A SunCam online continuing education course

2024 IBC
Structural Design Changes

by

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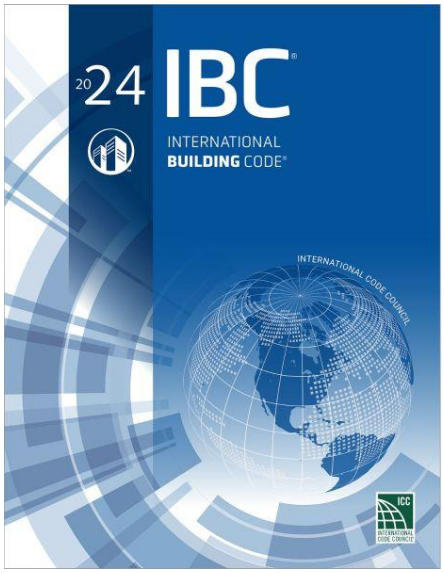
Course Outline:

IBC Overview



The International Building Code (IBC) by the International Code Council (ICC) is a detailed set of regulations that are used to govern construction and design standards. The main objective of the IBC code is to protect public health, welfare, and safety by establishing minimum quality standards for building improvements. The code also has a significant focus on the structural design of buildings.

When the IBC was formed in 2000, it was a merging of the following codes which are now discontinued:

- Uniform Building Code (UBC)
- BOCA National Building Code (BOCA/NBC)
- Standard Building Code (SBC)

The IBC is adopted in all 50 states, Canada, and many other countries. Most states adopt the latest IBC with amendments for additional requirements. Often it takes a few years for the latest IBC to be officially adopted by each state.

The IBC is updated every three years (2018, 2021, 2024, 2027, etc.). This course covers the changes between the 2021 to 2024 editions.

The IBC is part of a larger collection of volumes by the International Code Council (ICC). The full collection of (15) ICC volumes include the following:

- **2024 International Building Code (IBC)**
- 2024 International Residential Code without Energy (IRC)
- 2024 International Fire Code (IFC)
- 2024 International Plumbing Code (IPC)
- 2024 International Mechanical Code (IMC)
- 2024 International Fuel Gas Code (IFGC)
- 2024 International Existing Building Code (IEBC)
- 2024 International Property Maintenance Code (IPMC)
- 2024 International Zoning Code (IZC)
- 2024 International Swimming Pool and Spa Code (ISPSC)
- 2024 International Private Sewage Disposal Code (IPSDC)
- 2024 International Wildland Urban Interface Code (IWUIC)
- 2024 ICC Performance Code for Buildings and Facilities (ICCPC)
- 2024 International Green Construction Code (IgCC)
- 2024 International Energy Conservation Code (IECC)

All codes are available online at this ICC website, although a subscription is required to be able to select and copy-paste the code text:

https://www.iccsafe.org/about/2024-i-code-upd

The covers of the (15) IBC volumes/books are shown in Figure 1, with the volumes addressed in this course circled in red.

Figure 1: Covers of the full collection of 2024 ICC volumes/books, with the IBC volume addressed in this course circled in red.
Source: https://codes.iccsafe.org/codes/i-codes/2024-icodes

2024 IBC Contents

The following is the 2024 IBC table of contents with the chapter covered by this course in **bold**:

Chapter 16 Structural Design - Contents

The contents of Chapter 16 are pasted below, with those in **bold** with changes in 2024.

IBC User Notes

The following text is included at the beginning of Chapter 16:

> ***About this chapter:*** *Chapter 16 establishes minimum design requirements so that the structural components of buildings are proportioned to resist the loads that are likely to be encountered. In addition, this chapter assigns buildings and structures to risk categories that are indicative of their intended use. The loads specified herein along with the required load combinations have been established through research and service performance of buildings and structures. The application of these loads and adherence to the serviceability criteria enhance the protection of life and property.*

Chapter 16 Structural Design - Changes

The following is a paste of all substantive changes to Chapter 16 from 2021 to 2024, with the text changes highlighted yellow. Formatting and repetitive changes are not shown.

1601.1 Scope

2021 IBC:

1601.1 Scope. P

The provisions of this chapter shall govern the structural design of buildings, structures and portions thereof regulated by this code.

2024 IBC:

1601.1 Scope. P

The provisions of this chapter shall govern the structural design of *buildings*, *structures* and portions thereof.

1602.1 Notations

2021 IBC:

1602.1 Notations. P

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.
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) where applicable.
V	=	Basic design wind speeds, miles per hour (mph) (km/hr) determined from Figures 1609.3(1) through 1609.3(12) or ASCE 7.
W	=	Load due to wind pressure.
W_i	=	Wind-on-ice in accordance with Chapter 10 of ASCE 7.

2024 IBC:

1602.1 Notations. P

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 Figures 1608.2(1) through 1608.2(4) and Table 1608.2.
R	=	Rain load.
S	=	Snow load.
T	=	Cumulative effects of self-straining load forces and effects.
V_{asd}	=	*Allowable stress designwind speed*, mph (m/s) where applicable.
V	=	Basic wind speed, *V*, mph (m/s) determined from Figures 1609.3(1) through 1609.3(4) or ASCE 7.
V_T	=	Tornado speed, mph (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.

1603.1 General

2021 IBC:

1603.1 General. P

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*.

Exception: *Construction documents* for buildings constructed in accordance with the *conventional light-frame 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) 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.

2024 IBC:

1603.1 General. P

Construction documents shall show the material, 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*.

Exception: *Construction documents* for *buildings* constructed in accordance with the *conventional light-frame 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 , and *allowable stress design* ground snow load, $p_{g(asd)}$.
3. Basic *wind speed*, *V*, mph (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.

1603.1.3 Roof snow load data

2021 IBC:

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^2), 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_f.
2. Snow exposure factor, C_e.
3. Snow *load* importance factor, I_s.
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^2).
7. Width of snow drift(s), w.

2024 IBC:

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 15 pounds per square foot (psf) (0.72 kN/m^2), 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_f.
2. Snow exposure factor, C_e.
3. *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 30 psf (1.44 kN/m^2).
7. Width of snow drift(s), w.
8. Winter wind parameter for snow drift, W_2.

Figure 2: Snow buildup and snow drifts on a roof.
Source: commons.wikimedia.org/wiki/File:Snow_removed_from_Ranua_Zoo_roof_20120208_01.jpg, flightlog

1603.1.4 Wind and tornado design data

2021 IBC:

1603.1.4 Wind design data. P

The following information related to wind *loads* shall be shown, regardless of whether wind *loads* govern the design of the lateral force-resisting system of the structure:

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

2024 IBC:

1603.1.4 Wind and tornado design data. P

The following information related to wind *loads* and, where required by Section 1609.5, 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 *wind speed*, *V*, mph (m/s), tornado speed, V_T, mph (m/s), and *allowable stress design wind speed*, V_{asd}, mph (m/s), 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. Wind exposure. Applicable wind direction if more than one wind exposure is utilized.
5. Applicable internal pressure coefficients, and applicable tornado internal pressure coefficients.
6. Design wind pressures and their applicable zones with dimensions to be used for exterior component and cladding materials not specifically designed by the *registered design professional* responsible for the design of the *structure*, pounds per square foot (kN/m^2). Where design for tornado loads is required, the design pressures shown shall be the maximum of wind or tornado pressures.

Figure 3: Tornado causing high wind speed and wind pressure.
Source: commons.wikimedia.org/wiki/File:2020aug-derecho-ottawa-illinois-tornado.jpg, p.d.

1603.1.9 Roof rain load data

2021 IBC:

1603.1.9 Roof rain load data.

Rain intensity, *i* (in/hr) (cm/hr), shall be shown regardless of whether rain *loads* govern the design.

2024 IBC:

1603.1.9 Roof rain load data. P

Design rainfall intensity, *i* (in/hr) (cm/hr), and roof drain, *scupper* and overflow locations shall be shown regardless of whether rain *loads* govern the design.

Figure 4: Rain load on a roof.
Source: commons.wikimedia.org/wiki/File:Rain_on_roof.jpg, Philippe Alès, CC-BY-SA-4.0

TABLE 1604.3 DEFLECTION LIMITS

The following footnote “J” was added in 2024 IBC.

