heated slabs on grade installed in accordance with Section C402.2.4.

C402.2.7 Airspaces. Where the E-value of an airspace is used for compliance in accordance with Section C402.1, the airspace shall be enclosed in an unventilated cavity constructed in a manner, surface area and out of the enclosed airspace. Airflow shall be deemed minimized where the enclosed airspace is formed on the exterior side of the continuous air barrier and is bonded on all sides by building components.

Exception: The thermal resistance of airspaces located on the exterior side of the continuous air barrier and adjacent to, and behind the exterior wall-covering material shall be determined in accordance with ASTM C1345 modified with an airflow entering the bottom and exiting the top of the airspace or as an unventilated cavity of not less than 75 mm (3 inch) depth.

C402.3 Roof solar reflectance and thermal emittance. Low-sloped roofs shall have uncoated conditioned spaces in Climate Zones 3 through 7 shall comply with one or more of the options in Table C402.3.

Exception: The following roofs and portions of roofs are exempt from the requirements of Table C402.3:

1. Portions of the roof that article or are covered by the following:
 - 1.1. Photovoltaic systems or components;

“...average thickness...”

“...not less than 1 inch...”

ICC 2021 Commercial – Roof Reflectivity

TABLE C402.3 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS^a

Three-year-aged solar reflectance index^b of 55 and 3-year aged thermal emittance^c of 0.75

Three-year-aged solar reflectance index^d of 64

- The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for either solar reflectance or thermal emittance shall be assigned both a 3-year-aged solar reflectance in accordance with Section C402.3.1 and a 3-year-aged thermal emittance of 0.90.
- Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.
- Aged thermal emittance tested in accordance with ASTM C1371 or ASTM E408 or CRRC-S100.
- Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × ft² × °F (12 W/m² × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance.

C402.4 Fenestration. Fenestration shall comply with Sections C402.1.1 through C402.4.3 and Table C402.4. Daylight responsive controls shall comply with the section and Section C402.4.4.

C402.5 Roof solar reflectance and thermal emittance. Low-sloped roofs shall have uncoated conditioned spaces in Climate Zones 3 through 7 shall comply with one or more of the options in Table C402.3.

Exception: The following roofs and portions of roofs are exempt from the requirements of Table C402.3:

1. Portions of the roof that article or are covered by the following:
 - 1.1. Photovoltaic systems or components;

IECC 2021 Commercial – Air Retarders

COMMERCIAL ENDS

Daylight means daylight solar +

C402.4.5.1 Design, with Table C402 comply with 12. Considered as part of doors shall +

C402.4.5.2 One of Section C402

C402.4.5.1.1 C and doors that with a single by 1/2-inch Zone 3 three Climate Zone area is not be percent of the

Exception: pervious fenestration

C402.5 Air leakage shall Section C402.5.1.1 be tested in accordance with Section C402.5.2

C402.5.1 Air be provided through continuous air to outside of the building with Section C4

Exception: as located in C4

C402.5.1.1 A air barrier is following:

- The +
- Air is
- Masonry walls
- A finished

COMMERCIAL ENERGY EFFICIENCY

code official. The measured air leakage shall not exceed 0.40 cfm/ft² (0.0 L/s + m²) of the building thermal envelope area at a pressure differential of 0.1 inch water gauge (7.5 Pa). Alternatively, portions of the building shall be tested and the measured air leakage shall be area weighted by the surface area of the building envelope in each portion. The weighted average air leakage shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be tested:

- The entire envelope area of all rooms that have air space directly under a roof.
- The entire envelope area of all rooms that have a building entrance, exposed floor, or loading dock, or are below grade.
- Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the conditioned space.

Exception: Where the measured air leakage rate exceeds 0.40 cfm/ft² (0.0 L/s + m²) but does not exceed 0.60 cfm/ft² (0.1 L/s + m²), a diagnostic evaluation using smoke tracer or infrared imaging shall be conducted while the building is pressurized along with a visual inspection of the air barrier. Any leaks noted shall be sealed where visible sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section.

C402.5.4 Air leakage of fenestration. The air leakage of fenestration assemblies shall meet the provisions of Table C402.5.4. Testing shall be in accordance with the applica-

ble reference test standard in Table C402.5.4 by an accredited, independent testing laboratory and labeled by the manufacturer.

Exception:

- Field-fabricated fenestration assemblies that are sealed in accordance with Section C402.5.1.1
- Fenestration in buildings that comply with the testing alternative of Section C402.5 are not required to meet the air leakage requirements in Table C402.5.4.

C402.5.5 Rooms containing fuel-burning appliances. In Climate Zones 3 through 8, where combustion air is supplied through openings in an exterior wall, a room or space containing a space-conditioning fuel-burning appliance, one of the following shall apply:

- The room or space containing the appliance shall be located outside of the building thermal envelope.
- The room or space containing the appliance shall be enclosed and isolated from conditioned spaces inside the building thermal envelope. Such rooms shall comply with all of the following:
 - The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be sealed to be not less than required by the minimum requirement of below-grade walls as specified in Table C402.3.3 or Table C402.1.4.
 - The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be sealed in accordance with Section C402.5.1.1.

TABLE C402.5.4
MAXIMUM AIR LEAKAGE RATE FOR FENESTRATION ASSEMBLIES

FENESTRATION ASSEMBLY	MAXIMUM RATE (CFM/FT ²)	TEST PROCEDURE
Windows	0.20*	ANSI/NFPA 1951 or U.S. 2-AHG or NFRC 400
Sliding doors	0.20*	
Swinging doors	0.20*	
Partitions with condensation wedge openings	0.20*	
Skylights—all other	0.20*	
Canopy walls	0.05	
Fenestration glazing	0.05	NFRC 400 or ASTM E283 at 1.57 psf (75 Pa)
Commercial glazed swinging entrance doors	1.00	
Permanently tilted doors and power-operated sliding doors	1.00	ANSI/DINMA 105, NFRC 400, or ASTM E283 at 1.57 psf (75 Pa)
Rolling doors	1.00	
Garage doors	4.00	
Rolling doors	1.00	
High-speed doors	1.30	

* In 1/2 inch per square = 0.07 L/s, 1 square foot = 0.093 sq ft.
 † The maximum rate for windows, sliding and swinging doors, and skylights is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with ANSI/NFPA 1951, U.S. 2-AHG or U.S. 2-PHG (75 Pa).

57

IECC 2021 Commercial-- Reroofing

EXISTING BUILDINGS

C402.1.1 The addition shall comply with Section C402.1.3, C402.4.3 or C407

2. Where an addition with vertical fenestration that results in a total building fenestration area greater than Section C402.4.1 or an addition that exceeds the fenestration area greater than that permitted by Section C402.4.1, the fenestration shall comply with Section C402.4.1.3 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 C402.4.1.1, the addition shall comply with Section C402.1.3 or C407

C402.3.2 Skylight area. Skylights shall comply with the following:

- Where an addition has new skylight area that results in a total building fenestration area less than or equal to that permitted by Section C402.4.1, the addition shall comply with Section C402.1.3 or C407
- Where an addition has new skylight area that results in a total building skylight area greater than permitted by Section C402.4.1 or where additions have skylight area greater than that permitted by Section C402.4.1, the skylight area shall comply with Section C402.4.1.2 for the addition only.
- Where an addition has skylight area that results in a total building skylight area exceeding that permitted by Section C402.4.1.2, the addition shall comply with Section C402.1.3 or C407

C402.3.3 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 C403 and C408.

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 C403 and C408.

C402.3.6.1 Interior lighting power. The total interior lighting power for the addition shall comply with Section C402.3.2 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 C402.3.2 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 conditioned to the provisions of this code than the existing building or structure was prior to the alteration. Alternatively, an existing building, building system, or portion thereof shall conform to the provisions of this code or those portions related to new construction without requiring the unaltered portions of the existing building or building system to comply with this code. Alternatively, shall not create an unsafe or hazardous condition or overload 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:

- Storm windows installed over existing fenestration.
- Surface-applied window films installed on existing single-pane fenestration assemblies reducing solar heat gain, provided that the code does not require the glazing or fenestration to be replaced.
- Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.
- Construction where the existing roof, wall or floor cavity is not exposed.
- Roof repairs.
- Air barriers shall not be required for roof/ceiling and roof/interior walls for alterations or renovations to the building do not include abatement, restoration or repairs to the remainder of the building assembly.

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.

58

ICC has changed its development process for future editions of the IECC to their standard development process.

59



60

IEBC 2021 -- Reroofing

CHAPTER 7 ALTERATIONS—LEVEL 1

User note:
 About this chapter: Chapter 7 provides the technical requirements for those existing buildings that undergo Level 1 alterations as described in Section 602, which includes replacement or covering of existing materials, elements, equipment or fixtures using like materials for the same purpose. This chapter, similar to other chapters of this code, covers all building-related subjects, such as structural, mechanical, plumbing, electrical and accessibility as well as the fire and life safety issues when the alterations are classified as Level 1. The purpose of this chapter is to provide detailed requirements and provisions to identify the required improvements in the existing building element, building system and building structural system. This chapter is distinguished from Chapters 8 and 9 by involving only replacement of building components with new components. In contrast, Level 2 alterations involve more space reconfiguration, and Level 3 alterations involve more extensive space reconfiguration, exceeding 50 percent of the building area.

