

# **Amendments to the 2021 Houston *Building Code* & *Residential Code* for ASCE 7-2022 Update**



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**[EDITORIAL NOTE:** THIS SUPPLEMENTAL DOCUMENT WAS CREATED BY THE CONSTRUCTION CODE MODERNIZATION PROJECT CONSULTANT, JENSEN-HUGHES, AND PROVIDES AMENDMENTS TO THE 2021 HOUSTON BUILDING CODE AND RESIDENTIAL CODE TO UPDATE THE ASCE 7 STANDARD EDITION FROM THE 2016 TO THE 2022 EDITION. THIS SUPPLEMENTAL DOCUMENT IS SUBJECT TO CHANGE PENDING PUBLICATION OF THE INTERNATIONAL CODE COUNCIL'S 2024 EDITION OF THE INTERNATIONAL BUILDING CODE (IBC) AND INTERNATIONAL RESIDENTIAL CODE (IRC) TO INCORPORATE ANY PERTINENT AND RELATED CHANGES MADE TO THE MODEL CODE IN RELATION TO THE ASCE 7 STANDARD EDITION UPDATE.



# CHAPTER 1

## SCOPE AND ADMINISTRATION

### SECTION 108

#### TEMPORARY STRUCTURES AND USES

**[A] 108.1 General.** The *building official* is authorized to issue a *permit* for temporary structures and temporary uses. Such *permits* shall be limited as to time of service, but shall not be permitted for more than 180 days. The *building official* is authorized to grant extensions for demonstrated cause. Structures designed to comply with Section 3103.5 shall not be in service for a period of more than 1-year unless an extension of time is granted.

# CHAPTER 2

## DEFINITIONS

### SECTION 202 DEFINITIONS

**[BS] BASIC DESIGN WIND SPEED,  $V$ .** ~~Basic design wind speeds.~~ The wind speed used for design, as determined in Chapter 16.

**[BS] ESSENTIAL FACILITIES.** Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from *flood*, wind, tornadoes, snow or earthquakes.

**GROUND SNOW LOAD GEODATABASE.** The ASCE database (version 2022:1.0) of geocoded values of risk-targeted design ground snow load values.

**GROUND SNOW LOAD,  $p_g$**  - Design ground snow loads.

**GROUND SNOW LOAD,  $p_{g(asd)}$**  - Allowable stress design ground snow loads.

**[BS] HURRICANE-PRONE REGIONS.** Areas vulnerable to hurricanes defined as:

1. The US Atlantic Ocean and Gulf of Mexico coasts where the ~~basic design~~ wind speed,  $V$ , for Risk Category II buildings is greater than 115 mph (51.4 m/s);
2. Hawaii, Puerto Rico, Guam, Virgin Islands and American Samoa.

**[BS] NOMINAL LOADS.** The magnitudes of the *loads* specified in Chapter 16 (dead, live, soil, wind, tornado, snow, rain, *flood* and earthquake).

**PUBLIC-OCCUPANCY TEMPORARY STRUCTURE.** Any building or structure erected for a period of one year or less that support public or private assemblies, or that provide human shelter, protection, or safety. Public-occupancy temporary structures within the confines of another existing structure (such as convention booths) are exempted from Section 3103.5.

**[BS] RISK CATEGORY.** A categorization of buildings and *other structures* for determination of *flood*, wind, tornado, snow, ice and earthquake *loads* based on the risk associated with unacceptable performance.

**SERVICE LIFE.** The period of time that a structure serves its intended purpose. For temporary structures, this shall be the cumulative time of service for sequential temporary events which

may occur in multiple locations. For *public-occupancy temporary structures* this is assumed to be a minimum of 10 years.

**TEMPORARY EVENT.** A single use during the service life of a *public-occupancy temporary structure* at a given location which includes its installation, inspection, use and occupancy, and dismantling.

**TEMPORARY STRUCTURE.** Any building or structure erected for a period of 180 days or less to support *temporary events*. *Temporary structures* include a range of structure types (*public-occupancy temporary structures, temporary special event structures, tents, umbrella and other membrane structures, relocatable buildings, temporary bleachers, etc.*) for a range of purposes (storage, equipment protection, dining, workspace, assembly, etc.).

**[BS] WINDBORNE DEBRIS REGION.** Areas within *hurricane-prone regions* located:

1. Within 1 mile (1.61 km) of the mean high-water line where an Exposure D condition exists upwind at the waterline and the basic ~~design~~ windspeed,  $V$ , is 130 mph (58 m/s) or greater; or
2. In areas where the basic ~~design~~ wind speed,  $V$ , is 140 mph (63 m/s) or greater.

For *Risk Category II* buildings and structures and *Risk Category III* buildings and structures, except health care facilities, the windborne debris region shall be based on Figure 1609.3.(1) ~~1609.3.(2)~~. For *Risk Category III* health care facilities, and *Risk Category IV* buildings and structures and ~~*Risk Category III* health care facilities~~, the windborne debris should be based on Figure 1609.3.(2) ~~1609.3(3)~~ and Figure 1609.3 (4) respectively.

**[BS] WIND DESIGN GEODATABASE.** The ASCE database (version 2022-1.0) of geocoded wind speed design data. The ASCE Wind Design Geodatabase of geocoded wind speed design data is available at <https://asce7hazardtool.online/>.

# CHAPTER 14

## EXTERIOR WALLS

### SECTION 1404

#### INSTALLATION OF WALL COVERINGS

**[BS] 1404.16 Fiber-cement siding.** *Fiber-cement siding* complying with Section 1403.10 shall be permitted on *exterior walls* of Type I, II, III, IV and V construction for wind pressure resistance or basic wind speed exposures as indicated by the manufacturer's listing and *label* and *approved* installation instructions. Where specified, the siding shall be installed over sheathing or materials listed in Section 2304.6 and shall be installed to conform to the *water-resistive barrier* requirements in Section 1402. Siding and accessories shall be installed in accordance with *approved* manufacturer's instructions. Unless otherwise specified in the *approved* manufacturer's instructions, nails used to fasten the siding to wood studs shall be corrosion-resistant round head smooth shank and shall be long enough to penetrate the studs not less than 1 inch (25 mm). For cold formed steel *light-frame construction*, corrosion-resistant fasteners shall be used. Screw fasteners shall penetrate the cold-formed steel framing not fewer than three exposed full threads. Other fasteners shall be installed in accordance with the approved construction documents and manufacturer's instructions.

**[BS] 1404.18 Polypropylene siding.** *Polypropylene* siding conforming to the requirements of this section and complying with Section 1403.12 shall be limited to exterior walls located in areas where the basic wind speed,  $V$ , specified in Chapter 16 does not exceed 100 miles per hour (45 m/s) and the building height is less than or equal to 40 feet (12 192 mm) in Exposure C. Where construction is located in areas where the basic wind speed,  $V$ , exceeds 100 miles per hour (45 m/s), or building heights are in excess of 40 feet (12 192 mm), tests or calculations indicating compliance with Chapter 16 shall be submitted. *Polypropylene siding* shall be installed in accordance with the manufacturer's instructions. *Polypropylene siding* shall be secured to the building so as to provide weather protection for the *exterior walls* of the building.

# CHAPTER 15 ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

## SECTION 1504 PERFORMANCE REQUIREMENTS

**TABLE 1504.2  
CLASSIFICATION OF STEEP SLOPE ROOF SHINGLES TESTED IN ACCORDANCE  
WITH ASTM D3161 OR D7158**

MAXIMUM BASIC DESIGN WIND SPEED, V, FROM FIGURES 1609.3(1)- <del>(8)</del> - <u>(4)</u> ASCE 7 (mph)	MAXIMUM ALLOWABLE STRESS DESIGN WIND SPEED, $V_{asd}$ , FROM Table 1609.3.1 (mph)	ASTM D7158a CLASSIFICATION N	ASTM D3161 or UL 7103 CLASSIFICATION
110	85	D, G or H	A, D or F
116	90	D, G or H	A, D or F
129	100	G or H	A, D or F
142	110	G or H	F
155	120	G or H	F
168	130	H	F
181	140	H	F
194	150	H	F

For SI: 1 foot= 304.8 mm; 1 mph= 0.447 m/s.

- a. The standard calculations contained in ASTM D7158 assume Exposure Category B or C and building height of 60 feet or less. Additional calculations are required for conditions outside of these assumptions.

**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)~~ 1609.3(4) as applicable.

**TABLE 1504.9  
MINIMUM REQUIRED PARAPET HEIGHT (INCHES) FOR AGGREGATE SURFACED  
ROOFS<sup>a,b,c</sup>**

AGGREGATE SIZE	MEAN ROOF HEIGHT (ft)	WIND EXPOSURE AND BASIC DESIGN WIND SPEED, $V$ (MPH)																	
		Exposure B										Exposure C <sup>d</sup>							
		S95	100	105	110	115	120	130	140	150	S95	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
	150	17	19	22	25	27	30	36	41	46	23	26	29	32	35	38	44	50	56
ASTM D1863 (No. 6)	15	2	2	2	2	12	12	12	15	18	2	2	2	13	15	17	22	26	30
	20	2	2	2	2	12	12	13	17	21	2	2	12	15	17	19	23	28	32
	30	2	2	2	2	12	12	16	20	24	2	12	14	17	19	21	26	31	35
	50	12	12	12	12	14	16	20	24	28	12	15	17	19	22	24	29	34	39
	100	12	12	14	16	19	21	26	30	35	16	18	21	24	26	29	34	39	45
	150	12	14	17	19	22	24	29	34	39	18	21	23	26	29	32	37	43	48

For SI: 1 inch= 25.4 mm; 1 foot= 304.8 mm; 1 mile per hour= 0.447 m/s.

- Interpolation shall be permitted for mean roof height and parapet height.
- Basic design wind speed  $V$ , and wind exposure shall be determined in accordance with Section 1609.
- 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.
- 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).

**SECTION 1507  
REQUIREMENTS FOR ROOF COVERING**

**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 shingles* shall conform to the applicable standards listed in this chapter. Underlayment materials required to comply with ASTM D226, D1970, D4869 and D6757 shall bear a label indicating compliance with the standard designation and, if applicable, type classification indicated in Table 1507.1.1(1). Underlayment shall be applied in accordance with Table 1507.1.1(2). Underlayment shall be attached in accordance with Table 1507.1.1(3).

**Exceptions:**

- As an alternative, a minimum 4-inch-wide (102 mm) strip of self-adhering polymer modified bitumen membrane complying with ASTM D1970 and installed in accordance with the manufacturer's installation instructions for the deck material shall be applied over all joints in the roof decking. An approved underlayment for the applicable roof covering for design basic wind speeds,  $V$ , less than 120 mph

- (54 m/s) shall be applied over the 4-inch-wide (102 mm) membrane strips.
2. As an alternative, two layers of underlayment complying with ASTM D226 Type II or ASTM D4869 Type IV shall be permitted to be installed as follows: Apply a 19-inch (483 mm) strip of underlayment parallel with the eave. Starting at the eave, apply 36-inch-wide (914 mm) strips of underlayment felt, overlapping successive sheets 19 inches (483 mm). The underlayment shall be attached with corrosion-resistant fasteners in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at side and end laps. End laps shall be 4 inches (102 mm) and shall be offset by 6 feet (1829 mm). Underlayment shall be attached using metal or plastic cap nails with a nominal cap diameter of not less than 1 inch (25.4 mm). Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a thickness of not less than 0.010 inch (0.254 mm). Thickness of the outside edge of plastic caps shall be not less than 0.035 inch (0.89 mm). The cap nail shank shall be not less than 0.083 inch (2.1 mm) for ring shank cap nails and 0.091 inch (2.3 mm) for smooth shank cap nails. The cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than  $\frac{3}{4}$  inch (19.1 mm) into the roof sheathing.
  3. Structural metal panels that do not require a substrate or underlayment.

**TABLE 1507.1.1(1)  
UNDERLAYMENT TYPES**

ROOF COVERING	SECTION	MAXIMUM BASIC DESIGN WIND SPEED, V < 140	IC DESIGN WIND SPEED, V > 140 MPH
Asphalt shingles	1507.2	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV ASTM D6757	ASTM D226 Type II ASTM D4869 Type IV ASTM D6757
Clay and concrete tiles	1507.3	ASTM D226 Type II ASTM D2626 Type I ASTM D6380 Class M mineral surfaced roll roofing	ASTM D226 Type II ASTM D2626 Type I ASTM D6380 Class M mineral surfaced roll roofing
Metal roof panels	1507.4	Manufacturer's instructions	ASTM D226 Type II ASTM D4869 Type IV
Metal roof shingles	1507.5	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Mineral-surfaced roll roofing	1507.6	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Slate shingles	1507.7	ASTM D226 Type II ASTM D4869 Type III or IV	ASTM D226 Type II ASTM D4869 Type IV
Wood shingles	1507.8	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Wood shakes	1507.9	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Photovoltaic shingles	1507.16	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV ASTM D6757	ASTM D226 Type II ASTM D4869 Type IV ASTM D6757

**TABLE 1507.1.1(2)  
UNDERLAYMENT APPLICATION**

<b>Roof Covering</b>	<b>Section</b>	<b>MAXIMUM BASIC DESIGN WIND SPEED, <math>V &lt; 140</math> MPH</b>	<b>MAXIMUM BASIC DESIGN WIND SPEED, <math>V \geq 140</math> MPH</b>
Asphalt shingles	1507.2	For roof slopes from 2 units vertical in 12 units horizontal (2:12), up to 4 units vertical in 12 units horizontal (4:12), underlayment shall be two layers applied as follows: Apply a 19-inch strip of underlayment felt parallel to and starting at the eaves. Starting at the eave, apply 36-inch-wide sheets of underlayment, overlapping successive sheets 19 inches. End laps shall be 4 inches and shall be offset by 6 feet. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. For roof slopes of 4 units vertical in 12 units horizontal (4:12) or greater, underlayment shall be one layer applied as follows: Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 2 inches, Distortions in the underlayment shall not interfere with the ability of the shingles to seal. End laps shall be 4 inches and shall be offset by 6 feet.	Same as Maximum Basic Design Wind Speed, $V < 140$ mph except all laps shall be not less than 4 inches
Clay and concrete tile	1507.3	For roof slopes from 2 <sup>1</sup> / <sub>2</sub> units vertical in 12 units horizontal (2 <sup>1</sup> / <sub>2</sub> :12), up to 4 units vertical in 12 units horizontal (4:12), underlayment shall be not fewer than two layers applied as follows: Starting at the eave, a 19-inch strip of underlayment shall be applied parallel with the eave. Starting at the eave, a 36-inch-wide strip of underlayment felt shall be applied, overlapping successive sheets 19 inches. End laps shall be 4 inches and shall be offset by 6 feet. For roof slopes of 4 units vertical in 12 units horizontal (4:12) or greater, underlayment shall be one layer applied as follows: Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 2 inches. End laps shall be 4 inches and shall be offset by 6 feet.	Same as Maximum Basic Design Wind Speed, $V < 140$ mph except all laps shall be not less than 4 inches
Metal roof panels	1507.4	Apply in accordance with the manufacturer's installation instructions	For roof slopes from 2 units vertical in 12 units horizontal (2:12), up to 4 units vertical in 12 units horizontal (4:12), underlayment shall be two layers applied as follows: Apply a 19-inch strip of underlayment felt parallel to and starting at the eaves. Starting at the eave, apply 36-inch-wide sheets of underlayment, overlapping successive sheets 19 inches. End laps shall be 4 inches and shall be offset by 6 feet. For roof slopes of 4 units vertical in 12 units horizontal (4:12) or greater, underlayment shall be one layer applied as follows: Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 4 inches. End laps shall be 4 inches and shall be offset by 6 feet.
Metal roof shingles	1507.5		
Mineral-surfaced roll roofing	1507.6		
Slate shingles	1507.7		
Wood shingles	1507.8		
Wood shakes	1507.9		
Photovoltaic shingles	1507.16	For roof slopes from 3 units vertical in 12 units horizontal (3:12), up to 4 units vertical in 12 units horizontal (4:12), underlayment shall be two layers applied as follows: Apply a 19-inch strip of underlayment felt parallel to and starting at the eaves. Starting at the eave, apply 36-inch-wide sheets of underlayment, overlapping successive sheets 19 inches. End laps shall be 4 inches and shall be offset by 6 feet. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. For roof slopes of 4 units vertical in 12 units horizontal (4:12) or greater, underlayment shall be one layer applied as follows: Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 2 inches. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. End laps shall be 4 inches and shall be offset by 6 feet.	Same as Maximum Basic Design Wind Speed, $V < 140$ mph except all laps shall be not less than 4 inches

**TABLE 1507.1.1(3)  
UNDERLAYMENT ATTACHMENT**

ROOF COVERING	SECTION	MAXIMUM BASIC DESIGN WIND SPEED, $V < 140$ MPH	MAXIMUM BASIC DESIGN WIND SPEED, $V \geq 140$ MPH
Asphalt shingles	1507.2	Fastened sufficiently to hold in place	The underlayment shall be attached with corrosion-resistant fasteners in a grid pattern of 12 inches between side laps with a 6-inch spacing at side and end laps. Underlayment shall be attached using metal or plastic cap nails or cap staples with a nominal cap diameter of not less than 1 inch. Metal caps shall have a thickness of not less than 32-gage (0.0134 inch) sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails and 0.091 inch for smooth shank cap nails. Staples shall be not less than 21 gage (0.032 inch). The cap nail shank and cap staple legs shall have a length sufficient to penetrate through the roof sheathing or not less than $\frac{3}{4}$ inch into the roof sheathing.
Clay and concrete tile	1507.3		
Photovoltaic shingles	1507.16		
Metal roof panels	1507.4	Manufacturer's installation instructions	The underlayment shall be attached with corrosion-resistant fasteners in a grid pattern of 12 inches between side laps with a 6-inch spacing at side and end laps. Underlayment shall be attached using metal or plastic cap nails or cap staples with a nominal cap diameter of not less than 1 inch. Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails and 0.091 inch for smooth shank cap nails. Staples shall be not less than 21 gage. The cap nail shank and cap staple legs shall have a length sufficient to penetrate through the roof sheathing or not less than $\frac{3}{4}$ inch into the roof sheathing.
Metal roof shingles	1507.5		
Mineral-surfaced roll roofing	1507.6		
Slate shingles	1507.7		
Wood shingles	1507.8		
Wood shakes	1507.9		

For SI: 1 inch= 25.4 mm; 1 mile per hour= 0.447 m/s.

**1507.15 Vegetative roofs and landscaped roofs.** *Vegetative roofs* and landscaped roofs shall comply with the requirements of this chapter, Section ~~1607.14.2-21607.13.2~~ and the *International Fire Code*.

**1507.16.8 Wind resistance.** *Photovoltaic shingles* shall comply with the classification requirements of Table 1504.2 for the appropriate maximum nominal design ~~basic~~ wind speed,  $V$ .

## CHAPTER 16 STRUCTURAL DESIGN

### SECTION 1602

## NOTATIONS

**1602.1 Notations.** The following notations are used in this chapter:

- $D$  = Dead load.
- $D_i$  = Weight of ice in accordance with Chapter 10 of ASCE 7.
- $E$  = Combined effect of horizontal and vertical earthquake induced forces as defined in Section 12.4 of ASCE 7.
- $F$  = Load due to fluids with well-defined pressures and maximum heights.
- $F_a$  = Flood load in accordance with Chapter 5 of ASCE 7.
- $H$  = Load due to lateral earth pressures, ground water pressure or pressure of bulk materials.
- $L$  = Live load.
- $L_r$  = Roof live load.
- $P_{g(asd)}$  = Allowable stress design ground snow load
- $P_g$  = Ground snow load determined from reliability-targeted (strength-based) maps in Figures 1608.2(1) through 1608.2(4)
- $R$  = Rain load.
- $S$  = Snow load.
- $T$  = Cumulative effects of self-straining load forces and effects.
- $V_{asd}$  = Allowable stress design wind speed, miles per hour (mph) (~~km/hr~~ m/s) where applicable.
- $V$  = Basic design wind speed,  $V$ , miles per hour (mph) (~~km/hr~~ m/s) determined from Figures 1609.3(1) through 1609.3 (12) (4) or ASCE 7.
- $V_T$  = Tornado speed, miles per hour (mph) (~~km/hr~~ m/s) determined from Chapter 32 of ASCE 7.
- $W$  = Load due to wind pressure.
- $W_i$  = Wind-on-ice in accordance with Chapter 10 of ASCE 7.

## SECTION 1603 CONSTRUCTION DOCUMENTS

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

**Exceptions:** Construction documents for buildings constructed in accordance with conventional light framed construction provisions of Section 2308 shall indicate the following structural design information:

1. Floor and roof dead and live loads.
2. Ground snow load,  $p_g$ .
3. Basic design wind speed,  $V$ , miles per hour (mph) (~~km/hr~~ m/s) and allowable stress design wind speed,  $V_{asd}$ , as determined in accordance with Section 1609.3.1 and wind exposure.

4. *Seismic design category and site class.*
5. Flood design data, if located in *flood hazard areas* established in Section 1612.3.
6. Design load-bearing values of soils.
7. Rain load data.

**1603.1.2 Roof live load.** The *roof live load* used in the design shall be indicated for roof areas (~~1607.14~~).

**1603.1.3 Roof snow load data.** The ground snow *load*,  $p_g$ , shall be indicated. In areas where the ground snow *load*,  $p_g$ , exceeds 10 pounds per square foot (psf) (0.479 kN/m<sup>2</sup>), the following additional information shall also be provided, regardless of whether snow *loads* govern the design of the roof:

1. Flat-roof snow *load*,  $p$ .
2. Snow exposure factor,  $C$ .
3. ~~Snow load importance factor~~  $I_s$ , *Risk category*.
4. Thermal factor,  $C_t$ .
5. Slope factor(s),  $C_s$ .
6. Drift surcharge load(s),  $p_d$ , where the sum of  $p_d$ , and  $p_f$ , exceeds 20 psf (0.96 kN/m<sup>2</sup>).
7. Width of snow drift(s),  $w$ .

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

1. Basic ~~design wind speed~~,  $V$  (mph), tornado speed,  $V_T$  (mph), ~~miles per hour~~ and allowable stress design wind speed,  $V_{asd}$  (mph), as determined in accordance with Section 1609.3.1.
2. *Risk category*.
3. Effective plan area,  $A_e$ , for tornado design in accordance with Chapter 32 of ASCE 7.
4. ~~3.~~ Wind exposure. Applicable wind direction if more than one wind exposure is utilized.
5. ~~4.~~ Applicable internal pressure coefficients, and applicable tornado internal pressure coefficients.
6. ~~5.~~ Design wind pressures and their applicable zones with dimensions to be used for exterior component and cladding materials not specifically designed by the *registered design professional* responsible for the design of the structure, pounds per square foot (kN/m<sup>2</sup>). Where design for tornado loads is required, the design pressures shown shall be the maximum of wind or tornado pressures.

**1603.1.9 Roof rain load data.** Design rainfall ~~Rain~~ intensity,  $i$  (in/hr) (cm/hr), shall be shown regardless of whether rain *loads* govern the design.

**TABLE 1604.3 DEFLECTION LIMITS<sup>a, b, c, h, i</sup>**

CONSTRUCTION	<i>L</i> or <i>L<sub>r</sub></i>	<i>S</i> or <i>W<sup>f</sup></i>	<i>D</i> + <i>L<sup>d, g</sup></i>
Roof members: <sup>a</sup>			
Supporting plaster or stucco ceiling	<i>l</i> /360	<i>l</i> /360	<i>l</i> /240
Supporting nonplaster ceiling	<i>l</i> /240	<i>l</i> /240	<i>l</i> /180
Not supporting ceiling	<i>l</i> /180	<i>l</i> /180	<i>l</i> /120
Floor members	<i>l</i> /360	—	<i>l</i> /240
Exterior walls:			
With plaster or stucco finishes	—	<i>l</i> /360	—
With other brittle finishes	—	<i>l</i> /240	—
With flexible finishes	—	<i>l</i> /120	—
Interior partitions: <sup>b</sup>			
With plaster or stucco finishes	<i>l</i> /360	—	—
With other brittle finishes	<i>l</i> /240	—	—
With flexible finishes	<i>l</i> /120	—	—
Farm buildings	—	—	<i>l</i> /180
Greenhouses	—	—	<i>l</i> /120

For SI: 1 foot= 304.8 mm.

- a. For structural roofing and siding made of formed metal sheets, the total load deflection shall not exceed *l*/60. For secondary roof structural members supporting formed metal roofing, the live load deflection shall not exceed *l*/150. For secondary wall members supporting formed metal siding, the design wind load deflection shall not exceed *l*/90. For roofs, this exception only applies when the metal sheets have no roof covering.
- b. Flexible, folding and portable partitions are not governed by the provisions of this section. The deflection criterion for interior partitions is based on the horizontal load defined in Section 1607.16.
- c. See Section 2403 for glass supports.
- d. The deflection limit for the *D* + (*L* + *L<sub>r</sub>*) load combination only applies to the deflection due to the creep component of long-term dead load deflection plus the short-term live load deflection. For lumber, structural glued laminated timber, prefabricated wood I-joists and structural composite lumber members that are dry at time of installation and used under dry conditions in accordance with the ANSI/AWC NOS, the creep component of the long-term deflection shall be permitted to be estimated as the immediate dead load deflection resulting from 0.5*D*. For lumber and glued laminated timber members installed or used at all other moisture conditions or cross laminated timber and wood structural panels that are dry at time of installation and used under dry conditions in accordance with the ANSI/AWC NOS, the creep component of the long-term deflection is permitted to be estimated as the immediate dead load deflection resulting from *D*. The value of 0.5*D* shall not be used in combination with ANSI/AWC NOS provisions for long-term loading.
- e. The preceding deflections do not ensure against ponding. Roofs that do not have sufficient slope or camber to ensure adequate drainage shall be investigated for ponding. See Chapter 8 of ASCE 7.
- f. The wind load shall be permitted to be taken as 0.42 times the "component and cladding" loads or directly calculated using the 10-year mean return interval basic wind speed, *V<sub>b</sub>*, for the purpose of determining deflection limits in Table 1604.3. Where framing members support glass, the deflection limit therein shall not exceed that specified in Section 1604.3.7.
- g. For steel structural members, the deflection due to creep component of long-term dead load shall be permitted to be taken as zero.
- h. For aluminum structural members or aluminum panels used in skylights and sloped glazing framing, roofs or walls of sunroom additions or patio covers not supporting edge of glass or aluminum sandwich panels, the total load deflection shall not exceed *l*/60. For continuous aluminum structural members supporting edge of glass, the total load deflection shall not exceed *l*/175 for each glass lite or *l*/60 for the entire length of the member, whichever is more stringent. For aluminum sandwich panels used in roofs or walls of sunroom additions or patio covers, the total load deflection shall not exceed *l*/120.

- i.  $l$  = Length of the member between supports. For cantilever members,  $l$  shall be taken as twice the length of the cantilever.

## SECTION 1605 LOAD COMBINATIONS

**1605.1 General.** Buildings and *other structures* and portions thereof shall be designed to resist the strength load combinations specified in ASCE 7, Section 2.3, the *allowable stress design* load combinations specified in ASCE 7, Section 2.4, or the alternative *allowable stress design* load combinations of Section 1605.2.

### Exceptions:

1. The modifications to load combinations of ASCE 7 Section 2.3, ASCE 7 Section 2.4, and Section 1605.2 specified in ASCE 7 Chapters 18 and 19 shall apply.
2. Where the allowable stress design load combinations of ASCE 7 Section 2.4 are used, flat roof snow *loads* of ~~30-45~~ pounds per square foot (1.44-~~2.15~~ kN/m<sup>2</sup>) and *roof live loads* of 30 pounds per square foot (1.44 kN/m<sup>2</sup>) or less need not be combined with seismic load. Where flat roof snow *loads* exceed ~~30-45~~ pounds per square foot (1.44-~~2.15~~ kN/m<sup>2</sup>), ~~20-15~~ percent shall be combined with seismic loads.
3. Where the allowable stress design load combinations of ASCE 7 Section 2.4 are used, crane hook loads need not be combined with *roof live loads* or with more than three-fourths of the snow load or one-half of the wind loads.
4. Where tornado loads are required, the alternative *allowable stress design* load combinations of Section 1605.2 shall not apply when tornado loads govern the design.

**1605.2 Alternative allowable stress design load combinations.** In lieu of the load combinations in ASCE 7, Section 2.4, structures and portions thereof shall be permitted to be designed for the most critical effects resulting from the following combinations. Where using these alternative allowable stress load combinations that include wind or seismic *loads*, allowable stresses are permitted to be increased or load combinations reduced where permitted by the material chapter of this code or the referenced standards. For load combinations that include the counteracting effects of dead and wind *loads*, only two-thirds of the minimum *dead load* likely to be in place during a design wind event shall be used. Where using these alternative load combinations to evaluate sliding, overturning and soil bearing at the soil-structure interface, the reduction of foundation overturning from Section 12.13.4 in ASCE 7 shall not be used. Where using these alternative basic design *load* combinations for proportioning foundations for loadings, which include seismic *loads*, the vertical seismic *load effect*,  $E_v$ , in Equation 12.4-4 of ASCE 7 is permitted to be taken equal to zero. Where required by ASCE 7, Chapters 12, 13 and 15, the load combinations including overstrength of ASCE 7, Section 2.3.6 shall be used.

$$D + L + (L_r \text{ or } \underline{0.7S} \text{ or } R) \qquad \text{(Equation 16-1)}$$

$$D + L + 0.6W \qquad \text{(Equation 16-2)}$$

$$D + L + 0.6W + \underline{0.7S}/2 \qquad \text{(Equation 16-3)}$$

$$D + L + \underline{0.7S} + 0.6(W/2) \qquad \text{(Equation 16-4)}$$

$$D + L + 0.1S + E/1.4 \quad \text{(Equation 16-5)}$$

$$0.9D + E/1.4 \quad \text{(Equation 16-6)}$$

**Exceptions:**

1. Crane hook *loads* need not be combined with *roof live loads* or with more than three-fourths of the snow load or one-half of the wind load.
2. Flat roof snow *loads* of ~~30–45~~ pounds per square foot (1.44 2.15 kN/m<sup>2</sup>) or less and *roof live loads* of 30 pounds per square foot (1.44 kN/m<sup>2</sup>) or less need not be combined with seismic loads. Where flat roof snow loads exceed ~~30–45~~ pounds per square foot (1.44 2.15 kN/m<sup>2</sup>), ~~20–15~~ percent shall be combined with seismic loads.

**SECTION 1606  
DEAD LOADS**

**1606.1 General.** ~~Dead Loads are those loads defined in Chapter 2 of this code. Dead loads shall be considered to be permanent loads. Buildings, structures, and parts thereof shall be designed to resist the effects of dead loads.~~

**SECTION 1607  
LIVE LOADS**

**1607.1 General.** ~~Live loads are those loads defined in Chapter 2 of this code. Buildings, structures, and parts thereof shall be designed to resist the effects of live loads.~~

**1607.2 Loads not specified.** For occupancies or uses not designated in Section 1607, the *live load* shall be determined in accordance with a method *approved* by the *building official*.

**1607.3 Uniform live loads.** The *live loads* used in the design of buildings and *other structures* shall be the maximum loads expected by the intended use or occupancy but shall not be less than the minimum uniformly distributed *live loads* given in Table 1607.1. *Live loads acting on a sloping surface shall be assumed to act vertically on the horizontal projection of that surface.*

~~**1607.13–1607.3.1 Partial loading of floors.** Where uniform floor *live loads* are involved in the design of structural members arranged so as to create continuity, the minimum applied loads shall be the full *dead loads* on all spans in combination with the floor *live loads* on spans selected to produce the greatest *load effect* at each location under consideration. ~~Floor Uniform floor *live loads* applied to selected spans are permitted to be reduced in accordance with Section 1607.12.~~~~

~~**1607.14.1–1607.3.2 Partial loading of roofs.** Where uniform roof *live loads* are reduced to less than 20 psf (0.96 kN/m<sup>2</sup>) in accordance with Section ~~1607.14.2.1~~ 1607.13.1 and are applied to the design of structural members arranged so as to create continuity, the reduced roof live load shall be applied to adjacent spans or to alternate spans, whichever produces the most unfavorable load effect. ~~See Section 1607.14.2 for reductions in minimum roof *live loads* and Section 7.5 of ASCE 7 for partial snow loading.~~~~

**1607.5 Partition loads.** In office buildings and in other buildings where partition locations are

subject to change, provisions for partition weight shall be made, whether or not partitions are shown on the construction documents, ~~unless the specified live load is 80 psf (3.83 kN/m<sup>2</sup>) or greater.~~ The partition load shall be not less than a uniformly distributed *live load* of 15 psf (0.72 kN/m<sup>2</sup>) and shall not be reduced per Section 1607.12.

**Exception:** A partition is a live load is not required the minimum specified live load is 80 psf (3.83kN/m<sup>2</sup>) or greater.