2024 IBC:

TABLE 1604.3 DEFLECTION LIMITS[a, b, c, h, i]

CONSTRUCTION	*L* or L_r	*S* or *W* [f]	*D* + *L* [d, g]
Roof members:[e]			
Supporting plaster or stucco ceiling	*l*/360	*l*/360	*l*/240
Supporting nonplaster ceiling	*l*/240	*l*/240	*l*/180
Not supporting ceiling	*l*/180	*l*/180	*l*/120
Floor members	*l*/360	—	*l*/240
Exterior walls:			
With plaster or stucco finishes	—	*l*/360	—
With other brittle finishes	—	*l*/240	—
With flexible finishes	—	*l*/120	—
Interior partitions:[b]			
With plaster or stucco finishes	*l*/360	—	—
With other brittle finishes	*l*/240	—	—
With flexible finishes	*l*/120	—	—
Farm buildings	—	—	*l*/180
Greenhouses	—	—	*l*/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* or L_r) 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 NDS, 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 NDS, 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 NDS 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*, 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.

j. The snow load shall be permitted to be taken as 0.7 times the design snow load determined in accordance with Section 1608.1 for the purpose of determining deflection limits in Table 1604.3.

1604.4 Analysis

2021 IBC:

1604.4 Analysis. P

Load effects on structural members and their connections shall be determined by methods of structural analysis that take into account equilibrium, general stability, geometric compatibility and both short- and long-term material properties.

Members that tend to accumulate residual deformations under repeated service *loads* shall have included in their analysis the effects of added deformations expected to occur during their service life.

Any system or method of construction to be used shall be based on a rational analysis in accordance with well-established principles of mechanics. Such analysis shall result in a system that provides a complete *load* path capable of transferring *loads* from their point of origin to the load-resisting elements.

The total lateral force shall be distributed to the various vertical elements of the lateral force-resisting system in proportion to their rigidities, considering the rigidity of the horizontal bracing system or *diaphragm*. Rigid elements assumed not to be a part of the lateral force-resisting system are permitted to be incorporated into buildings provided that their effect on the action of the system is considered and provided for in the design. A *diaphragm* is rigid for the purpose of distribution of *story* shear and torsional moment when the lateral deformation of the *diaphragm* is less than or equal to two times the average *story* drift. Where required by ASCE 7, provisions shall be made for the increased forces induced on resisting elements of the structural system resulting from torsion due to eccentricity between the center of application of the lateral forces and the center of rigidity of the lateral force-resisting system.

Every structure shall be designed to resist the effects caused by the forces specified in this chapter, including overturning, uplift and sliding. Where sliding is used to isolate the elements, the effects of friction between sliding elements shall be included as a force.

2024 IBC:

1604.4 Analysis. P

Load effects on structural members and their connections shall be determined by methods of structural analysis that take into account equilibrium, general stability, geometric compatibility and both short- and long-term material properties.

Members that tend to accumulate residual deformations under repeated service *loads* shall have included in their analysis the effects of added deformations expected to occur during their *service life*.

Any system or method of construction to be used shall be based on a rational analysis in accordance with well-established principles of mechanics. Such analysis shall result in a system that provides a complete *load* path capable of transferring *loads* from their point of origin to the load-resisting elements.

The total lateral force shall be distributed to the various vertical elements of the lateral force-resisting system in proportion to their rigidities, considering the rigidity of the horizontal bracing system or *diaphragm*. Rigid elements assumed not to be a part of the lateral force-resisting system are permitted to be incorporated into *buildings* provided that their effect on the action of the system is considered and provided for in the design. Where a *diaphragm* is not permitted to be idealized as either flexible or rigid in accordance with ASCE 7 or for wood diaphragms in accordance with AWC SDPWS, the structure shall be analyzed and designed utlizing one of the following procedures:

1. An envelope analysis of the structure using a flexible and rigid diaphragm analysis separately and designing each component for the more severe load condition.
2. A semirigid diaphragm analysis and design.

Where required by ASCE 7, provisions shall be made for the increased forces induced on resisting elements of the structural system resulting from torsion due to eccentricity between the center of application of the lateral forces and the center of rigidity of the lateral force-resisting system.

Every *structure* shall be designed to resist the effects caused by the forces specified in this chapter, including overturning, uplift and sliding. Where sliding is used to isolate the elements, the effects of friction between sliding elements shall be included as a force.

1604.5 Risk category

2021 IBC:

1604.5 Risk category. P

Each building and structure shall be assigned a *risk category* in accordance with Table 1604.5. Where a referenced standard specifies an occupancy category, the *risk category* shall not be taken as lower than the occupancy category specified therein. Where a referenced standard specifies that the assignment of a *risk category* be in accordance with ASCE 7, Table 1.5-1, Table 1604.5 shall be used in lieu of ASCE 7, Table 1.5-1.

Exception: The assignment of buildings and structures to Tsunami *Risk Categories* III and IV is permitted to be in accordance with Section 6.4 of ASCE 7.

2024 IBC:

1604.5 Risk category. E P

Each *building* and *structure* shall be assigned a *risk category* in accordance with Table 1604.5. Where a referenced standard specifies an occupancy category, the *risk category* shall not be taken as lower than the occupancy category specified therein. Where a referenced standard specifies that the assignment of a *risk category* be in accordance with ASCE 7, Table 1.5-1, Table 1604.5 shall be used in lieu of ASCE 7, Table 1.5-1.

Exceptions:

1. The assignment of *buildings* and *structures* to Tsunami *Risk Categories* III and IV is permitted to be in accordance with Section 6.4 of ASCE 7.
2. Freestanding parking garages not used for the storage of emergency services vehicles or not providing means of egress for *buildings* or *structures* assigned to a higher risk category shall be assigned to Risk Category II.

Figure 5: Example of a freestanding parking garage.
Source: commons.wikimedia.org/wiki/File:Rybnik,_multistorey_car_park.jpg, Kamil Czainski, CC-BY-SA-4.0

TABLE 1604.5 RISK CATEGORY OF BUILDINGS AND OTHER STRUCTURES

2021 IBC:

RISK CATEGORY	NATURE OF OCCUPANCY
I	Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to: •Agricultural facilities. •Certain temporary facilities. •Minor storage facilities.
II	Buildings and other structures except those listed in Risk Categories I, III and IV.
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to: •Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300. •Buildings and other structures containing one or more public assembly spaces, each having an occupant load greater than 300 and a cumulative occupant load of these public assembly spaces of greater than 2,500. •Buildings and other structures containing Group E or Group I-4 occupancies or combination therof, with an occupant load greater than 250. •Buildings and other structures containing educational occupancies for students above the 12th grade with an occupant load greater than 500. •Group I-2, Condition 1 occupancies with 50 or more care recipients. •Group I-2, Condition 2 occupancies not having emergency surgery or emergency treatment facilities. •Group I-3 occupancies. •Any other occupancy with an occupant load greater than 5,000.[a] •Power-generating stations, water treatment facilities for potable water, wastewater treatment facilities and other public utility facilities not included in Risk Category IV. •Buildings and other structures not included in Risk Category IV containing quantities of toxic or explosive materials that: •Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area in accordance with the *International Fire Code*; and •Are sufficient to pose a threat to the public if released.[b]
IV	Buildings and other structures designated as essential facilities, including but not limited to: •Group I-2, Condition 2 occupancies having emergency surgery or emergency treatment facilities. •Ambulatory care facilities having emergency surgery or emergency treatment facilities. •Fire, rescue, ambulance and police stations and emergency vehicle garages •Designated earthquake, hurricane or other emergency shelters. •Designated emergency preparedness, communications and operations centers and other facilities required for emergency response. •Power-generating stations and other public utility facilities required as emergency backup facilities for *Risk Category* IV structures. •Buildings and other structures containing quantities of highly toxic materials that: •Exceed maximum allowable quantities per control area as given in Table 307.1(2) or per outdoor control area in accordance with the *International Fire Code*; and •Are sufficient to pose a threat to the public if released.[b] •Aviation control towers, air traffic control centers and emergency aircraft hangars. •Buildings and other structures having critical national defense functions. •Water storage facilities and pump structures required to maintain water pressure for fire suppression.

a. For purposes of occupant load calculation, occupancies required by Table 1004.5 to use gross floor area calculations shall be permitted to use net floor areas to determine the total occupant load.

b. Where approved by the building official, the classification of buildings and other structures as Risk Category III or IV based on their quantities of toxic, highly toxic or explosive materials is permitted to be reduced to Risk Category II, provided that it can be demonstrated by a hazard assessment in accordance with Section 1.5.3 of ASCE 7 that a release of the toxic, highly toxic or explosive materials is not sufficient to pose a threat to the public.