**SECTION 701
GENERAL**

***701.1 Scope.** Level 1 alterations as described in Section 602 shall comply with the requirements of this chapter. Level 1 alterations to historic buildings shall comply with this chapter, except as modified in Chapter 12.

***701.2 Conference.** An existing building or portion thereof shall not be altered such that the building becomes less safe than its existing condition.

Exception: Where the current level of safety or condition is proposed to be reduced, the portion altered shall conform to the requirements of the International Building Code.

[B5] *701.3 Flood hazard areas. In flood hazard areas, alterations that require substantial improvement shall require that the building comply with Section 612 of the International Building Code or Section 5122 of the International Residential Code, as applicable.

**SECTION 702
BUILDING ELEMENTS AND MATERIALS**

***702.1 Interior finishes.** Newly installed interior wall and ceiling finishes shall comply with Chapter 8 of the International Building Code.

***702.2 Interior floor finish.** New interior floor finish, including new carpeting used as an interior floor finish material, shall comply with Section 804 of the International Building Code.

***702.3 Interior trim.** Newly installed interior trim materials shall comply with Section 806 of the International Building Code.

***702.4 Window opening control devices on replacement windows.** In Group R-2 or R-3 buildings containing dwelling units and one- and two-family dwellings and townhouses regulated by the International Residential Code, window opening control devices complying with ASTM F2090 shall be installed when an existing window is replaced and when all of the following apply to the replacement window:

1. The window is operable.
2. One of the following applies:
 - 2.1. The window replacement includes replacement of the sash and frame.
 - 2.2. The window replacement includes the sash only when the existing frame remains.
3. One of the following applies:
 - 3.1. In Group R-2 or R-3 buildings containing dwelling units, the bottom of the clear opening of the window opening is at a height less than 36 inches (915 mm) above the finished floor.
 - 3.2. In one- and two-family dwellings and townhouses regulated by the International Residential Code, the bottom of the clear opening of the window opening is at a height less than 24 inches (610 mm) above the finished floor.
4. The window will permit openings that will allow passage of a 4-inch-diameter (102 mm) sphere when the window is in its largest opened position.
5. The vertical distance from the bottom of the clear opening of the window opening to the finished grade or other surface below, on the exterior of the building, is greater than 72 inches (1829 mm).

Exception: Operable windows where the bottom of the clear opening of the window opening is located more than 75 feet (22 800 mm) above the finished grade or other surface below, on the exterior of the room, space or building, and that are provided with window fall prevention devices that comply with ASTM F2096.

***702.5 Replacement window for emergency escape and rescue openings.** Where windows are required to provide emergency escape and rescue openings in Group R-2 and R-3 occupancies and one- and two-family dwellings and townhouses regulated by the International Residential Code, replacement windows shall be exempt from the requirements of Section 702.4.

61

ALTERATIONS—LEVEL 1

of Section 1011.3 of the International Building Code and Section 2310.2 of the International Residential Code, provided that the replacement window meets the following conditions:

1. The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening.
2. Where the replacement window is part of a change of occupancy it shall comply with Section 1011.5.6.

***702.5.1 Control devices.** Window opening control devices or fall prevention devices complying with ASTM F2090 shall be permitted for use on windows required to provide emergency escape and rescue openings. After operation to release the control device allowing the window to fully open, the control device shall not reduce the net clear opening area of the window unit. Emergency escape and rescue openings shall be operational from the inside of the room without the use of keys or tools.

***702.6 Bars, grilles, covers or screens.** Bars, grilles, covers, screens or similar devices are permitted to be placed over emergency escape and rescue openings, built-in enclosures or window wells that serve such openings, provided all of the following conditions are met:

1. The minimum net clear opening size complies with the code that was in effect at the time of construction.
2. Such devices shall be releasable or removable from the inside without the use of a key, tool or force greater than that which is required for normal operation of the escape and rescue opening.
3. Where such devices are installed, they shall not reduce the net clear opening of the emergency escape and rescue opening.
4. Smoke alarms shall be installed in accordance with Section 907.1.1.1 of the International Building Code.

***702.7 Materials and methods.** New materials and methods required by the International Building Code, International Existing Building Code, International Fire Code and International Fuel Gas Code, as applicable, that specify material standards, details of installation and construction, tests, precautions and consistency of any element, component or system in the building.

[FG] 702.7.1 International Fuel Gas Code. The following sections of the International Fuel Gas Code shall constitute the fuel gas materials and methods requirements for Level 1 alterations:

1. Chapter 3, entitled "General Regulations," except Sections 303.7 and 306.
2. Chapter 4, entitled "Gas Piping Installations," except Sections 401.9 and 402.2.
 - 2.1. Sections 401.8 and 402.3 shall apply where the work being performed increases the load on the system such that the existing pipe does not meet the size required by code. Existing systems that are modified shall not require reventing as long as the load on the system is not increased and the system length is not increased even if the altered system does not meet code requirements.
3. Chapter 5, entitled "Chimneys and Vents."
4. Chapter 6, entitled "Specific Appliances."

**SECTION 703
FIRE PROTECTION**

***703.1 General.** Alterations shall be done in a manner that maintains the level of fire protection provided.

**SECTION 704
MEANS OF EGRESS**

***704.1 General.** Alterations shall be done in a manner that maintains the level of protection provided for the means of egress.

***704.1.1 Projections in sleeping home corridors.** In Group I-2, Condition 1 occupancies, where the corridor is at least 96 inches (2438 mm) wide, projections into the corridor width are permitted in accordance with Section 407.4.3 of the International Building Code.

***704.2 Casework.** Addition, alteration or reconfiguration of modified and movable cases, counters and partitions not over 5 feet 9 inches (1773 mm) in height shall maintain the required means of egress path.

***704.3 Locking arrangements in educational occupancies.** In Group E occupancies, Group B educational occupancies and Group I-4 occupancies, egress doors with locking arrangements designed to keep students from entering the room shall comply with Section 1010.2.8 of the International Building Code.

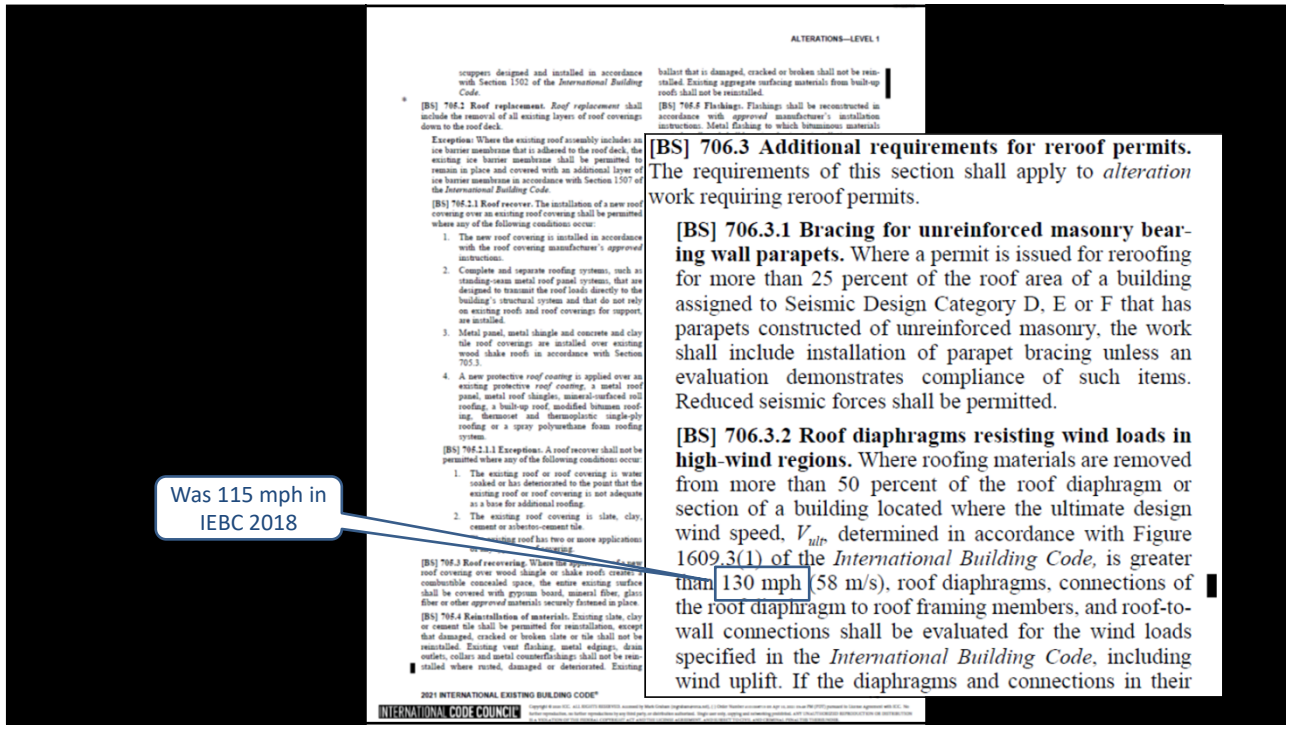
**SECTION 705
REROOFING**

[B5] 705.1 General. Materials and methods of application used for reroofing or replacing an existing roof covering shall comply with the requirements of Chapter 15 of the International Building Code.