**1607.6 Helipads.** Landing areas designed for a design basis helicopter with maximum take-off weight of 3,000 pounds (13.35 kN) shall be identified with a 3,000-pound (13.34 kN) weight limitation. The landing area weight limitation shall be indicated by the numeral "3" (kips) located in the bottom right corner of the landing area as viewed from the primary approach path. The indication for the landing area weight limitation shall be a minimum 5 feet (1524 mm) in height. Helipads shall be designed for the following live loads:

- ~~1. A uniform *live load*, *L*, as specified in Items 1.1 and 1.2. This *load* shall not be reduced.
  - ~~1.1 40 psf (1.92 kN/m<sup>2</sup>) where the design basis helicopter has a maximum take-off weight of 3,000 pounds (13.35 kN) or less.~~
  - ~~1.2 60 psf (2.87 kN/m<sup>2</sup>) where the design basis helicopter has a maximum take-off weight greater than 3,000 pounds (13.35 kN).~~~~
- ~~2. A single concentrated *live load*, *L*, of 3,000 pounds (13.35 kN) applied over an area of 4.5 inches by 4.5 inches (114 mm by 114 mm) and located so as to produce the maximum load effects on the structural elements under consideration. The concentrated *load* is not required to act concurrently with other uniform or concentrated live loads.~~
- ~~3. Two single concentrated live loads, *L*, 8 feet (2438 mm) apart applied on the landing pad (representing the helicopter's two main landing gear, whether skid type or wheeled type), each having a magnitude of 0.75 times the maximum take-off weight of the helicopter, and located so as to produce the maximum load effects on the structural elements under consideration. The concentrated loads shall be applied over an area of 8 inches by 8 inches (203 mm by 203 mm) and are not required to act concurrently with other uniform or concentrated live loads.~~

~~Landing areas designed for a design basis helicopter with maximum take-off weight of 3,000 pounds (13.35 kN) shall be identified with a 3,000-pound (13.34 kN) weight limitation. The landing area weight imitation shall be indicated by the numeral "3" (kips) located in the bottom right corner of the landing area as viewed from the primary approach path. The indication for the landing area weight imitation shall be a minimum 5 feet (1524 mm) in height.~~

**1607.6.1 Concentrated loads.** Helipads shall be designed for the following concentrated *live loads*:

1. A single concentrated *live load*, *L*, of 3,000 pounds (13.35 kN) applied over an area of 4.5 inches by 4.5 inches (114 mm by 114 mm) and located so as to produce the maximum *load effects* on the structural elements under consideration. The concentrated is not required to act concurrently with other uniform or concentrated *live loads*.
2. Two single concentrated *live loads*, *L*, 8 feet (2438 mm) apart applied on the landing pad (representing the helicopter's two main landing gear, whether skid type or wheeled type), each having a magnitude of 0.75 times the maximum take-off weight of the helicopter, and located so as to produce the maximum *load effects* on the

structural elements under consideration. The concentrated loads shall be applied over an area of 8 inches by 8 inches (203 mm by 203 mm) and are not required to act concurrently with other uniform or concentrated live loads.

**1607.7 Passenger vehicle garages.** Floors in garages ~~or~~ and portions of a building used for the storage of motor vehicles shall be designed for the uniformly distributed *live loads* indicated in Table 1607.1 or the following concentrated *load*:

1. For garages restricted to passenger vehicles accommodating not more than nine passengers, 3,000 pounds (13.35 kN) acting on an area of 4.5 inches by 4.5 inches (114 mm by 114 mm)
2. For mechanical parking structures without slab or deck that are used for storing passenger vehicles only, 2,250 pounds (10 kN) per wheel.

**1607.8.2 Fire truck and emergency vehicles.** Where a structure or portions of a structure are assessed ~~and loaded~~ by fire department ~~access~~ vehicles and other similar emergency vehicles, those portions of the structure subject to such loads shall be designed for the greater of the following *loads*:

1. The actual operational *loads*, including outrigger reactions and contact areas of the vehicles as stipulated and *approved* by the *building official*.
2. The live loading specified in Section 1607.8.1.

**1607.9.1 Handrails and guards.** *Handrails* and *guards* shall be designed to resist a linear *load* of 50 pounds per linear foot (pit) (0.73 kN/m) in accordance with Section 4.5.1.1 of ASCE 7. Glass *handrail* assemblies and *guards* shall comply with Section 2407.

**Exceptions:**

1. For one- and two-family dwellings, only the single concentrated *load* required by Section 1607.9.1.1 shall be applied.
2. In Group 1-3, F, H and S occupancies, for areas that are not accessible to the general public and that have an *occupant load* less than 50, the minimum *load* shall be 20 pounds per foot (0.29 kN/m).
3. For roofs not intended for occupancy, only the single concentrated load required by Section 1607.9.1.1 shall be applied.

**~~1607.17~~ ~~1607.10~~ Fixed ladders.** Fixed ladders with rungs shall be designed to resist a single concentrated *load* of 300 pounds (1.33 kN) in accordance with Section 4.5.4 of ASCE 7. Where rails of fixed ladders extend above a floor or platform at the top of the ladder, each side rail extension shall be designed to resist a single concentrated *load* of 100 pounds (0.445 kN) in accordance with Section 4.5.4 of ASCE 7. Ship's ladders shall be designed to resist the *stair loads* given in Table 1607.1.

**~~1607.10~~ ~~1607.11~~ Vehicle barriers.** *Vehicle barriers* for passenger vehicles shall be designed to resist a concentrated *load* of 6,000 pounds (26.70 kN) in accordance with Section 4.5.3 of ASCE 7. Garages accommodating trucks and buses shall be designed in accordance with an *approved* method that contains provisions for traffic railings.

**~~1607.11~~ ~~1607.12~~ Impact loads.** The *live loads* specified in Sections 1607.3 through ~~1607.10~~

1607.11 shall be assumed to include adequate allowance for ordinary impact conditions. Provisions shall be made in the structural design for uses and loads that involve unusual vibration and impact forces.

**1607.12 Reduction in uniform live loads.** Except for uniform *live loads* at roofs, all other minimum uniformly distributed *live loads*,  $L_o$ , in Table 1607.1 are permitted to be reduced in accordance with Section 1607.12.1 or 1607.12.2. Uniform *live loads* at roofs are permitted to be reduced in accordance with Section ~~1607.14.2~~ 1607.13.

**1607.12.1.2 Heavy live loads.** *Live loads* that exceed 100 psf (4.79 kN/m<sup>2</sup>) shall not be reduced.

**Exceptions:**

- 1 The *live loads* for members supporting two or more floors are permitted to be reduced by not greater than 20 percent, but the reduced live load shall be not less than  $L_s$  calculated in Section 1607.12.1.
- 2 For uses other than storage, where *approved*, additional *live load* reductions shall be permitted where shown by the *registered design professional* that a rational approach has been used and that such reductions are warranted.

**1607.12.1.3 Passenger vehicle garages.** The *live loads* shall not be reduced in passenger vehicle garages.

**Exception:** The *live loads* for members supporting two or more floors are permitted to be reduced by not greater than 20 percent, but the reduced live load shall be not less than  $L$  as calculated in Section 1607.12.1.

~~1607.14.2~~ **1607.13 Reduction in uniform roof live loads.** The minimum uniformly distributed *live loads* of roofs and *marquees*,  $L_o$ , in Table 1607.1 are permitted to be reduced in accordance with Section ~~1607.14.2.1~~ 1607.13.1.

**1607.14.2.1 1607.13.1 Ordinary roofs, awnings and canopies.** Ordinary flat, pitched and curved roofs, and *awnings* and canopies other than of fabric construction supported by a skeleton structure, are permitted to be designed for a reduced uniformly distributed *roof live load*,  $L_r$ , as specified in the following equations or other controlling combinations of *loads* as specified in Section 1605, whichever produces the greater *load effect*.

In structures such as *greenhouses*, where special scaffolding is used as a work surface for workers and materials during maintenance and repair operations, a lower roof *load* than specified in the following equations shall not be used unless *approved* by the *building official*. Such structures shall be designed for a minimum roof live *load* of 12 psf (0.58 kN/m<sup>2</sup>).

$$L_r = L_o R_1 R_2 \quad \text{(Equation 16-10)}$$

where:  $12 < L_r < 20$

For SI:

$$L_r = L_o R_1 R_2$$

where:  $0.58 < L_r < 0.96$

$L_o$  = Unreduced *roof live load* per square foot ( $m^2$ ) of horizontal projection supported by the member (see Table 1607.1).

$L_r$  = Reduced *roof live load* per square foot ( $m^2$ ) of horizontal projection supported by the member. The reduction factors  $R_1$  and  $R_2$  shall be determined as follows:

$$R_1 = 1 \text{ for } A_t \leq 200 \text{ square feet (18.58 m}^2\text{)} \quad \text{(Equation 16-11)}$$

$$R_1 = 1.2 - 0.001A_t \text{ for } 200 \text{ square feet} < A_t < 600 \text{ square feet} \quad \text{(Equation 16-12)}$$

$$R_1 = 0.6 \text{ for } A_t \geq 600 \text{ square feet (55.74 m}^2\text{)} \quad \text{(Equation 16-13)}$$

where:

$A_t$  = Tributary area (span length multiplied by effective width) in square feet ( $m^2$ ) supported by the member, and

$$R_2 = 1 \text{ for } F \leq 4 \quad \text{(Equation 16-14)}$$

$$R_2 = 1.2 - 0.05 F \text{ for } 4 < F < 12 \quad \text{(Equation 16-15)}$$

$$R_2 = 0.6 \text{ for } F \geq 12 \quad \text{(Equation 16-16)}$$

where:

$F$  = For a sloped roof, the number of inches of rise per foot (for SI:  $F = 0.12 \times$  slope, with slope expressed as a percentage), or for an arch or dome, the rise-to-span ratio multiplied by 32.

**1607.14.2.2–1607.13.2 Occupiable roofs.** Areas of roofs that are occupiable, such as *vegetative roofs*, landscaped roofs or for assembly or other similar purposes, and *marquees* are permitted to have their uniformly distributed *live loads* reduced in accordance with Section 1607.12.

**1607.14 Roof loads.** ~~The structural supports of roofs and *marquees* shall be designed to resist wind and, where applicable, tornado and snow and earthquake loads, in addition to the *dead load* of construction and the appropriate *live loads* as prescribed in this section, or as set forth in Table 1607.1. The *live loads* acting on a sloping surface shall be assumed to act vertically on the horizontal projection of that surface.~~

**1607.14.3–1607.14 Awnings and canopies.** *Awnings* and canopies shall be designed for uniform *live loads* as required in Table 1607.1 as well as for snow loads and wind and Tornado loads as specified in Sections 1608 and 1609.

**1607.15 Crane loads.** The crane *live load* shall be the rated capacity of the crane. Design loads for the runway beams, including connections and support brackets, of moving bridge cranes and monorail cranes shall be in accordance with Section 4.9 of ASCE 7. ~~Include the maximum wheel load of the crane including vertical impact, lateral and longitudinal forces induced by the moving crane.~~

~~**1607.15.1 Maximum Wheel Load.** The maximum wheel loads shall be the wheel loads produced by the weight of the bridge as applicable plus the sum of the rated capacity and the weight of the trolley with the trolley positioned on its runway at the location where the resulting load effect is maximum.~~

~~**1607.15.2 Vertical Impact Force.** The maximum wheel loads of the crane shall be increased by the following percentages to account for the effects of vertical impact or vibration:~~

Monorail cranes (powered)	25 percent
Cab-operated or remotely operated bridge cranes (powered)	25 percent
Pendant operated bridge cranes (powered)	40 percent
bridge trains and monorail cranes with hand geared bridge, trolley and hoist	0 percent

~~**1607.15.3 Lateral Force.** The lateral force on crane runway beams with electrically powered trolleys shall be calculated as 20% of the sum of the rated capacity of the crane and the weight of the hoist and trolley. The lateral force shall be assumed to act horizontally at the traction surface of the runway beam, in either direction perpendicular to the beam, and shall be distributed with new regard to the lateral stiffness of the runway beam and the supporting structure.~~

~~**1607.15.3 Longitudinal Force.** The longitudinal force on crane runway beams except for bridge cranes with hand geared bridges shall be calculated as 10% of the maximum wheel loads of the crane. The longitudinal force shall be assumed to act horizontally, at the traction surface of a runway beam, in either direction parallel to the beam.~~

**1607.14.4 1607.15 Photovoltaic panel systems.** Roof structures that provide support for *photovoltaic panel systems* shall be designed in accordance with Sections 1607.14.4.1-1607.15.1 through 1607.14.4.5-1607.15.5, as applicable.

**1607.14.4.1 1607.15.1 Roof live load.** Roof structures that support *photovoltaic panel systems* shall be designed to resist each of the following conditions:

1. Applicable uniform and concentrated roof *loads* with the *photovoltaic panel system dead loads*.

**Exception:** *Roof live loads* need not be applied to the area covered by *photovoltaic panels* where the clear space between the panels and the roof surface is 24 inches (610 mm) or less.

2. Applicable uniform and concentrated roof loads without the *photovoltaic panel system* present.

**1607.14.4.2 1607.15.2 Photovoltaic panels or modules.** The structure of a roof that supports solar *photovoltaic panels* or modules shall be designed to accommodate the full solar *photovoltaic panels* or modules and ballast *dead load*, including concentrated *loads* from support frames in combination with the *loads* from Section 1607.4.4.4 1607.15.1 and other applicable *loads*. Where applicable, snow drift *loads* created by the *photovoltaic panels* or modules shall be included.

**~~1607.14.4.3~~ 1607.15.3 Photovoltaic panels installed on open grid roof structures.** Structures with open grid framing and without a *roof deck* or sheathing supporting *photovoltaic panel systems* shall be designed to support the uniform and concentrated *roof live loads* specified in Section ~~1607.4.4.4~~ 1607.15.1, except that the uniform *roof live load* shall be permitted to be reduced to 12 psf (0.57 kN/m<sup>2</sup>).

**~~1607.14.4.4~~ 1607.15.4 Ground-mounted photovoltaic (PV) panel systems or modules installed as an independent structure.** Ground mounted photovoltaic (PV) panel systems that are independent structures and do not have accessible/occupied space underneath are not required to accommodate a roof photovoltaic *live load*. Other *loads* and combinations in accordance with Section 1605 shall be accommodated.

**~~1607.14.4.5~~ 1607.15.5 Ballasted photovoltaic panel systems.** Roof structures that provide support for ballasted *photovoltaic panel systems* shall be designed, or analyzed, in accordance with Section 1604.4; checked in accordance with Section 1604.3.6 for deflections; and checked in accordance with Section 1611 for ponding.

**TABLE 1607.1  
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L<sub>0</sub>, AND MINIMUM  
CONCENTRATED LIVE LOADS**

OCCUPAN CY OR USE		UNIFOR M (psf)	CONCENTRATED (pounds)	ALSO SEE SECTION
3	Armories and Drill rooms	150 <sup>ab</sup>	-	-
4	Assembly areas	Fixed seats (fastened to floor)	60 <sup>b</sup>	
		Follow spot, projections and control rooms	50	
		Lobbies	100 <sup>a</sup>	
		Movable seats	100 <sup>a</sup>	
		Stage floors	15	
		Platforms (assembly)	100 <sup>a</sup>	
		Bleachers, folding and telescopic seating and grandstands	100 <sup>a</sup> (See Section 1607.19)	
		Stadiums and arenas with fixed seats (fastened to the floor)	60 <sup>a</sup> (See Section 1607.19)	
	Other assembly areas	100 <sup>b</sup>		
15	Garages and vehicle floors	Passenger vehicles only garages	40 <sup>c</sup>	See Section 1607.7
		Trucks and buses		See Section 1607.8
		Fire trucks and emergency vehicles		See Section 1607.8
		Forklifts and movable equipment		See Section 1607.8
16	Handrails, guards and grab bars		See Section 1607.9	-
17	Helipads	Helicopter takeoff weight 3000 lbs (13.35 kN) or less	See Section 1607.6- 40	See Section 1607.6.1  See Section 1607.6
		Helicopter takeoff weight more than 3000 lbs (13.35 kN)	60	See Section 1607.6.1  See Section 1607.6
25	Recreational Uses	Bowling alleys, poolrooms and similar uses	75 <sup>a</sup>	
		Dance halls and ballrooms	100 <sup>a</sup>	
		Gymnasiums	100 <sup>a</sup>	
		Theater projection, control, and follow spot rooms	50	
		Ice skating rinks	250 <sup>b</sup> 100	
		Roller skating rinks	100 <sup>a</sup>	
		Public restrooms	Same as live load served but need not exceed 60 psf	
26.	Residential	One- and two-family dwellings:		Section 1607.22
		Uninhabitable attics without storage	10	
		Uninhabitable attics with storage	20	
		Habitable attics and sleeping areas	30	
		Canopies, including marquees	20	
		All other areas	40	

		Hotels and multifamily dwellings:			
		Private rooms and corridors serving them	40		
		Public rooms <del>and corridors serving them</del>	100 <sup>a</sup>		
		<u>Corridors serving public rooms</u>	<u>100</u>		
27.	Roofs	Ordinary flat, pitched, and curved roofs (that are not occupiable)	20		
		Roof areas used for assembly purposes	100 <sup>a</sup>		
		Roof areas used for occupancies other than assembly	Same as occupancy served		
		Vegetative and landscaped roofs:			
		Roof areas not intended for occupancy	20		
		Roof areas used for assembly purposes	100 <sup>a</sup>		
		Roof areas used for <del>other</del> occupancies <u>other than assembly</u>	Same as occupancy served		
		Awnings and canopies:			
		Fabric construction supported by a skeleton structure			
		All other construction, except one- and two-family dwellings	20		
		Primary roof members exposed to a work floor:			
		Single panel point of lower chord of roof trusses or any point along primary structural members supporting roofs over manufacturing, storage warehouses, and repair garages		2,000	
		All other primary roof members		300	
All roof surfaces subject to maintenance workers		300			
			Section 1607.15.2		

For SI: 1 inch= 25.4 mm, 1 square inch= 645.16 mm<sup>2</sup>,

1 square foot= 0.0929 m<sup>2</sup>,

1 pound per square foot = 0.0479 kN/m<sup>2</sup>, 1 pound = 0.004448 kN, 1 pound per cubic foot = 16 kg/m<sup>3</sup>.

- a. Live load reduction is not permitted.
- b. Live load reduction is only permitted in accordance with Section 1607.12.1.2 or Item 1 of Section 1607.12.2.
- c. Live load reduction is only permitted in accordance with Section 1607.12.1.3 or Item 2 of Section 1607.12.2.

## SECTION 1608 SNOW LOADS

**1608.1 General.** Design snow *loads* shall be determined in accordance with Chapter 7 of ASCE 7, but the design roof *load* shall be not less than that determined by Section 1607.

**Exception:** *Temporary structures* complying with Section 3103.5.1.3.

**1608.2 Ground snow loads.** The ground snow *loads* to be used in determining the design snow *loads* for roofs shall be determined in accordance with the reliability-targeted (strength based) ground snow load values in Chapter 7 of ASCE 7 or Figures 1608.2(1) and through 1608.2(2-4) for the contiguous United States and Table 1608.2 for Alaska. Site-specific case studies shall be determined in accordance with Chapter 7 of ASCE 7 and shall be approved by the *building official* made in areas designated "CS" in Figures 1608.2(1) and 1608.2(2). Ground snow loads for sites at elevations above the limits indicated in Figures 1608.2(1) and 1608.2(2) and for all sites within the CS areas shall be approved. Ground snow load determination for such sites shall be based on an extreme value statistical analysis of data available in the vicinity of the site using a value with a 2 percent annual probability of being exceeded (50-year mean recurrence interval). Snow loads are zero for Hawaii, except in mountainous regions as *approved* by the *building official*.

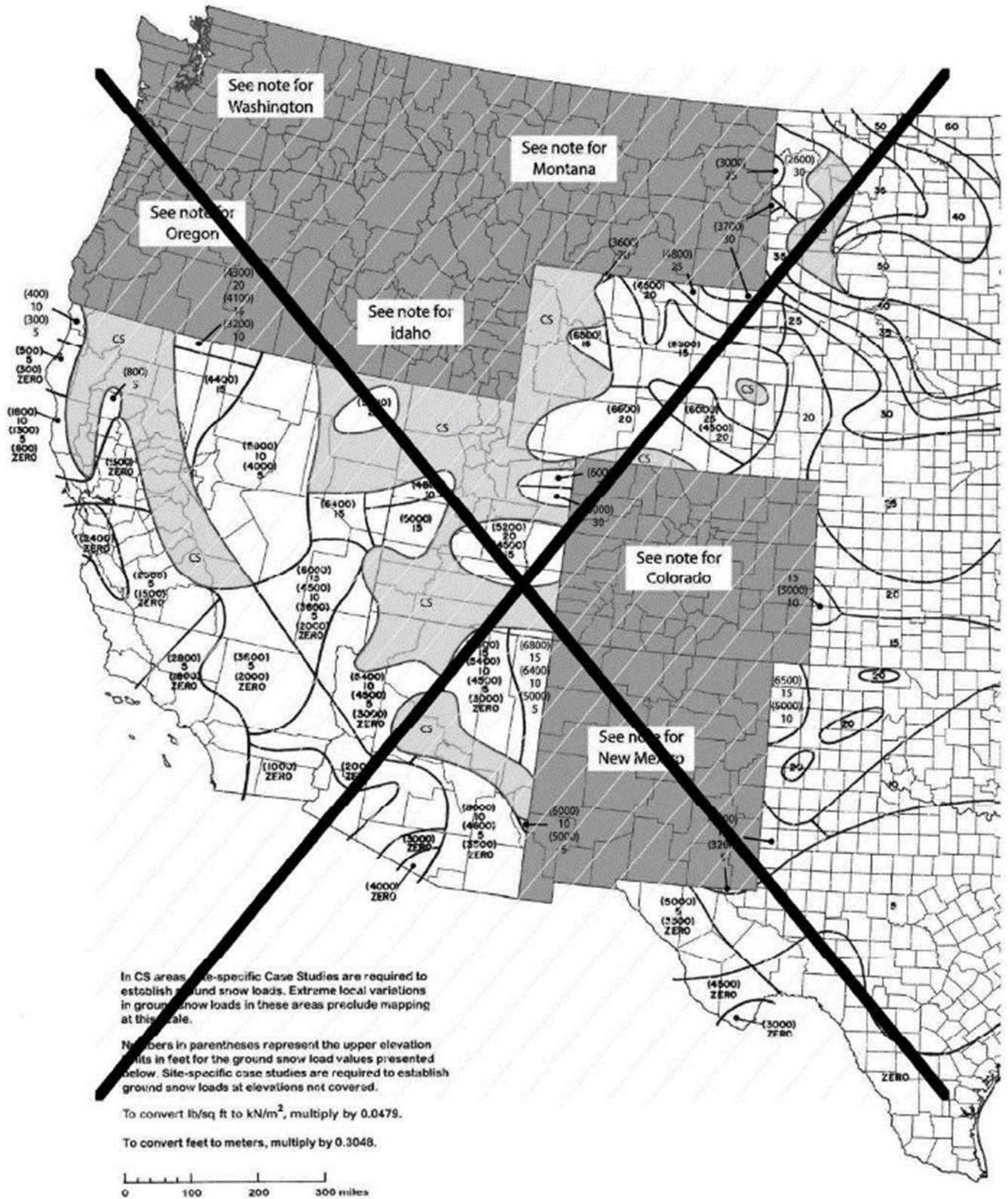
**1608.2.1 Ground snow conversion.** Where required, the ground snow loads,  $p_g$ , of Figures 1608.2(1) through 1608.2(4) shall be converted to allowable stress design ground snow loads,  $p_{g(asd)}$ , using Equation 16-17.

**(Equation 16-17)**

$$p_{g(asd)} = 0.7p_g$$

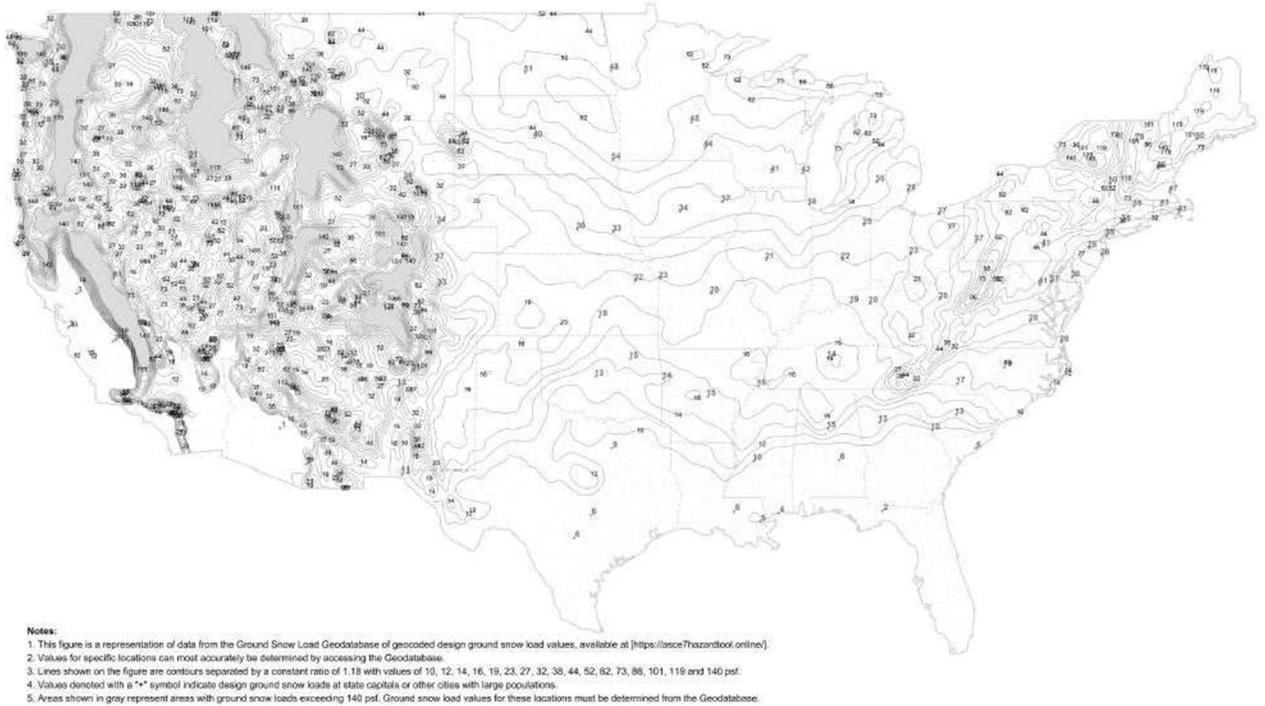
$p_{g(asd)}$  = Allowable stress design ground snow load

$p_g$  = Ground snow load determined from Figures 1608.2(1) through 1608.2(4)



**NOTE:** See ASCE 7 Table 7.2-2 for Colorado, Table 7.2-3 for Idaho, Table 7.2-4 for Montana, Table 7.2-5 for Washington, Table 7.2-6 for New Mexico and Table 7.2-7 for Oregon.

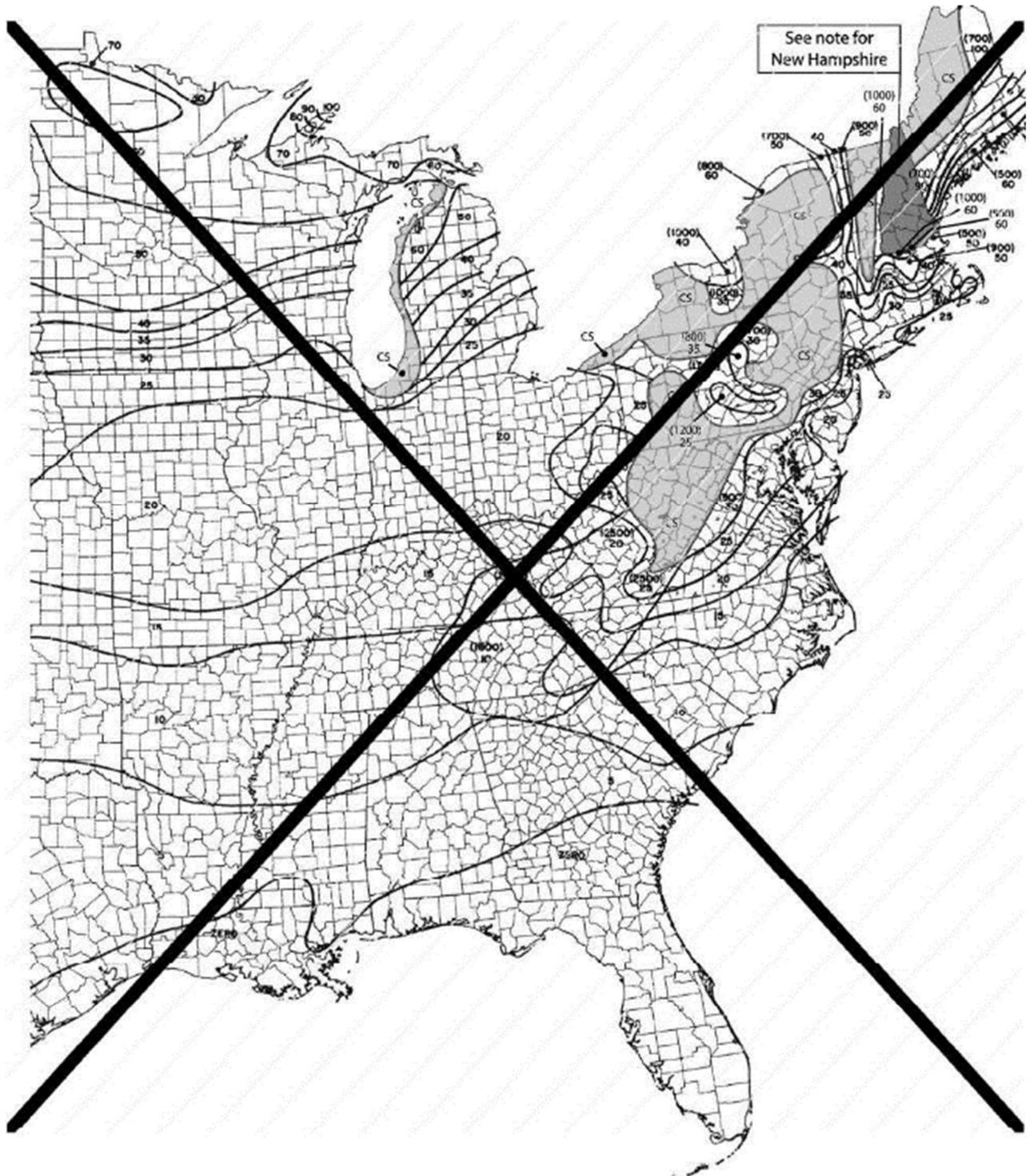
**FIGURE 1608.2(1) GROUND SNOW LOADS,  $p_g$ , FOR THE UNITED STATES (psf)**



**NOTES:**

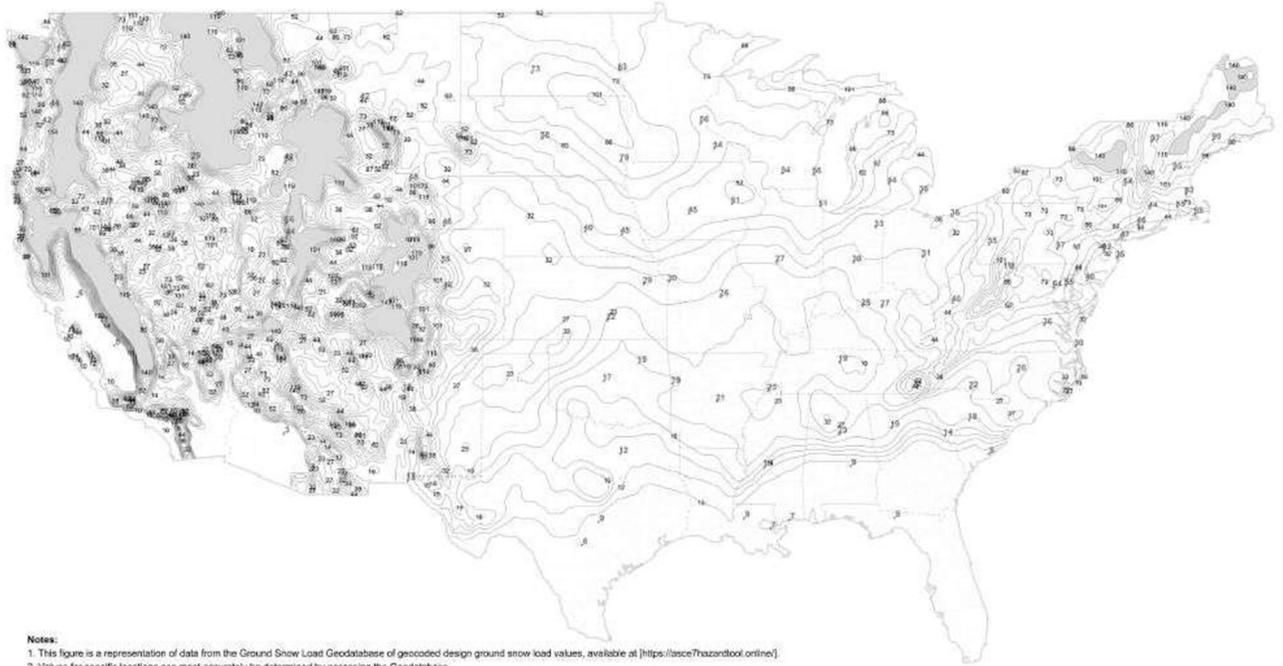
- a) Location-specific ground snow load values are provided in the *Ground Snow Load Geodatabase* of geocoded design ground snow load values, which can be accessed at the ASCE 7 Hazard Tool at <https://asce7hazardtool.online/> or an approved equivalent.
- b) Lines shown on the figure are contours separated by a constant ratio 1.18 with values of 10, 12, 14, 16, 19, 23, 27, 32, 38, 44, 52, 62, 73, 86, 101, 119, and 140 psf.
- c) Values denoted with a "+" symbol indicate design ground snow loads at state capitals or other high-population locations.
- d) Areas shown in gray represent areas with ground snow loads exceeding 140 psi. Ground snow load values for these locations can be determined from the Geodatabase.