2024 IBC:

TABLE 1604.5 RISK CATEGORY OF BUILDINGS AND OTHER STRUCTURES

RISK CATEGORY	NATURE OF OCCUPANCY
I	Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to: • Agricultural facilities. • Certain temporary facilities. • Minor storage facilities.
II	Buildings and other structures except those listed in Risk Categories I, III and IV.

III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to:
	• Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300.
	• Buildings and other structures containing one or more public assembly spaces, each having an occupant load greater than 300 and a cumulative occupant load of these public assembly spaces of greater than 2,500.
	• Buildings and other structures containing Group E or Group I-4 occupancies or combination thereof, with an occupant load greater than 250.
	• Buildings and other structures containing educational occupancies for students above the 12th grade with an occupant load greater than 500.
	• Group I-3, Condition 1 occupancies.
	• Any other occupancy with an occupant load greater than 5,000.[a]
	• Power-generating stations with individual power units rated 75 MW_{AC} (megawatts, alternating current) or greater, water treatment facilities for potable water, wastewater treatment facilities and other public utility facilities not included in Risk Category IV.
	• Buildings and other structures not included in Risk Category IV containing quantities of toxic or explosive materials that:
	  • Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area in accordance with the *International Fire Code*; and
	  • Are sufficient to pose a threat to the public if released.[b]

IV	Buildings and other structures designated as essential facilities and buildings where loss of function represents a substantial hazard to occupants or users, including but not limited to:
	• Group I-2, Condition 2 occupancies.
	• Ambulatory care facilities having emergency surgery or emergency treatment facilities.
	• Group I-3 occupancies other than Condition 1.
	• Fire, rescue, ambulance and police stations and emergency vehicle garages
	• Designated earthquake, hurricane or other emergency shelters.
	• Designated emergency preparedness, communications and operations centers and other facilities required for emergency response.
	• Public utility facilities providing power generation, potable water treatment, or wastewater treatment.
	• Power-generating stations and other public utility facilities required as emergency backup facilities for *Risk Category* IV structures.
	• Buildings and other structures containing quantities of highly toxic materials that:
	  • Exceed maximum allowable quantities per control area as given in Table 307.1(2) or per outdoor control area in accordance with the *International Fire Code*; and
	  • Are sufficient to pose a threat to the public if released.[b]
	• Aviation control towers, air traffic control centers and emergency aircraft hangars.
	• Buildings and other structures having critical national defense functions.
	• Water storage facilities and pump structures required to maintain water pressure for fire suppression.

a. For purposes of occupant load calculation, occupancies required by Table 1004.5 to use *gross floor area* calculations shall be permitted to use *net floor areas* to determine the total occupant load. The floor area for vehicular drive aisles shall be permitted to be excluded in the determination of net floor area in parking garages.

b. Where approved by the building official, the classification of buildings and other structures as Risk Category III or IV based on their quantities of toxic, highly toxic or explosive materials is permitted to be reduced to Risk Category II, provided that it can be demonstrated by a hazard assessment in accordance with Section 1.5.3 of ASCE 7 that a release of the toxic, highly toxic or explosive materials is not sufficient to pose a threat to the public.

1604.5.1 Multiple occupancies

2021 IBC:

1604.5.1 Multiple occupancies.

Where a building or structure is occupied by two or more occupancies not included in the same *risk category*, it shall be assigned the classification of the highest *risk category* corresponding to the various occupancies. Where buildings or structures have two or more portions that are structurally separated, each portion shall be separately classified. Where a separated portion of a building or structure provides required access to, required egress from or shares life safety components with another portion having a higher *risk category*, both portions shall be assigned to the higher *risk category*.

Exception: Where a *storm shelter* designed and constructed in accordance with ICC 500 is provided in a building, structure or portion thereof normally occupied for other purposes, the *risk category* for the normal occupancy of the building shall apply unless the *storm shelter* is a designated emergency shelter in accordance with Table 1604.5.

2024 IBC:

1604.5.1 Multiple occupancies. P

Where a *building* or *structure* is occupied by two or more occupancies not included in the same *risk category*, it shall be assigned the classification of the highest *risk category* corresponding to the various occupancies. Where *buildings* or *structures* have two or more portions that are structurally separated, each portion shall be separately classified. Where a separated portion of a *building* or *structure* provides required access to, required egress from or shares life safety systems, designated seismic systems, emergency power systems, or emergency and egress lighting systems with another portion having a higher *risk category*, or provides required electrical, communications, mechanical, plumbing or conveying support to another portion assigned to *Risk Category* IV, both portions shall be assigned to the higher *risk category*.

Exception: Where a *storm shelter* designed and constructed in accordance with ICC 500 is provided in a *building*, *structure* or portion thereof normally occupied for other purposes, the *risk category* for the normal occupancy of the *building* shall apply unless the *storm shelter* is a designated emergency shelter in accordance with Table 1604.5.

1604.5.2 Photovoltaic (PV) panel systems

The following section was added in the 2024 IBC.

2024 IBC:

1604.5.2 Photovoltaic (PV) panel systems. P

Photovoltaic (PV) panel systems and *elevated PV support structures* shall be assigned a *risk category* as follows:

1. *Ground-mounted PV panel systems* serving only Group R-3 *buildings* shall be assigned to *Risk Category* I.
2. *Ground-mounted PV panel systems* other than those described in Items 1 and 5 shall be assigned to *Risk Category* II.
3. *Elevated PV support structures* other than those described in Items 4, 5 and 6 shall be assigned to *Risk Category* II.
4. Rooftop-mounted *PV panel systems* and *elevated PV support structures* installed on top of *buildings* shall be assigned to the same *risk category* as the *risk category* of the *building* on which they are mounted.
5. *PV panel systems* and *elevated PV support structures* paired with energy storage systems (ESS) and serving as a dedicated, stand-alone source of backup power for *Risk Category* IV *buildings* shall be assigned to *Risk Category* IV.
6. *Elevated PV support structures* where the usable space underneath is used for parking of emergency vehicles shall be assigned to *Risk Category* IV.

1604.8.2 Structural walls

2021 IBC:

1604.8.2 Structural walls.

Walls that provide vertical load-bearing resistance or lateral shear resistance for a portion of the structure shall be anchored to the roof and to all floors and members that provide lateral support for the wall or that are supported by the wall. The connections shall be capable of resisting the horizontal forces specified in Section 1.4.4 of ASCE 7 for walls of structures assigned to *Seismic Design Category* A and to Section 12.11 of ASCE 7 for walls of structures assigned to all other *seismic design categories*. Required anchors in masonry walls of hollow units or *cavity walls* shall be embedded in a reinforced grouted structural element of the wall. See Sections 1609 for wind design requirements and 1613 for earthquake design requirements.

2024 IBC:

1604.8.2 Structural walls. P

Walls that provide vertical load-bearing resistance or lateral shear resistance for a portion of the *structure* shall be anchored to the roof and to all floors and members that provide lateral support for the wall or that are supported by the wall. The connections shall be capable of resisting the horizontal forces that result from the application of the prescribed *loads*. The required earthquake out-of-plane *loads* are specified in Section 1.4.4 of ASCE 7 for walls of *structures* assigned to *Seismic Design Category* A and to Section 12.11 of ASCE 7 for walls of *structures* assigned to all other *seismic design categories*. Required anchors in *masonry* walls of hollow units or cavity walls shall be embedded in a reinforced grouted structural element of the wall. See Sections 1609 for wind design requirements and 1613 for earthquake design requirements.

Figure 6: Steel moment frame connections capable of resisting out-of-plane loads.

Source: commons.wikimedia.org/wiki/File:Construction_site_at_London_Wall_(1)_-_geograph.org.uk_-_2559948.jpg
Peter Shimmon, CC-BY-SA-2.0

1605.1 General

2021 IBC:

1605.1 General. P

Buildings and *other structures* and portions thereof shall be designed to resist the strength load combinations specified in ASCE 7, Section 2.3, the a*llowable stress design* load combinations specified in ASCE 7, Section 2.4, or the alternative a*llowable 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 pounds per square foot (1.44 kN/m^2) and *roof live loads* of 30 pounds per square foot (1.44 kN/m^2) or less need not be combined with seismic load. Where flat roof snow *loads* exceed 30 pounds per square foot (1.44 kN/m^2), 20 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.