Exception:

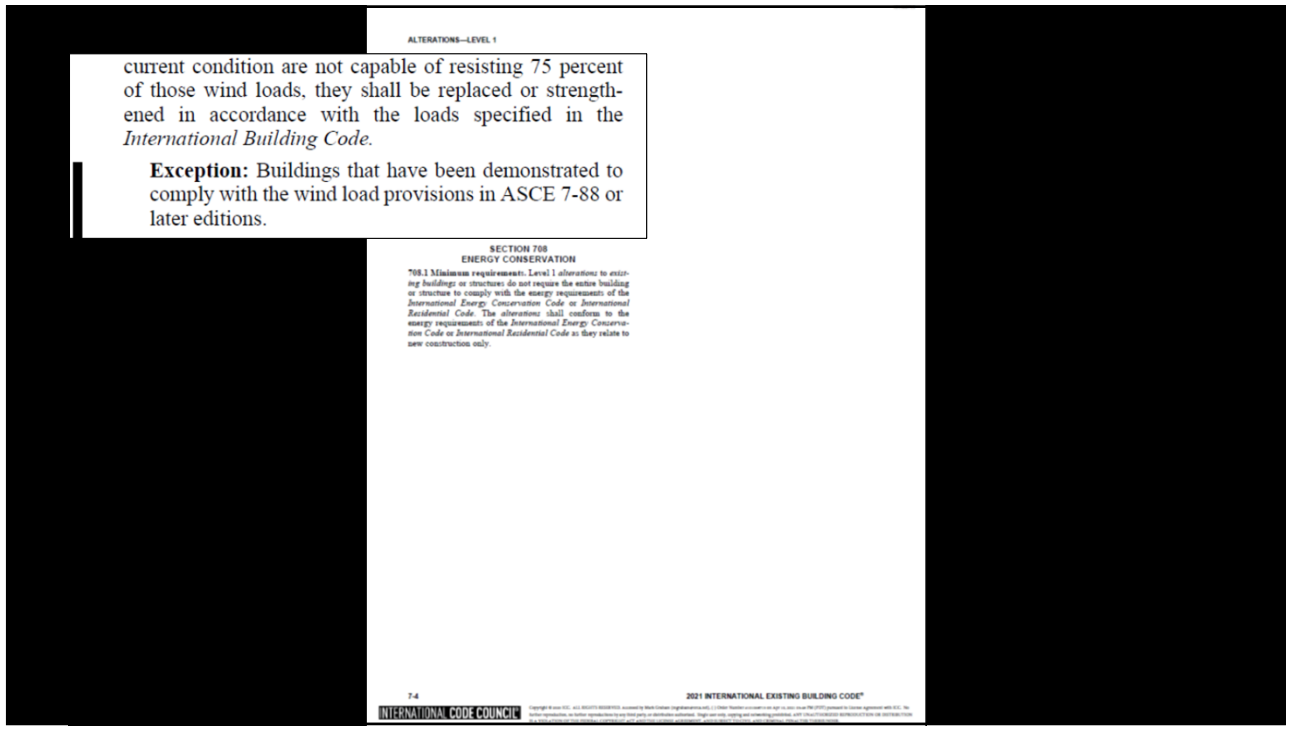
1. Roof replacement or roof rescue of existing low-slope roof coverings shall not be required to meet the minimum design slope requirement of 1/4" vertical in 12" horizontal (2 percent slope) in Section 1507 of the International Building Code for roofs that provide positive roof drainage.
2. Reroofing or replacing an existing roof covering shall not be required to meet the requirement for secondary (emergency overflow) drains or strainers in Section 1502 of the International Building Code for roofs that provide positive roof drainage. For the purpose of this exception, existing secondary drainage or strainer systems required in accordance with this code shall not be removed unless they are replaced by secondary drains or

62



Was 115 mph in IEBC 2018

[BS] 706.3.2 Roof diaphragms resisting wind loads in high-wind regions





International Fire Code, 2021 Edition

- Ch. 2-Definitions (torch-applied roof system)
- Sec. 303-Asphalt Kettle
- Sec. 317-Landscaped Roofs
- Sec. 905-Landscaped Roofs
- Sec. 3318-Safeguarding Roofing Operations

65

CHAPTER TOPICS

Parts and Chapters	Subjects
Part I—Chapters 1 and 2	Administrative and definitions
Part II—Chapters 3 and 4	General safety provisions
Part III—Chapters 5 through 12	Building and equipment design features
Part III—Chapters 13 through 19	Reserved for future use
Part IV—Chapters 20 through 40	Special occupancies and operations
Part IV—Chapters 41 through 49; 52	Reserved for future use
Part V—Chapters 50, 51 and 53 through 67	Hazardous materials
Part V—Chapters 68 through 79	Reserved for future use
Part VI—Chapter 80	Referenced standards
Part VII—Appendices A through N	Adoptable and informational appendices

66

raft shall not create an obstruction that is less than 7 feet (2133 mm) high above the surface of the roof.

Exceptions:

- Such obstruction shall be permitted where the wire, cable, rope, antenna or suspended obstruction is encased in a white, 2-inch (51 mm) minimum diameter plastic pipe or an approved equivalent.
- Such obstruction shall be permitted where there is a solid obstruction below such that accidentally walking into the wire, cable, rope, antenna or suspended obstruction is not possible.

316.5 Security device. Any security device or system that creates any medium that could obscure a means of egress in any building, structure or premises shall be prohibited.

316.6 Structures and outdoor storage underneath high-voltage transmission lines. Structures and outdoor storage underneath high-voltage transmission lines shall comply with Sections 316.6.1 and 316.6.2, respectively.

316.6.1 Structures. Structures shall not be constructed within the utility easement beneath high-voltage transmission lines.

Exception: Restrooms and unoccupied telecommunication structures of noncombustible construction less than 15 feet (4572 mm) in height.

316.6.2 Outdoor storage. Outdoor storage within the utility easement underneath high-voltage transmission lines shall be limited to noncombustible material. Storage of hazardous materials including, but not limited to, flammable and machine rooms, penthouses, skylights, roof vents, solar panels, antenna supports and building service equipment.

317.4 Vegetation. Vegetation shall be maintained in accordance with Sections 317.4.1 and 317.4.2.

317.4.1 Irrigation. Supplemental irrigation shall be provided to maintain levels of hydration necessary to keep green roof plants alive and to keep dry foliage to a minimum.

317.4.2 Dead foliage. Excess biomass, such as overgrown vegetation, leaves and other dead and decaying material, shall be removed at regular intervals not less than two times per year.

317.4.3 Maintenance plan. The fire code official is authorized to require a maintenance plan for vegetation placed on roofs due to the size of a landscaped roof, materials used or where a fire hazard exists to the building or exposures due to the lack of maintenance.

317.5 Maintenance equipment. Fueled equipment stored on roofs and used for the care and maintenance of vegetation on roofs shall be stored in accordance with Section 313.

SECTION 317 LANDSCAPED ROOFS

317.1 General. Landscaped roofs shall be installed and maintained in accordance with Sections 317.2 through 317.5 and Sections 1505 and 1507.16 of the *International Building Code*.

317.2 Landscaped roof size. Landscaped roof areas shall not exceed 15,625 square feet (1450 m²) in size for any single area with a maximum dimension of 125 feet (39 m) in length or width. A minimum 6-foot-wide (1.8 m) clearance consisting of a listed Class A roof assembly tested in accordance with ASTM E108 or UL 790 shall be provided between adjacent landscaped roof areas.

317.3 Rooftop structure and equipment clearance. For all vegetative roofs abutting combustible vertical surfaces, a Class A-rated roof system complying with ASTM E108 or UL 790 shall be achieved for a minimum 6-foot-wide (1829 mm) continuous border placed around rooftop structures and all rooftop equipment including, but not limited to, mechanical and machine rooms, penthouses, skylights, roof vents, solar panels, antenna supports and building service equipment.

317.4 Vegetation. Vegetation shall be maintained in accordance with Sections 317.4.1 and 317.4.2.

317.4.1 Irrigation. Supplemental irrigation shall be provided to maintain levels of hydration necessary to keep green roof plants alive and to keep dry foliage to a minimum.

317.4.2 Dead foliage. Excess biomass, such as overgrown vegetation, leaves and other dead and decaying material, shall be removed at regular intervals not less than two times per year.

317.4.3 Maintenance plan. The fire code official is authorized to require a maintenance plan for vegetation placed on roofs due to the size of a landscaped roof, materials used or where a fire hazard exists to the building or exposures due to the lack of maintenance.