**FIGURE 1608.2(1) Ground snow loads,  $p_g$ , for Risk Category I for the conterminous United States (lb/ft<sup>2</sup>)**



Note: See ASCE 7 Table 7.2-8 for New Hampshire.

FIGURE 1608.2(2) GROUND SNOW LOADS,  $p_g$ , FOR THE UNITED STATES (psf)

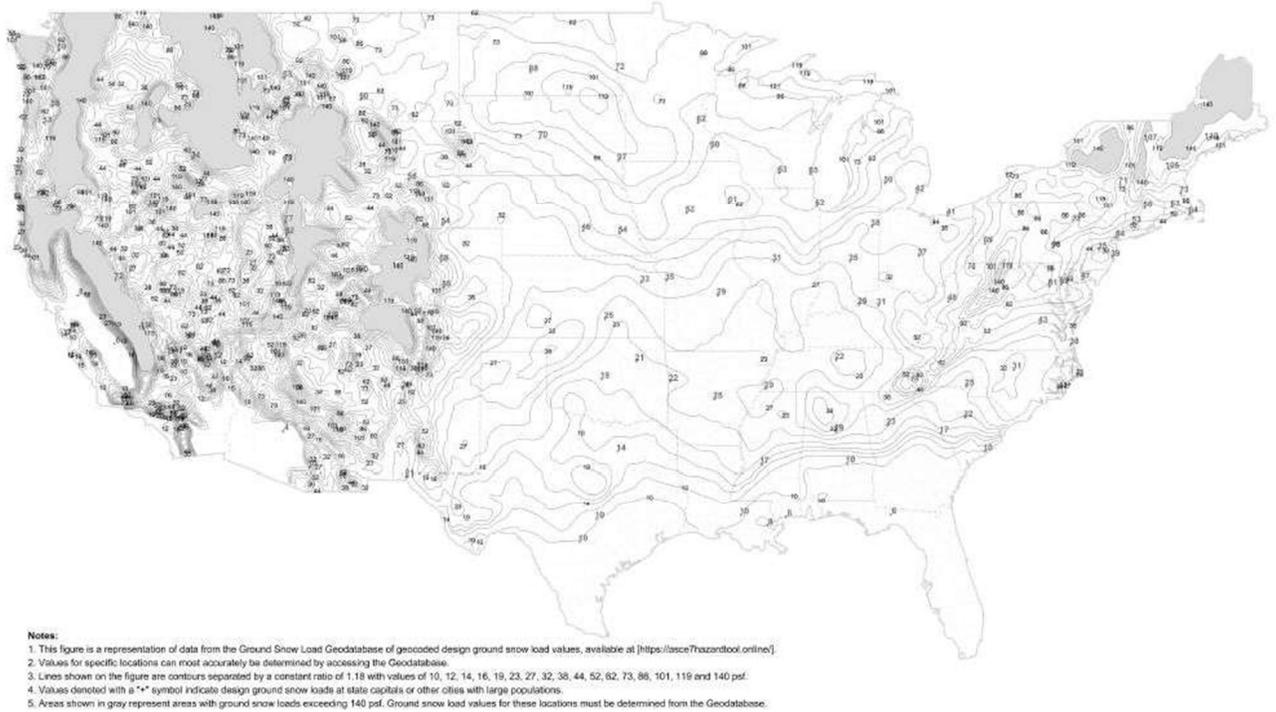


Notes:  
 1. This figure is a representation of data from the Ground Snow Load Geodatabase of geocoded design ground snow load values, available at [<https://asce7hazardtool.online/>].  
 2. Values for specific locations can most accurately be determined by accessing the Geodatabase.  
 3. Lines shown on the figure are contours separated by a constant ratio of 1.18 with values of 10, 12, 14, 16, 19, 23, 27, 32, 38, 44, 52, 62, 73, 86, 101, 119 and 140 psf.  
 4. Values denoted with a "+" symbol indicate design ground snow loads at state capitals or other cities with large populations.  
 5. Areas shown in gray represent areas with ground snow loads exceeding 140 psf. Ground snow load values for these locations must be determined from the Geodatabase.

**NOTES:**

- a) Location-specific ground snow load values are provided in the *Ground Snow Load Geodatabase* of geocoded design ground snow load values, which can be accessed at the ASCE 7 Hazard Tool at <https://asce7hazardtool.online/> or an approved equivalent.
- b) Lines shown on the figure are contours separated by a constant ratio 1.18 with values of 10, 12, 14, 16, 19, 23, 27, 32, 38, 44, 52, 62, 73, 86, 101, 119, and 140 psf.
- c) Values denoted with a "+" symbol indicate design ground snow loads at state capitals or other high-population locations.
- d) Areas shown in gray represent areas with ground snow loads exceeding 140 psi. Ground snow load values for these locations can be determined from the Geodatabase.

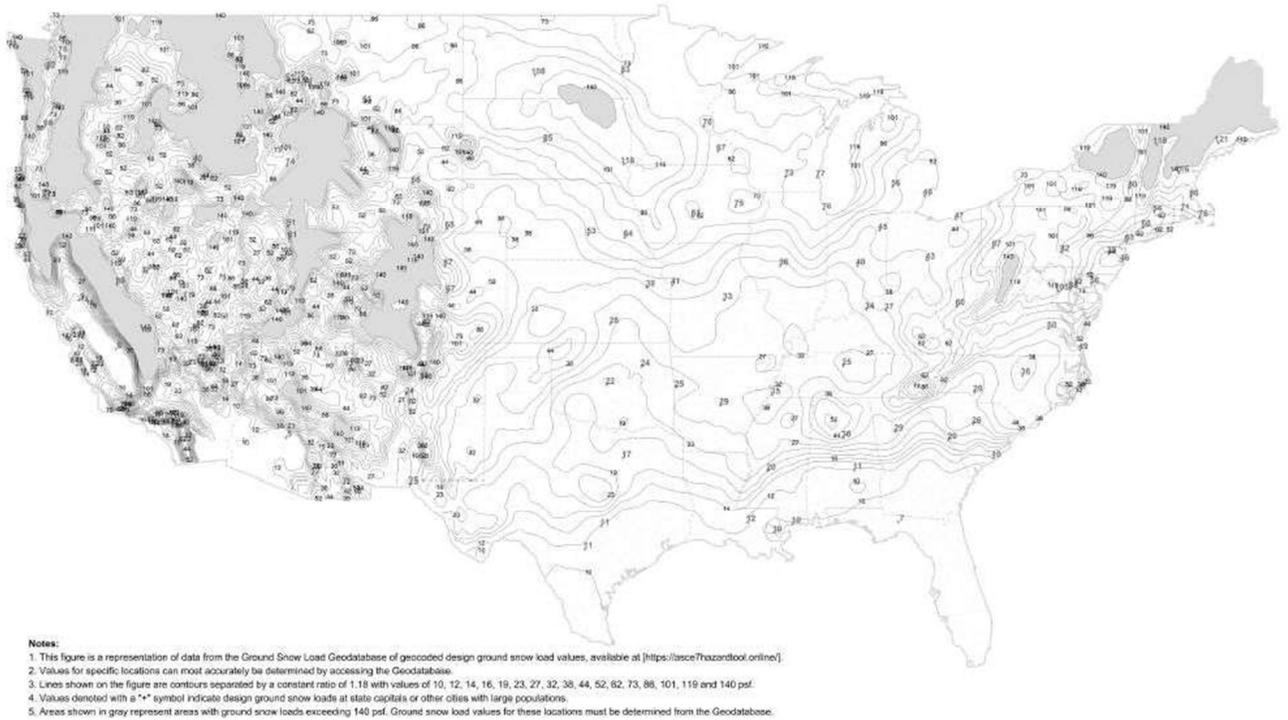
**FIGURE 1608.2(2) Ground snow loads,  $p_g$ , for Risk Category II for the conterminous United States (lb/ft<sup>2</sup>)**



**NOTES:**

- a) Location-specific ground snow load values are provided in the *Ground Snow Load Geodatabase* of geocoded design ground snow load values, which can be accessed at the ASCE 7 Hazard Tool at <https://asce7hazardtool.online/> or an approved equivalent.
- b) Lines shown on the figure are contours separated by a constant ratio 1.18 with values of 10, 12, 14, 16, 19, 23, 27, 32, 38, 44, 52, 62, 73, 86, 101, 119, and 140 psf.
- c) Values denoted with a "+" symbol indicate design ground snow loads at state capitals or other high-population locations.
- d) Areas shown in gray represent areas with ground snow loads exceeding 140 psi. Ground snow load values for these locations can be determined from the Geodatabase.

**FIGURE 1608.2(3) Ground snow loads,  $p_g$ , for Risk Category III for the conterminous United States (lb/ft<sup>2</sup>)**



**NOTES:**

- a) Location-specific ground snow load values are provided in the *Ground Snow Load Geodatabase* of geocoded design ground snow load values, which can be accessed at the ASCE 7 Hazard Tool at <https://asce7hazardtool.online/> or an approved equivalent.
- b) Lines shown on the figure are contours separated by a constant ratio 1.18 with values of 10, 12, 14, 16, 19, 23, 27, 32, 38, 44, 52, 62, 73, 86, 101, 119, and 140 psf.
- c) Values denoted with a "+" symbol indicate design ground snow loads at state capitals or other high-population locations.
- d) Areas shown in gray represent areas with ground snow loads exceeding 140 psi. Ground snow load values for these locations can be determined from the Geodatabase.

**FIGURE 1608.2(4) Ground snow loads,  $p_g$ , for Risk Category IV for the conterminous United States (lb/ft<sup>2</sup>)**

**SECTION 1609  
WIND LOADS**

**1609.1.1 Determination of wind loads.** Wind loads on every building or structure shall be determined in accordance with Chapters 26 to 30 of ASCE 7. The type of opening protection required the basic design wind speed,  $V$ , and the exposure category for a site is permitted to be determined in accordance with Section 1609 or ASCE 7. Wind shall be assumed to come from any horizontal direction and wind pressures shall be assumed to act normal to the surface considered.

**Exceptions:**

1. Subject to the limitations of Section 1609.1.1.1, the provisions of ICC 600 shall be permitted for applicable Group R-2 and R-3 buildings.
2. Subject to the limitations of Section 1609.1.1.1, residential structures using the provisions of AWC WFCM.
3. Subject to the limitations of Section 1609.1.1.1, residential structures using the provisions of AISI S230.
4. Designs using NAAMM FP 1001.
5. Designs using TIA-222 for antenna-supporting structures and antennas, provided that the horizontal extent of Topographic Category 2 escarpments in Section 2.6.6.2 of TIA-222 shall be 16 times the height of the escarpment.
6. Wind tunnel tests in accordance with ASCE 49 and Sections 31.4 and 31.5 of ASCE 7.
7. Temporary structures complying with Section 3103.5.1.4.

The wind speeds in Figures 1609.3(1) through ~~1609.3(12)~~1609.3(4) are basic design wind speeds,  $V$ , and shall be converted in accordance with Section 1609.3.1 to allowable stress design wind speeds,  $V_{asd}$ , when the provisions of the standards referenced in Exceptions 4 and 5 are used.

**TABLE 1609.2  
WINDBORNE DEBRIS PROTECTION FASTENING SCHEDULE FOR WOOD  
STRUCTURAL PANELS<sup>a,b,c,d</sup>**

FASTENER TYPE	FASTENER SPACING (inches)		
	Panel Span 4 feet	4 feet < Panel Span 6 feet	6 feet < Panel Span 8 feet
No. 8 wood-screw-based anchor with 2-inch embedment length	16	10	8
No. 10 wood-screw-based anchor with 2-inch embedment length	16	12	9
¼-inch diameter lag-screw-based anchor with 2-inch embedment length	16	16	16

For SI: 1 inch= 25.4 mm, 1 foot= 304.8 mm, 1 pound= 4.448 N, 1 mile per hour= 0.447 m/s.

- a. This table is based on a 140 mph basic design wind speed,  $V$ , and a 45-foot mean roof height.
- b. Fasteners shall be installed at opposing ends of the wood structural panel. Fasteners shall be located not less than 1 inch from the edge of the panel.
- c. Anchors shall penetrate through the exterior wall covering with an embedment length of 2 inches minimum into the building frame. Fasteners shall be located not less than 2 ½ inches from the edge of concrete block or concrete.
- d. Where panels are attached to masonry or masonry/stucco, they shall be attached using vibration-resistant anchors having a minimum ultimate withdrawal capacity of 1,500 pounds.

**1609.2.2 Application of ASTM E1996.** The text of Section 6.2.2 of ASTM E1996 shall be substituted as follows:

6.2.2 Unless otherwise specified, select the wind zone based on the basic design wind speed,  $V$ , as follows:

6.2.2.1 Wind Zone 1 – 130 mph basic design wind speed,  $V \leq 140$  mph.

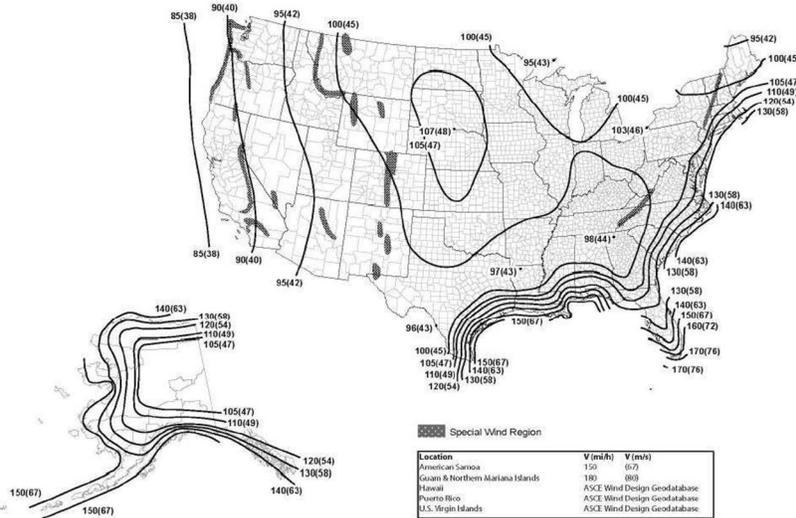
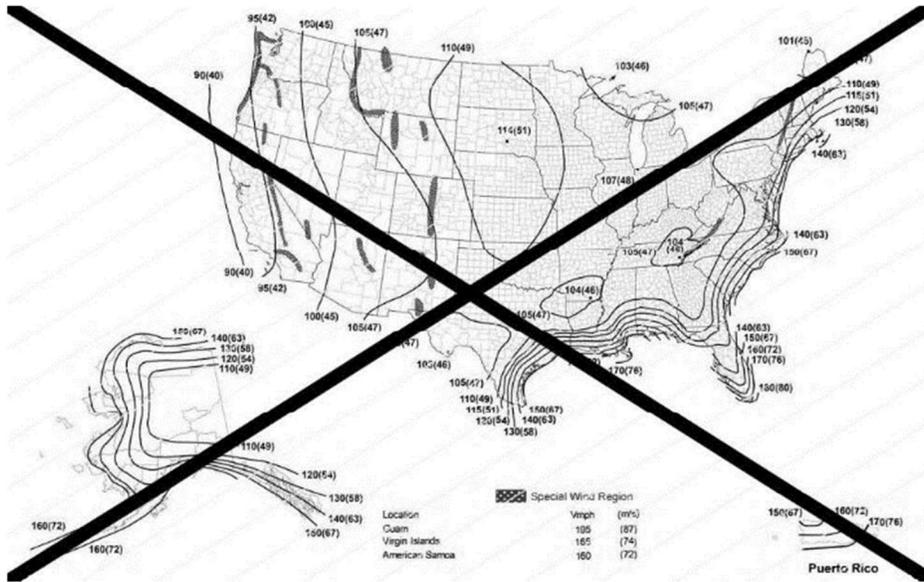
6.2.2.2 Wind Zone 2 – 140 mph > basic design wind speed,  $V \leq 150$  mph at greater than one mile (1.61 km) from the coastline. The coastline shall be measured from the mean high water mark.

6.2.2.3 Wind Zone 3 – 150 mph (67.1 m/s)  $\leq$  basic design wind speed,  $V \leq 160$  mph (71.5 m/s), or 140 mph (62.6 m/s)  $\leq$  basic design wind speed,  $V \leq 160$  mph (71.5 m/s) and within one mile (1.61 km) of the coastline. The coastline shall be measured from the mean high water mark.

6.2.2.4 Wind Zone 4 – basic design wind speed,  $V > 160$  mph (71.5 m/s).

**1609.3 Basic design wind speed.** The basic design wind speed,  $V$ , in mph, for the determination of the wind loads shall be determined by Figures 1609.3(1) through ~~1609.3(12)~~ 1609.3(4). The basic design wind speed,  $V$ , for use in the design of Risk Category ~~II~~ I buildings and structures shall be obtained from Figures 1609.3(1), ~~1609.3(5) and 1609.3(6)~~. The basic design wind speed,  $V$ , for use in the design of Risk Category ~~III~~ II buildings and structures shall be obtained from Figures ~~1609.3(2)~~, ~~1609.3(7) and 1609.3(7)~~. The basic design wind speed,  $V$ , for use in the design of Risk Category ~~IV~~ III buildings and structures shall be obtained from Figures 1609.3(3), ~~1609.3(9) and 1609.3(10)~~. The basic design wind speed,  $V$ , for use in the design of Risk Category ~~I~~ IV buildings and structures shall be obtained from Figures 1609.3(4), ~~1609.3(11) and 1609.3(12)~~. Basic wind speeds for Hawaii, US Virgin Islands, and Puerto Rico shall be determined by using the ASCE Wind Design Geodatabase. The ASCE Wind Design Geodatabase is available a <https://asce7hazardtool.online>, or an approved equivalent.

The basic design wind speed,  $V$ , for the special wind regions indicated near mountainous terrain and near gorges shall be in accordance with local jurisdiction requirements. The basic design wind speeds,  $V$ , determined by the local jurisdiction shall be in accordance with Chapter 26 of ASCE 7. In non-hurricane-prone regions, when the basic design wind speed,  $V$ , is estimated from regional climatic data, the basic design wind speed,  $V$ , shall be determined in accordance with Chapter 26 of ASCE 7.

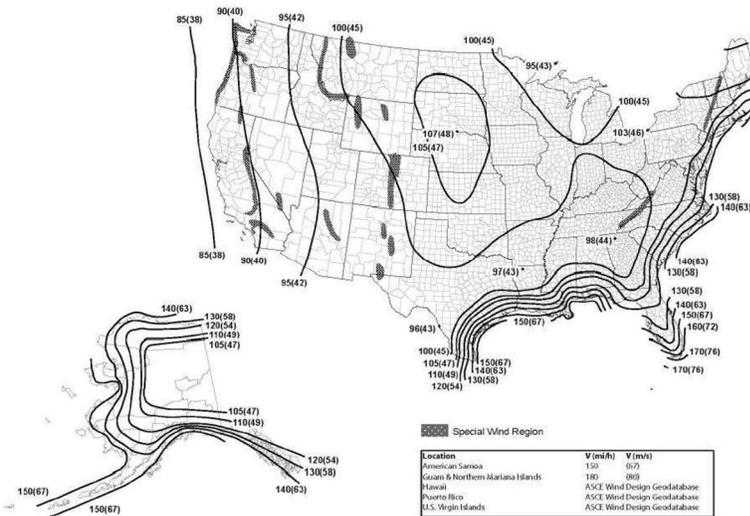
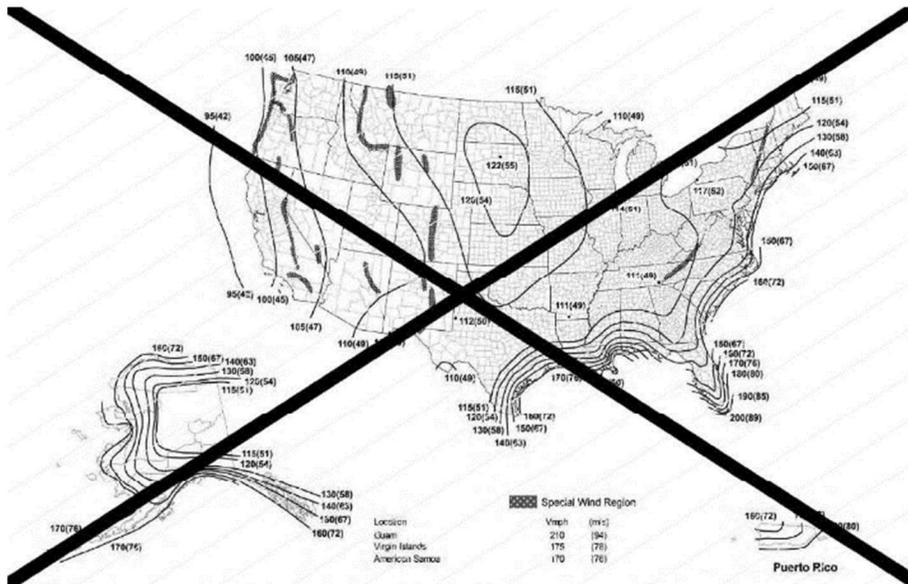


**Notes:**

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 feet (10 m) above ground for Exposure C Category.
2. Linear interpolation between contours. Point values are provided to aid with interpolation.
3. Is lands, coastal areas, and boundaries outside the last contour shall use the last wind speed contour.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (Annual Exceedance Probability 0.00143, MR 700 Years).
6. Location specific basic wind speeds shall be permitted to be determined using [www.atccouncil.org/windspeed](http://www.atccouncil.org/windspeed).

1. Values are 3 s gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure Category C.
2. Linear interpolation is permitted between contours. Point values are provided to aid with interpolation.
3. Islands, coastal areas, and land boundaries outside the last contour shall use the last wind speed contour.
4. Location-specific basic design wind speeds shall be permitted to be determined using the ASCE Wind Design Geodatabase.
5. Wind speeds for Hawaii, US Virgin Islands, and Puerto Rico shall be determined from the ASCE Wind Design Geodatabase.
6. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions. Site-specific values for selected special wind regions shall be permitted to be determined using the ASCE Wind Design Geodatabase.
7. Wind speeds correspond to approximately a 15% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00033, MRI = 300 years)
8. The ASCE Wind Design Geodatabase can be accessed at the ASCE 7 Hazard Tool (<https://asce7hazardtool.online>) or approved equivalent.

**FIGURE 1609.3(1)**  
**BASIC DESIGN WIND SPEEDS, V, FOR RISK CATEGORY II-BUILDINGS AND OTHER STRUCTURES**



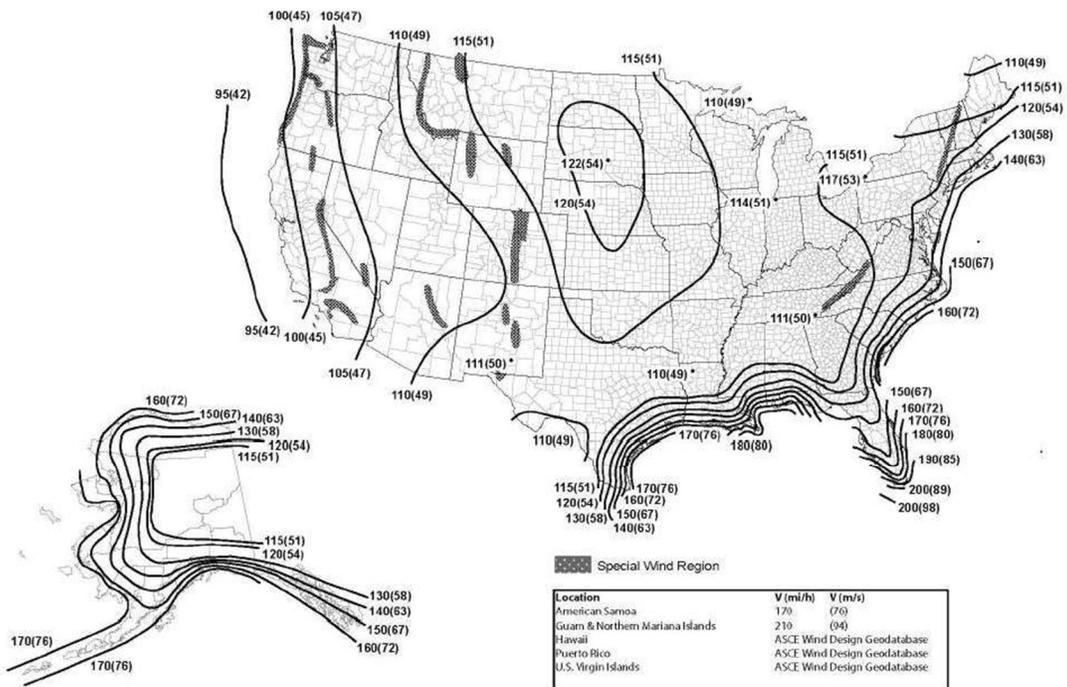
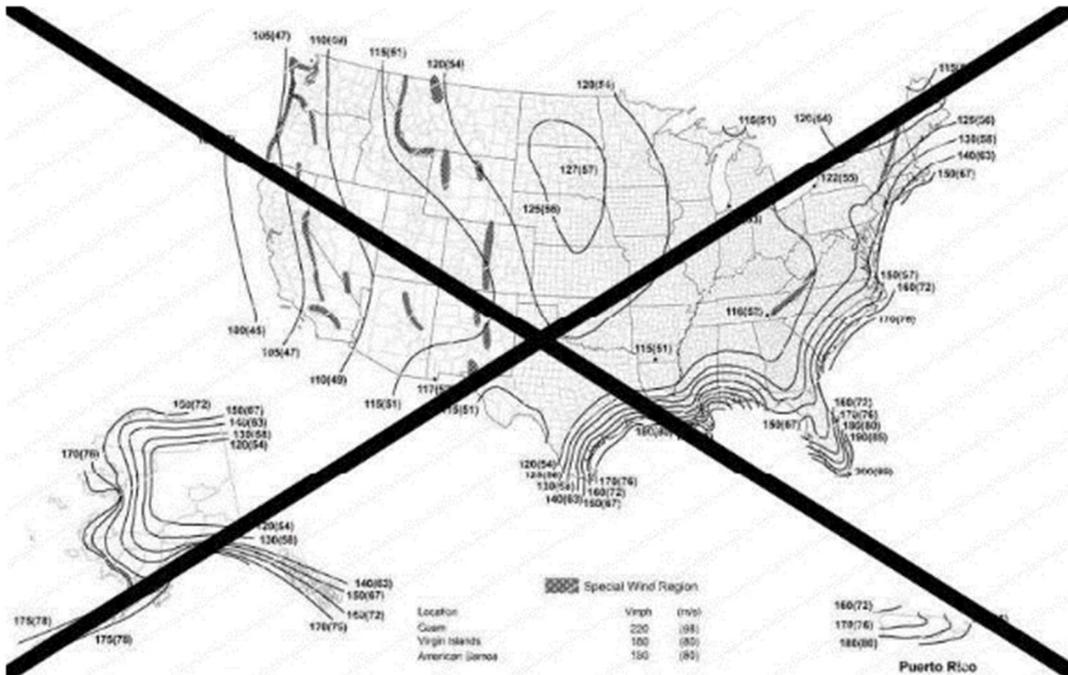
**Notes:**

1. ~~Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 feet (10 m) above ground for Exposure C Category.~~
2. ~~Linear interpolation between contours. Point values are provided to aid with interpolation.~~
3. ~~Islands, coastal areas, and boundaries outside the last contour shall use the last wind speed contour.~~
4. ~~Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.~~
5. ~~Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (Annual Exceedance Probability 0.00143, MR 700 Years).~~
6. ~~Location-specific basic wind speeds shall be permitted to be determined using [www.atccouncil.org/windspeed](http://www.atccouncil.org/windspeed).~~

1. Values are 3 s gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure Category C.
2. Linear interpolation is permitted between contours. Point values are provided to aid with interpolation.
3. Islands, coastal areas, and land boundaries outside the last contour shall use the last wind speed contour.

4. Location-specific basic design wind speeds shall be permitted to be determined using the ASCE Wind Design Geodatabase.
5. Wind speeds for Hawaii, US Virgin Islands, and Puerto Rico shall be determined from the ASCE Wind Design Geodatabase.
6. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions. Site-specific values for selected special wind regions shall be permitted to be determined using the ASCE Wind Design Geodatabase.
7. Wind speeds correspond to approximately a 15% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00033, MRI = 300 years)
8. The ASCE Wind Design Geodatabase can be accessed at the ASCE 7 Hazard Tool (<https://asce7hazardtool.online>) or approved equivalent.

**FIGURE 1609.3(2)**  
**BASIC DESIGN WIND SPEEDS,  $V$ , FOR RISK CATEGORY III-II BUILDINGS AND OTHER STRUCTURES**

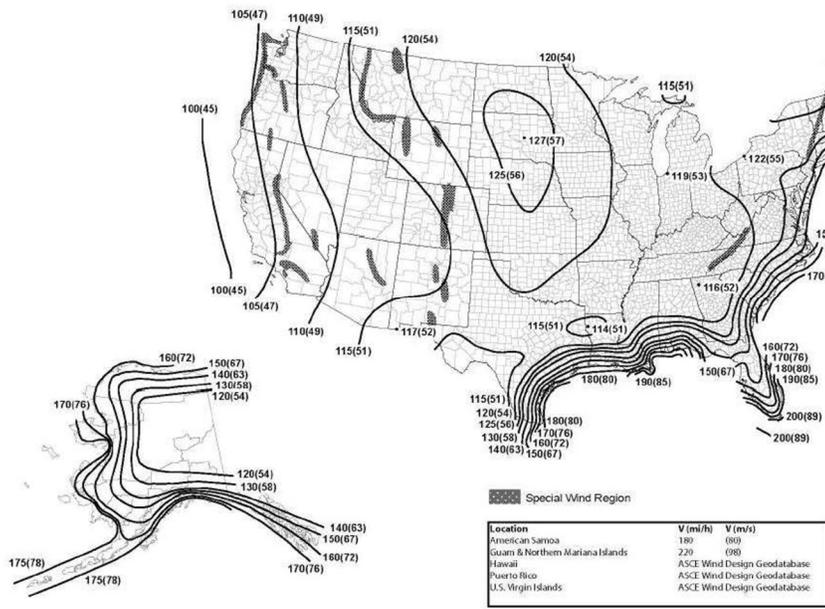
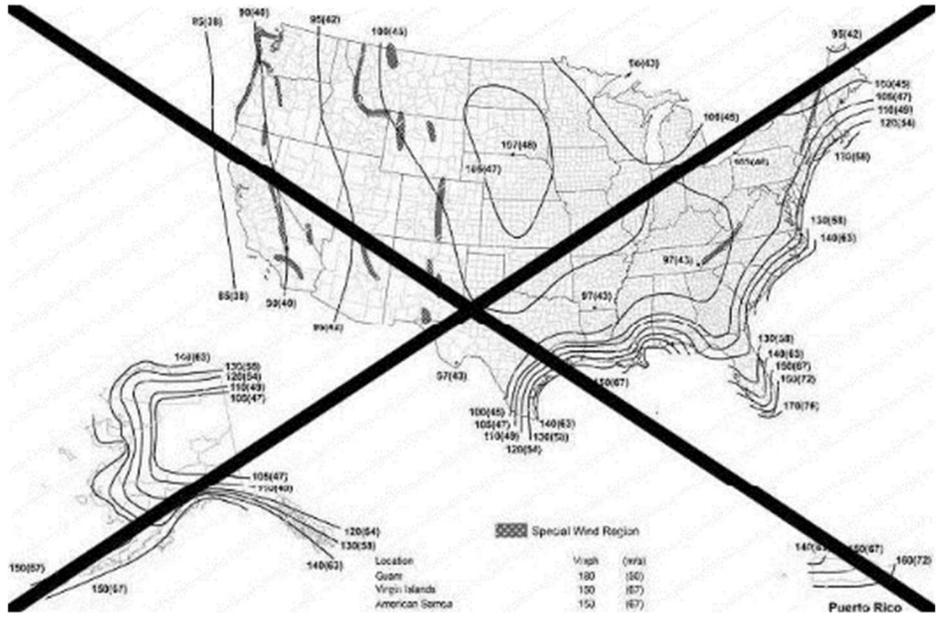


**Notes:**

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 feet (10 m) above ground for Exposure C Category.
2. Linear interpolation between contours. Point values are provided to aid with interpolation.
3. Islands, coastal areas, and boundaries outside the last contour shall use the last wind speed contour.

- ~~4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.~~
  - ~~5. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (Annual Exceedance Probability 0.00143, MR 700 Years).~~
  - ~~6. Location specific basic wind speeds shall be permitted to be determined using [www.atcouncil.org/windspeed](http://www.atcouncil.org/windspeed).~~
1. Values are 3 s gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure Category C.
  2. Linear interpolation is permitted between contours. Point values are provided to aid with interpolation.
  3. Islands, coastal areas, and land boundaries outside the last contour shall use the last wind speed contour.
  4. Location-specific basic design wind speeds shall be permitted to be determined using the ASCE Wind Design Geodatabase.
  5. Wind speeds for Hawaii, US Virgin Islands, and Puerto Rico shall be determined from the ASCE Wind Design Geodatabase.
  6. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions. Site-specific values for selected special wind regions shall be permitted to be determined using the ASCE Wind Design Geodatabase.
  7. Wind speeds correspond to approximately a 15% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00033, MRI = 300 years)
  8. The ASCE Wind Design Geodatabase can be accessed at the ASCE 7 Hazard Tool (<https://asce7hazardtool.online>) or approved equivalent.