2024 IBC:

1605.1 General. P

Buildings and *other structures* and portions thereof shall be designed to resist the strength load combinations specified in ASCE 7, Section 2.3, the a*llowable stress design* load combinations specified in ASCE 7, Section 2.4, or the alternative a*llowable 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 45 pounds per square foot (2.15 kN/m^2) and *roof live loads* of 30 pounds per square foot (1.44 kN/m^2) or less need not be combined with seismic load. Where flat roof snow *loads* exceed 45 pounds per square foot (2.15 kN/m^2), 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 design for tornado loads is 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

2021 IBC:

1605.2 Alternative allowable stress design load combinations.

…

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

$D + L + 0.6W$ **(Equation 16-2)**

$D + L + 0.6W + S/2$ **(Equation 16-3)**

$D + L + S + 0.6W/2$ **(Equation 16-4)**

$D + L + S + E/1.4$ **(Equation 16-5)**

$0.9D + E/1.4$ **(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 pounds per square foot (1.44 kN/m^2) or less and *roof live loads* of 30 pounds per square foot (1.44 kN/m^2) or less need not be combined with seismic loads. Where flat roof snow loads exceed 30 pounds per square foot (1.44 kN/m^2), 20 percent shall be combined with seismic loads.

2024 IBC:

1605.2 Alternative allowable stress design load combinations.

…

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

$D + L + 0.6W$ **(Equation 16-2)**

$D + L + 0.6W + 0.7S/2$ (Equation 16-3)

$D + L + 0.7S + 0.6(W/2)$ (Equation 16-4)

$D + L + 0.7S + E/1.4$ (Equation 16-5)

$0.9D + E/1.4$ **(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 45 pounds per square foot (2.15 kN/m^2) or less and *roof live loads* of 30 pounds per square foot (1.44 kN/m^2) or less need not be combined with seismic loads. Where flat roof snow loads exceed 45 pounds per square foot (2.15 kN/m^2), 15 percent shall be combined with seismic loads.

1606.1 General

The 2021 IBC Table 1607.1 is not shown since the 2024 changes can be understood with the highlights below.

2024 IBC:

TABLE 1607.1
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_0, AND MINIMUM CONCENTRATED LIVE LOADS

	OCCUPANCY OR USE		UNIFORM (psf)	CONCENTRATED (pounds)	ALSO SEE SECTION
1.	Apartments (see residential)		—	—	—
2.	Access floor systems	Office use	50	2,000	—
		Computer use	100	2,000	—
3.	Armories and drill rooms		150[a]	—	—
4.	Assembly areas	Fixed seats (fastened to floor)	60[a]	—	—
		Lobbies	100[a]		
		Movable seats	100[a]		
		Stage floors	150[a]		
		Platforms (assembly)	100[a]		
		Bleachers, folding and telescopic seating and grandstands	100[a] (See Section 1607.18)		
		Stadiums and arenas with fixed seats (fastened to the floor)	60[a] (See Section 1607.18)		
		Other assembly areas	100[a]		
5.	Balconies and decks		1.5 times the live load for the area served, not required to exceed 100	—	—
6.	Catwalks for maintenance and service access		40	300	—
7.	Cornices		60	—	—
8.	Corridors	First floor	100	—	—
		Other floors	Same as occupancy served except as indicated		
9.	Dining rooms and restaurants		100[a]	—	—
10.	Dwellings (see residential)		—	—	—
10.	Dwellings (see residential)		—	—	—
11.	Elevator machine room and control room grating (on area of 2 inches by 2 inches)		—	300	—
12.	Finish light floor plate construction (on area of 1 inch by 1 inch)		—	200	—
13.	Fire escapes		100	—	—
		On single-family dwellings only	40		
14.	Fixed ladders		See Section 1607.10		—
15.	Garages and vehicle floors	Passenger vehicle garages	40[c]	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 3,000 pounds or less	40[a]	See Section 1607.6.1	Section 1607.6
		Helicopter takeoff weight more than 3,000 pounds	60[a]	See Section 1607.6.1	Section 1607.6
18.	Hospitals	Corridors above first floor	80	1,000	—
		Operating rooms, laboratories	60	1,000	
		Patient rooms	40	1,000	
19.	Hotels (see residential)		—	—	—
20.	Libraries	Corridors above first floor	80	1,000	—
		Reading rooms	60	1,000	—
		Stack rooms	150[b]	1,000	Section 1607.17
21.	Manufacturing	Heavy	250[b]	3,000	—
		Light	125[b]	2,000	
22.	Marquees, except one- and two-family dwellings		75	—	—
23.	Office buildings	Corridors above first floor	80	2,000	—
		File and computer rooms shall be designed for heavier loads based on anticipated occupancy	—	—	
		Lobbies and first-floor corridors	100	2,000	
		Offices	50	2,000	
24.	Penal institutions	Cell blocks	40	—	—
		Corridors	100		
25.	Public restrooms		Same as live load for area served but not required to exceed 60 psf	—	—
26.	Recreational uses	Bowling alleys, poolrooms and similar uses	75[a]	—	—
		Dance halls and ballrooms	100[a]		
		Gymnasiums	100[a]		
		Theater projection, control, and follow spot rooms	50		
		Ice skating rinks	250[b]		
		Roller skating rinks	100[a]		
27.	Residential	One- and two-family dwellings:		—	Section 1607.21
		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	100[a]		
		Corridors serving public rooms	100		

28.	Roofs	Ordinary flat, pitched, and curved roofs (that are not occupiable)	20	—	Section 1607.14
		Roof areas used for assembly purposes	100[a]	—	
		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[a]	—	
		Roof areas used for occupancies other than assembly	Same as occupancy served	—	
		Awnings and canopies:			
		Fabric construction supported by a skeleton structure	5[a]	—	
		All other construction, except one- and two-family dwellings	20	—	
		Primary roof members exposed to a work floor:			Section 1607.15
		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	
29.	Schools	Classrooms	40	1,000	—
		Corridors above first floor	80	1,000	
		First-floor corridors	100	1,000	
30.	Scuttles, skylight ribs and accessible ceilings		—	200	—
31.	Sidewalks, vehicular driveways and yards, subject to trucking		250[b]	8,000	Section 1607.19
32.	Stairs and exits	One- and two-family dwellings	40	300	Section 1607.20
		All other	100	300	Section 1607.20
33.	Storage areas above ceilings		20	—	—
34.	Storage warehouses (shall be designed for heavier loads if required for anticipated storage)	Heavy	250[b]	—	—
		Light	125[b]		
35.	Stores	Retail:			—
		First floor	100	1,000	
		Upper floors	75	1,000	
		Wholesale, all floors	125[b]	1,000	
36.	Vehicle barriers		See Section 1607.11		—
37.	Walkways and elevated platforms (other than exitways)		60	—	—
38.	Yards and terraces, pedestrian		100[a]	—	—

1607.3 Uniform live loads

2021 IBC:

1607.3 Uniform live loads. P

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.

2024 IBC:

1607.3 Uniform live loads. P

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.

1607.3.1 & 2 Partial loading of floors & roofs

The following subsections were added in 2024 IBC.

2024 IBC:

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. Uniform floor *live loads* applied to selected spans are permitted to be reduced in accordance with Section 1607.13.

1607.3.2 Partial loading of roofs.

Where uniform *roof live loads* are reduced to less than 20 pounds per square foot (0.96 kN/m^2) in accordance with Section 1607.14.1 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*.

1607.5 Partition loads

2021 IBC:

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^2) or greater. The partition *load* shall be not less than a uniformly distributed *live load* of 15 psf (0.72 kN/m^2).

2024 IBC:

1607.5 Partition loads. P

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.* The partition *load* shall be not less than a *live load* of 15 pounds per square foot (0.72 kN/m^2) and live load reductions in accordance with Section 1607.13 are not permitted to be applied to the partition loads.

Exception: A partition *live load* is not required where the minimum specified *live load* is 80 pounds per square foot (3.83 kN/m^2) or greater.

Figure 7: Example partition wall (non-load bearing wall).
Source: commons.wikimedia.org/wiki/File:Partition_inside_of_the_old_Pubali_Bank_building_in_Kadirpar,_Cumilla.jpg, Afifa Afrin

1607.6 Helipads

2021 IBC:

1607.6 Helipads.

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^2) 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^2) 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 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.

2024 IBC:

1607.6 Helipads. P

Helipads shall be marked to indicate the maximum takeoff weight. The takeoff weight limitation shall be indicated in units of thousands of pounds and placed in a box that is located in the bottom right corner of the landing area as viewed from the primary approach path. The box shall be not less than 5 feet (1524 mm) in height.

1607.6.1 Concentrated loads. P

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 load 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 takeoff 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*.