317.5 Maintenance equipment. Fueled equipment stored on roofs and used for the care and maintenance of vegetation on roofs shall be stored in accordance with Section 313.

SECTION 319 MOBILE FOOD PREPARATION VEHICLES

319.1 General. Mobile food preparation vehicles that are equipped with appliances that produce smoke or grease-laden vapors shall comply with this section.

319.2 Permit required. Permits shall be required as set forth in Section 105.5.

319.3 Exhaust hood. Cooking equipment that produces grease-laden vapors shall be provided with a kitchen exhaust hood in accordance with Section 606.

319.4 Fire protection. Fire protection shall be provided in accordance with Sections 319.4.1 and 319.4.2.

319.4.1 Fire protection for cooking equipment. Cooking equipment shall be protected by automatic fire-extinguishing systems in accordance with Section 904.13.

SECTION 317 LANDSCAPED ROOFS

317.1 General. Landscaped roofs shall be installed and maintained in accordance with Sections 317.2 through 317.5 and Sections 1505 and 1507.16 of the *International Building Code*.

317.2 Landscaped roof size. Landscaped roof areas shall not exceed 15,625 square feet (1450 m²) in size for any single area with a maximum dimension of 125 feet (39 m) in length or width. A minimum 6-foot-wide (1.8 m) clearance consisting of a listed Class A roof assembly tested in accordance with ASTM E108 or UL 790 shall be provided between adjacent landscaped roof areas.

317.3 Rooftop structure and equipment clearance. For all vegetative roofs abutting combustible vertical surfaces, a Class A-rated roof system complying with ASTM E108 or UL 790 shall be achieved for a minimum 6-foot-wide (1829 mm) continuous border placed around rooftop structures and all rooftop equipment including, but not limited to, mechanical

SECTION 319 MOBILE FOOD PREPARATION VEHICLES

319.1 General. Mobile food preparation vehicles that are equipped with appliances that produce smoke or grease-laden vapors shall comply with this section.

319.2 Permit required. Permits shall be required as set forth in Section 105.5.

319.3 Exhaust hood. Cooking equipment that produces grease-laden vapors shall be provided with a kitchen exhaust hood in accordance with Section 606.

319.4 Fire protection. Fire protection shall be provided in accordance with Sections 319.4.1 and 319.4.2.

319.4.1 Fire protection for cooking equipment. Cooking equipment shall be protected by automatic fire-extinguishing systems in accordance with Section 904.13.

SECTION 317 LANDSCAPED ROOFS

317.1 General. Landscaped roofs shall be installed and maintained in accordance with Sections 317.2 through 317.5 and Sections 1505 and 1507.16 of the *International Building Code*.

317.2 Landscaped roof size. Landscaped roof areas shall not exceed 15,625 square feet (1450 m²) in size for any single area with a maximum dimension of 125 feet (39 m) in length or width. A minimum 6-foot-wide (1.8 m) clearance consisting of a listed Class A roof assembly tested in accordance with ASTM E108 or UL 790 shall be provided between adjacent landscaped roof areas.

317.3 Rooftop structure and equipment clearance. For all vegetative roofs abutting combustible vertical surfaces, a Class A-rated roof system complying with ASTM E108 or UL 790 shall be achieved for a minimum 6-foot-wide (1829 mm) continuous border placed around rooftop structures and all rooftop equipment including, but not limited to, mechanical

Vegetative Roofs

IFC 2021, Section 317-Landscaped Roofs

67

FIRE PROTECTION AND LIFE SAFETY SYSTEMS

4. At public entrances at the perimeter line of an open mall building.

5. At other locations as necessary so that the distance to reach all portions of a tenant space does not exceed 200 feet (60 960 mm) from a hose connection.

905.3.4 Stages. Stages greater than 1,000 square feet (93 071 m²) in area shall be equipped with a Class III wet standpipe system with 1 1/2-inch and 2 1/2-inch (38 mm and 64 mm) hose connections on each side of the stage.

Exception: Where the building or area is equipped throughout with an automatic sprinkler system, a 1 1/2-inch (38 mm) hose connection shall be installed in accordance with NFPA 13 or in accordance with NFPA 14 for Class II or III standpipes.

905.3.4.1 Hose and cabinet. The 1 1/2-inch (38 mm) hose connections shall be equipped with sufficient lengths of 1 1/2-inch (38 mm) hose to provide fire protection for the stage area. Hose connections shall be equipped with an approved adjustable fog nozzle and be mounted in a cabinet or on a rack.

905.3.5 Underground buildings. Underground buildings shall be equipped throughout with a Class I automatic wet or manual wet standpipe system.

905.3.6 Helistops and helipads. Buildings with a roof-top helistop or helipad shall be equipped with a Class I or III standpipe system extended to the roof level on which the helistop or helipad is located in accordance with Section 2007.5.

905.3.7 Marinas and boatyards. Standpipes in marinas.

905.3.8 Landscaped roofs. Buildings or structures that have landscaped roofs and that are equipped with a standpipe system shall have the standpipe system extended to the roof level on which the landscaped roof is located.

1. In every required interior exit stairway, a hose connection shall be provided for each story above and below grade plane. Hose connections shall be located at the main floor landing unless otherwise approved by the fire code official.

Exception: A single hose connection shall be permitted to be installed in the open corridor or open breezeway between open areas that are not greater than 75 feet (22 860 mm) apart.

2. On each side of the wall adjacent to the exit opening of a horizontal exit.

Exception: Where floor areas adjacent to a horizontal exit are reachable from an interior exit stairway hose connection by a 30-foot (9144 mm) hose stream from a nozzle attached to 100 feet (30 480 mm) of hose, a hose connection shall not be required at the horizontal exit.

3. In every exit passageway, at the entrance from the exit passageway to other areas of a building.

Exception: Where floor areas adjacent to an exit passageway are reachable from an interior exit stairway hose connection by a 30-foot (9144 mm) hose stream from a nozzle attached to 100 feet (30 480 mm) of hose, a hose connection shall not be required at the entrance from the exit passageway to other areas of the building.

4. In covered mall buildings, adjacent to each exterior public entrance to the mall and adjacent to each entrance from an exit passageway or exit corridor to the mall. In open mall buildings, adjacent to each public entrance to the mall at the perimeter line and adjacent to each entrance from an exit passageway or exit corridor to the mall.

5. Where the roof has a slope less than 4 units vertical in 12 units horizontal (33.3 percent slope), a hose connection shall be located to serve the roof or at the highest landing of an interior exit stairway with access to the roof provided in accordance with Section 1011.12.

6. Where the most remote portion of a nonparticled floor or story is more than 150 feet (45 720 mm) from a hose connection or the most remote portion of a sprinkled floor or story is more than 200 feet (60 960 mm) from a hose connection, the fire code official is authorized to require that additional hose connections be provided in approved locations.

905.4.1 Protection. Stairs and laterals of Class I standpipe systems not located within an interior exit stairway 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 interior exit stairway are not required to be enclosed within fire-resistance-rated construction.

905.4.2 Interconnection. In buildings where more than one standpipe is provided, the standpipes shall be interconnected in accordance with NFPA 14.

905.5 Location of Class II standpipe hose connections. Class II standpipe hose connections shall be located so that all portions of the building are within 30 feet (9144 mm) of a nozzle attached to 100 feet (30 480 mm) of hose. Class II standpipe hose connections shall be located where they have ready access.

905.5.1 Groups A-1 and A-2. In Group A-1 and A-2 occupancies with occupant loads of more than 1,000, hose connections shall be located on each side of any stage, on each side of the rear of the auditorium, on each side of the balcony and on each tier of dressing rooms.

905.5.2 Protection. Fire-resistance-rated protection of risers and laterals of Class II standpipe systems is not required.