**FIGURE 1609.3(3)**  
**BASIC DESIGN WIND SPEEDS, V, FOR RISK CATEGORY IV-III BUILDINGS AND OTHER STRUCTURES**



**Notes:**

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 feet (10 m) above ground for Exposure C Category.
2. Linear interpolation between contours. Point values are provided to aid with interpolation.
3. Islands, coastal areas, and boundaries outside the last contour shall use the last wind speed contour.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (Annual Exceedance Probability 0.00443, MR 700 Years).
6. Location-specific basic wind speeds shall be permitted to be determined using

[www.atccouncil.org/windspeed](http://www.atccouncil.org/windspeed).

1. Values are 3 s gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure Category C.
2. Linear interpolation is permitted between contours. Point values are provided to aid with interpolation.
3. Islands, coastal areas, and land boundaries outside the last contour shall use the last wind speed contour.
4. Location-specific basic design wind speeds shall be permitted to be determined using the ASCE Wind Design Geodatabase.
5. Wind speeds for Hawaii, US Virgin Islands, and Puerto Rico shall be determined from the ASCE Wind Design Geodatabase.
6. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions. Site-specific values for selected special wind regions shall be permitted to be determined using the ASCE Wind Design Geodatabase.
7. Wind speeds correspond to approximately a 15% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00033, MRI = 300 years)
8. The ASCE Wind Design Geodatabase can be accessed at the ASCE 7 Hazard Tool (<https://asce7hazardtool.online>) or approved equivalent.

**FIGURE 1609.3(4)**  
**BASIC DESIGN WIND SPEEDS, V, FOR RISK CATEGORY I-IV BUILDINGS AND OTHER STRUCTURES**

**Delete without substitution IBC 2021 Figures 1609.3(5)-1609.3(12).**

**1609.3.1 Wind speed conversion.** Where required, the basic design wind speed,  $V$ , of Figures 1609.3(1) through ~~1609.3(12)~~1609.3(4) shall be converted to *allowable stress design* wind speeds,  $V_{asd}$ , using Table 1609.3.1 or Equation 16-17

$$V_{asd} = V\sqrt{0.6} \qquad \text{Equation 16-17}$$

where:

$V_{asd}$  = *Allowable stress design* wind speed applicable to methods specified in Exceptions 4 and 5 of Section 1609.1.1.

$V$  = Basic design wind speeds determined from Figures 1609.3(1) through ~~1609.3(12)~~1609.3(4).

**TABLE 1609.3.1**  
**WIND SPEED CONVERSIONS<sup>a,b,c</sup>**

$V$	100	110	120	130	140	150	160	170	180	190	200
$V_{asd}$	78	85	93	101	108	116	124	132	139	147	155

For SI: 1 mile per hour = 0.447 m/s.

- a. Linear interpolation is permitted.
- b.  $V_{asd}$  = allowable stress design wind speed applicable to methods specified in Exceptions 1 through 5 of Section 1609.1.1.
- c.  $V$  = basic design wind speeds determined from Figures 1609.3(1) through ~~1609.3(12)~~1609.3(4).

**1609.5 Tornado Loads.** The design and construction of *Risk Category III and IV buildings and other structures* located in the tornado-prone region as shown in Figure 1609.5 shall be in accordance with Chapter 32 of ASCE 7, except as modified by this code.



**FIGURE 1609.5  
TORNADO-PRONE REGION**

**1609.5 1609.6 Roof systems.** Roof systems shall be designed and constructed in accordance with Sections 1609.5.4 1609.6.1 through 1609.5.3 1609.6.3 as applicable.

**1609.5.4 1609.6.1 Roof deck.** The *roof deck* shall be designed to withstand the greater of wind pressures or tornado pressures determined in accordance with ASCE 7.

**1609.5.2 1609.6.2 Roof coverings.** *Roof coverings* shall comply with Section 1609.5.4 1609.6.1.

**Exception:** Rigid tile *roof coverings* that are air permeable and installed over a *roof deck* complying with Section 1609.5.4 1609.6.1 are permitted to be designed in accordance with Section 1609.6.3 1609.6.3.

Asphalt shingles installed over a *roof deck* complying with Section 1609.5.4 1609.6.1 shall comply with the wind-resistance requirements of Section 1504.2.

**1609.6.3 Rigid Tile.** Wind and tornado load on rigid tiles shall comply with Sections 1609.6.3.1 or 1609.6.3.2, as applicable.

**1609.5.3 1609.6.3.1 Rigid Tile Wind loads.** Wind loads on rigid tile *roof coverings* shall be determined in accordance with the following equation:

$$M_a = q_h K_d C_L b L L_a \left[ 1.0 - (GC_p) \right] \quad \text{(Equation 16-18)}$$

For SI:

$$M_a = q_h K_d C_L b L L_a \left[ 1.0 - (GC_p) \right] / 1000$$

where:

$b$  = Exposed width, feet (mm) of the roof tile.

$C_L$  = Lift coefficient. The lift coefficient for concrete and clay tile shall be 0.2 or shall be determined by test in accordance with Section 1504.3.1.

$(GC_p)$  = Roof pressure coefficient for each applicable roof zone determined from Chapter 30 of ASCE 7. Roof coefficients shall not be adjusted for internal pressure.

$K_d$  = Wind directionality factor determined from Chapter 26 of ASCE7.

$L$  = Length, feet (mm) of the roof tile.

$L_a$  = Moment arm, feet (mm) from the axis of rotation to the point of uplift on the roof tile. The point of uplift shall be taken at 0.76L from the head of the tile and the middle of the exposed width. For roof tiles with nails or screws (with or without a tail clip), the axis of rotation shall be taken as the head of the tile for direct deck application or as the top edge of the batten for battened applications. For roof tiles fastened only by a nail or screw along the side of the tile, the axis of rotation shall be determined by testing. For roof tiles installed with battens and fastened only by a clip near the tail of the tile, the moment arm shall be determined about the top edge of the batten with consideration given for the point of rotation of the tiles based on straight bond or broken bond and the tile profile.

$M_a$  = Aerodynamic uplift moment, feet-pounds (N-mm) acting to raise the tail of the tile.

$q_h$  = Wind velocity pressure, psf (kN/m<sup>2</sup>) determined from Section 26.10.2 of ASCE 7.

Concrete and clay roof tiles complying with the following limitations shall be designed to withstand the aerodynamic uplift moment as determined by this section.

1. The roof tiles shall be either loose laid on battens, mechanically fastened, *mortar* set or adhesive set.
2. The roof tiles shall be installed on solid sheathing that has been designed as components and cladding.
3. An *underlayment* shall be installed in accordance with Chapter 15.
4. The tile shall be single lapped interlocking with a minimum head lap of not less than 2 inches (51 mm).
5. The length of the tile shall be between 1.0 and 1.75 feet (305 mm and 533 mm).
6. The exposed width of the tile shall be between 0.67 and 1.25 feet (204 mm and 381 mm).
7. The maximum thickness of the tail of the tile shall not exceed 1.3 inches (33 mm).
8. Roof tiles using *mortar* set or adhesive set systems shall have not less than two-thirds of the tile's area free of *mortar* or adhesive contact.

**1609.6.3.2 Tornado Loads.** Tornado loads on rigid tile roof coverings shall be determined in accordance with Section 1609.6.3.1, replacing,  $q_h$ , with  $q_{hT}$  and  $(GC_p)$  with  $K_{VT}(GC_p)$  in Equation 16-18, where:

$q_{hT}$  = tornado velocity pressure, psf (kN/m<sup>2</sup>) determined in accordance with Section 32.10 of ASCE 7.

$K_{VT}$  = tornado pressure coefficient adjustment factor for vertical winds, determined in

accordance with Section 32.14 of ASCE 7.

## SECTION 1610 SOIL LOADS AND HYDROSTATIC PRESSURE

**1610.1 Lateral pressures.** ~~Foundation walls and retaining walls~~ Structures below grade shall be designed to resist lateral soil *loads* from adjacent soil. Soil *loads* specified in Table 1610.1 shall be used as the minimum design lateral soil *loads* unless determined otherwise by a geotechnical investigation in accordance with Section 1803. Foundation walls and other walls in which horizontal movement is restricted at the top shall be designed for at-rest pressure. ~~Retaining walls~~ Walls that are free to move and rotate at the top, such as retaining walls, shall be permitted to be designed for active pressure.

Where applicable, lateral ~~lateral~~ pressure from fixed or moving surcharge *loads* shall be added to the lateral soil *load*. Lateral pressure shall be increased if expansive soils are present at the site. Foundation walls shall be designed to support the weight of the full hydrostatic pressure of undrained backfill unless a drainage system is installed in accordance with Sections 1805.4.2 and 1805.4.3.

**Exception:** Foundation walls extending not more than 8 feet (2438 mm) below grade and laterally supported at the top by flexible *diaphragms* shall be permitted to be designed for active pressure.

## SECTION 1611 RAIN LOADS

**1611.1 Design rain loads.** Each portion of a roof shall be designed to sustain the *load* of rainwater as per the requirements of Chapter 8 of ASCE 7. Rain loads shall be based on the summation of the static head,  $d_s$ , hydraulic head,  $d_h$ , and ponding head,  $d_p$ , using Eqn. 16-19. The hydraulic head shall be based on hydraulic test data or hydraulic calculations assuming a flow rate corresponding to a rainfall intensity equal to or greater than the 15-min duration storm with return period given in Table 1611.1. Rainfall intensity shall be determined in inches per hour for 15-minute duration storms for Risk Category given in Table 1611.1. The design rainfall shall be based on the 100-year 15-minute duration event or on other rainfall rates determined from approved local weather data. Alternatively, a design rainfall of twice the 100-year hourly rainfall rate indicated in Figures 1611.1(1) through 1611.1(5) shall be permitted. The ponding head shall be based on structural analysis as the depth of water due to deflections of the roof subjected to unfactored rain load and unfactored dead load.

$$R = 5.2 (d_s + d_h + d_p) \quad \text{(Equation 16-19)}$$

For SI:

$$R = 0.0098(d_s + d_h + d_p)$$

where:

$d_h$  = hydraulic head equal to the depth of water on the undeflected roof above the inlet of the secondary drainage system for structural loading (SDSL) required to achieve the design flow in inches (mm). Additional depth of water on the undeflected roof above the

~~inlet of secondary drainage system at its design flow (in other words, the hydraulic head) in inches (mm).~~

~~$d_s$  = static head equal to the depth of water on the undeflected roof up to the inlet of the secondary drainage system for structural loading (SDSL) in inches (mm). Depth of water on the undeflected roof up to the inlet of the secondary drainage system when the primary drainage system is blocked (in other words, the static head) in inches (mm).~~

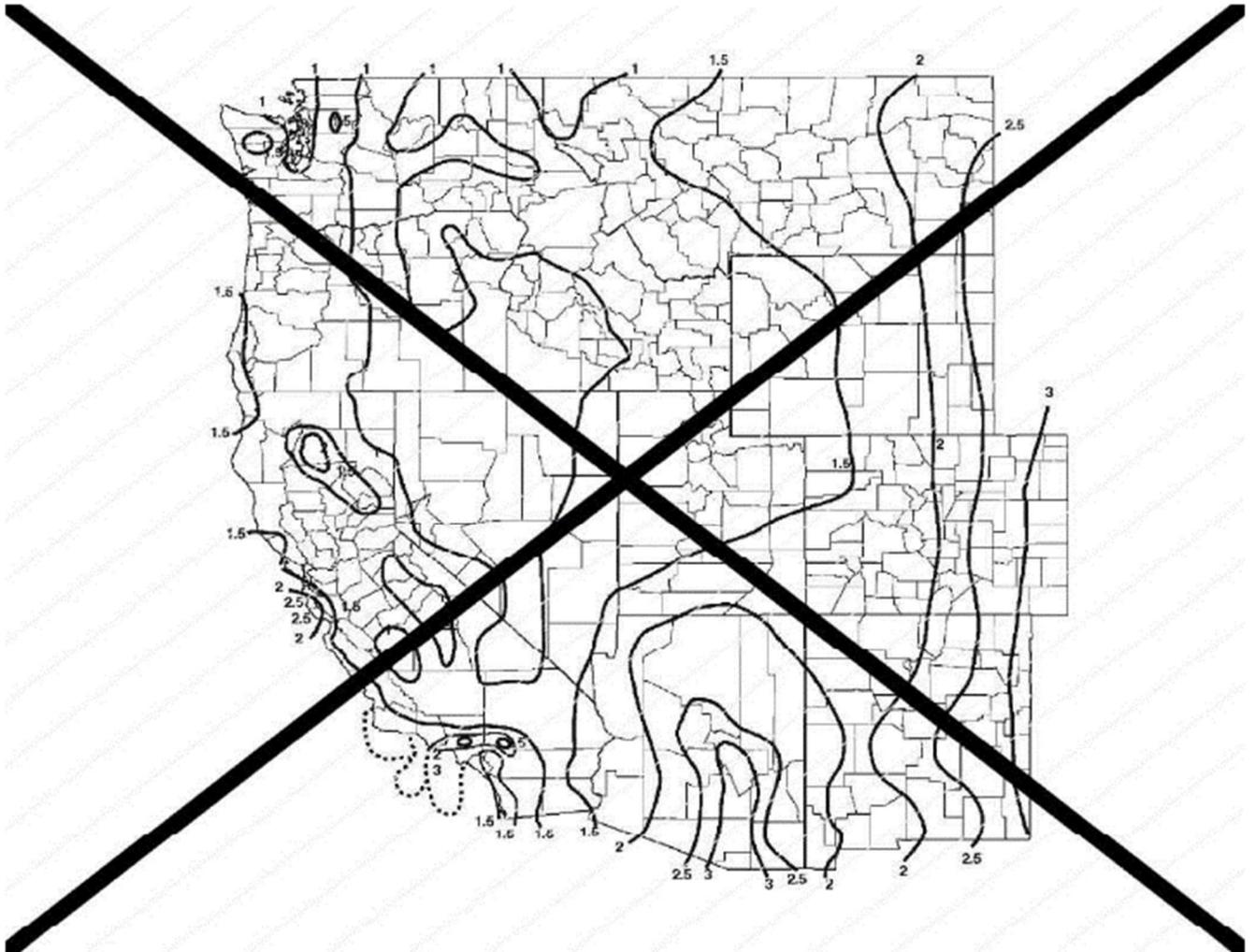
~~$d_p$  = ponding head equ to the depth of water due to deflections of the roof subjected to unfactored rain load and unfactored dead load, in in. (mm)~~

~~$R$  = Rain load, on the undeflected roof in psf (kN/m<sup>2</sup>). Where the phrase “undeflected roof” is used, deflections from loads, including dead loads, shall not be considered when determining the amount of rain on the roof.~~

~~SDSL is the roof drainage system through which water is drained from the roof when the drainage systems listed in ASCE 7 Section 8.2 (a) through (d) are blocked or not working.~~

**TABLE 1611.1**  
**DESIGN STORM RETURN PERIOD BY RISK CATEGORY**

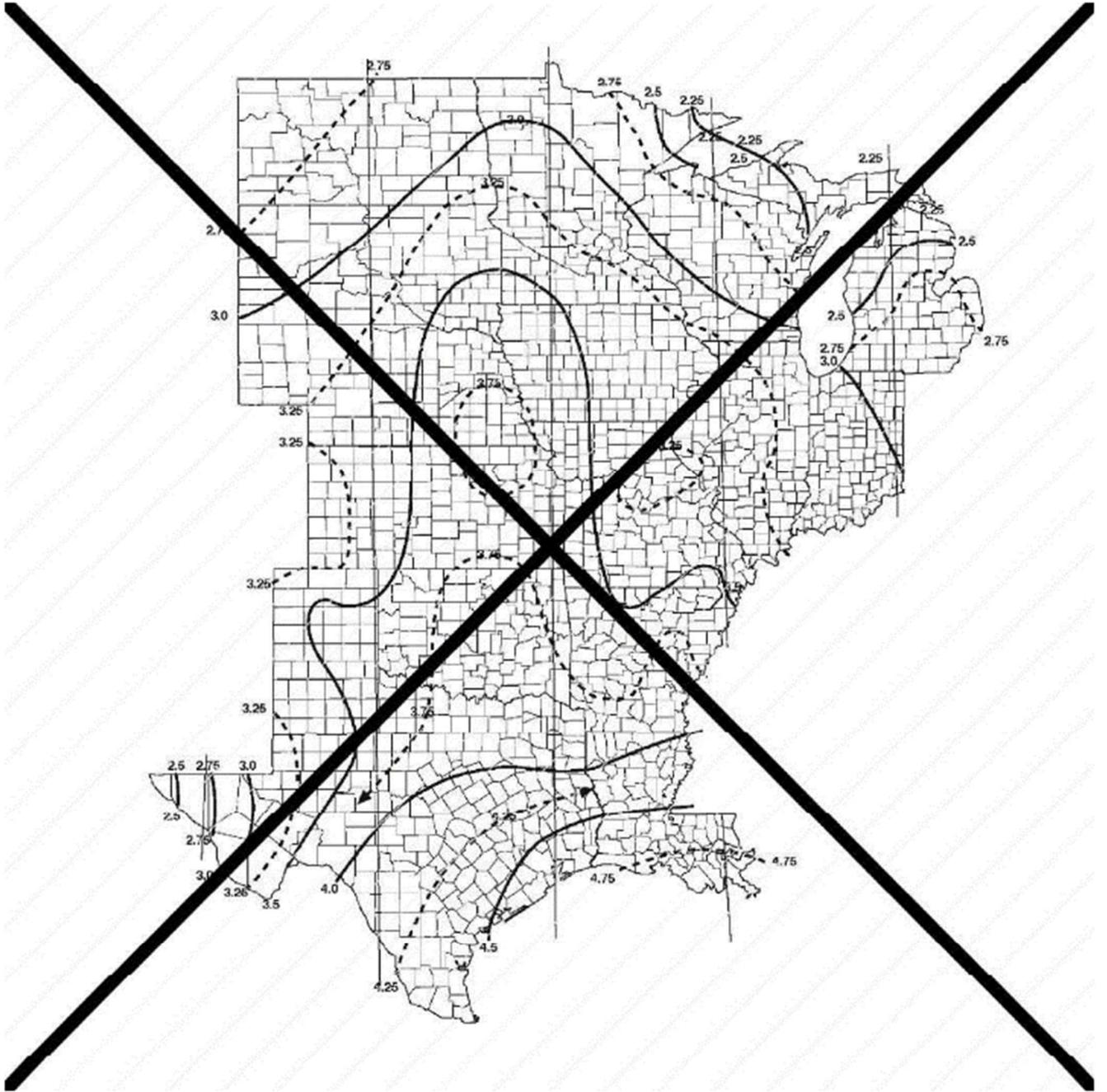
<u>Risk Category</u>	<u>Design Storm Return Period</u>
<u>I &amp; II</u>	<u>100 Years</u>
<u>III</u>	<u>200 Years</u>
<u>IV</u>	<u>500 Years</u>



For SI: 1 inch = 25.4 mm.

Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington, DC.

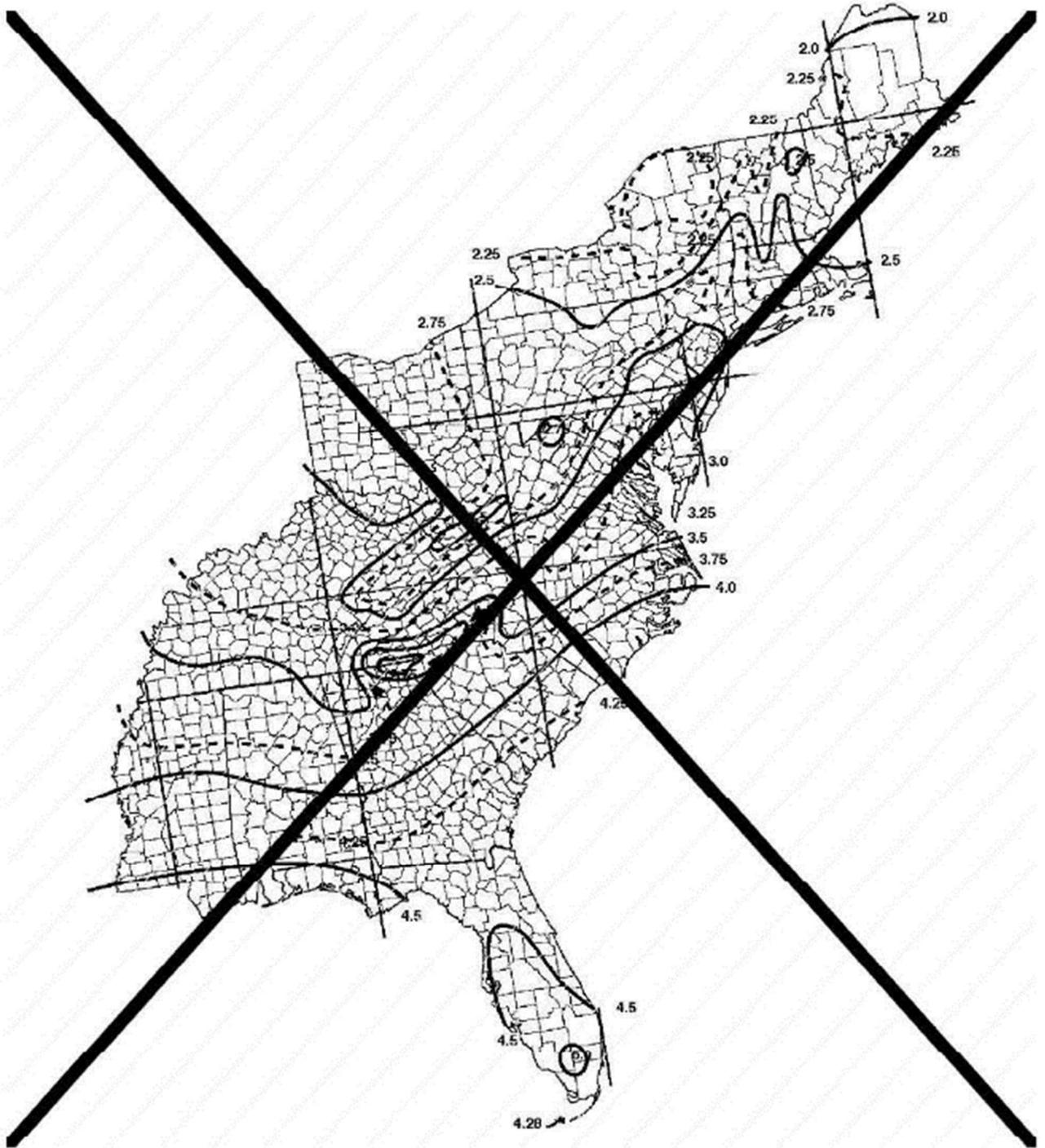
**FIGURE 1611.1(1) 100-YEAR, 1-HOUR RAINFALL (INCHES) WESTERN UNITED STATES**



For SI: 1 inch = 25.4 mm.

Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington, DC.

**FIGURE 1611.1(2) 100-YEAR, 1-HOUR RAINFALL (INCHES) CENTRAL UNITED STATES**

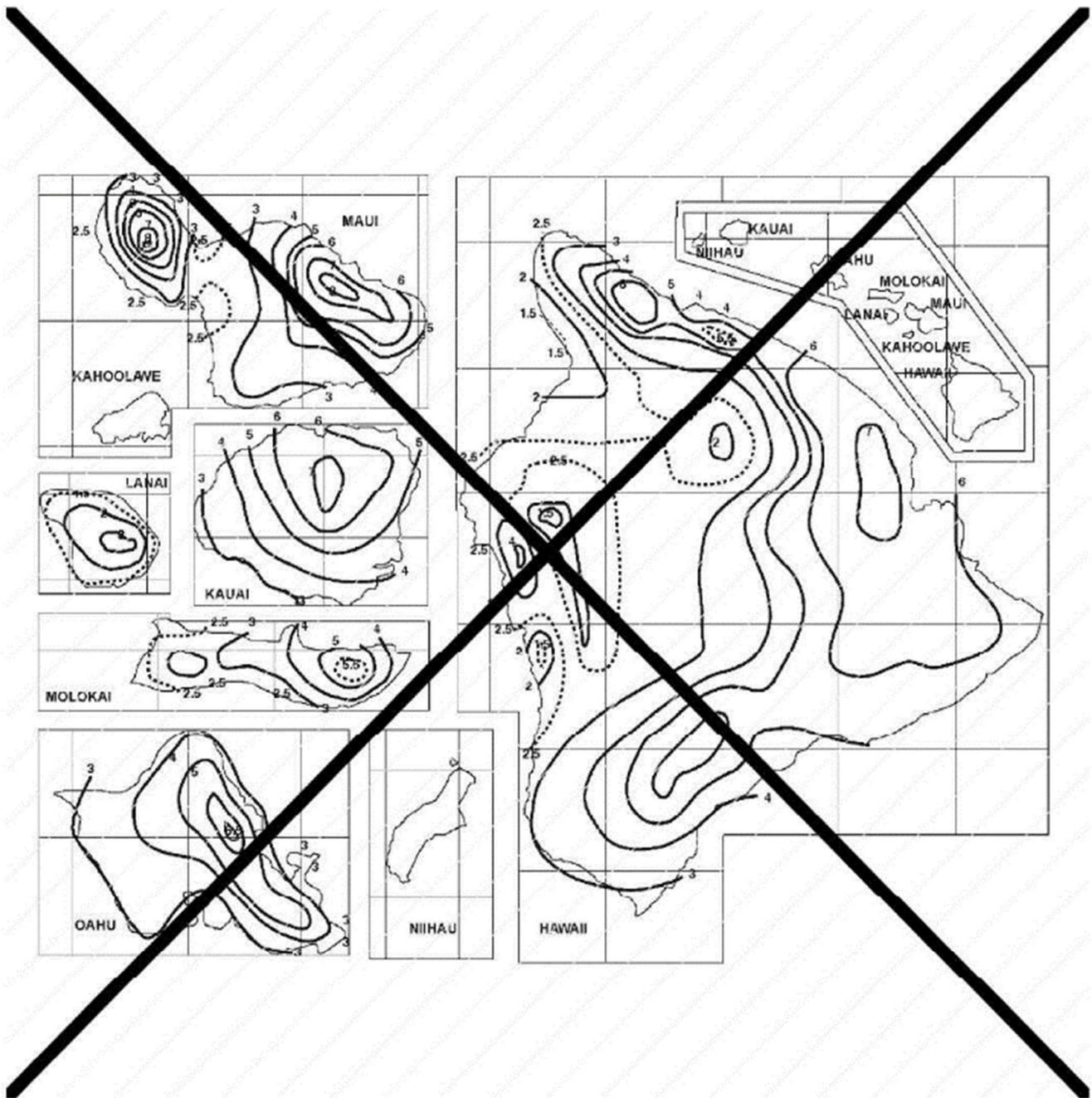


For SI: 1 inch = 25.4 mm.

Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington, DC.

**FIGURE 1611.1(3) 100-YEAR, 1-HOUR RAINFALL (INCHES) EASTERN UNITED STATES**





For SI: 1 inch = 25.4 mm.

Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington, DC.

**FIGURE 1611.1(5) 100-YEAR, 1-HOUR RAINFALL (INCHES) HAWAII**

## SECTION 1612 FLOOD LOADS

**1612.2 Design and construction.** The design and construction of buildings and structures located in *flood hazard areas*, including *coastal high hazard areas* and *coastal A zones*, shall be in accordance with Chapter 5 of ASCE 7 and ASCE 24.

**Exception:** Temporary structures complying with Section 3103.5.1.5.

## SECTION 1613 EARTHQUAKE LOAD

**1613.1 Scope.** Every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motions in accordance with Chapters 11, 12, 13, 15, 17 and 18 of ASCE 7, as applicable. The *seismic design category* for a structure is permitted to be determined in accordance with Section 1613 or ASCE 7.

### Exceptions:

1. Detached one- and two-family dwellings, assigned to *Seismic Design Category A, B or C*, or located where the mapped short-period spectral response acceleration,  $S_s$ , is less than 0.4g.
2. The *seismic force-resisting system* of wood-frame buildings that conform to the provisions of Section 2308 are not required to be analyzed as specified in this section.
3. Agricultural storage structures intended only for incidental human occupancy.
4. Structures that require special consideration of their response characteristics and environment that are not addressed by this code or ASCE 7 and for which other regulations provide seismic criteria, such as vehicular bridges, electrical transmission towers, hydraulic structures, buried utility lines and their appurtenances and nuclear reactors.
5. References within ASCE 7 to Chapter 14 shall not apply, except as specifically required herein.
6. Temporary structures complying with Section 3103.5.1.6.

## SECTION 1614 ATMOSPHERIC ICE LOADS

**1614.1 General.** *Ice-sensitive structures* shall be designed for atmospheric ice loads in accordance with Chapter 10 of ASCE 7. Public-occupancy temporary structures shall comply with Section 3103.7.3.

**Exception:** Temporary structures complying with Section 3103.5.1.7.

**SECTION 1615  
TSUNAMI LOADS**

**1615.1 General.** The design and construction of *Risk Category III* and *IV* buildings and structures located in the *Tsunami Design Zones* defined in the *Tsunami Design Geodatabase* shall be in accordance with Chapter 6 of ASCE 7, except as modified by this code.

**Exception:** *Temporary structures complying with Section 3103.5.1.8.*

# CHAPTER 17

## SPECIAL INSPECTIONS AND TESTS

### SECTION 1705 REQUIRED SPECIAL INSPECTIONS AND TESTS

**1705.12 Special inspections for wind resistance.** *Special inspections* for wind resistance specified in Sections 1705.12.1 through 1705.12.3, unless exempted by the exceptions to Section 1704.2, are required for buildings and structures constructed in the following areas:

1. In wind Exposure Category B, where basic wind speed,  $V$  is 150 miles per hour (67.1 m/sec) or greater.
2. In wind Exposure Category C or D, where basic wind speed,  $V$  is 140 mph (62.6 m/sec) or greater.

# CHAPTER 18

## SOILS AND FOUNDATIONS

### SECTION 1808 FOUNDATIONS

**1808.3 Design loads.** Foundations shall be designed for the most unfavorable effects due to the combinations of *loads* specified in Section 2.3 or 2.4 of ASCE 7 or the alternative allowable stress design load combinations of Section 1605.2. The *dead load* is permitted to include the weight of foundations and overlying fill. Reduced *live loads*, as specified in Sections 1607.12 and ~~1607.14~~ 1607.13, shall be permitted to be used in the design of foundations.

# CHAPTER 23

## WOOD

### SECTION 2304 GENERAL CONSTRUCTION REQUIREMENTS

**2304.6.1 Wood structural panel sheathing.** Where *wood structural* panel sheathing is used as the exposed finish on the outside of *exterior walls*, it shall have an exterior exposure durability classification. Where *wood structural* pane/sheathing is used elsewhere, but not as the exposed finish, it shall be of a type manufactured with exterior glue (Exposure 1 or Exterior). *Wood structural* panel sheathing, connections and framing spacing shall be in accordance with Table 2304.6.1 for the applicable allowable stress design wind speed and exposure category where used in enclosed buildings with a mean roof height not greater than 30 feet (9144 mm) and a topographic factor ( $K_{zt}$ ) of 1.0.