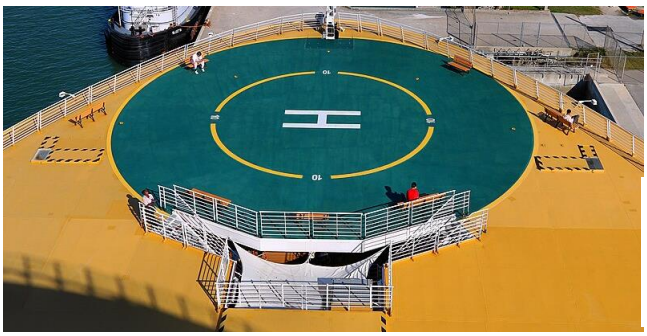


Figure 8: Example helipad.

Source: https://commons.wikimedia.org/wiki/File:Helipad_Allure_of_the_Seas_2024.jpg, Larry D. Moore, CC-BY-4.0

1607.8.2 Fire truck and emergency vehicles

2021 IBC:

1607.8.2 Fire truck and emergency vehicles.

Where a structure or portions of a structure are accessed and loaded by fire department access vehicles and other similar emergency vehicles, the structure 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.

2024 IBC:

1607.8.2 Fire truck and emergency vehicles.

Where a *structure* or portions of a *structure* are accessed by fire department 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.

Emergency vehicle *loads* need not be assumed to act concurrently with other uniform *live loads*.

Figure 9: Example fire truck emergency vehicle.
Source: commons.wikimedia.org/wiki/File:ChicoCAEngine4.jpg, CC-BY-SA-3.0

1607.9.1 Concentrated load

2021 IBC:

1607.9.1 Handrails and guards.

Handrails and *guards* shall be designed to resist a linear *load* of 50 pounds per linear foot (plf) (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 I-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).

1607.9.1.1 Concentrated load. P

Handrails and *guards* shall be designed to resist a concentrated *load* of 200 pounds (0.89 kN) in accordance with Section 4.5.1 of ASCE 7.

2024 IBC:

1607.9.1 Concentrated load.

Handrails and *guards* shall be designed to resist a concentrated *load* of 200 pounds (0.89 kN) in accordance with Section 4.5.1 of ASCE 7. Glass *handrail* assemblies and guards shall comply with Section 2407.

1607.9.1.1 Uniform load.

Handrails and *guards* shall be designed to resist a linear *load* of 50 pounds per linear foot (plf) (0.73 kN/m) in accordance with Section 4.5.1.1 of ASCE 7. This load need not be assumed to act concurrently with the concentrated load specified in Section 1607.9.1.

Exceptions:

1. For one- and two-family *dwellings*, only the single concentrated *load* required bySection 1607.9.1 shall be applied.
2. In Group I-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 shall be applied.

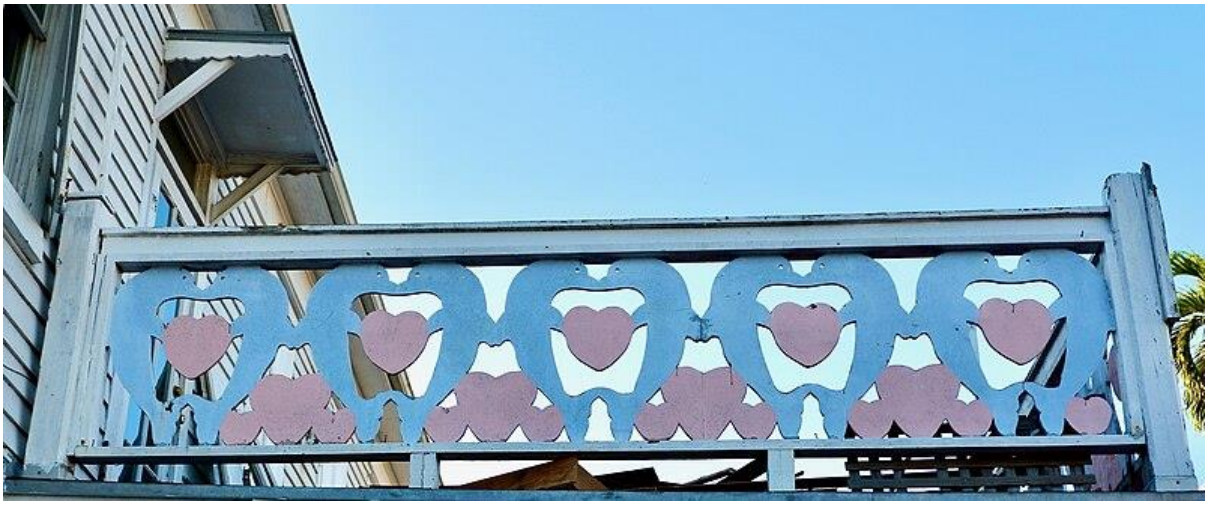


Figure 10: Special guardrail design on a balcony.
Source: commons.wikimedia.org/wiki/File:Dolphin_Love_Balcony,_Key_West_FL.jpg, CC-BY-2.0

1607.13.2 Alternative uniform live load reduction

2021 IBC:

1607.12.2 Alternative uniform live load reduction.

As an alternative to Section 1607.12.1 and subject to the limitations of Table 1607.1, uniformly distributed *live loads* are permitted to be reduced in accordance with the following provisions. Such reductions shall apply to slab systems, beams, girders, columns, piers, walls and foundations.

1. A reduction shall not be permitted where the *live load* exceeds 100 psf (4.79 kN/m^2) except that the design *live load* for members supporting two or more floors is permitted to be reduced by not greater than 20 percent.

   Exception: 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.
2. A reduction shall not be permitted in passenger vehicle parking garages except that the *live loads* for members supporting two or more floors are permitted to be reduced by not greater than 20 percent.
3. For *live loads* not exceeding 100 psf (4.79 kN/m^2), the design *live load* for any structural member supporting 150 square feet (13.94 m^2) or more is permitted to be reduced in accordance with Equation 16-8
4. For one-way slabs, the area, *A*, for use in Equation 16-8 shall not exceed the product of the slab span and a width normal to the span of 0.5 times the slab span.

$$R = 0.08(A - 150) \qquad \textbf{(Equation 16-8)}$$

For SI: $R = 0.861(A - 13.94)$

Such reduction shall not exceed the smallest of:

1. 40 percent for members supporting one floor.
2. 60 percent for members supporting two or more floors.
3. *R* as determined by the following equation:

$$R = 23.1(1 + D/L_o) \qquad \textbf{(Equation 16-9)}$$

where:

A = Area of floor supported by the member, square feet (m^2).

D = *Dead load* per square foot (m^2) of area supported.

L_o = Unreduced *live load* per square foot (m^2) of area supported.

R = Reduction in percent.

2024 IBC:

1607.13.2 Alternative uniform live load reduction.

As an alternative to Section 1607.13.1 and subject to the limitations of Table 1607.1, uniformly distributed *live loads* are permitted to be reduced in accordance with the following provisions. Such reductions shall apply to slab systems, beams, girders, columns, piers, walls and foundations.

1. For *live loads* not exceeding 100 pounds per square foot (4.79 kN/m^2), the design *live load* for structural members supporting 150 square feet (13.94 m^2) or more is permitted to be reduced in accordance with Equation 16-8.

$$R = 0.08(A - 150) \quad \text{(Equation 16-8)}$$

For SI: $R = 0.861(A - 13.94)$
where:
A = Area of floor supported by the member, square feet (m^2).
R = Reduction in percent.Such reduction shall not exceed the smallest of:

1.1. 40 percent for members supporting one floor.
1.2. 60 percent for members supporting two or more floors.
1.3. R as determined by the following equation:

$$R = 23.1(1 + D/L_o) \quad \text{(Equation 16-9)}$$

where:
D = *Dead load* per square foot (m^2) of area supported.
L_o = Unreduced *live load* per square foot (m^2) of area supported.

2. A reduction shall not be permitted where the *live load* exceeds 100 pounds per square foot (4.79 kN/m^2) except that the design *live load* for members supporting two or more floors is permitted to be reduced by not greater than 20 percent.

   Exception: 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.

3. A reduction shall not be permitted in passenger vehicle parking garages except that the *live loads* for members supporting two or more floors are permitted to be reduced by not greater than 20 percent.

4. For one-way slabs, the area, A, for use in Equation 16-8 shall not exceed the product of the slab span and a width normal to the span of 0.5 times the slab span.

1607.14 Reduction in uniform roof live loads

2021 IBC:

1607.14.2 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.

2024 IBC:

1607.14 Reduction in uniform roof live loads.

The minimum uniformly distributed *live loads* of roofs, *marquees* and *canopies*, L_o, in Table 1607.1 are permitted to be reduced in accordance with Section 1607.14.1.