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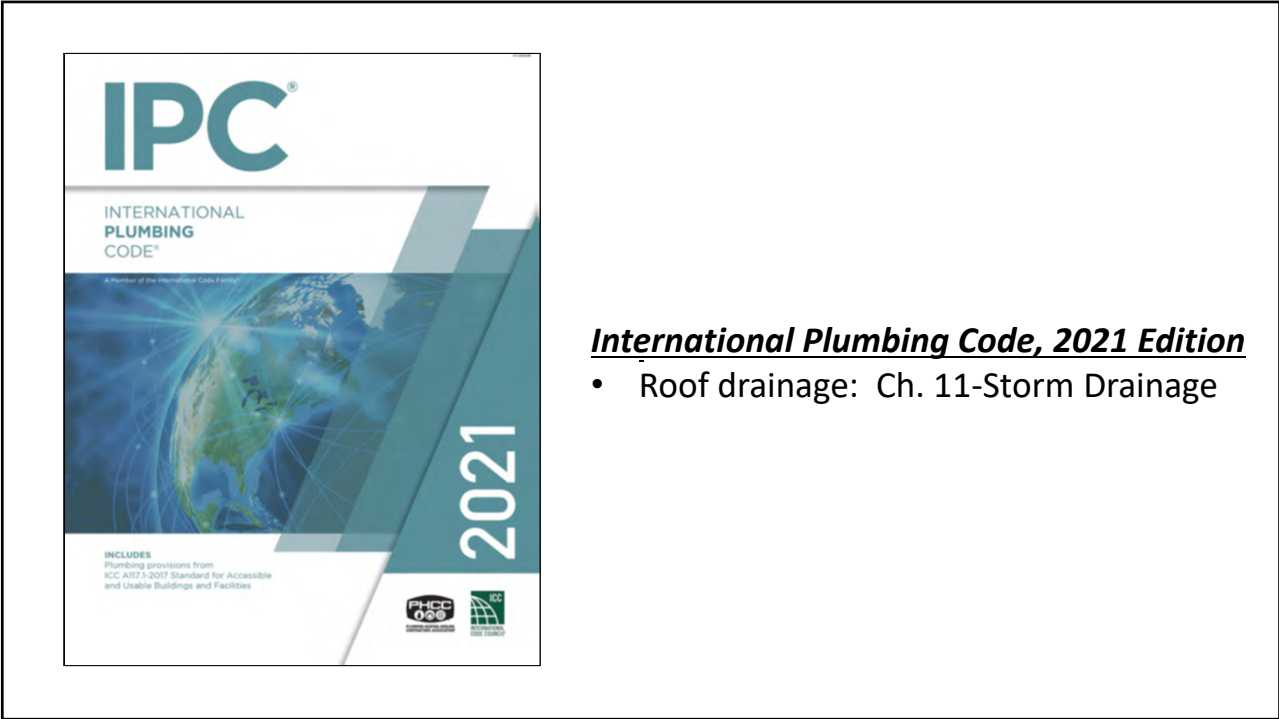
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9-47

Vegetative Roofs

IFC 2021, Section 905.3.8-Landscaped Roofs

68



International Plumbing Code, 2021 Edition

- Roof drainage: Ch. 11-Storm Drainage

69

STORM DRAINAGE

1102.5 Subsoil drain pipe. Subsoil drains shall be open-jointed, horizontally split or perforated pipe conforming to one of the standards listed in Table 1102.5.

MATERIAL	STANDARD
Cast iron pipe	ASTM A174, ASTM A888, CNSF 301
Polyethylene (PE) plastic pipe	ASTM F406, ASTM F1042, CSA B182.1, CSA B182.6, CSA B182.8
Polyvinyl chloride (PVC) plastic pipe (type sewer pipe, SDR35, PS25, PS50 or PS100)	ASTM D2728, ASTM D2001, ASTM F801, CSA B182.2, CSA B182.4
"Standard vent drainage" systems, Type 316L	ASME A112.3.1
Veriflow clay pipe	ASTM C4, ASTM C70

1102.6 Roof drains. Roof drains shall conform to ASME A112.3.1 or ASME A112.6.4. Roof drains, other than siphonic roof drains, shall be tested and rated in accordance with ASME A112.6.4 or ASPE/APMO Z1034.

ducts capable of retarding or obstructing flow in the piping. Threaded drainage pipe fittings shall be of the recessed drainage type.

SECTION 1103 TRAPS

1103.1 Main trap. Leaders and storm drains connected to a combined sewer shall be trapped. Individual storm water traps shall be installed on the storm water drain branch serving each conductor, or a single trap shall be installed in the main storm drain just before its connecting with the combined building sewer or the public sewer. Leaders and storm drains connected to a building storm sewer shall not be required to be trapped.

1103.2 Material. Storm water traps shall be of the same material as the piping system to which they are attached.

1103.3 Size. Traps for individual conductors shall be the same size as the horizontal drain to which they are connected.

1103.4 Cleanout. A cleanout shall be installed on the building side of the trap and shall be provided with access.

SECTION 1104 CONDUCTORS AND CONNECTIONS

1104.1 Prohibited use. Conductor pipes shall not be used as soil, waste or vent pipes, and soil, waste or vent pipes shall not be used as conductors.

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic	ASTM D2661, ASTM D3311, CSA B181.1
Cast iron	ASME B18.4, ASME B18.12, ASTM A74, ASTM A888, CNSF 301
Controlled composite ABS and drain DR-PS in PS25, PS50, PS100, PS140, PS200	ASTM D2751
Controlled composite ABS DWV Schedule 40 IPS pipe (solid or cellular core)	ASTM D2661, ASTM D3311, ASTM F428
Controlled composite PVC DWV Schedule 40 IPS DR, PS140, PS200 (solid or cellular core)	ASTM D2661, ASTM D3311, ASTM F801
Controlled composite PVC sewer and drain DR-PS in PS25, PS50, PS100, PS140, PS200	ASTM D3034
Copper or copper alloy	ASME B18.15, ASME B18.18, ASME B18.21, ASME B18.25, ASME B18.29
Gray iron and ductile iron	AWWA C110/A21.10
Malleable iron	ASME B18.3
Plastic, general	ASTM F409
Polyethylene (PE) plastic pipe	ASTM F2369/F2369M
Polyvinyl chloride (PVC) plastic	ASTM D2661, ASTM D3311, ASTM F1866
Stainless steel drainage systems, Type 316L	ASME A112.3.1
Steel	ASME B18.9, ASME B18.11, ASME B18.28

1104.2 Floor drains. Floor drains shall not be connected to a storm drain.

SECTION 1105 ROOF DRAINS

1105.1 General. Roof drains shall be installed in accordance with the manufacturer's instructions. The inside opening for the roof drain shall not be obstructed by the roofing membrane material.

1105.2 Roof drain flow rate. The published roof drain flow rate, based on the head of water above the roof drain, shall be used to size the storm drainage system in accordance with Section 1106. The flow rate used for sizing the storm drainage piping shall be based on the maximum anticipated ponding at the roof drain.

11-2
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70

STORM DRAINAGE

**SECTION 1106
SIZE OF CONDUCTORS,
LEADERS AND STORM DRAINS**

1106.1 General. The size of the vertical conductors and leaders, building storm drains, building storm sewers and any horizontal branches of such drains or sewers shall be based on the 100-year hourly rainfall rate indicated in Figures 1106.1(1) through 1106.1(5) or on other rainfall rates determined from approved local weather data.

1106.2 Size of storm drain piping. Vertical and horizontal storm drain piping shall be sized based on the flow rate through the roof drain. The flow rate, as calculated in accordance with Section 1106.2.1, shall be checked against the roof drain manufacturer's published flow rate for the specific roof drain model and size to verify that the selected roof drain will handle the anticipated flow. The flow rate in storm drain piping shall not exceed that specified in Table 1106.2.

1106.2.1 Rainfall rate conversion method. The rainfall rate falling on a roof surface shall be converted to a gallon per minute (L/m) flow rate in accordance with Equation 11-1.

$$GPM = R \times A \times 0.0104 \quad \text{(Equation 11-1)}$$

where:
 R = Rainfall intensity in inches (mm) per hour.
 A = Roof area in square feet (m²).

1106.5 Parapet wall scuppers. Where scuppers are used for primary roof drainage or for secondary (emergency overflow) roof drainage or both, the quantity, size, location and inlet elevation of the scuppers shall be chosen to prevent the depth of ponding water on the roof from exceeding the maximum water depth that the roof was designed for as determined by Section 1611.1 of the International Building Code. Scupper openings shall be not less than 4 inches (102 mm) in height and have a width that is equal to or greater than the circumference of a roof drain sized for the same roof area. The flow through the primary system shall not be considered when locating and sizing secondary scuppers.

**TABLE 1106.3
VERTICAL LEADER SIZING**

SIZE OF LEADER (inches)	CAPACITY (gpm)
2	30
2 x 2	30
1 1/2 x 2 1/2	30
2 1/2	54
2 1/2 x 2 1/2	54
3	92
2 x 4	92
2 1/2 x 3	92
4	192
2 x 4 1/2	192
2 1/2 x 4	192
5	360
4 x 5	360
4 1/2 x 4 1/2	360
6	563
5 x 6	563
5 1/2 x 5 1/2	563
8	1208
6 x 8	1208

For SI: 1 inch = 25.4 mm, 1 gallon per minute = 3.785 L/m.

**TABLE 1106.2
STORM DRAIN PIPE SIZING**

PIPE SIZE (inches)	VERTICAL DRAIN	CAPACITY (gpm)			
		SLOPE OF HORIZONTAL DRAIN			
		1/8 inch per foot	1/4 inch per foot	1/2 inch per foot	3/4 inch per foot
2	31	15	22	31	44
3	87	39	56	79	111
4	180	81	115	163	231
5	311	117	165	234	331
6	538	243	344	487	689
8	1,117	505	714	1,019	1,429
10	2,050	927	1,311	1,855	2,623
12	3,272	1,480	2,093	2,960	4,187
15	5,543	2,508	3,546	5,016	7,093

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 gallon per minute = 3.785 L/m.