**TABLE 2304.10.2  
FASTENING SCHEDULE**

DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER <sup>a</sup>	SPACING AND LOCATION
<b>Roof</b>		
1. Blocking between ceiling joists, rafters or trusses to top plate or other framing below	4-8d box (2½" x 0.113"); or 3-8d common (2½" x 0.131"); or 3-10d box (3" x 0.128"); or 3-3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	Each end, toenail
Blocking between rafters or truss not at the wall top plate, to rafter or truss	2-8d common (2½" x 0.131") 2-3" x 0.131" nails 2-3" 14 gage staples	Each end, toenail
	2-16 d common (3½" x 0.162") 3-3" x 0.131" nails 3-3" 14 gage staples	End nail
Flat blocking to truss and web filler	16d common (3½" x 0.162") @ 6" o.c. 3" x 0.131" nails @ 6" o.c. 3" x 14 gage staples @ 6" o.c	Face nail
2. Ceiling joists to top plate	4-8d box (2½" x 0.113"); or 3-8d common (2½" x 0.131"); or 3-10d box (3" x 0.128"); or 3-3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	Each joist, toenail
3. Ceiling joist not attached to parallel rafter, laps over partitions (no thrust) (see Section 2308.7.3.1, Table 2308.7.3.1)	3-16d common (3½" x 0.162"); or 4-10d box (3" x 0.128"); or 4-3" x 0.131" nails; or 4-3" 14 gage staples, 7/16" crown	Face nail
4. Ceiling joist attached to parallel rafter (heel joint) (see Section 2308.7.3.1, Table 2308.7.3.1)	Per Table 2308.7.3.1	Face nail
5. Collar tie to rafter	3-10d common (3" x 0.148"); or 4-10d box (3" x 0.128"); or 4-3" x 0.131" nails; or 4-3" 14 gage staples, 7/16" crown	Face nail
6. Rafter or roof truss to top plate (See Section 2308.7.5, Table 2308.7.5)	3-10 common (3" x 0.148"); or 3-16d box (3½" x 0.135"); or 4-10d box (3" x 0.128"); or 4-3" x 0.131 nails; or 4-3" 14 gage staples, 7/16" crown	2 toenails on one side and 1 toenail on opposite side of rafter or truss <sup>c</sup>
7. Roof rafters to ridge valley or hip rafters; or roof rafter to 2-inch ridge beam	2-16d common (3½" x 0.162"); or 3-16d box (3½" x 0.135"); or 3-10d box (3" x 0.128"); or 3-3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	End nail
	3-10d common (3½" x 0.148"); or 4-16d box (3½" x 0.135"); or 4-10d box (3" x 0.128"); or 4-3" x 0.131" nails; or 4-3" 14 gage staples, 7/16" crown	Toenail
<b>Wall</b>		
8. Stud to stud (not at braced wall panels)	16d common (3½" x 0.162");	24" o.c. face nail
	10d box (3" x 0.128"); or 3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	16" o.c. face nail

DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER <sup>a</sup>	SPACING AND LOCATION
Wall		
9. Stud to stud and abutting studs at intersecting wall corners (at braced wall panels)	16d common (3 1/2" x 0.162")	16" o.c. face nail
	16d box (3 1/2" x 0.135"); or 3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	12" o.c. face nail
10. Built-up header (2" to 2" header)	16d common (3 1/2" x 0.162")	16" o.c. each edge, face nail
	16d box (3 1/2" x 0.135")	12" o.c. each edge, face nail
11. Continuous header to stud	4-8d common (2 1/2" x 0.131"); or 4-10d box (3" x 0.128"); or 5-8d box (2 1/2" x 0.113")	Toenail
12. Top plate to top plate	16d common (3 1/2" x 0.162")	16" o.c. face nail
	10d box (3" x 0.128"); or 3" x 0.131" nails; or 3" 14 gage staples, 7/16" crown	12" o.c. face nail
13. Top plate to top plate, at end joints	8-16d common (3 1/2" x 0.162"); or 12-16d box (3 1/2" x 0.135"); or 12-10d box (3" x 0.128"); or 12-3" x 0.131" nails; or 12-3" 14 gage staples, 7/16" crown	Each side of end joint, face nail (minimum 24" lap splice length each side of end joint)
14. Bottom plate to joist, rim joist, band joist or blocking (not at braced wall panels)	16d common (3 1/2" x 0.162")	16" o.c. face nail
	16d box (3 1/2" x 0.135"); or 3" x 0.131" nails; or 3" 14 gage staples, 7/16" crown	12" o.c. face nail
15. Bottom plate to joist, rim joist, band joist or blocking at braced wall panels	2-16d common (3 1/2" x 0.162"); or 3-16d box (3 1/2" x 0.135"); or 4-3" x 0.131" nails; or 4-3" 14 gage staples, 7/16" crown	16" o.c. face nail
16. Stud to top or bottom plate	3-16d box (3 1/2" x 0.135"); or 4-8d common (2 1/2" x 0.131"); or 4-10d box (3" x 0.128"); or 4-3" x 0.131" nails; or 4-8d box (2 1/2" x 0.113"); or 4-3" 14 gage staples, 7/16" crown	Toenail
	2-16d common (3 1/2" x 0.162"); or 3-16d box (3 1/2" x 0.135"); or 3-10d box (3" x 0.128"); or 3-3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	End nail
17. Top plates, laps at corners and intersections	2-16d common (3 1/2" x 0.162"); or 3-10d box (3" x 0.128"); or 3-3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	Face nail
18. 1" brace to each stud and plate	3-8d box (2 1/2" x 0.113"); or 2-8d common (2 1/2" x 0.131"); or 2-10d box (3" x 0.128"); or 2-3" x 0.131" nails; or 2-3" 14 gage staples, 7/16" crown	Face nail
19. 1" x 6" sheathing to each bearing	3-8d box (2 1/2" x 0.113"); or 2-8d common (2 1/2" x 0.131"); or 2-10d box (3" x 0.128"); or 2-1 3/4" 16 gage staples, 1" crown	Face nail

DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER <sup>a</sup>	SPACING AND LOCATION
<b>Wall</b>		
20. 1" x 8" and wider sheathing to each bearing	3-8d common (2 1/2" x 0.131"); or 3-8d box (2 1/2" x 0.113"); or 3-10d box (3" x 0.128"); or 3-1 3/4" 16 gage staples, 1" crown	Face nail
	Wider than 1" x 8" 3-8d common (2 1/2" x 0.131"); or 4-8d box (2 1/2" x 0.113"); or 3-10d box (3" x 0.128"); or 4-1 3/4" 16 gage staples, 1" crown	
<b>Floor</b>		
21. Joist to sill, top plate, or girder	4-8d box (2 1/2" x 0.113"); or 3-8d common (2 1/2" x 0.131"); or floor 3-10d box (3" x 0.128"); or 3-3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	Toenail
22. Rim joist, band joist, or blocking to top plate, sill or other framing below	8d box (2 1/2" x 0.113")	4" o.c., toenail
	8d common (2 1/2" x 0.131"); or 10d box (3" x 0.128"); or 3" x 0.131" nails; or 3" 14 gage staples, 7/16" crown	6" o.c., toenail
23. 1" x 6" subfloor or less to each joist	3-8d box (2 1/2" x 0.113"); or 2-8d common (2 1/2" x 0.131"); or 3-10d box (3" x 0.128"); or 2-1 3/4" 16 gage staples, 1" crown	Face nail
24. 2 subfloor to joist or girder	3-16d box (3 1/2" x 0.135"); or 2-16d common (3 1/2" x 0.162")	Blind and face nail
25. 2" planks (plank & beam – floor & roof)	3-16d box (3 1/2" x 0.135"); or 2-16d common (3 1/2" x 0.162")	Each bearing, face nail
26. Built-up girders and beams, 2" lumber layers	20d common (4" x 0.192")	32" o.c., face nail at top and bottom staggered on opposite sides
	10d box (3" x 0.128"); or 3" x 0.131" nails; or 3" 14 gage staples, 7/16" crown	24" o.c. face nail at top and bottom staggered on opposite sides
	And: 2-20d common (4" x 0.192"); or 3-10d box (3" x 0.128"); or 3-3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	Ends and at each splice, face nail
27. Ledger strip supporting joists or rafters	3-16d common (3 1/2" x 0.162"); or 4-16d box (3 1/2" x 0.135"); or 4-10d box (3" x 0.128"); or 4-3" x 0.131" nails; or 4-3" 14 gage staples, 7/16" crown	Each joist or rafter, face nail
28. Joist to band joist or rim joist	3-16d common (3 1/2" x 0.162"); or 4-10d box (3" x 0.128"); or 4-3" x 0.131" nails; or 4-3" 14 gage staples, 7/16" crown	End nail
29. Bridging or blocking to joist, rafter or truss	2-8d common (2 1/2" x 0.131"); or 2-10d box (3" x 0.128"); or 2-3" x 0.131" nails; or 2-3" 14 gage staples, 7/16" crown	Each end, toenail

DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER <sup>a</sup>	SPACING AND LOCATION	
Wood structural panels (WSP), subfloor, roof and interior wall sheathing to framing and particleboard wall sheathing to framing <sup>a</sup>			
		Edges (inches)	Intermediate supports (inches)
30. $\frac{3}{8}$ " - $\frac{1}{2}$ "	6d common or deformed ( $2" \times 0.113"$ ); or $2\frac{3}{8}" \times 0.113"$ nail (subfloor and wall)	6	12
	8d common or deformed ( $2\frac{1}{2}" \times 0.131" \times 0.281"$ head) (roof) or RSRS-01 ( $2\frac{3}{8}" \times 0.113"$ ) nail (roof) <sup>d</sup>	6 <sup>e</sup>	6 <sup>e</sup>
	$1\frac{3}{4}"$ 16 gage staple, $\frac{7}{16}"$ crown (subfloor and wall)	4	8
	$2\frac{3}{8}" \times 0.113" \times 0.266"$ head nail (roof)	3 <sup>f</sup>	3 <sup>f</sup>
	$1\frac{3}{4}"$ 16 gage staple, $\frac{7}{16}"$ crown (roof)	3 <sup>f</sup>	3 <sup>f</sup>
31. $\frac{19}{32}"$ - $\frac{3}{4}"$	8d common ( $2\frac{1}{2}" \times 0.131"$ ); or deformed ( $2" \times 0.113"$ ) (subfloor and wall)	6	12
	8d common or deformed ( $2\frac{1}{2}" \times 0.131" \times 0.281"$ head) (roof) or RSRS-01 ( $2\frac{3}{8}" \times 0.113"$ ) nail (roof) <sup>d</sup>	6 <sup>e</sup>	6 <sup>e</sup>
	$2\frac{3}{8}" \times 0.113" \times 0.266"$ head nail; or 2" 16 gage staple, $\frac{7}{16}"$ crown	4	8
32. $\frac{7}{8}"$ - $1\frac{1}{4}"$	10d common ( $3" \times 0.148"$ ); or deformed ( $2\frac{1}{2}" \times 0.131" \times 0.281"$ head)	6	12
<b>Other exterior wall sheathing</b>			
33. $\frac{1}{2}"$ fiberboard sheathing <sup>b</sup>	$1\frac{1}{2}" \times 0.120"$ , galvanized roofing nail ( $\frac{7}{16}"$ head diameter); or $1\frac{1}{4}"$ 16 gage staple with $\frac{7}{16}"$ or 1" crown	3	6
34. $\frac{25}{32}"$ fiberboard sheathing <sup>b</sup>	$1\frac{3}{4}" \times 0.120"$ galvanized roofing nail ( $\frac{7}{16}"$ diameter head); or $1\frac{1}{2}"$ 16 gage staple with $\frac{7}{16}"$ or 1" crown	3	6
<b>Wood structural panels, combination subfloor underlayment to framing</b>			
35. $\frac{3}{4}"$ and less	8d common ( $2\frac{1}{2}" \times 0.131"$ ); or deformed ( $2" \times 0.113"$ ); or deformed ( $2" \times 0.120"$ )	6	12
36. $\frac{7}{8}"$ - 1"	8d common ( $2\frac{1}{2}" \times 0.131"$ ); or deformed ( $2\frac{1}{2}" \times 0.131"$ ); or deformed ( $2\frac{1}{2}" \times 0.120"$ )	6	12
37. $1\frac{1}{8}"$ - $1\frac{1}{4}"$	10d common ( $3" \times 0.148"$ ); or deformed ( $2\frac{1}{2}" \times 0.131"$ ); or deformed ( $2\frac{1}{2}" \times 0.120"$ )	6	12
<b>Panel siding to framing</b>			
38. $\frac{1}{2}"$ or less	6d corrosion-resistant siding ( $1\frac{7}{8}" \times 0.106"$ ); or 6d corrosion-resistant casing ( $2" \times 0.099"$ )	6	12
39. $\frac{5}{8}"$	8d corrosion-resistant siding ( $2\frac{3}{8}" \times 0.128"$ ); or 8d corrosion-resistant casing ( $2\frac{1}{2}" \times 0.113"$ )	6	12

DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER <sup>a</sup>	SPACING AND LOCATION	
Wood structural panels (WSP), subfloor, roof and interior wall sheathing to framing and particleboard wall sheathing to framing <sup>b</sup>			
		Edges (inches)	Intermediate supports (inches)
Interior paneling			
40. $\frac{3}{4}$ "	4d casing ( $1\frac{1}{2}$ " $\times$ 0.080"); or 4d finish ( $1\frac{1}{2}$ " $\times$ 0.072")	6	12
41. $\frac{3}{8}$ "	6d casing (2" $\times$ 0.099"); or 6d finish (2" $\times$ 0.092") (Panel supports at 24 inches)	6	12

For SI: 1 inch= 25.4 mm.

- a. Nails spaced at 6 inches at intermediate supports where spans are 48 inches or more. For nailing of wood structural panel and particleboard diaphragms and shear walls, refer to Section 2305. Nails for wall sheathing are permitted to be common, box or casing.
- b. Spacing shall be 6 inches on center on the edges and 12 inches on center at intermediate supports for nonstructural applications. Panel supports at 16 inches (20 inches if strength axis in the long direction of the panel, unless otherwise marked).
- c. Where a rafter is fastened to an adjacent parallel ceiling joist in accordance with this schedule and the ceiling joist is fastened to the top plate in accordance with this schedule, the number of toenails in the rafter shall be permitted to be reduced by one nail.
- d. RSRS-01 is a Roof Sheathing Ring Shank nail meeting the specifications in ASTM F1667.
- e. Tabulated fastener requirements apply where the basic ~~ultimate design~~ basic wind speed,  $V$ , is less than 140 mph. For wood structural panel roof sheathing attached to gable-end roof framing and to intermediate supports within 48 inches of roof edges and ridges, nails shall be spaced at 4 inches on center where the basic ~~ultimate design~~ basic wind speed,  $V$ , is greater than 130 mph in Exposure B or greater than 110 mph in Exposure C. Spacing exceeding 6 inches on center at intermediate supports shall be permitted where the fastening is designed per the AWC NOS.
- f. Fastening is only permitted where the ~~ultimate design~~ basic wind speed,  $V$ , is less than or equal to 110 mph.
- g. Nails and staples are carbon steel meeting the specifications of ASTM F1667. Connections using nails and staples of other materials, such as stainless steel, shall be designed by acceptable engineering practice or approved under Section 104.11.

**TABLE 2304.8(3) ALLOWABLE SPANS AND LOADS FOR WOOD STRUCTURAL PANEL SHEATHING AND SINGLE-FLOOR GRADES CONTINUOUS OVER TWO OR MORE SPANS WITH STRENGTH AXIS PERPENDICULAR TO SUPPORTS<sup>a</sup>**

SHEATHING GRADES		ROOF <sup>b</sup>				FLOOR <sup>c</sup>
Panel span rating roof/floor span	Panel thickness (inches)	Maximum span (inches)		Load <sup>d</sup> (psf)		Maximum span (inches)
		With edge support <sup>e</sup>	Without edge support	Total load	Live load	
16/0	3/8	16	16	40	30	0
20/0	3/8	20	20	40	30	0
24/0	3/8, 7/16, 1/2	24	20 <sup>f</sup>	40	30	0
24/16	7/16, 1/2	24	24	50	40	16
32/16	15/32, 1/2, 5/8	32	28	40	30	16 <sup>g</sup>
40/20	19/32, 5/8, 3/4, 7/8	40	32	40	30	20 <sup>g,h</sup>
48/24	23/32, 3/4, 7/8	48	36	45	35	24
54/32	7/8, 1	54	40	45	35	32
60/32	7/8, 1 1/8	60	48	45	35	32
SINGLE FLOOR GRADES		ROOF <sup>b</sup>				FLOOR <sup>c</sup>
Panel span rating	Panel thickness (inches)	Maximum span (inches)		Load <sup>e</sup> (psf)		Maximum span (inches)
		With edge support <sup>e</sup>	Without edge support	Total load	Live load	
16 o.c.	1/2, 19/32, 5/8	24	24	50	40	16 <sup>g</sup>
20 o.c.	19/32, 5/8, 3/4	32	32	40	30	20 <sup>g,h</sup>
24 o.c.	23/32, 3/4	48	36	35	25	24
32 o.c.	7/8, 1	48	40	50	40	32
48 o.c.	1 3/32, 1 1/8	60	48	50	40	48

For SI: 1 inch= 25.4 mm, 1 pound per square foot= 0.0479 kN/m<sup>2</sup>.

- a. Applies to panels 24 inches or wider.
- b. Uniform load deflection limitations 1/180 of span under live load plus dead load, 1/180 under live load only.
- c. Panel edges shall have approved tongue-and-groove joints or shall be supported with blocking unless 1/4-inch minimum thickness underlayment or 1 1/2 inches of approved cellular or lightweight concrete is placed *over* the subfloor, or finish floor is 3/4 -inch wood strip. Allowable uniform load based on deflection of 1/360 of span is 100 pounds per square foot except the span rating of 48 inches on center is based on a total load of 65 pounds per square foot.
- d. Allowable load at maximum span. Where the total load includes snow, use allowable stress design snow loads.
- e. Tongue-and-groove edges, panel edge clips (one midway between each support, except two equally spaced between supports 48 inches on center), lumber blocking or other. Only lumber blocking shall satisfy blocked diaphragm requirements. Where the total load includes snow, use allowable stress design snow loads.
- f. For 1/2-inch panel, maximum span shall be 24 inches.
- g. Span is permitted to be 24 inches on center where 3/4 -inch wood strip flooring is installed at right angles to joist.
- h. Span is permitted to be 24 inches on center for floors where 1 1/2 inches of cellular or lightweight concrete is applied *over* the pane

**TABLE 2304.8(5) ALLOWABLE LOAD (PSF) FOR WOOD STRUCTURAL PANEL ROOF SHEATHING CONTINUOUS OVER TWO OR MORE SPANS AND STRENGTH AXIS PARALLEL TO SUPPORTS (Plywood structural panels are five-ply, five-layer unless otherwise noted)<sup>a</sup>**

PANEL GRADE	THICKNESS (inch)	MAXIMUM SPAN (inches)	LOAD AT MAXIMUM SPAN (psf)	
			Live	Total <sup>c</sup>
Structural I sheathing	$\frac{7}{16}$	24	20	30
	$\frac{15}{32}$	24	35 <sup>b</sup>	45 <sup>b</sup>
	$\frac{1}{2}$	24	40 <sup>b</sup>	50 <sup>b</sup>
	$\frac{19}{32}, \frac{5}{8}$	24	70	80
	$\frac{23}{32}, \frac{3}{4}$	24	90	100
Sheathing, other grades covered in DOC PS 1 or DOC PS 2	$\frac{7}{16}$	16	40	50
	$\frac{15}{32}$	24	20	25
	$\frac{1}{2}$	24	25	30
	$\frac{19}{32}$	24	40 <sup>b</sup>	50 <sup>b</sup>
	$\frac{5}{8}$	24	45 <sup>b</sup>	55 <sup>b</sup>
	$\frac{23}{32}, \frac{3}{4}$	24	60 <sup>b</sup>	65 <sup>b</sup>

For SI: 1 inch= 25.4 mm, 1 pound per square foot= 0.0479 kN/m<sup>2</sup>.

- a. Uniform load deflection limitations  $\frac{1}{180}$  of span under live load plus dead load,  $\frac{1}{240}$  under live load only. Edges shall be blocked with lumber or other approved type of edge supports.
- b. For composite and four-ply plywood structural panel, load shall be reduced by 15 pounds per square foot.
- c. Where the total load includes snow, use allowable stress design snow loads.

TABLE 2308.4.1.1(1) HEADER AND GIRDER SPANS<sup>a, b</sup> FOR EXTERIOR BEARING WALLS (Maximum spans for Douglas fir-larch, hem-fir, Southern pine and spruce-pine-fir and required number of jack studs)

Portions of table not shown remain unchanged.

GIRDERS AND HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD, $P_g(assl)$ , (psf) <sup>c</sup>																	
		30						50						70					
		Building width <sup>c</sup> (feet)																	
		12		24		36		12		24		36		12		24		36	
Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>		
Roof and ceiling	1-2 x 6	4-0	1	3-1	2	2-7	2	3-5	1	2-8	2	2-3	2	3-0	2	2-4	2	2-0	2
	1-2 x 8	5-1	2	3-11	2	3-3	2	4-4	2	3-4	2	2-10	2	3-10	2	3-0	2	2-6	3
	1-2 x 10	6-0	2	4-8	2	3-11	2	5-2	2	4-0	2	3-4	3	4-7	2	3-6	3	3-0	3
	1-2 x 12	7-1	2	5-5	2	4-7	3	6-1	2	4-8	3	3-11	3	5-5	2	4-2	3	3-6	3
	2-2 x 4	4-0	1	3-1	1	2-7	1	3-5	1	2-7	1	2-2	1	3-0	1	2-4	1	2-0	1
	2-2 x 6	6-0	1	4-7	1	3-10	1	5-1	1	3-11	1	3-3	2	4-6	1	3-6	2	2-11	2
	2-2 x 8	7-7	1	5-9	1	4-10	2	6-5	1	5-0	2	4-2	2	5-9	1	4-5	2	3-9	2
	2-2 x 10	9-0	1	6-10	2	5-9	2	7-8	2	5-11	2	4-11	2	6-9	2	5-3	2	4-5	2
	2-2 x 12	10-7	2	8-1	2	6-10	2	9-0	2	6-11	2	5-10	2	8-0	2	6-2	2	5-2	3
	3-2 x 8	9-5	1	7-3	1	6-1	1	8-1	1	6-3	1	5-3	2	7-2	1	5-6	2	4-8	2
	3-2 x 10	11-3	1	8-7	1	7-3	2	9-7	1	7-4	2	6-2	2	8-6	1	6-7	2	5-6	2
	3-2 x 12	13-2	1	10-1	2	8-6	2	11-3	2	8-8	2	7-4	2	10-0	2	7-9	2	6-6	2
	4-2 x 8	10-11	1	8-4	1	7-0	1	9-4	1	7-2	1	6-0	1	8-3	1	6-4	1	5-4	2
	4-2 x 10	12-11	1	9-11	1	8-4	1	11-1	1	8-6	1	7-2	2	9-10	1	7-7	2	6-4	2
	4-2 x 12	15-3	1	11-8	1	9-10	2	13-0	1	10-0	2	8-5	2	11-7	1	8-11	2	7-6	2
Roof, ceiling and one center-bearing floor	1-2 x 6	3-3	1	2-7	2	2-2	2	3-0	2	2-4	2	2-0	2	2-9	2	2-2	2	1-10	2
	1-2 x 8	4-1	2	3-3	2	2-9	2	3-9	2	3-0	2	2-6	3	3-6	2	2-9	2	2-4	3
	1-2 x 10	4-11	2	3-10	2	3-3	3	4-6	2	3-6	3	3-0	3	4-1	2	3-3	3	2-9	3
	1-2 x 12	5-9	2	4-6	3	3-10	3	5-3	2	4-2	3	3-6	3	4-10	3	3-10	3	3-3	4
	2-2 x 4	3-3	1	2-6	1	2-2	1	3-0	1	2-4	1	2-0	1	2-8	1	2-2	1	1-10	1
	2-2 x 6	4-10	1	3-9	1	3-3	2	4-5	1	3-6	2	3-0	2	4-1	1	3-3	2	2-9	2
	2-2 x 8	6-1	1	4-10	2	4-1	2	5-7	2	4-5	2	3-9	2	5-2	2	4-1	2	3-6	2

GIRDERS AND HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD, $P_g(\text{adj.})$ (psf)																	
		30						50						70					
		Building width (feet)																	
		12		24		36		12		24		36		12		24		36	
Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ		
Roof, ceiling and one center-bearing floor	2-2 x 10	7-3	2	5-8	2	4-10	2	6-8	2	5-3	2	4-5	2	6-1	2	4-10	2	4-1	2
	2-2 x 12	8-6	2	6-8	2	5-8	2	7-10	2	6-2	2	5-3	3	7-2	2	5-8	2	4-10	3
	3-2 x 8	7-8	1	6-0	1	5-1	2	7-0	1	5-6	2	4-8	2	6-5	1	5-1	2	4-4	2
	3-2 x 10	9-1	1	7-2	2	6-1	2	8-4	1	6-7	2	5-7	2	7-8	2	6-1	2	5-2	2
	3-2 x 12	10-8	2	8-5	2	7-2	2	9-10	2	7-8	2	6-7	2	9-0	2	7-1	2	6-1	2
	4-2 x 8	8-10	1	6-11	1	5-11	1	8-1	1	6-4	1	5-5	2	7-5	1	5-11	1	5-0	2
	4-2 x 10	10-6	1	8-3	2	7-0	2	9-8	1	7-7	2	6-5	2	8-10	1	7-0	2	6-0	2
4-2 x 12	12-4	1	9-8	2	8-3	2	11-4	2	8-11	2	7-7	2	10-4	2	8-3	2	7-0	2	
Roof, ceiling and one clear span floor	1-2 x 6	2-11	2	2-3	2	1-11	2	2-9	2	2-1	2	1-9	2	2-7	2	2-0	2	1-8	2
	1-2 x 8	3-9	2	2-10	2	2-5	3	3-6	2	2-8	2	2-3	3	3-3	2	2-6	3	2-2	3
	1-2 x 10	4-5	2	3-5	3	2-10	3	4-2	2	3-2	3	2-8	3	3-11	2	3-0	3	2-6	3
	1-2 x 12	5-2	2	4-0	3	3-4	3	4-10	3	3-9	3	3-2	4	4-7	3	3-6	3	3-0	4
	2-2 x 4	2-11	1	2-3	1	1-10	1	2-9	1	2-1	1	1-9	1	2-7	1	2-0	1	1-8	1
	2-2 x 6	4-4	1	3-4	2	2-10	2	4-1	1	3-2	2	2-8	2	3-10	1	3-0	2	2-6	2
	2-2 x 8	5-6	2	4-3	2	3-7	2	5-2	2	4-0	2	3-4	2	4-10	2	3-9	2	3-2	2
	2-2 x 10	6-7	2	5-0	2	4-2	2	6-1	2	4-9	2	4-0	2	5-9	2	4-5	2	3-9	3
	2-2 x 12	7-9	2	5-11	2	4-11	3	7-2	2	5-7	2	4-8	3	6-9	2	5-3	3	4-5	3
	3-2 x 8	6-11	1	5-3	2	4-5	2	6-5	1	5-0	2	4-2	2	6-1	1	4-8	2	4-0	2
	3-2 x 10	8-3	2	6-3	2	5-3	2	7-8	2	5-11	2	5-0	2	7-3	2	5-7	2	4-8	2
	3-2 x 12	9-8	2	7-5	2	6-2	2	9-0	2	7-0	2	5-10	2	8-6	2	6-7	2	5-6	3
	4-2 x 8	8-0	1	6-1	1	5-1	2	7-5	1	5-9	2	4-10	2	7-0	1	5-5	2	4-7	2
	4-2 x 10	9-6	1	7-3	2	6-1	2	8-10	1	6-10	2	5-9	2	8-4	1	6-5	2	5-5	2
4-2 x 12	11-2	2	8-6	2	7-2	2	10-5	2	8-0	2	6-9	2	9-10	2	7-7	2	6-5	2	

GIRDERS AND HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD, $D_G(ASD)$ (psf)																	
		30						50						70					
		Building width (feet)																	
		12		24		36		12		24		36		12		24		36	
Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ		
Roof, ceiling and two center-bearing floors	1-2 x 6	2-8	2	2-1	2	1-10	2	2-7	2	2-0	2	1-9	2	2-5	2	1-11	2	1-8	2
	1-2 x 8	3-5	2	2-8	2	2-4	3	3-3	2	2-7	2	2-2	3	3-1	2	2-5	3	2-1	3
	1-2 x 10	4-0	2	3-2	3	2-9	3	3-10	2	3-1	3	2-7	3	3-8	2	2-11	3	2-5	3
	1-2 x 12	4-9	3	3-9	3	3-2	4	4-6	3	3-7	3	3-1	4	4-3	3	3-5	3	2-11	4
	2-2 x 4	2-8	1	2-1	1	1-9	1	2-6	1	2-0	1	1-8	1	2-5	1	1-11	1	1-7	1
	2-2 x 6	4-0	1	3-2	2	2-8	2	3-9	1	3-0	2	2-7	2	3-7	1	2-10	2	2-5	2
	2-2 x 8	5-0	2	4-0	2	3-5	2	4-10	2	3-10	2	3-3	2	4-7	2	3-7	2	3-1	2
	2-2 x 10	6-0	2	4-9	2	4-0	2	5-8	2	4-6	2	3-10	3	5-5	2	4-3	2	3-8	3
	2-2 x 12	7-0	2	5-7	2	4-9	3	6-8	2	5-4	3	4-6	3	6-4	2	5-0	3	4-3	3
	3-2 x 8	6-4	1	5-0	2	4-3	2	6-0	1	4-9	2	4-1	2	5-8	2	4-6	2	3-10	2
	3-2 x 10	7-6	2	5-11	2	5-1	2	7-1	2	5-8	2	4-10	2	6-9	2	5-4	2	4-7	2
	3-2 x 12	8-10	2	7-0	2	5-11	2	8-5	2	6-8	2	5-8	3	8-0	2	6-4	2	5-4	3
	4-2 x 8	7-3	1	5-9	1	4-11	2	6-11	1	5-6	2	4-8	2	6-7	1	5-2	2	4-5	2
	4-2 x 10	8-8	1	6-10	2	5-10	2	8-3	2	6-6	2	5-7	2	7-10	2	6-2	2	5-3	2
	4-2 x 12	10-2	2	8-1	2	6-10	2	9-8	2	7-8	2	6-7	2	9-2	2	7-3	2	6-2	2
Roof, ceiling and two clear span floors	1-2 x 6	2-3	2	1-9	2	1-5	2	2-3	2	1-9	2	1-5	3	2-2	2	1-8	2	1-5	3
	1-2 x 8	2-10	2	2-2	3	1-10	3	2-10	2	2-2	3	1-10	3	2-9	2	2-1	3	1-10	3
	1-2 x 10	3-4	2	2-7	3	2-2	3	3-4	3	2-7	3	2-2	4	3-3	3	2-6	3	2-2	4
	1-2 x 12	4-0	3	3-0	3	2-7	4	4-0	3	3-0	4	2-7	4	3-10	3	3-0	4	2-6	4
	2-2 x 4	2-3	1	1-8	1	1-4	1	2-3	1	1-8	1	1-4	1	2-2	1	1-8	1	1-4	2
	2-2 x 6	3-4	1	2-6	2	2-2	2	3-4	2	2-6	2	2-2	2	3-3	2	2-6	2	2-1	2
	2-2 x 8	4-3	2	3-3	2	2-8	2	4-3	2	3-3	2	2-8	2	4-1	2	3-2	2	2-8	3
	2-2 x 10	5-0	2	3-10	2	3-2	3	5-0	2	3-10	2	3-2	3	4-10	2	3-9	3	3-2	3
	2-2 x 12	5-11	2	4-6	3	3-9	3	5-11	2	4-6	3	3-9	3	5-8	2	4-5	3	3-9	3

GIRDERS AND HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD, $P_{g(roof)}$ (psf)																	
		30						50						70					
		Building width (feet)																	
		12		24		36		12		24		36		12		24		36	
		Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ	Span	NJ
Roof, ceiling and two clear span floors	3-2 x 8	5-3	1	4-0	2	3-5	2	5-3	2	4-0	2	3-5	2	5-1	2	3-11	2	3-4	2
	3-2 x 10	6-3	2	4-9	2	4-0	2	6-3	2	4-9	2	4-0	2	6-1	2	4-8	2	4-0	3
	3-2 x 12	7-5	2	5-8	2	4-9	3	7-5	2	5-8	2	4-9	3	7-2	2	5-6	3	4-8	3
	4-2 x 8	6-1	1	4-8	2	3-11	2	6-1	1	4-8	2	3-11	2	5-11	1	4-7	2	3-10	2
	4-2 x 10	7-3	2	5-6	2	4-8	2	7-3	2	5-6	2	4-8	2	7-0	2	5-5	2	4-7	2
	4-2 x 12	8-6	2	6-6	2	5-6	2	8-6	2	6-6	2	5-6	2	8-3	2	6-4	2	5-4	3

For SI: 1 inch= 25.4 mm, 1 pound per square foot= 0.0479 kPa.

- Spans are given in feet and inches.
- Spans are based on minimum design properties for No. 2 grade lumber of Douglas fir-larch, hem-fir, Southern pine and spruce-pine fir.
- Building width is measured perpendicular to the ridge. For widths between those shown, spans are permitted to be interpolated.
- NJ = Number of jack studs required to support each end. Where the number of required jack studs equals one, the header is permitted to be supported by an approved framing anchor attached to the full-height wall stud and to the header.
- Use 30 psf allowable stress design ground snow load for cases in which allowable stress design ground snow load is less than 30 psf and the roof live load is equal to or less than 20 psf.
- Spans are calculated assuming the top of the header or girder is laterally braced by perpendicular framing. Where the top of the header or girder is not laterally braced (for example, cripple studs bearing on the header), tabulated spans for headers consisting of 2 x 8, 2 x 10, or 2 x 12 sizes shall be multiplied by 0.70 or the header or girder shall be designed.

**TABLE 2308.7.2(3) RAFTER SPANS FOR COMMON LUMBER SPECIES**

(Ground snow load,  $p_{(asd)}$  = 30 psf, ceiling not attached to rafters,  $L/\Delta$ = 180)

Portions of table not shown remain unchanged.