Figure 11: Example self-supporting canopy (left) and awning/marquee (right).
Sources: commons.wikimedia.org/wiki/File:Canopy_structure_at_Lafayette_station,_April_2018.JPG, Pi.1415926535
commons.wikimedia.org/wiki/File:Copper_Canopy_at_Kohl_Hall.jpg, Mbrickn, CC-BY-4.0

1607.14.3.3 Elevated photovoltaic (PV) support structures with open grid framing

2021 IBC:

1607.14.4.3 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 1607.14.4.1, except that the uniform *roof live load* shall be permitted to be reduced to 12 psf (0.57 kN/m^2).

2024 IBC:

1607.14.3.3 Elevated photovoltaic (PV) support structures with open grid framing.

Elevated photovoltaic (PV) support structures with open grid framing and without a *roof deck* or sheathing shall be designed to support the uniform and concentrated *roof live loads* specified in Section 1607.14.3.1, except that the uniform *roof live load* shall be permitted to be reduced to 12 psf (0.57 kN/m^2).

1607.14.3.4 Ground-mounted photovoltaic (PV) panel systems

2021 IBC:

1607.14.4.4 Ground-mounted photovoltaic (PV) panel systems.

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.

2024 IBC:

1607.14.3.4 Ground-mounted photovoltaic (PV) panel systems.

Ground-mounted photovoltaic (PV) panel systems are not required to accommodate a roof *live load*. Other *loads* and combinations in accordance with Section 1605 shall be accommodated.

Figure 12: PV panel system (solar panels) on a flat roof with a tilt towards the south.
Source: http://solarframeworks.com, Chris Bills, Chris Erickson, Calla Leonard, Patrina Eiffert

1607.15 Crane loads

2021 IBC:

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 include the maximum wheel *loads* of the crane and the vertical impact, lateral and longitudinal forces induced by the moving crane.

2024 IBC:

1607.15 Crane loads. P

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.

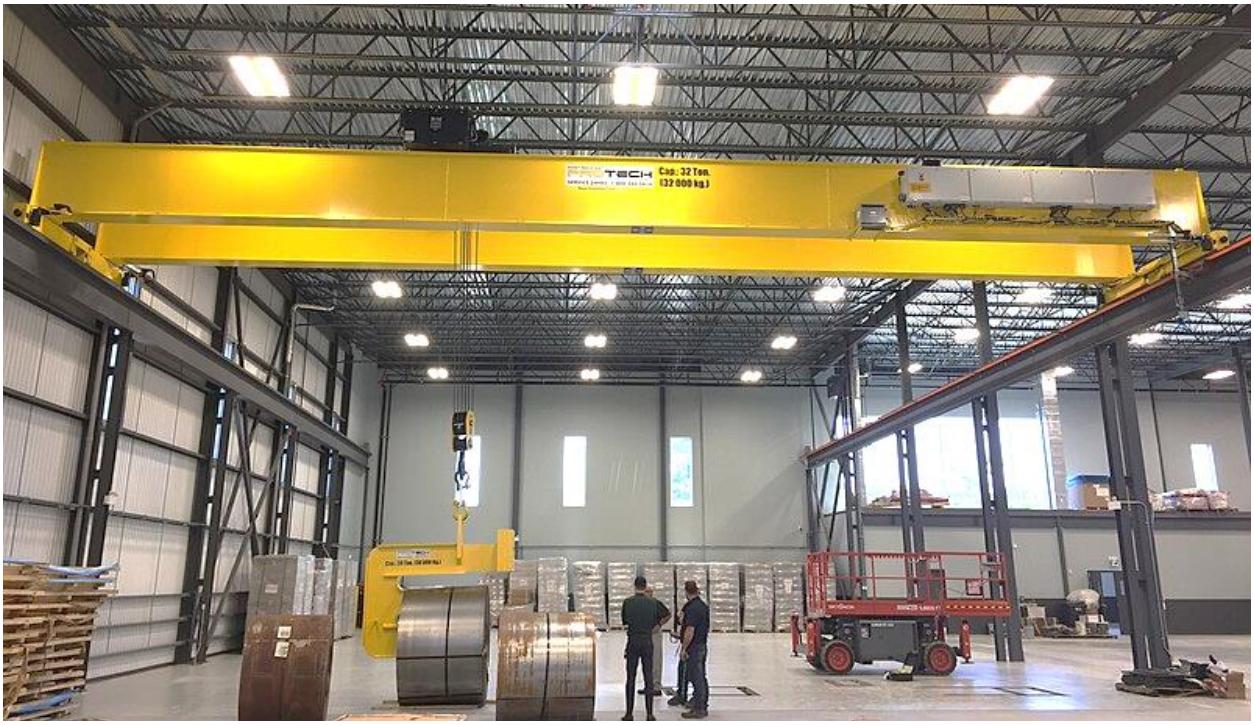


Figure 13: Overhead bridge crane that moves along rail beams.
Source: commons.wikimedia.org/wiki/File:Overhead_Crane_for_Coil_Lifting.jpg, Sclaferriere, CC-BY-SA-4.0

1608.1 General

2021 IBC:

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.

2024 IBC:

1608.1 General. P

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 3103.6.1.1.

Figure 14: Example temporary structure.

Source: commons.wikimedia.org/wiki/File:Snow_beside_the_tennis_tent_-_geograph.org.uk_-_2177833.jpg, David Lally

1608.2 Ground snow loads

2021 IBC:

1608.2 Ground snow loads. P

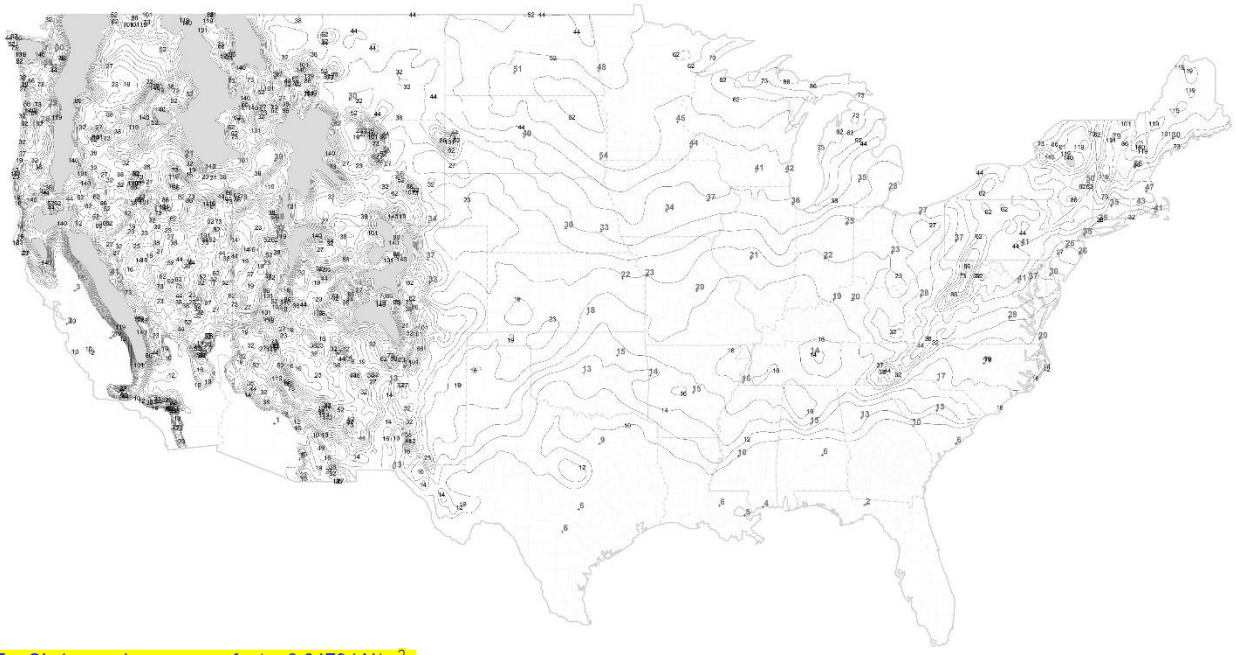
The ground snow *loads* to be used in determining the design snow *loads* for roofs shall be determined in accordance with ASCE 7 or Figures 1608.2(1) and 1608.2(2) for the contiguous United States and Table 1608.2 for Alaska. Site-specific case studies shall be made in areas designated "CS" in Figures 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*.

...

2024 IBC (Risk Category I map is shown; new Risk Category II, III & IV maps are similar):

1608.2 Ground snow loads. P

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) through 1608.2(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*. Snow loads are zero for Hawaii, except in mountainous regions as *approved* by the *building official* .