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71

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

72



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73

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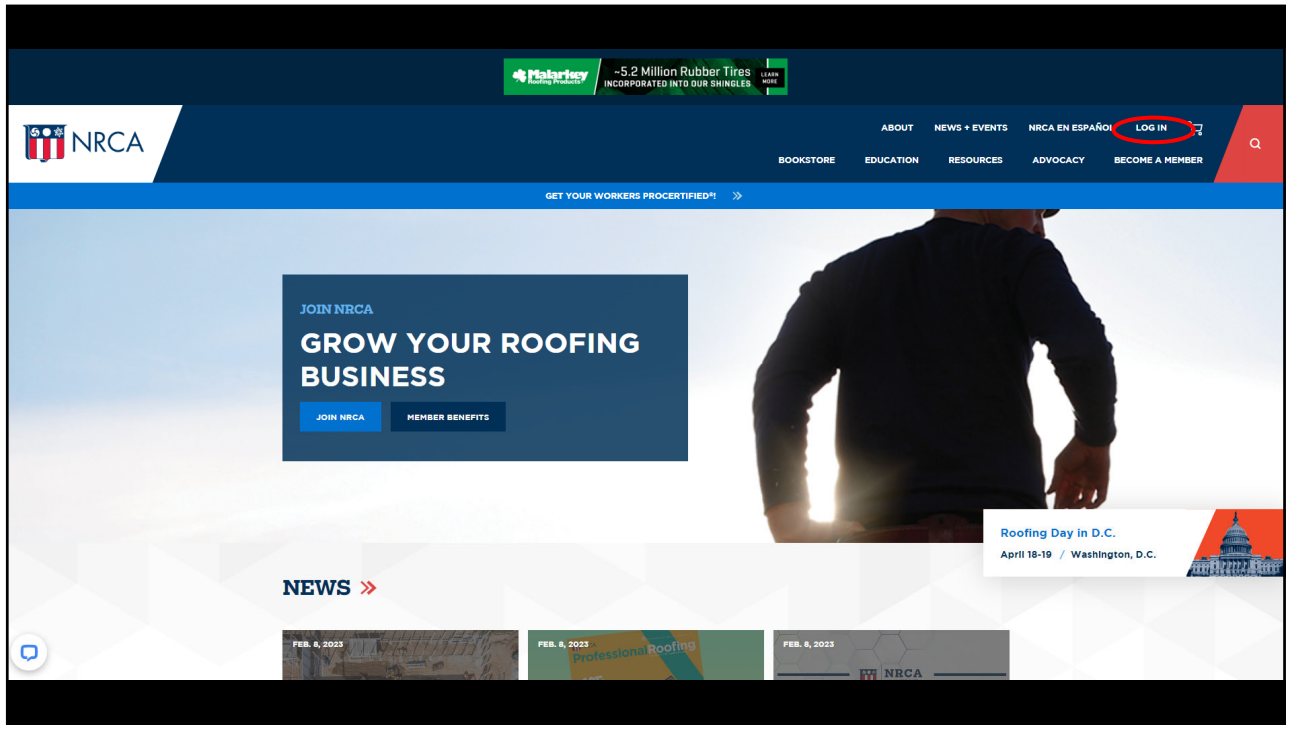
74