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf					DEAD LOAD = 20 psf				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans <sup>a</sup>									
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	
12	Douglas Fir-Larch	SS	10-0	15-9	20-9	Note b	Note b	10-0	15-9	20-1	24-6	Note b
	Douglas Fir-Larch	#1	9-8	14-9	18-8	22-9	Note b	9-0	13-2	16-8	20-4	23-7
	Douglas Fir-Larch	#2	9-5	13-9	17-5	21-4	24-8	8-5	12-4	15-7	19-1	22-1
	Douglas Fir-Larch	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Hem-Fir	SS	9-6	14-10	19-7	25-0	Note b	9-6	14-10	19-7	24-1	Note b
	Hem-Fir	#1	9-3	14-4	18-2	22-2	25-9	8-9	12-10	16-3	19-10	23-0
	Hem-Fir	#2	8-10	13-7	17-2	21-0	24-4	8-4	12-2	15-4	18-9	21-9
	Hem-Fir	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Southern Pine	SS	9-10	15-6	20-5	Note b	Note b	9-10	15-6	20-5	25-4	Note b
	Southern Pine	#1	9-6	14-10	19-0	22-3	26-0	9-0	13-5	17-0	19-11	23-7
	Southern Pine	#2	8-7	12-11	16-4	19-5	22-10	7-8	11-7	14-8	17-4	20-5
	Southern Pine	#3	6-7	9-9	12-4	15-0	17-9	5-11	8-9	11-0	13-5	15-10
	Spruce-Pine-Fir	SS	9-3	14-7	19-2	24-6	Note b	9-3	14-7	18-8	22-9	Note b
	Spruce-Pine-Fir	#1	9-1	13-9	17-5	21-4	24-8	8-5	12-4	15-7	19-1	22-1
	Spruce-Pine-Fir	#2	9-1	13-9	17-5	21-4	24-8	8-5	12-4	15-7	19-1	22-1
	Spruce-Pine-Fir	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
16	Douglas Fir-Larch	SS	9-1	14-4	18-10	23-9	Note b	9-1	13-9	17-5	21-3	24-8
	Douglas Fir-Larch	#1	8-9	12-9	16-2	19-9	22-10	7-10	11-5	14-5	17-8	20-5
	Douglas Fir-Larch	#2	8-2	11-11	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Douglas Fir-Larch	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6
	Hem-Fir	SS	8-7	13-6	17-10	22-9	Note b	8-7	13-6	17-1	20-10	24-2
	Hem-Fir	#1	8-5	12-5	15-9	19-3	22-3	7-7	11-1	14-1	17-2	19-11
	Hem-Fir	#2	8-0	11-9	14-11	18-2	21-1	7-2	10-6	13-4	16-3	18-10
	Hem-Fir	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6
	Southern Pine	SS	8-11	14-1	18-6	23-8	Note b	8-11	14-1	18-5	21-11	25-11
	Southern Pine	#1	8-7	13-0	16-6	19-3	22-10	7-10	11-7	14-9	17-3	20-5
	Southern Pine	#2	7-6	11-2	14-2	16-10	19-10	6-8	10-0	12-8	15-1	17-9
	Southern Pine	#3	5-9	8-6	10-8	13-0	15-4	5-2	7-7	9-7	11-7	13-9
	Spruce-Pine-Fir	SS	8-5	13-3	17-5	22-1	25-7	8-5	12-9	16-2	19-9	22-10
	Spruce-Pine-Fir	#1	8-2	11-11	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Spruce-Pine-Fir	#2	8-2	11-11	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Spruce-Pine-Fir	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6
19.2	Douglas Fir-Larch	SS	8-7	13-6	17-9	21-8	25-2	8-7	12-6	15-10	19-5	22-6
	Douglas Fir-Larch	#1	7-11	11-8	14-9	18-0	20-11	7-1	10-5	13-2	16-1	18-8
	Douglas Fir-Larch	#2	7-5	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
	Douglas Fir-Larch	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2
	Hem-Fir	SS	8-1	12-9	16-9	21-4	24-8	8-1	12-4	15-7	19-1	22-1
	Hem-Fir	#1	7-9	11-4	14-4	17-7	20-4	6-11	10-2	12-10	15-8	18-2
	Hem-Fir	#2	7-4	10-9	13-7	16-7	19-3	6-7	9-7	12-2	14-10	17-3

RAFTER SPACING (Inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf					DEAD LOAD = 20 psf				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Hem-Fir	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2
	Southern Pine	SS	8-5	13-3	17-5	22-3	Note b	8-5	13-3	16-10	20-0	23-7
	Southern Pine	#1	8-0	11-10	15-1	17-7	20-11	7-1	10-7	13-5	15-9	18-8
	Southern Pine	#2	6-10	10-2	12-11	15-4	18-1	6-1	9-2	11-7	13-9	16-2
	Southern Pine	#3	5-3	7-9	9-9	11-10	14-0	4-8	6-11	8-9	10-7	12-6
	Spruce-Pine-Fir	SS	7-11	12-5	16-5	20-2	23-4	7-11	11-8	14-9	18-0	20-11
	Spruce-Pine-Fir	#1	7-5	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
	Spruce-Pine-Fir	#2	7-5	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
	Spruce-Pine-Fir	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2
24	Douglas Fir-Larch	SS	7-11	12-6	15-10	19-5	22-6	7-8	11-3	14-2	17-4	20-1
	Douglas Fir-Larch	#1	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Douglas Fir-Larch	#2	6-8	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
	Douglas Fir-Larch	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10
	Hem-Fir	SS	7-6	11-10	15-7	19-1	22-1	7-6	11-0	13-11	17-0	19-9
	Hem-Fir	#1	6-11	10-2	12-10	15-8	18-2	6-2	9-1	11-6	14-0	16-3
	Hem-Fir	#2	6-7	9-7	12-2	14-10	17-3	5-10	8-7	10-10	13-3	15-5
	Hem-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10
	Southern Pine	SS	7-10	12-3	16-2	20-0	23-7	7-10	11-10	15-0	17-11	21-2
	Southern Pine	#1	7-1	10-7	13-5	15-9	18-8	6-4	9-6	12-0	14-1	16-8
	Southern Pine	#2	6-1	9-2	11-7	13-9	16-2	5-5	8-2	10-4	12-3	14-6
	Southern Pine	#3	4-8	6-11	8-9	10-7	12-6	4-2	6-2	7-10	9-6	11-2
	Spruce-Pine-Fir	SS	7-4	11-7	14-9	18-0	20-11	7-1	10-5	13-2	16-1	18-8
	Spruce-Pine-Fir	#1	6-8	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
	Spruce-Pine-Fir	#2	6-8	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
Spruce-Pine-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10	

Check sources for availability of lumber in lengths greater than 20 feet.

For SI: 1 inch= 25.4 mm, 1 foot= 304.8 mm, 1 pound per square foot= 0.0479 kPa.

- a. The tabulated rafter spans assume that ceiling joists are located at the bottom of the attic space or that some other method of resisting the outward push of the rafters on the bearing walls, such as rafter ties, is provided at that location. Where ceiling joists or rafter ties are located higher in the attic space, the rafter spans shall be multiplied by the adjustment factors in Table 2308.7.2(7).
- b. Span exceeds 26 feet in length.

**TABLE 2308.7.2(4) RAFTER SPANS FOR COMMON LUMBER SPECIES**

(Ground snow load,  $p_{(gsd)}$  = 50 psf, ceiling not attached to rafters,  $L/\Delta = 180$ )

Portions of table not shown remain unchanged.

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf					DEAD LOAD = 20 psf				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans <sup>a</sup>									
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
12	Douglas Fir-Larch	SS	8-5	13-3	17-6	22-4	26-0	8-5	13-3	17-0	20-9	24-0
	Douglas Fir-larch	#1	8-2	12-0	15-3	18-7	21-7	7-7	11-2	14-1	17-3	20-0
	Douglas Fir-larch	#2	7-8	11-3	14-3	17-5	20-2	7-1	10-5	13-2	16-1	18-8
	Douglas Fir-larch	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
	Hem-Fir	SS	8-0	12-6	16-6	21-1	25-6	8-0	12-6	16-6	20-4	23-7
	Hem-Fir	#1	7-10	11-9	14-10	18-1	21-0	7-5	10-10	13-9	16-9	19-5
	Hem-Fir	#2	7-5	11-1	14-0	17-2	19-11	7-0	10-3	13-0	15-10	18-5
	Hem-Fir	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
	Southern Pine	SS	8-4	13-1	17-2	21-11	Note b	8-4	13-1	17-2	21-5	25-3
	Southern Pine	#1	8-0	12-3	15-6	18-2	21-7	7-7	11-4	14-5	16-10	20-0
	Southern Pine	#2	7-0	10-6	13-4	15-10	18-8	6-6	9-9	12-4	14-8	17-3
	Southern Pine	#3	5-5	8-0	10-1	12-3	14-6	5-0	7-5	9-4	11-4	13-5
	Spruce-Pine-Fir	SS	7-10	12-3	16-2	20-8	24-1	7-10	12-3	15-9	19-3	22-4
	Spruce-Pine-Fir	#1	7-8	11-3	14-3	17-5	20-2	7-1	10-5	13-2	16-1	18-8
	Spruce-Pine-Fir	#2	7-8	11-3	14-3	17-5	20-2	7-1	10-5	13-2	16-1	18-8
	Spruce-Pine-Fir	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
16	Douglas Fir-Larch	SS	7-8	12-1	15-10	19-5	22-6	7-8	11-7	14-8	17-11	20-10
	Douglas Fir-Larch	#1	7-1	10-5	13-2	16-1	18-8	6-7	9-8	12-2	14-11	17-3
	Douglas Fir-Larch	#2	6-8	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2
	Douglas Fir-Larch	#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3
	Hem-Fir	SS	7-3	11-5	15-0	19-1	22-1	7-3	11-5	14-5	17-8	20-5
	Hem-Fir	#1	6-11	10-2	12-10	15-8	18-2	6-5	9-5	11-11	14-6	16-10
	Hem-Fir	#2	6-7	9-7	12-2	14-10	17-3	6-1	8-11	11-3	13-9	15-11
	Hem-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3
	Southern Pine	SS	7-6	11-10	15-7	19-11	23-7	7-6	11-10	15-7	18-6	21-10
	Southern Pine	#1	7-1	10-7	13-5	15-9	18-8	6-7	9-10	12-5	14-7	17-3
	Southern Pine	#2	6-1	9-2	11-7	13-9	16-2	5-8	8-5	10-9	12-9	15-0
	Southern Pine	#3	4-8	6-11	8-9	10-7	12-6	4-4	6-5	8-1	9-10	11-7
	Spruce-Pine-Fir	SS	7-1	11-2	14-8	18-0	20-11	7-1	10-9	13-8	15-11	19-4
	Spruce-Pine-Fir	#1	6-8	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2
	Spruce-Pine-Fir	#2	6-8	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2
	Spruce-Pine-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3
19.2	Douglas Fir-Larch	SS	7-3	11-4	14-6	17-8	20-6	7-3	10-7	13-5	16-5	19-0
	Douglas Fir-Larch	#1	6-6	9-6	12-0	14-8	17-1	6-0	8-10	11-2	13-7	15-9
	Douglas Fir-Larch	#2	6-1	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
	Douglas Fir-Larch	#3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2
	Hem-Fir	SS	6-10	10-9	14-2	17-5	20-2	6-10	10-5	13-2	16-1	18-8
	Hem-Fir	#1	6-4	9-3	11-9	14-4	16-7	5-10	8-7	10-10	13-3	15-5

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf					DEAD LOAD = 20 psf				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
			(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Hem-Fir	#2	6-0	8-9	11-1	13-7	15-9	5-7	8-1	10-3	12-7	14-7
	Hem-Fir	#3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2
	Southern Pine	SS	7-1	11-2	14-8	18-3	21-7	7-1	11-2	14-2	16-11	20-0
	Southern Pine	#1	6-6	9-8	12-3	14-4	17-1	6-0	9-0	11-4	13-4	15-9
	Southern Pine	#2	5-7	8-4	10-7	12-6	14-9	5-2	7-9	9-9	11-7	13-8
	Southern Pine	#3	4-3	6-4	8-0	9-8	11-5	4-0	5-10	7-4	8-11	10-7
	Spruce-Pine-Fir	SS	6-8	10-6	13-5	16-5	19-1	6-8	9-10	12-5	15-3	17-8
	Spruce-Pine-Fir	#1	6-1	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
	Spruce-Pine-Fir	#2	6-1	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
	Spruce-Pine-Fir	#3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2
24	Douglas Fir-Larch	SS	6-8	10-3	13-0	15-10	18-4	6-6	9-6	12-0	14-8	17-0
	Douglas Fir-Larch	#1	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
	Douglas Fir-Larch	#2	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
	Douglas Fir-Larch	#3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0
	Hem-Fir	SS	6-4	9-11	12-9	15-7	18-0	6-4	9-4	11-9	14-5	16-8
	Hem-Fir	#1	5-8	8-3	10-6	12-10	14-10	5-3	7-8	9-9	11-10	13-9
	Hem-Fir	#2	5-4	7-10	9-11	12-1	14-1	4-11	7-3	9-2	11-3	13-0
	Hem-Fir	#3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0
	Southern Pine	SS	6-7	10-4	13-8	16-4	19-3	6-7	10-0	12-8	15-2	17-10
	Southern Pine	#1	5-10	8-8	11-0	12-10	15-3	5-5	8-0	10-2	11-11	14-1
	Southern Pine	#2	5-0	7-5	9-5	11-3	13-2	4-7	6-11	8-9	10-5	12-3
	Southern Pine	#3	3-10	5-8	7-1	8-8	10-3	3-6	5-3	6-7	8-0	9-6
	Spruce-Pine-Fir	SS	6-2	9-6	12-0	14-8	17-1	6-0	8-10	11-2	13-7	15-9
	Spruce-Pine-Fir	#1	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
	Spruce-Pine-Fir	#2	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
	Spruce-Pine-Fir	#3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0

Check sources for availability of lumber in lengths greater than 20 feet.

For SI: 1 inch= 25.4 mm, 1 foot= 304.8 mm, 1 pound per square foot= 0.0479 kPa.

- a. The tabulated rafter spans assume that ceiling joists are located at the bottom of the attic space or that some other method of resisting the outward push of the rafters on the bearing walls, such as rafter ties, is provided at that location. Where ceiling joists or rafter ties are located higher in the attic space, the rafter spans shall be multiplied by the adjustment factors in Table 2308.7.2(7).
- b. Span exceeds 26 feet in length.

**TABLE 2308.7.2(5) RAFTER SPANS FOR COMMON LUMBER SPECIES**

(Ground snow load,  $p_{(asd)}$  = 30 psf, ceiling attached to rafters,  $L/\Delta = 240$ )

Portions of table not shown remain unchanged.

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf					DEAD LOAD = 20 psf				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans <sup>a</sup>									
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	
12	Douglas Fir-Larch	SS	9-1	14-4	18-10	24-1	Note b	9-1	14-4	18-10	24-1	Note b
	Douglas Fir-Larch	#1	8-9	13-9	18-2	22-9	Note b	8-9	13-2	16-8	20-4	23-7
	Douglas Fir-Larch	#2	8-7	13-6	17-5	21-4	24-8	8-5	12-4	15-7	19-1	22-1
	Douglas Fir-Larch	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Hem-Fir	SS	8-7	13-6	17-10	22-9	Note b	8-7	13-6	17-10	22-9	Note b
	Hem-Fir	#1	8-5	13-3	17-5	22-2	25-9	8-5	12-10	16-3	19-10	23-0
	Hem-Fir	#2	8-0	12-7	16-7	21-0	24-4	8-0	12-2	15-4	18-9	21-9
	Hem-Fir	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Southern Pine	SS	8-11	14-1	18-6	23-8	Note b	8-11	14-1	18-6	23-8	Note b
	Southern Pine	#1	8-7	13-6	17-10	22-3	Note b	8-7	13-5	17-0	19-11	23-7
	Southern Pine	#2	8-3	12-11	16-4	19-5	22-10	7-8	11-7	14-8	17-4	20-5
	Southern Pine	#3	6-7	9-9	12-4	15-0	17-9	5-11	8-9	11-0	13-5	15-10
	Spruce-Pine-Fir	SS	8-5	13-3	17-5	22-3	Note b	8-5	13-3	17-5	22-3	Note b
	Spruce-Pine-Fir	#1	8-3	12-11	17-0	21-4	24-8	8-3	12-4	15-7	19-1	22-1
	Spruce-Pine-Fir	#2	8-3	12-11	17-0	21-4	24-8	8-3	12-4	15-7	19-1	22-1
	Spruce-Pine-Fir	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
16	Douglas Fir-Larch	SS	8-3	13-0	17-2	21-10	Note b	8-3	13-0	17-2	21-3	24-8
	Douglas Fir-Larch	#1	8-0	12-6	16-2	19-9	22-10	7-10	11-5	14-5	17-8	20-5
	Douglas Fir-Larch	#2	7-10	11-11	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Douglas Fir-Larch	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6
	Hem-Fir	SS	7-10	12-3	16-2	20-8	25-1	7-10	12-3	16-2	20-8	24-2
	Hem-Fir	#1	7-8	12-0	15-9	19-3	22-3	7-7	11-1	14-1	17-2	19-11
	Hem-Fir	#2	7-3	11-5	14-11	18-2	21-1	7-2	10-6	13-4	16-3	18-10
	Hem-Fir	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6
	Southern Pine	SS	8-1	12-9	16-10	21-6	Note b	8-1	12-9	16-10	21-6	25-11
	Southern Pine	#1	7-10	12-3	16-2	19-3	22-10	7-10	11-7	14-9	17-3	20-5
	Southern Pine	#2	7-6	11-2	14-2	16-10	19-10	6-8	10-0	12-8	15-1	17-9
	Southern Pine	#3	5-9	8-6	10-8	13-0	15-4	5-2	7-7	9-7	11-7	13-9
	Spruce-Pine-Fir	SS	7-8	12-0	15-10	20-2	24-7	7-8	12-0	15-10	19-9	22-10
	Spruce-Pine-Fir	#1	7-6	11-9	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Spruce-Pine-Fir	#2	7-6	11-9	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Spruce-Pine-Fir	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6
	Douglas Fir-Larch	SS	7-9	12-3	16-1	20-7	25-0	7-9	12-3	15-10	19-5	22-6
	Douglas Fir-Larch	#1	7-6	11-8	14-9	18-0	20-11	7-1	10-5	13-2	16-1	18-8
	Douglas Fir-Larch	#2	7-4	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
	Douglas Fir-Larch	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2
	Hem-Fir	SS	7-4	11-7	15-3	19-5	23-7	7-4	11-7	15-3	19-1	22-1
	Hem-Fir	#1	7-2	11-4	14-4	17-7	20-4	6-11	10-2	12-10	15-8	18-2
	Hem-Fir	#2	6-10	10-9	13-7	16-7	19-3	6-7	9-7	12-2	14-10	17-3

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf					DEAD LOAD = 20 psf				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
			(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Hem-Fir	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2
	Southern Pine	SS	7-8	12-0	15-10	20-2	24-7	7-8	12-0	15-10	20-0	23-7
	Southern Pine	#1	7-4	11-7	15-1	17-7	20-11	7-1	10-7	13-5	15-9	18-8
	Southern Pine	#2	6-10	10-2	12-11	15-4	18-1	6-1	9-2	11-7	13-9	16-2
	Southern Pine	#3	5-3	7-9	9-9	11-10	14-0	4-8	6-11	8-9	10-7	12-6
	Spruce-Pine-Fir	SS	7-2	11-4	14-11	19-0	23-1	7-2	11-4	14-9	18-0	20-11
	Spruce-Pine-Fir	#1	7-0	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
	Spruce-Pine-Fir	#2	7-0	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
	Spruce-Pine-Fir	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2
24	Douglas Fir-Larch	SS	7-3	11-4	15-0	19-1	22-6	7-3	11-3	14-2	17-4	20-1
	Douglas Fir-Larch	#1	7-0	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Douglas Fir-Larch	#2	6-8	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
	Douglas Fir-Larch	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10
	Hem-Fir	SS	6-10	10-9	14-2	18-0	21-11	6-10	10-9	13-11	17-0	19-9
	Hem-Fir	#1	6-8	10-2	12-10	15-8	18-2	6-2	9-1	11-6	14-0	16-3
	Hem-Fir	#2	6-4	9-7	12-2	14-10	17-3	5-10	8-7	10-10	13-3	15-5
	Hem-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10
	Southern Pine	SS	7-1	11-2	14-8	18-9	22-10	7-1	11-2	14-8	17-11	21-2
	Southern Pine	#1	6-10	10-7	13-5	15-9	18-8	6-4	9-6	12-0	14-1	16-8
	Southern Pine	#2	6-1	9-2	11-7	13-9	16-2	5-5	8-2	10-4	12-3	14-6
	Southern Pine	#3	4-8	6-11	8-9	10-7	12-6	4-2	6-2	7-10	9-6	11-2
	Spruce-Pine-Fir	SS	6-8	10-6	13-10	17-8	20-11	6-8	10-5	13-2	16-1	18-8
	Spruce-Pine-Fir	#1	6-6	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
	Spruce-Pine-Fir	#2	6-6	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
	Spruce-Pine-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10

Check sources for availability of lumber in lengths greater than 20 feet.

For SI: 1 inch= 25.4 mm, 1 foot= 304.8 mm, 1 pound per square foot= 0.0479 kPa.

- a. The tabulated rafter spans assume that ceiling joists are located at the bottom of the attic space or that some other method of resisting the outward push of the rafters on the bearing walls, such as rafter ties, is provided at that location. Where ceiling joists or rafter ties are located higher in the attic space, the rafter spans shall be multiplied by the adjustment factors in Table 2308.7.2(7).
- b. Span exceeds 26 feet in length.

**TABLE 2308.7.2(6) RAFTER SPANS FOR COMMON LUMBER SPECIES**

(Ground snow load,  $p_{(asd)}$  = 50 psf, ceiling attached to rafters,  $L/\Delta = 240$ )

Portions of table not shown remain unchanged.

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf					DEAD LOAD = 20 psf				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans <sup>a</sup>									
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
12	Douglas Fir-Larch	SS	7-8	12-1	15-11	20-3	24-8	7-8	12-1	15-11	20-3	24-0
	Douglas Fir-Larch	#1	7-5	11-7	15-3	18-7	21-7	7-5	11-2	14-1	17-3	20-0
	Douglas Fir-Larch	#2	7-3	11-3	14-3	17-5	20-2	7-1	10-5	13-2	16-1	18-8
	Douglas Fir-Larch	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
	Hem-Fir	SS	7-3	11-5	15-0	19-2	23-4	7-3	11-5	15-0	19-2	23-4
	Hem-Fir	#1	7-1	11-2	14-8	18-1	21-0	7-1	10-10	13-9	16-9	19-5
	Hem-Fir	#2	6-9	10-8	14-0	17-2	19-11	6-9	10-3	13-0	15-10	18-5
	Hem-Fir	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
	Southern Pine	SS	7-6	11-10	15-7	19-11	24-3	7-6	11-10	15-7	19-11	24-3
	Southern Pine	#1	7-3	11-5	15-0	18-2	21-7	7-3	11-4	14-5	16-10	20-0
	Southern Pine	#2	6-11	10-6	13-4	15-10	18-8	6-6	9-9	12-4	14-8	17-3
	Southern Pine	#3	5-5	8-0	10-1	12-3	14-6	5-0	7-5	9-4	11-4	13-5
	Spruce-Pine-Fir	SS	7-1	11-2	14-8	18-9	22-10	7-1	11-2	14-8	18-9	22-4
	Spruce-Pine-Fir	#1	6-11	10-11	14-3	17-5	20-2	6-11	10-5	13-2	16-1	18-8
	Spruce-Pine-Fir	#2	6-11	10-11	14-3	17-5	20-2	6-11	10-5	13-2	16-1	18-8
	Spruce-Pine-Fir	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
16	Douglas Fir-Larch	SS	7-0	11-0	14-5	18-5	22-5	7-0	11-0	14-5	17-11	20-10
	Douglas Fir-Larch	#1	6-9	10-5	13-2	16-1	18-8	6-7	9-8	12-2	14-11	17-3
	Douglas Fir-Larch	#2	6-7	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2
	Douglas Fir-Larch	#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3
	Hem-Fir	SS	6-7	10-4	13-8	17-5	21-2	6-7	10-4	13-8	17-5	20-5
	Hem-Fir	#1	6-5	10-2	12-10	15-8	18-2	6-5	9-5	11-11	14-6	16-10
	Hem-Fir	#2	6-2	9-7	12-2	14-10	17-3	6-1	8-11	11-3	13-9	15-11
	Hem-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3
	Southern Pine	SS	6-10	10-9	14-2	18-1	22-0	6-10	10-9	14-2	18-1	21-10
	Southern Pine	#1	6-7	10-4	13-5	15-9	18-8	6-7	9-10	12-5	14-7	17-3
	Southern Pine	#2	6-1	9-2	11-7	13-9	16-2	5-8	8-5	10-9	12-9	15-0
	Southern Pine	#3	4-8	6-11	8-9	10-7	12-6	4-4	6-5	8-1	9-10	11-7
	Spruce-Pine-Fir	SS	6-5	10-2	13-4	17-0	20-9	6-5	10-2	13-4	16-8	19-4
	Spruce-Pine-Fir	#1	6-4	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2
	Spruce-Pine-Fir	#2	6-4	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2
	Spruce-Pine-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3
	Douglas Fir-Larch	SS	6-7	10-4	13-7	17-4	20-6	6-7	10-4	13-5	16-5	19-0
	Douglas Fir-Larch	#1	6-4	9-6	12-0	14-8	17-1	6-0	8-10	11-2	13-7	15-9
	Douglas Fir-Larch	#2	6-1	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
	Douglas Fir-Larch	#3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2
	Hem-Fir	SS	6-2	9-9	12-10	16-5	19-11	6-2	9-9	12-10	16-1	18-8
	Hem-Fir	#1	6-1	9-3	11-9	14-4	16-7	5-10	8-7	10-10	13-3	15-5

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf					DEAD LOAD = 20 psf				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
			(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Hem-Fir	#2	5-9	8-9	11-1	13-7	15-9	5-7	8-1	10-3	12-7	14-7
	Hem-Fir	#3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2
	Southern Pine	SS	6-5	10-2	13-4	17-0	20-9	6-5	10-2	13-4	16-11	20-0
	Southern Pine	#1	6-2	9-8	12-3	14-4	17-1	6-0	9-0	11-4	13-4	15-9
	Southern Pine	#2	5-7	8-4	10-7	12-6	14-9	5-2	7-9	9-9	11-7	13-8
	Southern Pine	#3	4-3	6-4	8-0	9-8	11-5	4-0	5-10	7-4	8-11	10-7
	Spruce-Pine-Fir	SS	6-1	9-6	12-7	16-0	19-1	6-1	9-6	12-5	15-3	17-8
	Spruce-Pine-Fir	#1	5-11	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
	Spruce-Pine-Fir	#2	5-11	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
	Spruce-Pine-Fir	#3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2
24	Douglas Fir-Larch	SS	6-1	9-7	12-7	15-10	18-4	6-1	9-6	12-0	14-8	17-0
	Douglas Fir-Larch	#1	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
	Douglas Fir-Larch	#2	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
	Douglas Fir-Larch	#3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0
	Hem-Fir	SS	5-9	9-1	11-11	15-2	18-0	5-9	9-1	11-9	14-5	15-11
	Hem-Fir	#1	5-8	8-3	10-6	12-10	14-10	5-3	7-8	9-9	11-10	13-9
	Hem-Fir	#2	5-4	7-10	9-11	12-1	14-1	4-11	7-3	9-2	11-3	13-0
	Hem-Fir	#3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0
	Southern Pine	SS	6-0	9-5	12-5	15-10	19-3	6-0	9-5	12-5	15-2	17-10
	Southern Pine	#1	5-9	8-8	11-0	12-10	15-3	5-5	8-0	10-2	11-11	14-1
	Southern Pine	#2	5-0	7-5	9-5	11-3	13-2	4-7	6-11	8-9	10-5	12-3
	Southern Pine	#3	3-10	5-8	7-1	8-8	10-3	3-6	5-3	6-7	8-0	9-6
	Spruce-Pine-Fir	SS	5-8	8-10	11-8	14-8	17-1	5-8	8-10	11-2	13-7	15-9
	Spruce-Pine-Fir	#1	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
	Spruce-Pine-Fir	#2	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
Spruce-Pine-Fir	#3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0	

Check sources for availability of lumber in lengths greater than 20 feet.

For SI: 1 inch= 25.4 mm, 1 foot= 304.8 mm, 1 pound per square foot= 0.0479 kPa.

- a. The tabulated rafter spans assume that ceiling joists are located at the bottom of the attic space or that some other method of resisting the outward push of the rafters on the bearing walls, such as rafter ties, is provided at that location. Where ceiling joists or rafter ties are located higher in the attic space, the rafter spans shall be multiplied by the adjustment factors in Table 2308.7.2(7).

TABLE 2308.7.3.1 RAFTER TIE CONNECTIONS<sup>1</sup>

RAFTER SLOPE	TIE SPACING (inches)	LIVE LOAD ONLY <sup>9</sup>			GROUND SNOW LOAD, $p_{g(ASD)}$ (pounds per square foot)					
					30 pounds per square foot			50 pounds per square foot		
		Roof span (feet)								
		12	24	36	12	24	36	12	24	36
Required number of 16d common (3 <sup>1</sup> / <sub>2</sub> " x 0.162") nails per connection <sup>a, b, c, d, e, f, h</sup>										
3:12	12	3	5	8	3	6	9	5	9	13
	16	4	7	10	4	8	12	6	12	17
	19.2	4	8	12	5	10	14	7	14	21
	24	5	10	15	6	12	18	9	17	26
	32	7	13	20	8	16	24	12	23	34
	48	10	20	29	12	24	35	17	34	51
4:12	12	3	4	6	3	5	7	4	7	10
	16	3	5	8	3	6	9	5	9	13
	19.2	3	6	9	4	7	11	6	11	16
	24	4	8	11	5	9	13	7	13	19
	32	5	10	15	6	12	18	9	17	26
	48	8	15	22	9	18	26	13	26	38
5:12	12	3	3	5	3	4	6	3	6	8
	16	3	4	6	3	5	7	4	7	11
	19.2	3	5	7	3	6	9	5	9	13
	24	3	6	9	4	7	11	6	11	16
	32	4	8	12	5	10	14	7	14	21
	48	6	12	18	7	14	21	11	21	31
7:12	12	3	3	4	3	3	4	3	4	6
	16	3	3	5	3	4	5	3	5	8
	19.2	3	4	5	3	4	6	3	6	9
	24	3	5	7	3	5	8	4	8	11
	32	3	6	9	4	7	10	5	10	15
	48	5	9	13	5	10	15	8	15	22
9:12	12	3	3	3	3	3	3	3	3	5
	16	3	3	4	3	3	4	3	4	6
	19.2	3	3	4	3	4	5	3	5	7
	24	3	4	5	3	4	6	3	6	9
	32	3	5	7	3	6	8	4	8	12
	48	4	7	10	4	8	12	6	12	17

12:12	12	3	3	3	3	3	3	3	3	4
	16	3	3	3	3	3	3	3	3	5
	19.2	3	3	3	3	3	4	3	4	6
	24	3	3	4	3	3	5	3	5	7
	32	3	4	5	3	4	6	3	6	9
	48	3	5	8	3	6	9	5	9	13

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.8 N/m<sup>2</sup>.

- 10d common (3" x 0.148") nails shall be permitted to be substituted for 16d common (3½" x 0.162") nails where the required number of nails is taken as 1.2 times the required number of 16d common nails, rounded up to the next full nail.
- Rafter tie heel joint connections are not required where the ridge is supported by a load-bearing wall, header or ridge beam.
- Where intermediate support of the rafter is provided by vertical struts or purlins to a load-bearing wall, the tabulated heel joint connection requirements are permitted to be reduced proportionally to the reduction in span.
- Equivalent nailing patterns are required for ceiling joist to ceiling joist lap splices.
- Connected members shall be of sufficient size to prevent splitting due to nailing.
- For allowable stress design snow loads less than 30 pounds per square foot, the required number of nails is permitted to be reduced by multiplying by the ratio of actual snow load plus 10 divided by 40, but not less than the number required for no snow load.
- Applies to roof live load of 20 psf or less.
- Tabulated heel joint connection requirements assume that ceiling joists or rafter ties are located at the bottom of the attic space. Where ceiling joists or rafter ties are located higher in the attic, heel joint connection requirements shall be increased by the adjustment factors in Table 2308.7.3.1(1).
- Tabulated requirements are based on 10 psf roof dead load in combination with the specified roof snow load and roof live load.

**TABLE 2308.7.5 REQUIRED RATING OF APPROVED UPLIFT CONNECTORS**  
(pounds)<sup>a,b,c,e,f,g,h</sup>

NOMINAL-ALLOWABLE STRESS DESIGN WIND SPEED, <i>V<sub>asd</sub></i>	ROOF SPAN (feet)							OVERHANGS (pounds/foot) <sup>d</sup>
	12	20	24	28	32	36	40	
85	-72	-120	-145	-169	-193	-217	-241	-38.55
90	-91	-151	-181	-212	-242	-272	-302	-43.22
100	-131	-281	-262	-305	-349	-393	-436	-53.36
110	-175	-292	-351	-409	-467	-526	-584	-64.56

For SI: 1 inch= 25.4 mm, 1 foot= 304.8 mm, 1 mile per hour = 1.61 km/hr 0.447 meters per second, 1 pound = 0.454 Kg, 1 pound/foot= 14.59 N/m.