For SI: 1 pound per square foot = 0.0479 kN/m^2.

Notes:

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.
3. Values denoted with a "+" symbol indicate design ground snow loads at state capitals or other high-population locations.
4. 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 1608.2(1)
GROUND SNOW LOADS, p_g, FOR RISK CATEGORY I FOR THE CONTERMINOUS UNITED STATES (lb/ft^2)

1608.2.1 Ground snow conversion

The following subsection was added to 2024 IBC:

2024 IBC:

1608.2.1 Ground snow conversion. P

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

$$p_{g(asd)} = 0.7\, p_g \qquad \text{(Equation 16-17)}$$

where:

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

p_g = Ground snow load determined from Figures 1608.2(1) through 1608.2(4) and Table 1608.2.

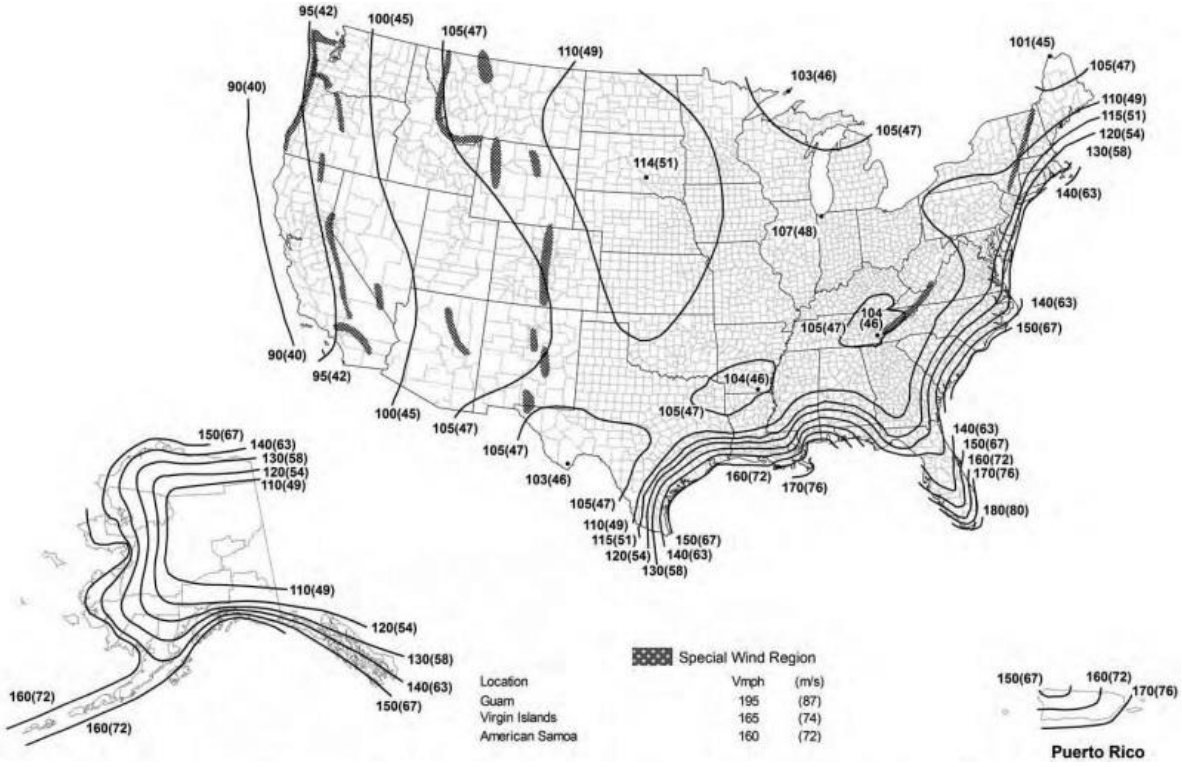
1609.3 Basic design wind speed

2021 IBC:

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). The basic design *wind speed*, *V*, for use in the design of *Risk Category* II 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 buildings and structures shall be obtained from Figures 1609.3(2), 1609.3(7) and 1609.3(8). The basic design *wind speed*, *V*, for use in the design of *Risk Category* IV 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 buildings and structures shall be obtained from Figures 1609.3(4), 1609.3(11) and 1609.3(12). 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 nonhurricane-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. Islands, coastal areas, and land 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, MRI = 700 Years).
6. Location-specific basic wind speeds shall be permitted to be determined using www.atcouncil.org/windspeed

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

2024 IBC (Risk Category I map is shown; new Risk Category II, III & IV maps are similar):

1609.3 Basic design wind speed. E P

The ***basic*** *wind speed*, *V*, in mph, for the determination of the wind *loads* shall be determined by Figures 1609.3(1) through 1609.3(4).

The ***basic*** *wind speed*, *V*, for use in the design of *Risk Category* I *buildings* and *structures* shall be obtained from Figure 1609.3(1).

The ***basic*** *wind speed*, *V*, for use in the design of *Risk Category* II *buildings* and *structures* shall be obtained from Figure 1609.3(2).

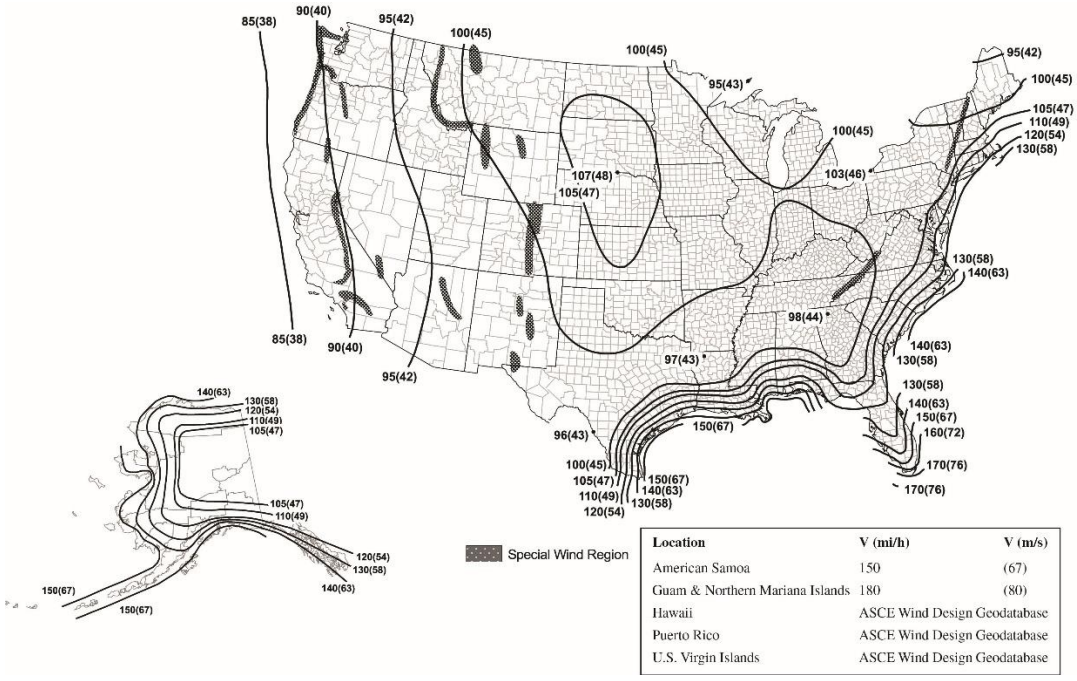
The ***basic*** *wind speed*, *V*, for use in the design of *Risk Category* III *buildings* and *structures* shall be obtained from Figure 1609.3(3).

The ***basic*** *wind speed*, *V*, for use in the design of *Risk Category* IV *buildings* and *structures* shall be obtained fromFigure 1609.3(4).

Basic wind speeds for Hawaii, the US Virgin Islands and Puerto Rico shall be determined by using the ASCE Wind Design Geodatabase. The ASCE Wind Design Geodatabase is available at https://asce7hazardtool.online, or an approved equivalent.

The ***basic*** *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*** *wind speeds*, *V*, determined by the local *jurisdiction* shall be in accordance with Chapter 26 of ASCE 7.

In nonhurricane-prone regions, when the ***basic*** *wind speed*, *V*, is estimated from regional climatic data, the ***basic*** *wind speed*, *V*, shall be determined in accordance with Chapter 26 of ASCE 7.