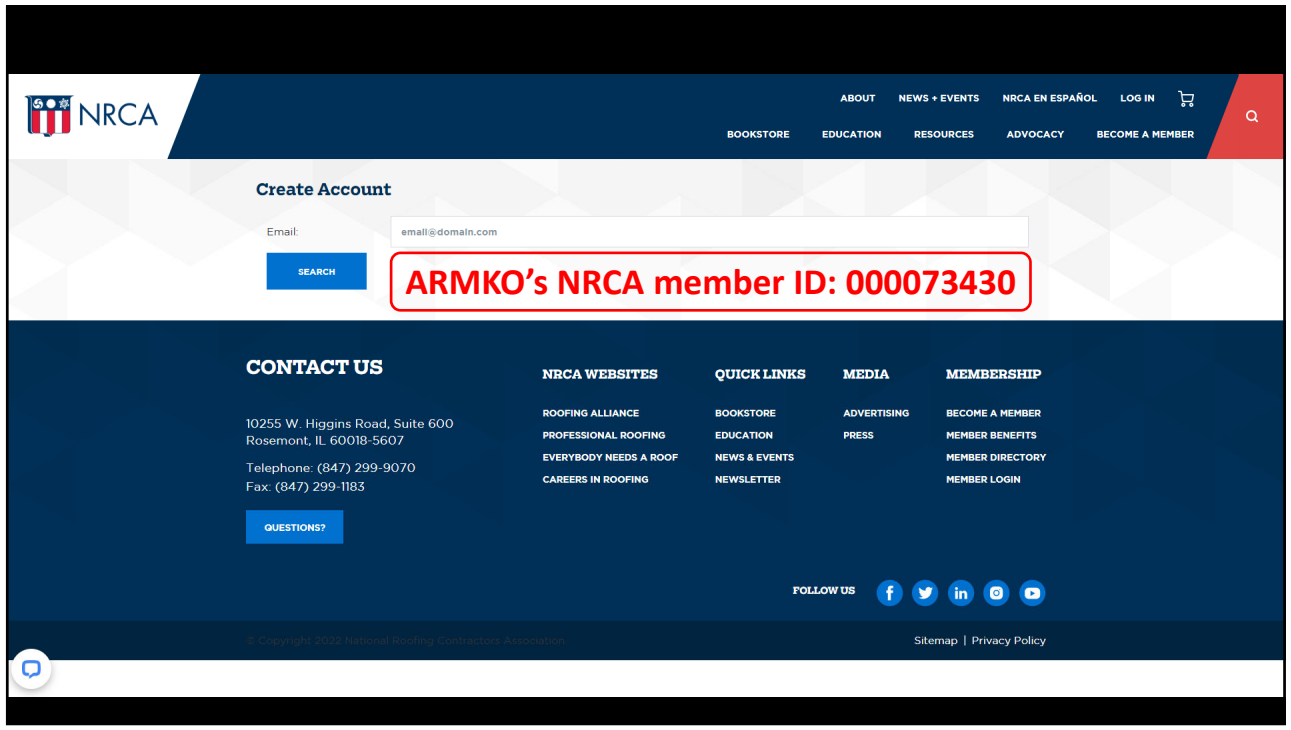
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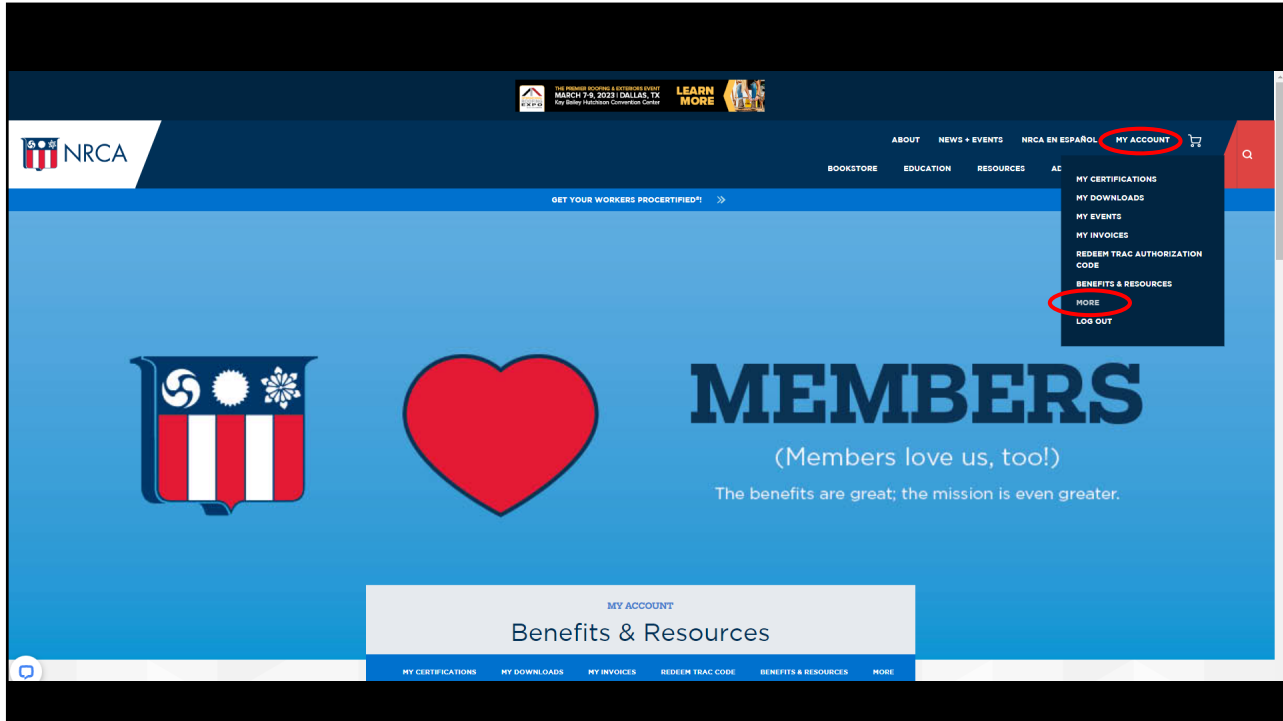
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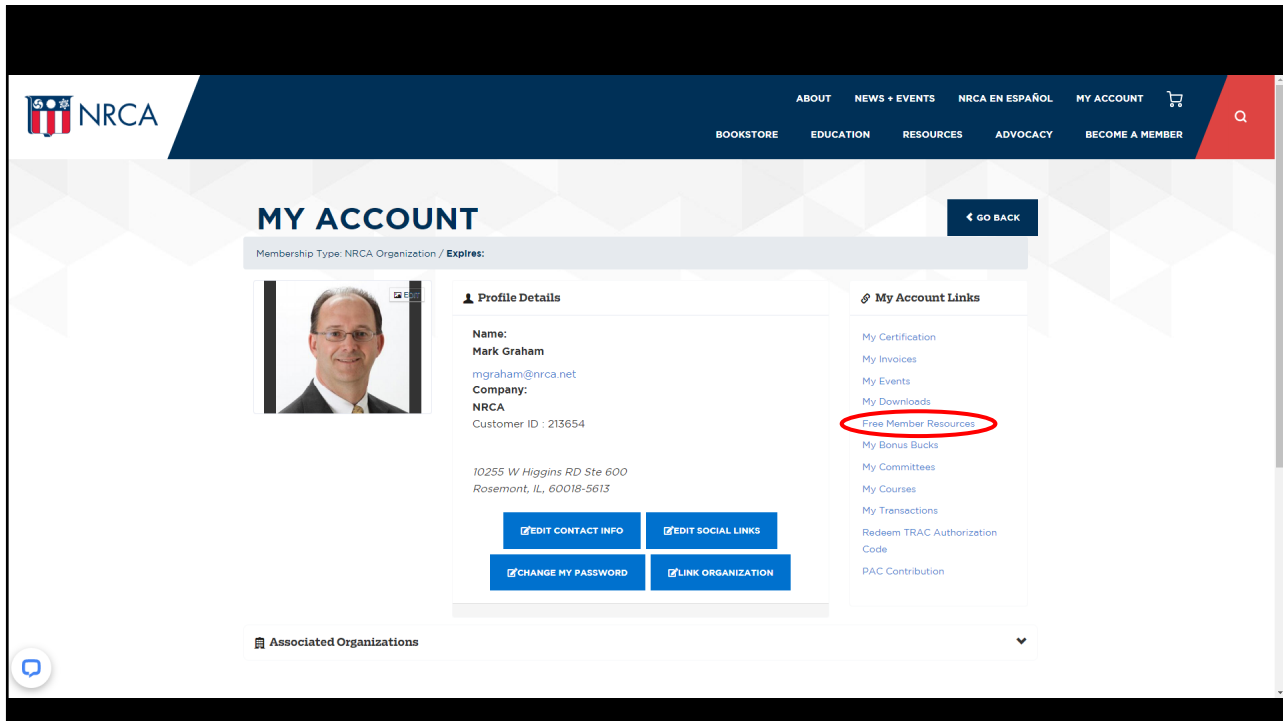
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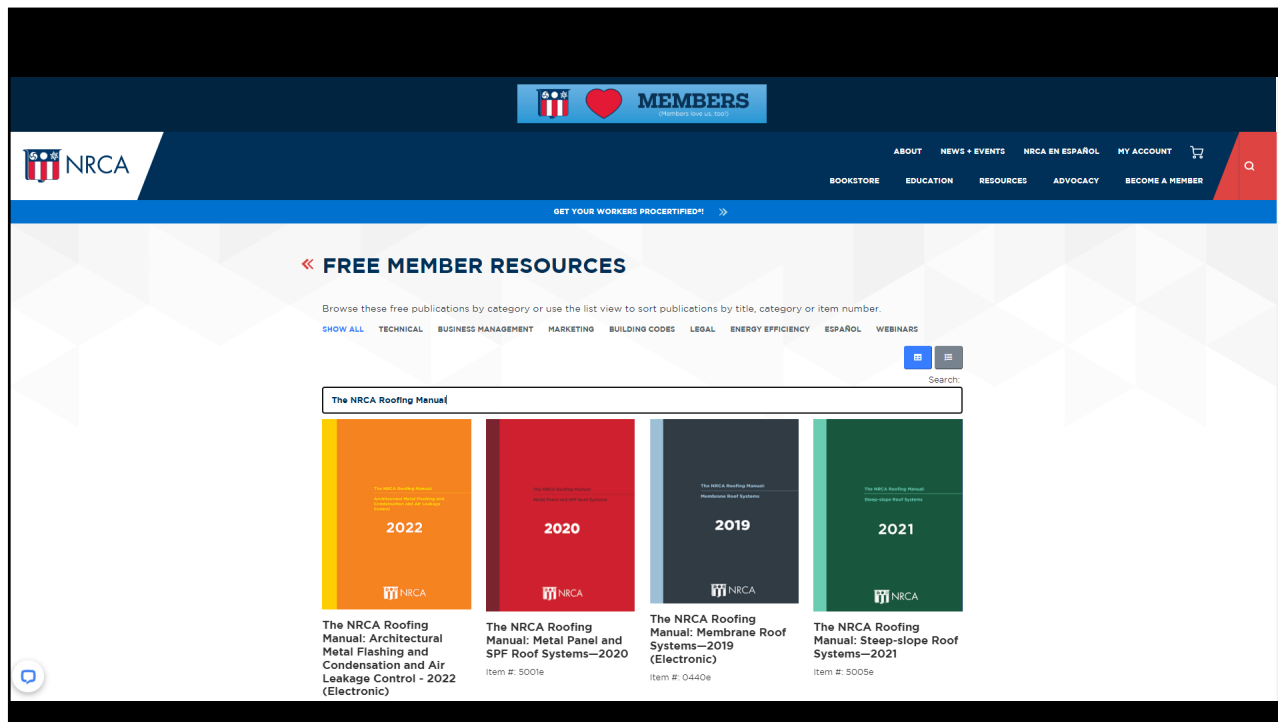
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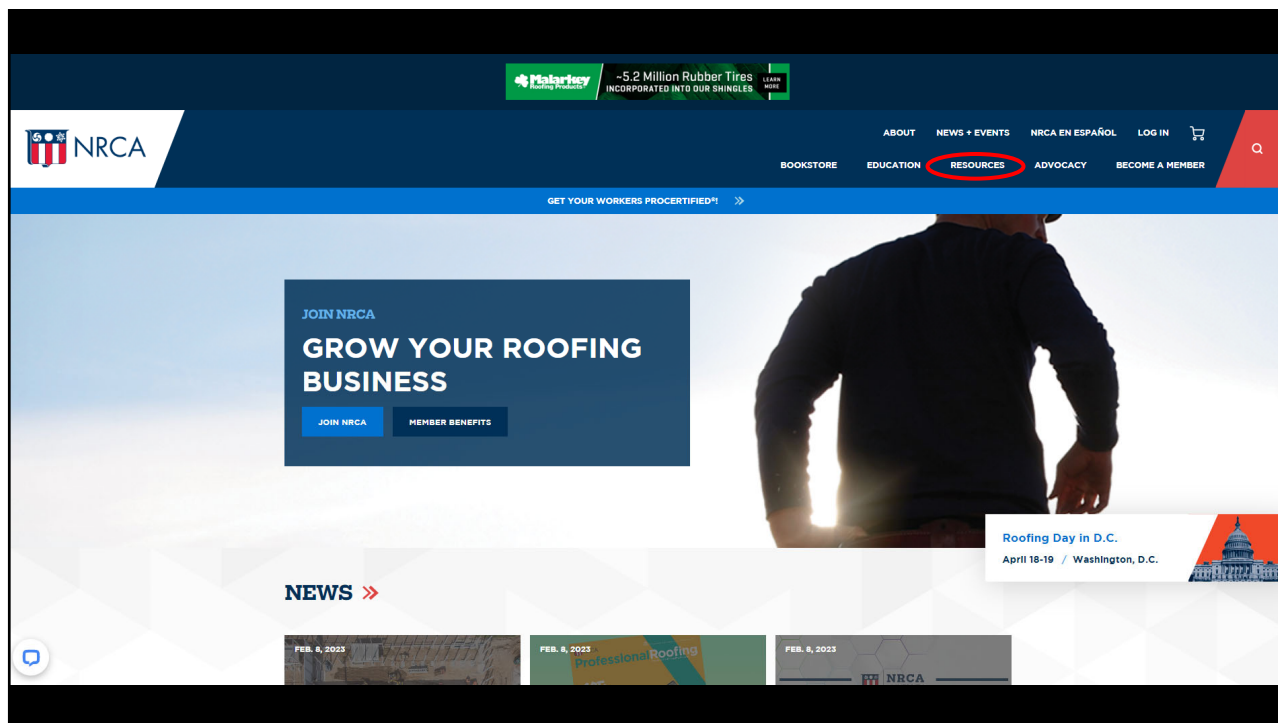