- The uplift connection requirements are based on a 30-foot mean roof height located in Exposure B. For Exposure C or D and for other mean roof heights, multiply the loads by the following adjustment coefficients:

EXPOSURE	Mean Roof Height (feet)									
	15	20	25	30	35	40	45	50	55	60
B	1.00	1.00	1.00	1.00	1.05	1.09	1.12	1.16	1.19	1.22
C	1.21	1.29	1.35	1.40	1.45	1.49	1.53	1.56	1.59	1.62
D	1.47	1.55	1.61	1.66	1.70	1.74	1.78	1.81	1.84	1.87

- b. The uplift connection requirements are based on the framing being spaced 24 inches on center. Multiply by 0.67 for framing spaced 16 inches on center and multiply by 0.5 for framing spaced 12 inches on center.
- c. The uplift connection requirements include an allowance for 10 pounds of dead load.
- d. The uplift connection requirements do not account for the effects of overhangs. The magnitude of the loads shall be increased by adding the overhang loads found in the table. The overhang loads are based on framing spaced 24 inches on center. The overhang loads given shall be multiplied by the overhang projection and added to the roof uplift value in the table.
- e. The uplift connection requirements are based on wind loading on end zones as defined in Figure 28.5-1 of ASCE 7. Connection loads for connections located a distance of 20 percent of the least horizontal dimension of the building from the corner of the building are permitted to be reduced by multiplying the table connection value by 0.7 and multiplying the overhang load by 0.8.
- f. For wall-to-wall and wall-to-foundation connections, the capacity of the uplift connector is permitted to be reduced by 100 pounds for each full wall above. (For example, if a 500-pound rated connector is used on the roof framing, a 400-pound rated connector is permitted at the next floor level down).
- g. Interpolation is permitted for intermediate values of  $V_{asd}$  and roof spans.
- h. The rated capacity of approved tie-down devices is permitted to include up to a 60-percent increase for wind effects where allowed by material specifications.
- i.  $V_{asd}$  shall be determined in accordance with Section 1609.3.1.

## SECTION 2308 CONVENTIONAL LIGHT-FRAME CONSTRUCTION

**2308.2.3 Allowable loads.** *Loads* shall be in accordance with Chapter 16 and shall not exceed the following:

1. Average *dead loads* shall not exceed 15 psf (718 N/m<sup>2</sup>) for combined roof and ceiling, *exterior walls*, floors and partitions.

**Exceptions:**

1. Subject to the limitations of Section 2308.6.10, stone or masonry *vener* up to the less of 5 inches (127 mm) thick or 50 pounds per square foot (2395 N/m<sup>2</sup>) and installed in accordance with Chapter 14 is permitted to a height of 30 feet (9144 mm) above a noncombustible foundation, with an additional 8 feet (2439) permitted for *gable ends*.
  2. Concrete or masonry fireplaces, heaters and chimneys shall be permitted in accordance with the provisions of this code.
2. *Live loads* shall not exceed 40 psf (1916 N/m<sup>2</sup>) for floors.
 

**Exception:** *Live loads* for concrete slab-on-ground floors in *Risk Categories I and II* shall be not more than 125 psf.
  3. Ground snow *loads* shall not exceed 50 psf (2395 N/m<sup>2</sup>).
  4. Tornado loads on the main wind force resisting system and all components and cladding shall not exceed the corresponding wind loads on these same elements.

# CHAPTER 24

## GLASS AND GLAZING

### SECTION 2404

#### WIND, SNOW, SEISMIC AND DEAD LOADS ON GLASS

**2404.1 Vertical glass.** Glass sloped 15 degrees (0.26 rad) or less from vertical in windows, curtain and window walls, doors and other exterior applications shall be designed to resist the wind *loads* due to basic ~~design~~ wind *speed*,  $V$ , in Section 1609 for components and cladding. Glass in glazed curtain walls, glazed storefronts and glazed partitions shall meet the seismic requirements of ASCE 7, Section 13.5.9. The load resistance of glass under uniform *load* shall be determined in accordance with ASTM E1300.

The design of vertical glazing shall be based on Equation 24-1.

$$0.6F_{gw} \leq F_{ga} \quad \text{(Equation 24-1)}$$

where:

$F_{gw}$  = Wind *load* on the glass due to basic ~~design~~ wind *speed*,  $V$ , computed in accordance with Section 1609.

$F_{ga}$  = Short duration *load* on the glass as determined in accordance with ASTM E1300.

**2404.2 Sloped glass.** Glass sloped more than 15 degrees (0.26 rad) from vertical in skylights, *sunrooms*, sloped roofs and other exterior applications shall be designed to resist the most critical combinations of loads determined by Equations 24-2, 24-3 and 24-4.

$$F_g = 0.6W_o - D \quad \text{(Equation 24-2)}$$

$$F_g = 0.6W_i + D + 0.5\underline{0.35S} \quad \text{(Equation 24-3)}$$

$$F_g = 0.3W_i + D + \underline{0.7S} \quad \text{(Equation 24-4)}$$

where:

$D$  = Glass *dead* load psf (kN/m<sup>2</sup>).

For glass sloped 30 degrees (0.52 rad) or less from horizontal,

=  $13 t_g$  (For SI:  $0.0245 t_g$ ).

For glass sloped more than 30 degrees (0.52 rad) from horizontal,

=  $13 t_g \cos \theta$  (For SI:  $0.0245 t_g \cos \theta$ )

$F_g$  = Total *load*, psf (kN/m<sup>2</sup>) on glass.

$S$  = Snow *load*, psf (kN/m<sup>2</sup>) as determined in Section 1608 from the reliability-targeted (strength-based) maps in Figures 1608.2(1) through 1608.2(4)

$t_g$  = Total glass thickness, inches (mm) of glass panes and plies.

$W_i$  = Inward wind force, psf (kN/m<sup>2</sup>) due to basic ~~design~~ wind speed,  $V$ , as calculated in Section 1609

$W_o$  = Outward wind force, psf (kN/m<sup>2</sup>) due to basic ~~design~~ wind speed,  $V$ , as calculated in Section 1609.

$\theta$  = Angle of slope from horizontal.

**Exception:** The performance grade rating of *unit skylights* and *tubular daylighting devices* shall be determined in accordance with Section 2405.5.

The design of sloped glazing shall be based on Equation 24-5.

$$F_g \leq F_{ga} \quad \text{(Equation 24-5)}$$

Where:

$F_g$  = Total *load* on the glass as determined by Equations 24-2, 24-3 and 24-4.

$F_{ga}$  = Short duration *load* resistance of the glass as determined in accordance with ASTM E1300 for Equations 24-2 and 24-3; or the long duration *load* resistance of the glass as determined in accordance with ASTM E1300 for Equation 24-4.

**2404.3.1 Vertical wired glass.** Wired glass sloped 15 degrees (0.26 rad) or less from vertical in windows, curtain and window walls, doors and other exterior applications shall be designed to resist the wind *loads* in Section 1609 for components and cladding according to the following equation:

$$0.6F_{gw} < F_{ga} \quad \text{(Equation 24-6)}$$

where:

$F_{gw}$  = Wind *load* on the glass due to basic ~~design~~ wind speed,  $V$ , computed in accordance with Section 1609.

$F_{ge}$  = Nonfactored *load* from ASTM E1300 using a thickness designation for monolithic glass that is not greater than the thickness of wired glass.

**2404.3.3 Vertical patterned glass.** Patterned glass sloped 15 degrees (0.26 rad) or less from vertical in windows, curtain and window walls, doors and other exterior applications shall be designed to resist the wind *loads* in Section 1609 for components and cladding according to Equation 24-9.

$$F_{gw} < 1.0 F_{ge} \quad \text{(Equation 24-9)}$$

where:

$F_{gw}$  = Wind *load* on the glass due to basic ~~design~~ wind speed,  $V$ , computed in accordance with Section 1609.

$F_{ge}$  = Nonfactored *load* in accordance with ASTM E1300. The value for patterned glass shall be based on the thinnest part of the glass. Interpolation between nonfactored *load* charts in ASTM E1300 shall be permitted.

**2404.3.5 Vertical sandblasted glass.** Sandblasted glass sloped 15 degrees (0.26 rad) or less from vertical in windows, curtain and window walls, doors, and other exterior applications shall be designed to resist the wind *loads* in Section 1609 for components and cladding according to Equation 24-12.

$$0.6F_{gi} < 0.5F_{ge} \quad \text{(Equation 24-12)}$$

where:

$F_g$  = Wind *load* on the glass due to basic design wind speed,  $V$ , computed in accordance with Section 1609.

$F_{ge}$  = Nonfactored *load* in accordance with ASTM E1300. The value for sandblasted glass is for moderate levels of sandblasting.

**2405.5.2 Skylights rated for separate performance grades for positive and negative design pressure.** The design of skylights rated for performance grade for both positive and negative design pressures shall be based on Equations 24-14 and 24-15.

$$F_{gi} \leq PG_{Pos} \quad \text{(Equation 24-14)}$$

$$F_{go} \leq PG_{Neg} \quad \text{(Equation 24-15)}$$

where:

$PG_{Pos}$  = Performance grade rating of the skylight under positive design pressure;

$PG_{Neg}$  = Performance grade rating of the skylight under negative design pressure; and

$F_{gi}$  and  $F_{go}$  are determined in accordance with the following:

For  $0.6W_o \geq D$

where:

$W_o$  = Outward wind force, psf (kN/m<sup>2</sup>) due to basic design wind speed,  $V$ , as calculated in Section 1609.

$D$  = The dead weight of the glazing, psf (kN/m<sup>2</sup>) as determined in Section 2404.2 for glass, or by the weight of the plastic, psi (kN/m<sup>2</sup>) for plastic glazing.

$F_{gi}$  = Maximum load on the skylight determined from Equations 24-3 and 24-4 in Section 2404.2.

$F_{go}$  = Maximum load on the skylight determined from Equations 24-2.

For  $0.6 W_o < D$ ,

where:

$W_o$  = The outward wind force, psf (kN/m<sup>2</sup>) due to basic design wind speed,  $V$ , as calculated in Section 1609.

$D$  = The dead weight of the glazing, psf (kN/m<sup>2</sup>) as determined in Section 2404.2 for glass,

or by the weight of the plastic for plastic glazing.

$F_{gl}$  = Maximum load on the skylight determined from Equations 24-2 through 24-4 in Section 2404.2.

$$F_{go} = 0$$

# CHAPTER 31

## SPECIAL CONSTRUCTION

### SECTION 3103

#### TEMPORARY STRUCTURES

**3103.1 General.** The provisions of Sections 3103.1 through ~~3103.4~~ 3103.7 shall apply to structures erected for a period of less than 180 days. Temporary special event structures, tents, umbrella structures and other membrane structures erected for a period of less than 180 days shall also comply with the *International Fire Code*. ~~These Temporary structures~~ erected for a longer period of time and public-occupancy temporary structures shall comply with applicable sections of this code.

**Exception:** Public-occupancy temporary structures complying with Section 3103.1.1 shall be permitted to remain in service for 180 days or more but not more than 1 year when approved by the *Building Official*.

**3103.1.1 Extended period of service time.** Public-occupancy temporary structures shall be permitted to remain in service for 180 days or more without complying with requirements in this code for new buildings or structures when extensions for up to 1 year are granted by the *Building Official* in accordance with Section 108.1 and when the following conditions are satisfied:

1. Additional inspections as determined by the *Building Official* shall be performed to verify that site conditions and the approved installation comply with the conditions of approval at the time of final inspection.
2. The *Building Official* shall perform follow up inspections after initial occupancy at intervals not exceeding 180 days to verify the site conditions and the installation conform to the approved site conditions and installation requirements.
3. An examination shall be performed by a registered design professional to determine the adequacy of the *temporary structure* to resist the structural loads required in Section 3103.5.
4. Relocation of the *temporary structures* shall require a new approval by the building official.
5. The use or occupancy approved at the time of final inspection shall remain unchanged.

**~~3103.1.1~~ 3103.1.2 Conformance.** Temporary structures and uses shall conform to the structural strength, fire safety, *means of egress*, accessibility, light, *ventilation* and sanitary requirements of this code as necessary to ensure public health, safety and general welfare.

**~~3103.1.2~~ 3103.1.3 Permit required.** Temporary structures that cover an area greater than 120 square feet (11.16 m<sup>2</sup>), including connecting areas or spaces with a common *means of egress* or entrance that are used or intended to be used for the gathering together of 10 or more persons, shall not be erected, operated or maintained for any purpose without obtaining a *permit* from the *building official*.

**3103.5 Structural requirements.** *Temporary structures shall comply with Chapter 16 of this code. Public-occupancy temporary structures shall be designed and erected to comply with requirements of this Section.*

**3103.5.1 Structural loads.** *Public-occupancy temporary structures shall be classified, based on the risk to human life, health, and welfare associated with damage or failure by nature of their occupancy or use, according to Table 1604.5 for the purposes of applying flood, wind, snow, earthquake, and ice provisions. Additionally, public assembly facilities that require more than 15 min to evacuate to a safe location and any structure whose failure or collapse would endanger the public assembled near the structure, such as speaker stands or other temporary structures for public gatherings shall be classified as Risk Category III.*

**TABLE 3103.5.1  
REDUCTION FACTORS FOR GROUND SNOW LOADS FOR PUBLIC-OCCUPANCY  
TEMPORARY STRUCTURES**

<b>Risk Category</b>	<b>Service Life</b>	
	<b>&lt;10 yr.</b>	<b>&gt;10 yr.</b>
II	0.7	1.0
III	0.8	1.0
IV	1.0	1.0

**3103.5.1.1 Dead.** *Dead loads on public-occupancy temporary structures shall be determined in accordance with Section 1606.*

**3103.5.1.2 Live.** *Live loads on public-occupancy temporary structures shall be determined in accordance with Section 1607.*

**Exception:** *Where approved, live loads less than those prescribed by Table 1607.1 Minimum Uniformly Distributed Live Loads,  $L_q$ , and Minimum Concentrated Live Loads shall be permitted where shown by the registered design professional that a rational approach has been used and that such reductions are warranted.*

**3103.5.1.3 Snow.** *Snow loads on public-occupancy temporary structures shall be determined in accordance with Section 1608 and Chapter 7 of ASCE 7. The ground snow loads,  $S_g$ , in Section 1608 shall be modified according to Table 3103.5.1.*

*If the public-occupancy temporary structure is not subject to snow loads or not constructed and occupied during winter months when snow is to be expected, snow loads need not be considered, provided that the design is reviewed and modified, as appropriate, to account for snow loads if the period of time when the public-occupancy temporary structure is in service shifts to include winter months.*

**Exception:** *Risk Category II public-occupancy temporary structures that employ controlled occupancy measures per Section 3103.7.2 shall be permitted to use a ground snow load reduction factor of 0.65 instead of the ground snow load reduction factors in Table 3105.1.*

**3103.5.1.4 Wind.** Wind loads on public-occupancy temporary structures shall be determined in accordance with Section 1609 and Chapters 26 to 30 of ASCE 7. The design wind load shall be modified according to Table 3103.5.2.

**Exceptions:**

1. Public-occupancy temporary structures that employ controlled occupancy measures per section 3103.7.1 shall be permitted to use load reduction factor of 0.65 instead of the load reduction factors in Table 3103.5.2.
2. Public-occupancy temporary structures erected in a hurricane-prone region outside of hurricane season, the design wind speed shall be set at the following 3-second gust basic design wind speeds depending on Risk Category:
  - 2.1 For Risk Category II use 115 mph,
  - 2.2 For Risk Category III use 120 mph, and
  - 2.3 For Risk Category IV use 125 mph.

**3103.5.1.5 Flood.** An Emergency Action Plan, in accordance with 3103.5.4, shall be submitted for public-occupancy temporary structures in a Flood Hazard Area when requested by the Building or Fire Official. Public-occupancy temporary structures need not be designed for flood loads specified in Section 1615 except when specifically designed as a dry floodproofed structure or designated to be occupied during a storm event per the approved Emergency Action Plan.

**3103.5.1.6 Seismic.** Seismic loads on public-occupancy temporary structures assigned to Seismic Design Categories C through F shall be determined in accordance with Section 1613. The resulting seismic loads are permitted to be taken as 75% of those determined by Section 1613. Public-occupancy temporary structures assigned to Seismic Design Categories A and B need not be designed for seismic loads.

**3103.5.1.7 Ice.** Ice loads on public-occupancy temporary structures shall be determined in accordance with Section 1614, Chapter 10 of ASCE 7, with the largest maximum nominal thickness being 0.5 in, for all Risk Categories. When ice is expected during the occupancy of public-occupancy temporary structures, ice loads shall be determined for surfaces on which ice could accumulate in accordance with ASCE 7. If the public-occupancy temporary structure is not subject to ice loads or not constructed and occupied during winter months when ice is to be expected, ice loads need not be considered, provided that the design is reviewed and modified, as appropriate, to account for ice loads if the period of time when the temporary structure is in service shifts to include winter months.

**3103.5.1.8 Tsunami.** An Emergency Action Plan, in accordance with 3103.5.4, shall be submitted for public-occupancy temporary structures Tsunami Design Zone when requested by the Building or Fire Official. The public-occupancy temporary structure need not be designed for tsunami loads specified in Section 1615.

**3103.5.2 Foundations.** Public-occupancy temporary structures may be supported on the ground with temporary foundations when approved by the Building Official. Consideration shall be given for the impacts of differential settlement when foundations do not extend below the ground or foundations supported on compressible materials. The presumptive load-bearing value for public-occupancy temporary structures supported on a pavement, slab on grade or on other Collapsible or Controlled Low Strength substrates soils such as beach sand

or grass shall be assumed not to exceed 1,000 psf unless determined through testing and evaluation by a registered design professional. The presumptive load-bearing values listed in Table 1806.2 shall be permitted to be used for other supporting soil conditions.

**TABLE 3103.5.2**  
**REDUCTION FACTORS FOR WIND LOADS FOR PUBLIC-OCCUPANCY TEMPORARY STRUCTURES**

<u>Risk Category</u>	<u>Service Life</u>	
	<u>&lt;10 yr.</u>	<u>&gt;10 yr.</u>
<u>II</u>	<u>0.8</u>	<u>1.0</u>
<u>III</u>	<u>0.9</u>	<u>1.0</u>
<u>IV</u>	<u>1.0</u>	<u>1.0</u>

**3103.5.3 Installation and maintenance inspections.** A qualified person shall inspect public-occupancy temporary structures that are assembled using transportable and reusable materials; components shall be inspected when purchased or acquired and at least once per year. The inspection shall evaluate individual components, and the fully assembled structure, to determine suitability for use based on the requirements in ESTA ANSI E1.21. Inspection records shall be kept and shall be made available for verification by the Building Official. Additionally, public-occupancy temporary structures shall be inspected at regular intervals when in service.

**3103.5.4 Emergency Action plans.** When required by the Building Official, Emergency Action Plans shall be submitted and approved. Emergency Action Plans shall include procedures to be implemented due to flood, wind, or snow hazards, or within the tsunami design zone. The action plans shall include provisions for evacuating, securing, or dismantling public-occupancy temporary structures, in whole or in part, and removal to prevent damage to surrounding buildings or structures.

**3103.5.5 Durability and maintenance.** Reusable components used in the erection and the installation of public-occupancy temporary structures shall be manufactured of durable materials necessary to withstand environmental conditions at the service location. Components damaged during transportation or installation and due to the effects of weathering shall be replaced or repaired.

A qualified person shall inspect public-occupancy temporary structures, including components, when purchased or acquired and at least once per year, based on the requirements in ANSI E1.21. Inspection records shall be kept and shall be made available for verification by the building official. Additionally, public-occupancy temporary structures shall be inspected at regular intervals when in service to ensure that the structure continues to perform as designed and initially erected.

**3103.6 Serviceability.** The effects of structural loads or conditions shall not adversely affect the serviceability or performance of the occupancy temporary structure.

**3103.7 Controlled occupancy.** Public-occupancy temporary structures that comply with Section 3103.5 for structural requirements do not require monitoring for controlled occupancy. Public-occupancy temporary structures that employ exceptions for reduced environmental loads shall employ controlled occupancy procedures as specified in this section and in accordance with ANSI ES1.7. An operations management and conforming to ANSI E1.21 with an occupant

evacuation plan shall be submitted to the *Building Official* for approval as a part of the permit documents.

**3103.7.1 Wind.** Wind speeds associated with the design wind loads shall be monitored before and during occupancy of the *public-occupancy* Temporary structure. The *public-occupancy* temporary structure. Shall be evacuated in the event that the design wind speed is expected to be exceeded during its occupancy.

**3103.7.2 Snow.** Surfaces on which snow accumulates shall be monitored before and during occupancy of the *public-occupancy temporary structure* and any loads in excess of the design snow load shall be removed prior to its occupancy, or the *public-occupancy temporary structure* shall be vacated in the event that the design snow load is exceeded during its occupancy.

**3103.7.3 Ice.** Surfaces on which ice accumulates shall be monitored before and during occupancy of the *public-occupancy temporary structure* and any loads in excess of the design ice load shall be removed prior to its occupancy, or the *public-occupancy temporary structure* shall be vacated in the event that the design ice load is exceeded during its occupancy.

## SECTION 3111 SOLAR ENERGY SYSTEMS

**3111.1 General.** Solar energy systems shall comply with the requirements of this section.

**3111.1.1 Wind resistance.** Rooftop-mounted photovoltaic (PV) panel systems and solar thermal collectors shall be designed in accordance with Section 1609.

**3111.1.2 Roof live load.** Roof structures that provide support for solar energy systems shall be designed in accordance with ~~4607.44.4~~ 1607.15.

## SECTION 3115 INTERMODAL SHIPPING CONTAINERS

**3115.8.2 Welds.** The strength of new welds and connections shall be no less than the strength provided by the original connection. All new welds and connections shall be designed and constructed in accordance with Chapters 16, 17, and 22.

**3115.8.4 Detailed design procedure.** A structural analysis meeting the requirements of this section shall be provided to *the building official* to demonstrate the structural adequacy of the intermodal shipping containers.

**Exception:** Structures using an intermodal shipping container designed in accordance with Section 3115.8.5.

**3115.8.5.3 Allowable shear.** The allowable shear for the corrugated steel side walls (longitudinal) and end walls (transverse) for wind design and seismic design using the coefficients of Section 3115.8.5.2 shall be in accordance with Table 3115.8.5.3, provided that all of the following conditions are met:

1. The total linear length of all openings in any individual side wall or end wall shall be limited to not more than 50 percent of the length of that side wall or end wall, as shown in Figure

3115.8.5.3(1).

2. Any full-height wall length, or portion thereof, less than 4 feet (305 mm) shall not be considered as a portion of the lateral force-resisting system, as shown in Figure 3115.8.5.3(2).
3. All side walls or end walls used as part of the lateral force-resisting system shall have an existing or new boundary element on all sides to form a continuous load path, or paths, with adequate strength and stiffness to transfer all forces from the point of application to the final point of resistance, as shown in Figure 3115.8.5.3(3). The existing door interlocking mechanism shall not be considered as a component of the required load path.
4. Where openings are made in container walls, floors or roofs, for doors, windows and other openings:
  - 4.1 The openings shall be framed with steel elements that are designed in accordance with Chapters 16 and 22.
  - 4.2 The cross section and material grade of any new steel element shall be equal to or greater than the steel element removed.
5. A maximum of one penetration not greater than 6 inches (152 mm) in diameter for conduits, pipes, tubes or vents, or not greater than 16 square inches (10 323 mm<sup>2</sup>) for electrical boxes, is permitted for each individual 8-foot (2438 mm) length of lateral force-resisting wall. Penetrations located in walls that are not part of the lateral force-resisting system shall not be limited in size or quantity. Existing *intermodal shipping container* vents shall not be considered a penetration, as shown in Figure 3115.8.5.3(4).
6. End wall doors designated as part of the lateral force-resisting system shall be welded closed around the full perimeter of the door panels.

**3115.8.4.1 Material properties.** Structural material properties for existing *intermodal shipping container* steel components shall be established by Section 2202.

**3115.8.4.3 Allowable shear value.** The allowable shear values for the *intermodal shipping container* corrugated steel sheet panel side walls and end walls shall be determined in accordance with the design approach selected in Section 3115.8.4.2. Where penetrations are made in the side walls or end walls designated as part of the lateral force-resisting system, the penetrations shall be substantiated by rational analysis.

# International Residential Code

## TABLE R301.2 CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA

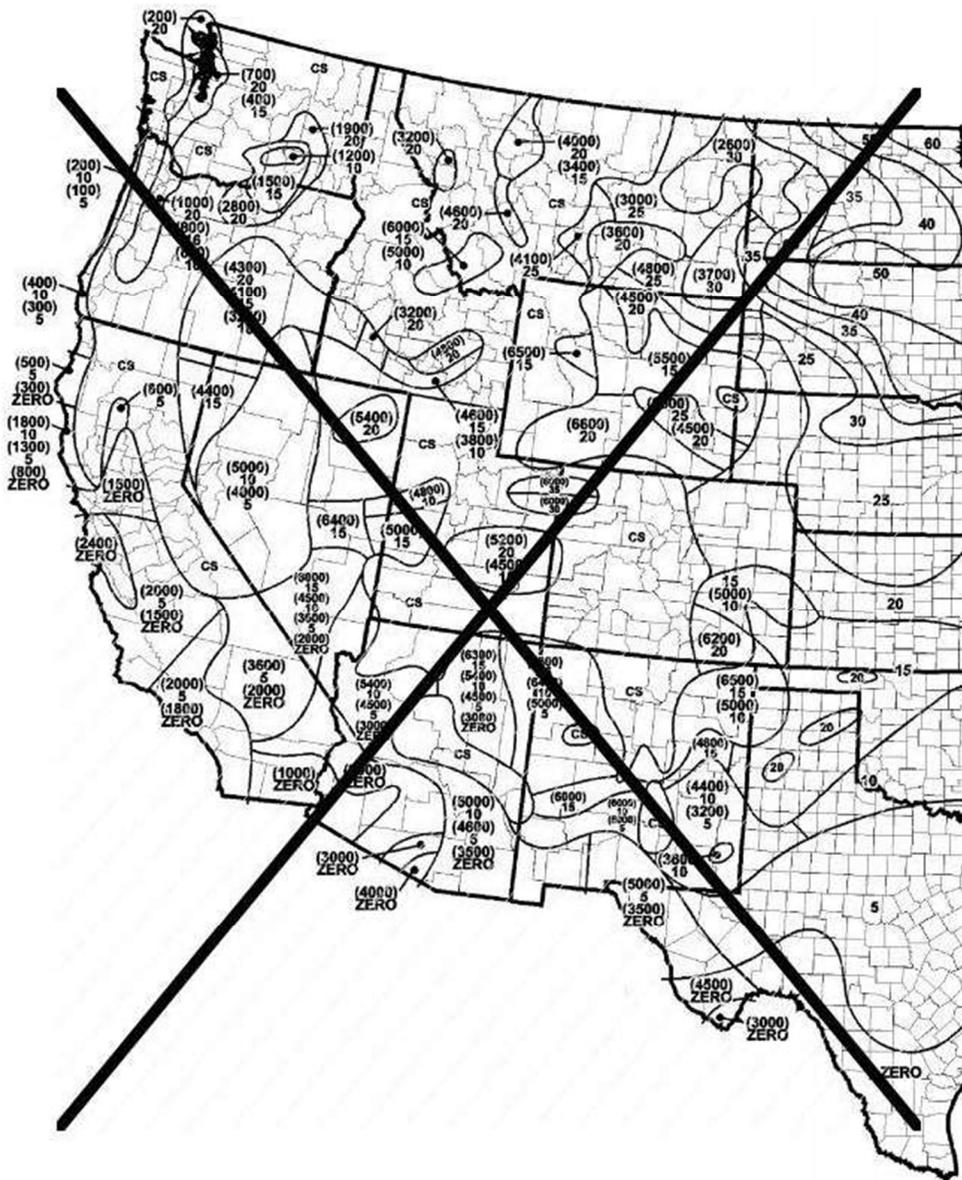
GROUND SNOW LOAD <i>P<sub>g(asd)</sub></i> <sup>o</sup>	WIND DESIGN				SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>
	Speed <sup>d</sup> (mph)	Topographic effects <sup>k</sup>	Special wind Region <sup>l</sup>	Windborne debris zone <sup>m</sup>		Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>			
-	-	-	-	-	-	-	-	-	-	-	-
<b>MANUAL J DESIGN CRITERIA</b>											
Elevation			Altitude correctio n factor	Coincident wet bulb	Indoor winter design dry- bulb temperature	Indoor winter design dry- bulb temperature	Outdoor winter design dry- bulb temperature		Heating		
-			-	-	-	-	-		-		
Latitude			Daily range	Summer design gains	Indoor summer design relative humidity	Indoor summer design dry- bulb temperature	Outdoor summer design dry- bulb temperature		Cooling		
-			-	-	-	-	-		-		

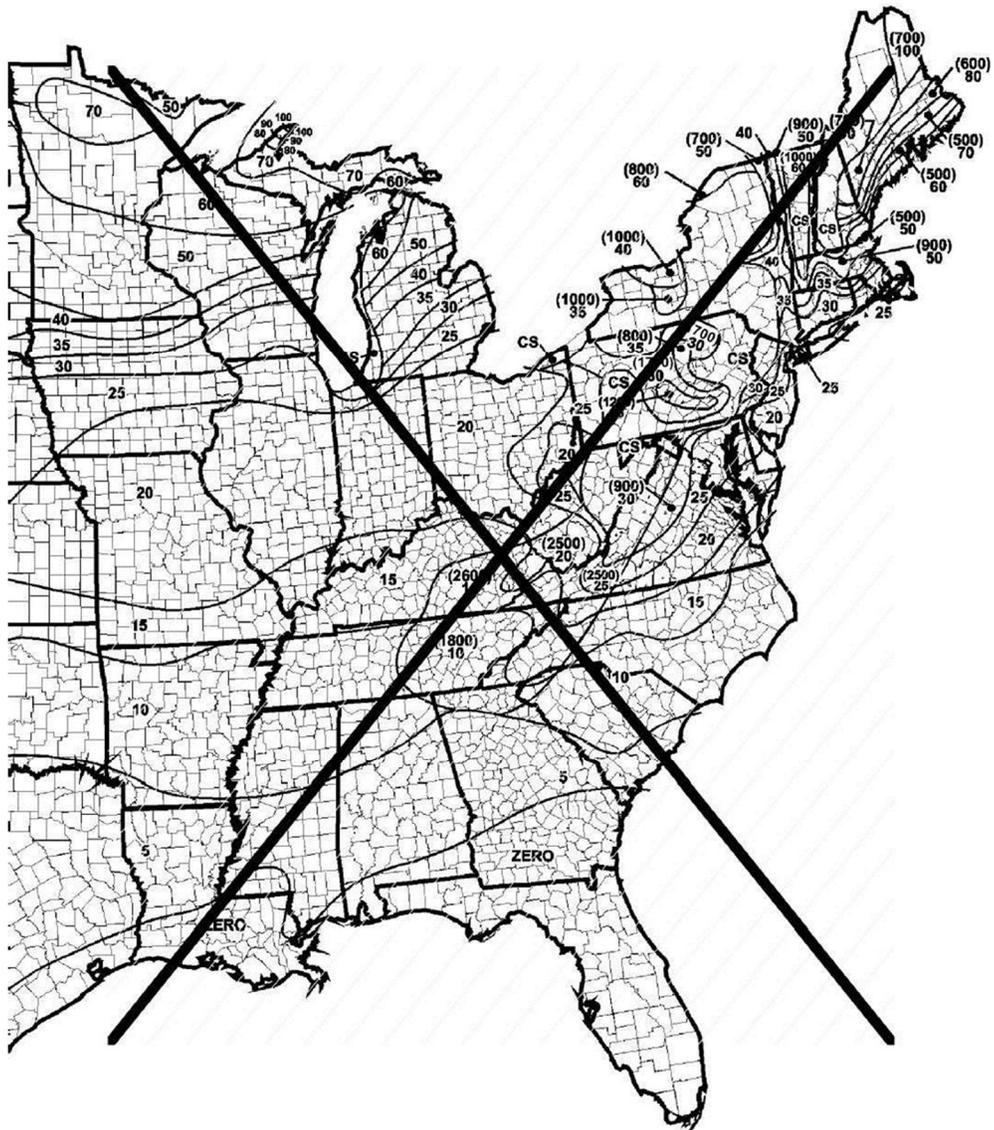
For SI: 1 pound per square foot= 0.0479 kPa, 1 mile per hour= 0.447 m/s.

- a. Where weathering requires a higher strength concrete or grade of masonry than necessary to satisfy the structural requirements of this code, the frost line depth strength required for weathering shall govern. The weathering column shall be filled in with the weathering index, "negligible," "moderate" or "severe" for concrete as determined from Figure R301.2(1). The grade of masonry units shall be determined from ASTM C34, ASTM C55, ASTM C62, ASTM C73, ASTM C90, ASTM C129, ASTM C145, ASTM C216 or ASTM C652.
- b. Where the frost line depth requires deeper footings than indicated in Figure R403.1(1), the frost line depth strength required for weathering shall govern. The jurisdiction shall fill in the frost line depth column with the minimum depth of footing below finish grade.
- c. The jurisdiction shall fill in this part of the table to indicate the need for protection depending on whether there has been a history of local subterranean termite damage.
- d. The jurisdiction shall fill in this part of the table with the wind speed from the basic design wind speed map [Figure R301.2(2)]. Wind exposure category shall be determined on a site-specific basis in accordance with Section R301.2.1.4.
- e. The jurisdiction shall fill in this section of the table to establish the design criteria using Table 1QA from ACCA Manual J or established criteria determined by the jurisdiction.
- f. The jurisdiction shall fill in this part of the table with the seismic design category determined from Section R301.2.2.1.
- g. The jurisdiction shall fill in this part of the table with the date of the jurisdiction's entry into the National Flood Insurance Program (date of adoption of the first code or ordinance for management of flood hazard areas); and the title and date of the currently effective Flood Insurance Study or other flood hazard study and maps adopted by the authority having jurisdiction, as amended.
- h. In accordance with Sections R905.1.2, R905.4.3.1, R905.5.3.1, R905.6.3.1, R905.7.3.1 and R905.8.3.1, where there has been a history of local damage from the effects of ice damming, the jurisdiction shall fill in this part of the table with "YES."

Otherwise, the jurisdiction shall fill in this part of the table with "NO."

- i. The jurisdiction shall fill in this part of the table with the 100-year return period air freezing index (BF-days) from Figure R403.3(2) or from the 100-year (99 percent) value on the National Climatic Data Center data table "Air Freezing Index-USA Method (Base 32° F)."
- j. The jurisdiction shall fill in this part of the table with the mean annual temperature from the National Climatic Data Center data table "Air Freezing Index-USA Method (Base 32° F)."
- k. In accordance with Section R301.2.1.5, where there is local historical data documenting structural damage to buildings due to topographic wind speed-up effects, the jurisdiction shall fill in this part of the table with "YES." Otherwise, the jurisdiction shall indicate "NO" in this part of the table.
- l. In accordance with Figure R301.2(2), where there is local historical data documenting unusual wind conditions, the jurisdiction shall fill in this part of the table with "YES" and identify any specific requirements. Otherwise, the jurisdiction shall indicate "NO" in this part of the table.
- m. In accordance with Section R301.2.1.2 the jurisdiction shall indicate the wind-borne debris wind zone(s). Otherwise, the jurisdiction shall indicate "NO" in this part of the table.
- n. The jurisdiction shall fill in these sections of the table to establish the design criteria using Table 1a or 1b from ACCA Manual J or established criteria determined by the jurisdiction.
- o. The jurisdiction shall fill in this section of the table using the allowable stress design Ground Snow Loads,  $p_{g(asd)}$ , in Figures R301.2(3) and R301.2(4).

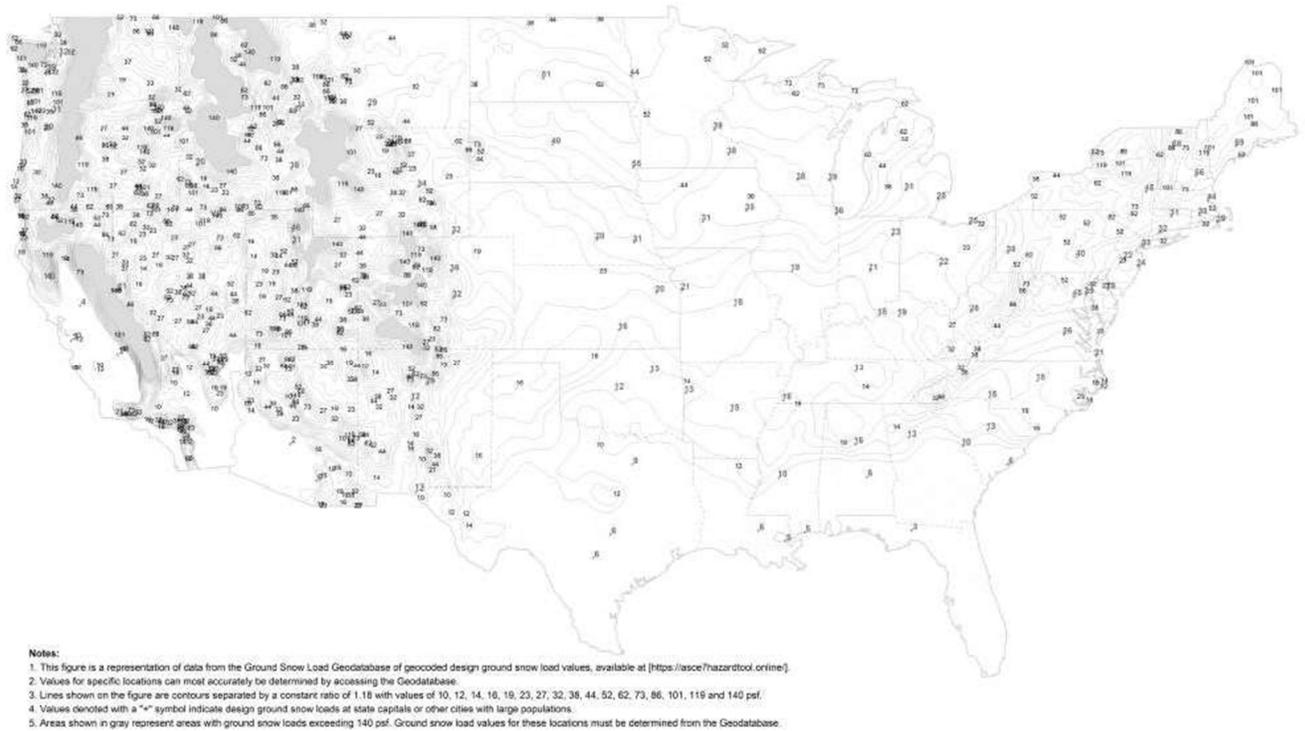




For SI: 1 foot = 304.8mm, 1 pound per square foot = 0.0479 kPa, 1 mile = 1.61 km.

- a) In CS areas, site specific case studies are required to establish ground snow loads. Extreme local variations in ground snow loads in these areas preclude mapping at this scale.
- b) Numbers in parentheses represent the upper elevation limits in feet for the ground snow load values presented below. Site specific case studies are required to establish ground snow loads at elevations not covered.

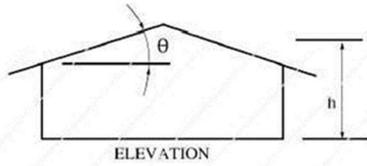
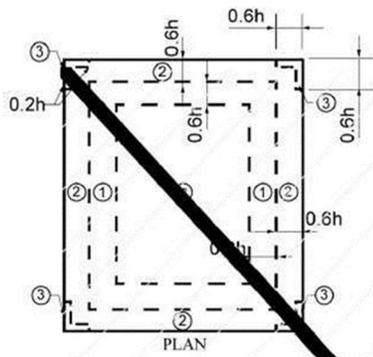
**FIGURE R301.2(4) GROUND SNOW LOADS FOR THE UNITED STATES (lb/ft<sup>2</sup>)**



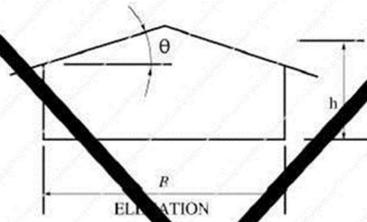
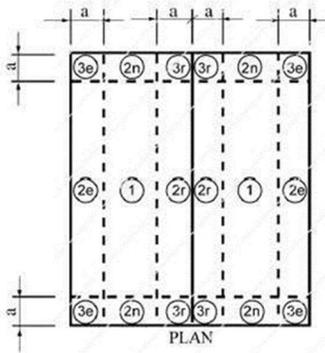
1. Location-specific ground snow load values are provided in the Ground Snow Load Geodatabase of geocoded design ground snow load values, which can be accessed at the ASCE 7 Hazard Tool at <https://asce7hazardtool.online/> or an approved equivalent.
2. Lines shown on the figure are contours separated by a constant ratio 1.18 with values of 10, 12, 14, 16, 19, 23, 27, 32, 38, 44, 52, 62, 73, 86, 101, 119, and 140 psf.  
Values denoted with a "+" symbol indicate design ground snow loads at state capitals or other high-population locations.
3. Areas shown in gray represent areas with ground snow loads exceeding 140 psf. Ground snow load values for these locations can be determined from the Geodatabase.

**FIGURE R301.2(3) ALLOWABLE STRESS DESIGN GROUND SNOW LOADS,  $p_{g(asd)}$ , FOR THE UNITED STATES (lb/ft<sup>2</sup>)**

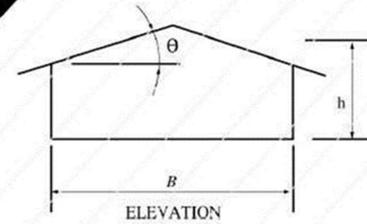
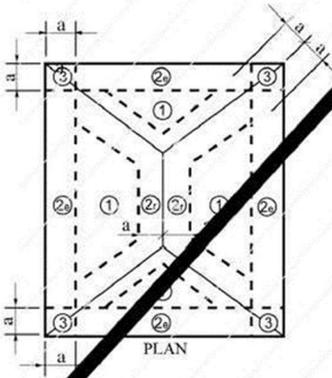
**R301.2.3 Snow loads.** Ground snow loads shall be determined in accordance with Figure R301.2(3) Allowable Stress Design Ground Snow Loads,  $p_{g(asd)}$ , or shall be determined in accordance with Section 1608 of the IBC. Wood-framed construction, cold-formed, steel-framed construction and masonry and concrete construction, and *structural insulated panel* construction in regions with allowable stress design ground snow loads,  $p_{g(asd)}$ , 70 pounds per square foot (3.35 kPa) or less, shall be in accordance with Chapters 5, 6 and 8. Buildings in regions with allowable stress design ground snow loads,  $p_{g(asd)}$ , greater than 70 pounds per square foot (3.35 kPa) shall be designed in accordance with accepted engineering practice.



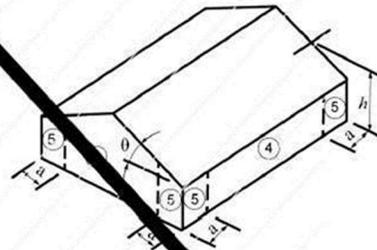
Gable and Flat Roofs  $\theta \leq 7^\circ$



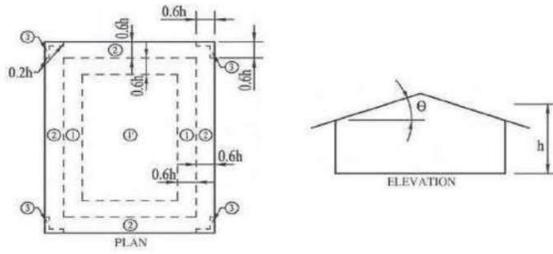
Gable and Flat Roofs  $7^\circ < \theta \leq 45^\circ$



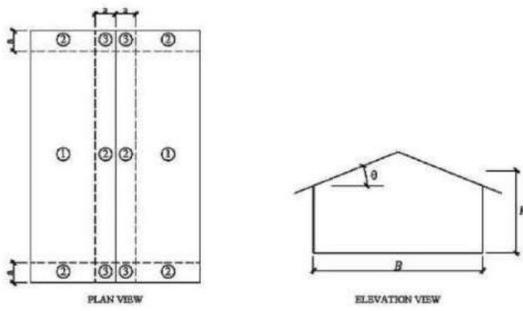
Hip Roofs  $7^\circ < \theta \leq 45^\circ$



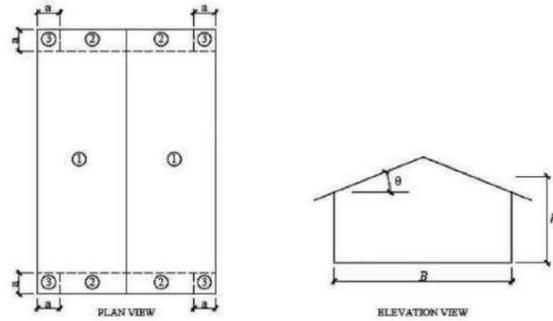
Walls



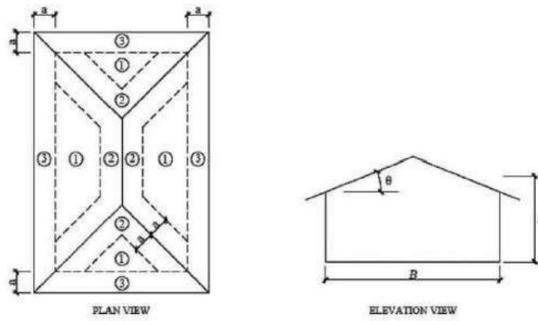
**Gable and Flat Roofs  $\theta \leq 7^\circ$**



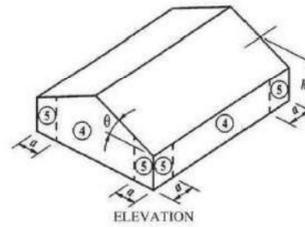
**Gable Roofs  $7^\circ < \theta \leq 27^\circ$**



**Gable Roofs  $27^\circ < \theta \leq 45^\circ$**



**Hip Roofs  $7^\circ < \theta \leq 45^\circ$**



**Walls**

For SI: 1 foot = 304.8mm, 1 degree = 0.0175 rad

**Note:** a = 4 feet in all cases

**FIGURE R301.2.1 COMPONENT AND CLADDING PRESSURE ZONES**

TABLE R301.2.1(2) HEIGHT AND EXPOSURE ADJUSTMENT COEFFICIENTS FOR Table R301.2.1(1)

MEAN ROOF HEIGHT	EXPOSURE		
	B	C	D
15	0.82	1.21	1.47
20	0.89	1.29	1.55
25	0.94	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	<del>1.09</del> 1.06	1.49	1.74
45	<del>1.12</del> 1.10	1.53	1.78
50	<del>1.16</del> 1.13	1.56	1.81
55	<del>1.19</del> 1.16	1.59	1.84
60	<del>1.22</del> 1.19	1.62	1.87

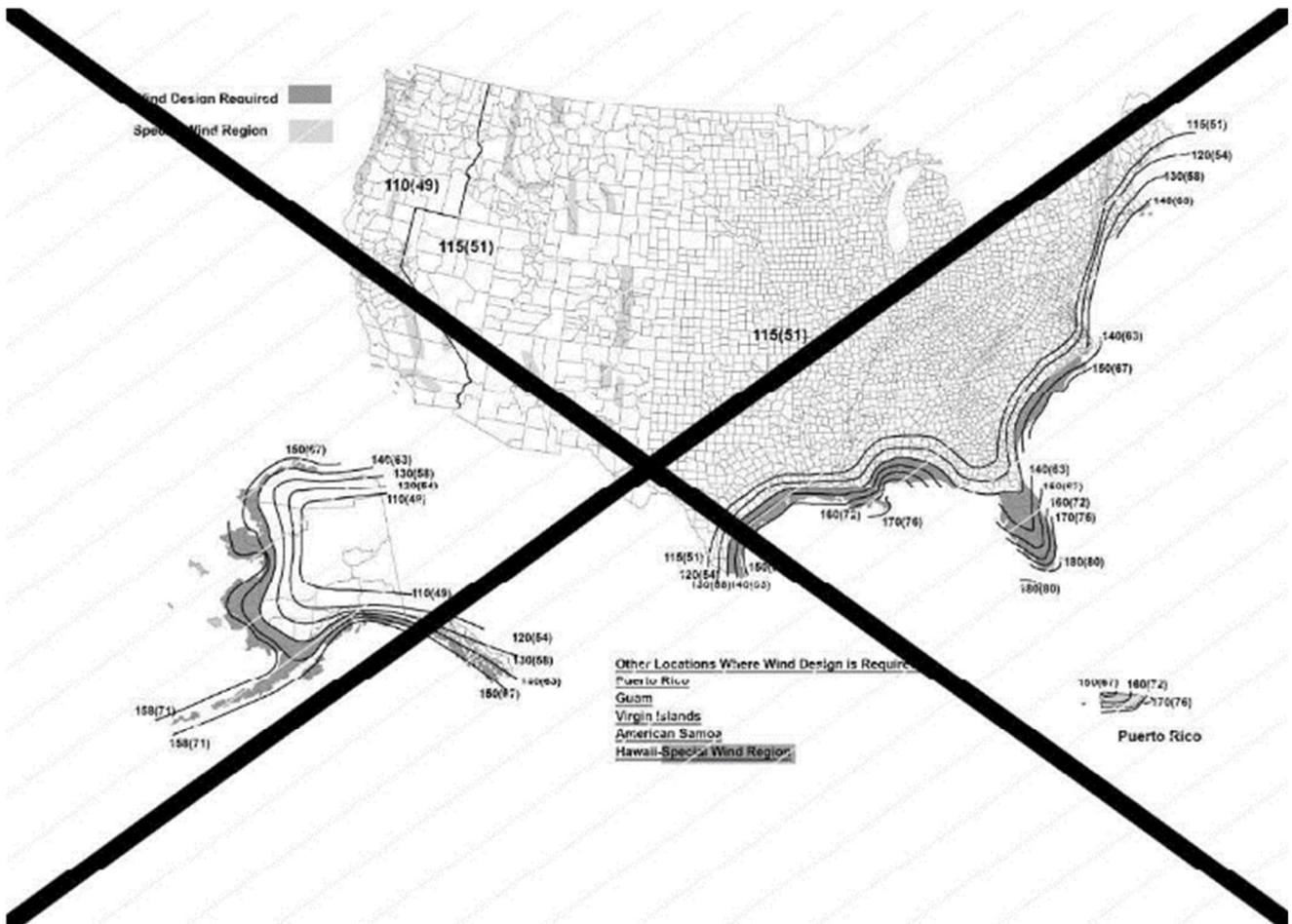


FIGURE R301.2.1.1 REGIONS WHERE WIND DESIGN IS REQUIRED

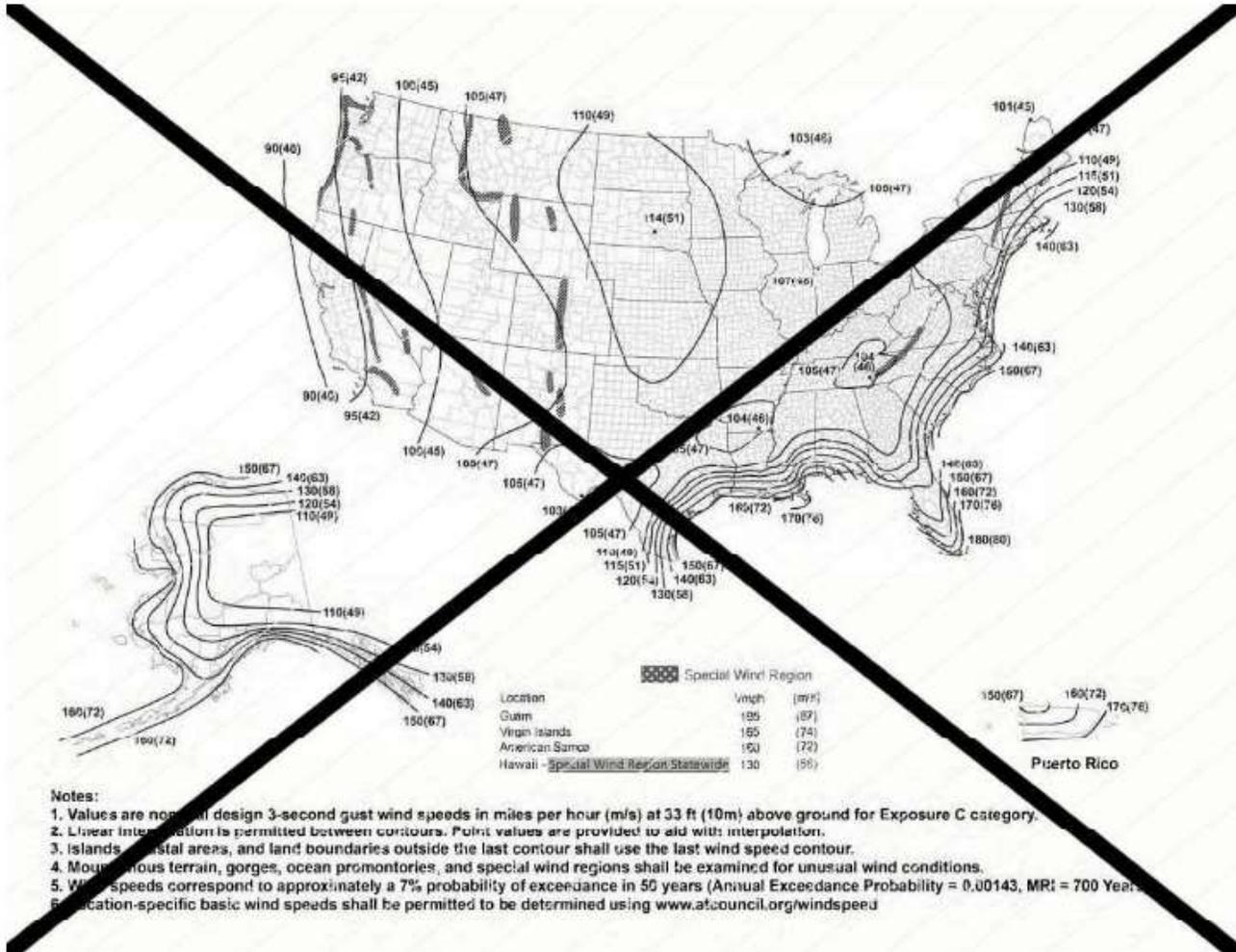
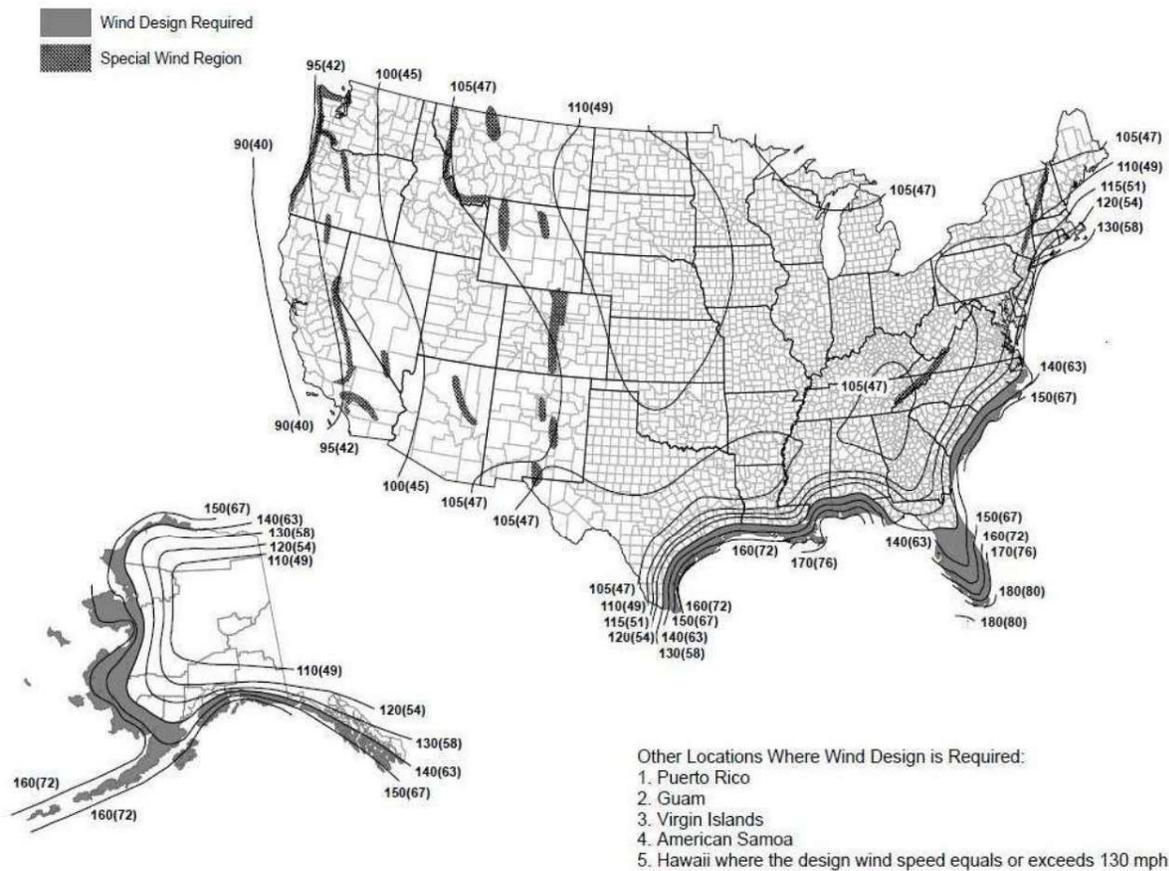
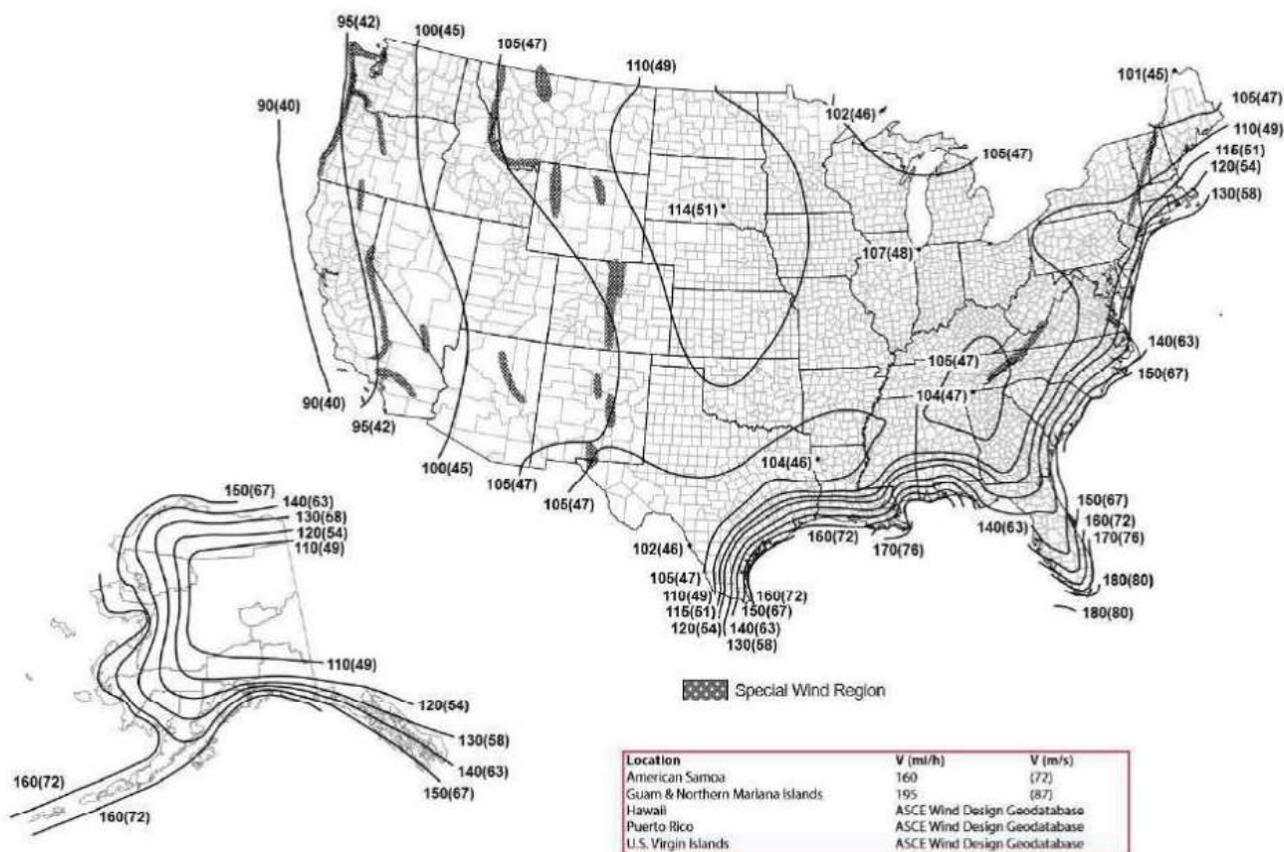


FIGURE R301.2(2) ULTIMATE DESIGN WIND SPEEDS



**FIGURE R301.2.1.1 REGIONS WHERE WIND DESIGN IS REQUIRED**



**Notes:**

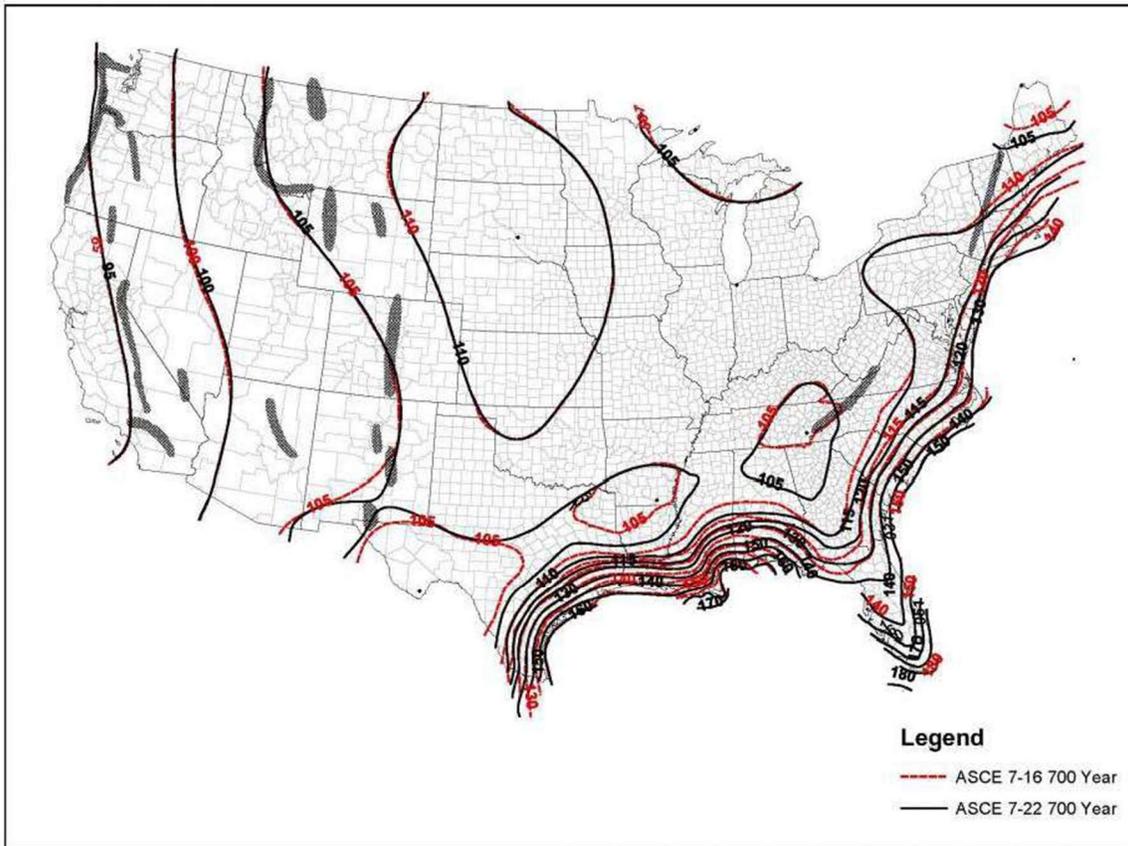
1. Values are 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure Category C.
2. Linear interpolation is permitted between contours. Point values are provided to aid with interpolation.
3. Islands, coastal areas, and land boundaries outside the last contour shall use the last wind speed contour.
4. Location-specific basic design wind speeds shall be permitted to be determined using the ASCE Wind Design Geodatabase.
5. Wind speeds for Hawaii, US Virgin Islands, and Puerto Rico shall be determined from the ASCE Wind Design Geodatabase.
6. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions. Site specific values for selected special wind regions shall be permitted to be determined using the ASCE Wind Design Geodatabase.
7. Wind speeds correspond to approximately a 15% probability of exceedance in 50 years (Annual Exceedance Probability= 0.00143, MRI= 700 years).
8. The ASCE Wind Design Geodatabase can be accessed at the ASCE 7 Hazard Tool (<https://asce7hazardtool.online>) or approved equivalent.

**FIGURE R301.2(2) ULTIMATE DESIGN WIND SPEEDS**

**R301.2.1.5 Topographic wind effects.** In areas designated in Table R301.2 as having local historical data documenting structural damage to buildings caused by wind speed-up at isolated *hills*, ridges and escarpments that are abrupt changes from the general topography of the area, topographic wind effects shall be considered in the design of the building in accordance with Section R301.2.1.5.1 or in accordance with the provisions of ASCE 7. See Figure R301.2.1.5.1(1) for topographic features for wind speed-up effect.

In these designated areas, topographic wind effects shall apply only to buildings sited on the top half of an isolated *hill*, *ridge* or escarpment where all of the following conditions exist:

1. The average slope of the top half of the *hill*, *ridge* or escarpment is 10 percent or greater.
2. The *hill*, *ridge* or escarpment is 60 feet (18 288 mm) or greater in height for Exposure B, 30 feet (9144 mm) or greater in height for Exposure C, and 15 feet (4572 mm) or greater in height for Exposure D.
- ~~3. The hill, ridge or escarpment is located or unobstructed by other topographic features of similar height in the upwind direction for a distance measured from its high point of 100 times its height, or 2 miles (3.2 km), whichever is less. See figure R301.2.1.5.1(3) for upwind obstruction.~~
- ~~4. The hill, ridge or escarpment protrudes by a factor of two or more above the height of the other upwind topographic features located in any quadrant within a radius of 2 miles (3.2 km) measured from its high point.~~



**FIGURE: Comparison of ASCE/SEI 7-22 basic design wind speeds for Risk Category II (700 Year MRI) to ASCE/SEI 7-16. (Courtesy ARA)**