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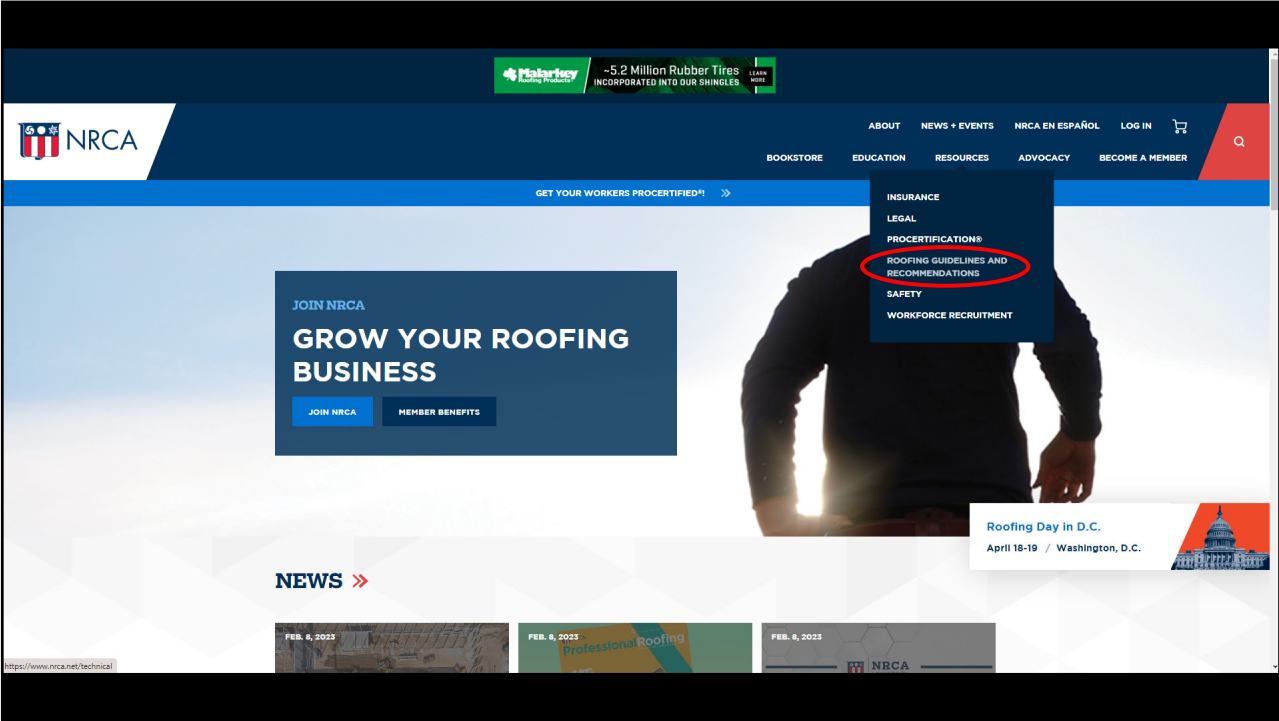
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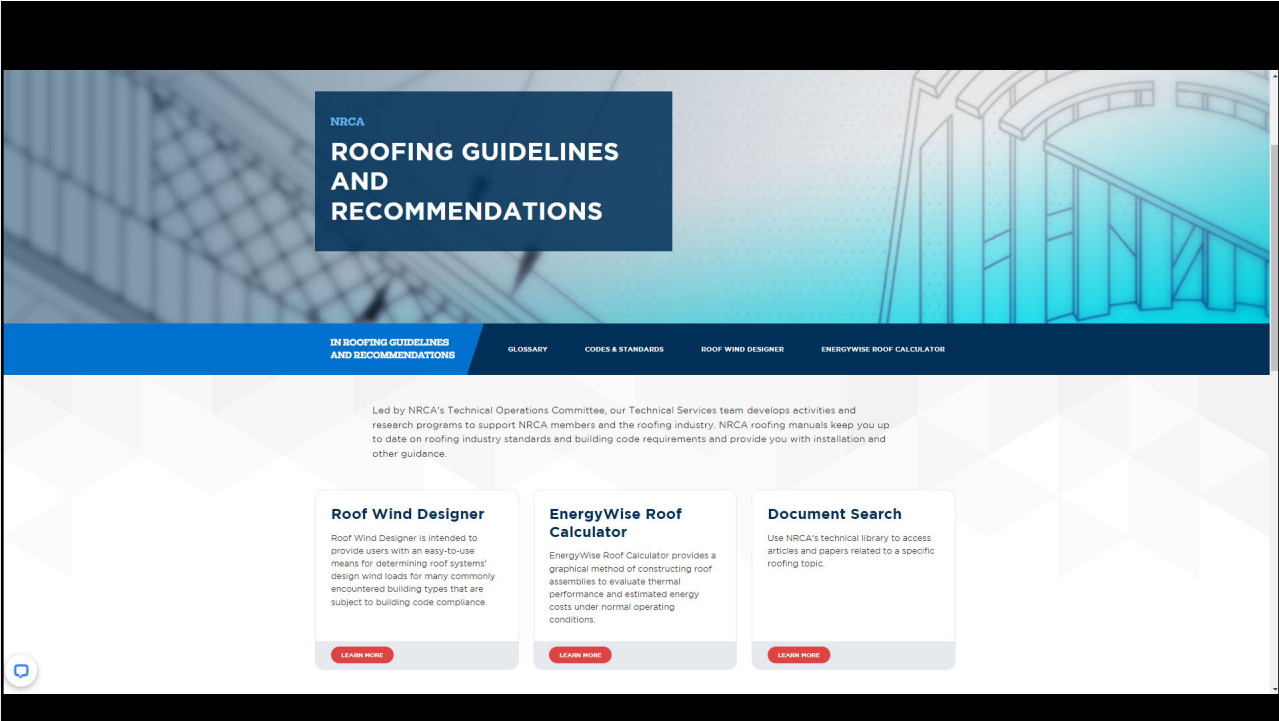
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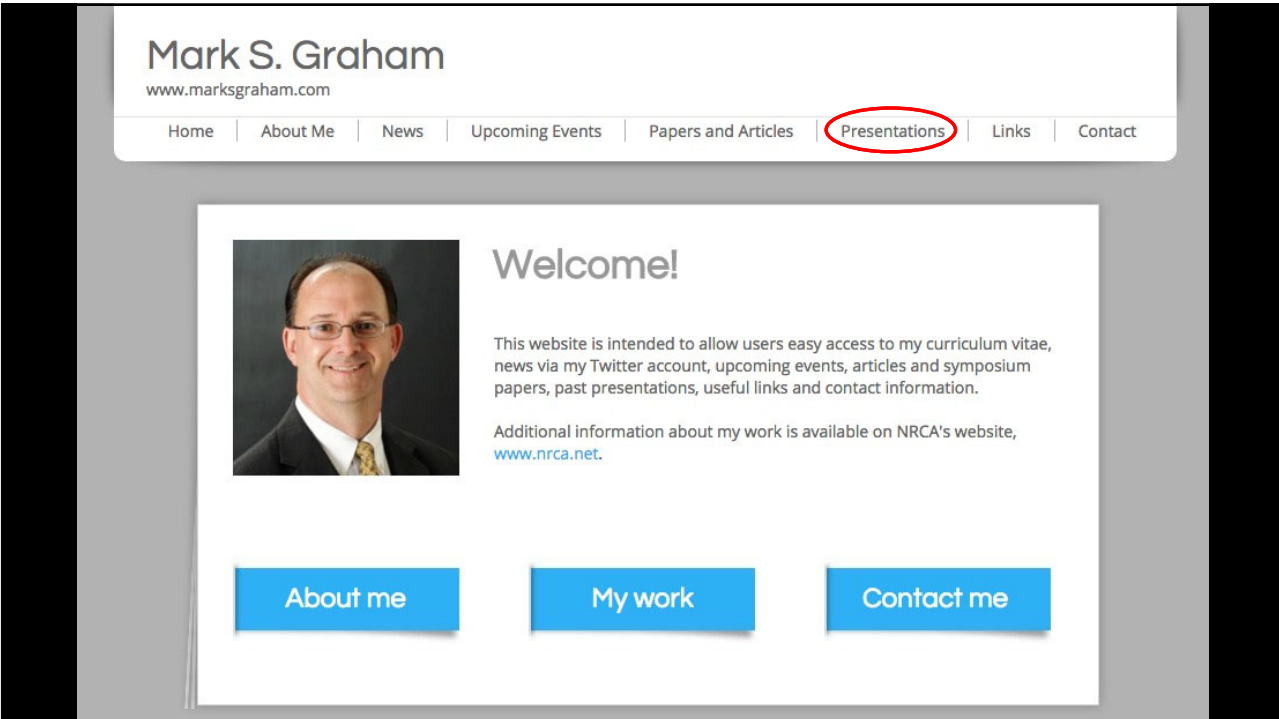
83



84



85



86



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87



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88