Location	V (mi/h)	V (m/s)
American Samoa	150	(67)
Guam & Northern Mariana Islands	180	(80)
Hawaii	ASCE Wind Design Geodatabase	
Puerto Rico	ASCE Wind Design Geodatabase	
U.S. Virgin Islands	ASCE Wind Design Geodatabase	

Notes:

1. Values are 3-second gust wind speeds in miles per hour (m/s) at 33 feet (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 wind speeds* shall be determined using the ASCE Wind Design Geodatabase.
5. Wind speeds for Hawaii, the 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 determined using the ASCE Wind Design Geodatabase.
7. Wind speeds correspond to approximately a 15-percent probability of exceedance in 50 years (annual exceedance probability = 0.00333, 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 WIND SPEEDS, *V*, FOR RISK CATEGORY I BUILDINGS AND OTHER STRUCTURES

1609.5 Tornado loads

The following subsection was added in 2024 IBC.

2024 IBC:

1609.5 Tornado loads. P

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.

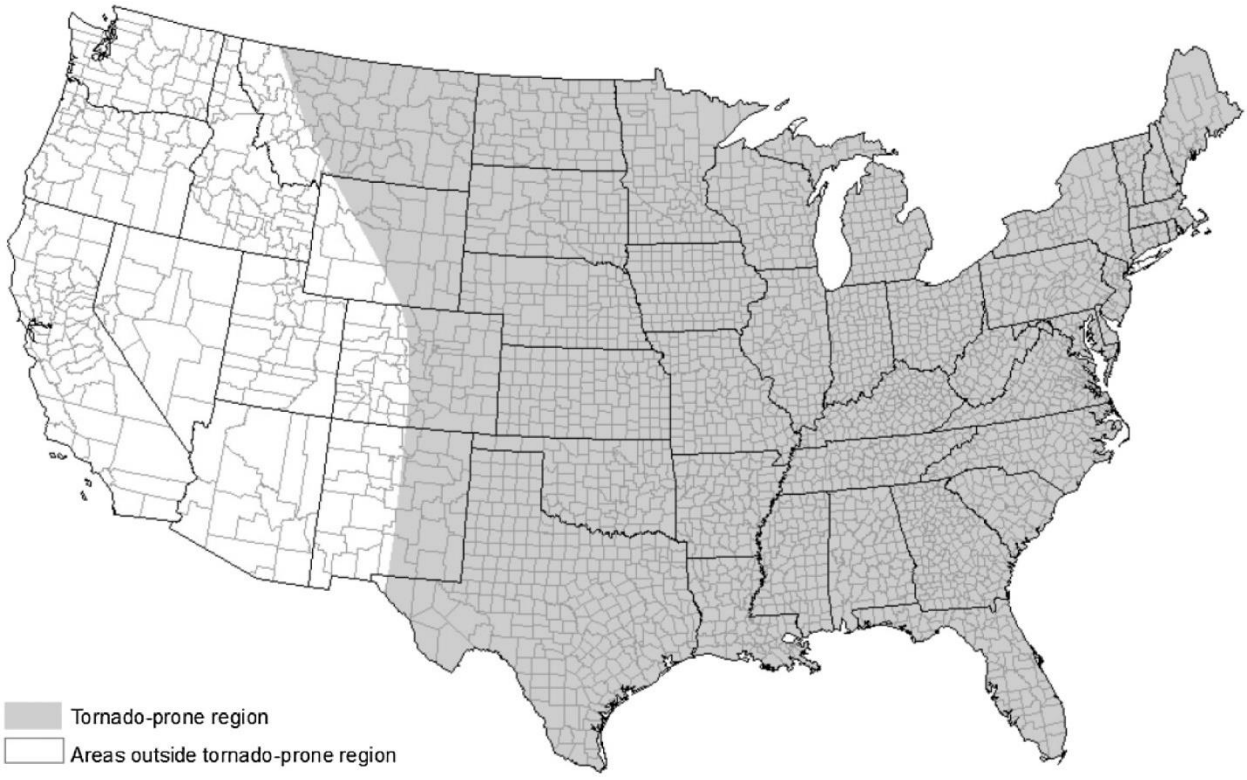


FIGURE 1609.5 TORNADO-PRONE REGION

1609.6.1 Roof deck

2021 IBC:

1609.5.1 Roof deck.

The *roof deck* shall be designed to withstand the wind pressures determined in accordance with ASCE 7.

2024 IBC:

1609.6.1 Roof deck. P

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

1609.6.3 Rigid tile

2021 IBC:

1609.5.3 Rigid tile.

Wind *loads* on rigid tile *roof coverings* shall be determined in accordance with the following equation:

$$M_a = q_h C_L b L L_a [1.0 - G C_p] \qquad \textbf{(Equation 16-18)}$$

For SI: $M_a = \frac{q_h C_L b L L_a [1.0 - G C_p]}{1.000}$

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.

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^2) 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.

2024 IBC Structural Design Changes
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2024 IBC:

1609.6.3 Rigid tile.

Wind and tornado loads on rigid tiles shall comply with Section 1609.6.3.1 or 1609.6.3.2, as applicable.

1609.6.3.1 Aerodynamic uplift moment.

The aerodynamic uplift moment for rigid tile *roof coverings* shall be determined in accordance with the following equation:

$$M_a = q_h K_d C_L b L L_a [1.0 - GC_p] \qquad \text{Equation 16-19}$$

For SI:

$M_a = q_h K_d C_L b L L_a [1.0 - GC_p] / 1000$

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 ASCE 7.

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^2) 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 16-19, where:

q_{hT} = tornado velocity pressure, pounds per square foot (kN/m^2) 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.

1609.7 Elevators, escalators and other conveying systems

The following subsection was added in 2024 IBC.

2024 IBC:

1609.7 Elevators, escalators and other conveying systems. P

Elevators, escalators and other conveying systems and their components exposed to outdoor environments shall satisfy the wind design requirements of ASCE 7.

Figure 15: Outdoor escalators must satisfy wind and applicable seismic design requirements.

Source: commons.wikimedia.org/wiki/File:Escalator_connecting_the_Square_and_Taichung_Railway_Station.jpg
Tbatb, CC-BY-SA-4.0

1610.1 Lateral pressures

2021 IBC:

1610.1 Lateral pressures. P

Foundation walls and retaining walls 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 free to move and rotate at the top shall be permitted to be designed for active pressure. Lateral pressure from 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.

2024 IBC:

1610.1 Lateral pressures. P

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. 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 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.

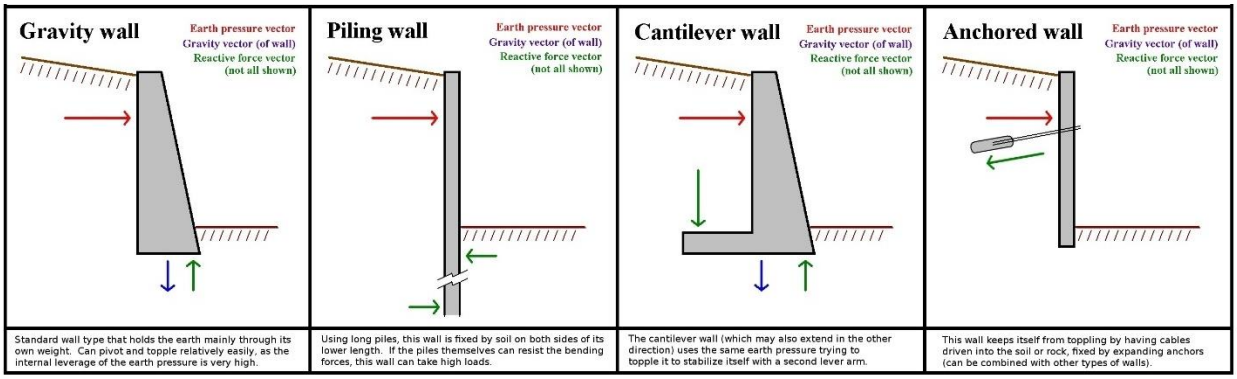


Figure 16: Types of retaining walls with arrows for earth pressure (red), gravity load (blue) and reaction force (green).
Source: https://commons.wikimedia.org/wiki/File:Retaining_Wall_Type_Function.jpg, p.d.

1611.1 Design rain loads

2021 IBC:

1611.1 Design rain loads. P

Each portion of a roof shall be designed to sustain the *load* of rainwater as per the requirements of Chapter 8 of ASCE 7. 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.

$$R = 5.2(d_s + d_h)$$ **(Equation 16-19)**

For SI: $R = 0.0098(d_s + d_h)$

where:

d_h = 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 = Depth of water on the undeflected roof up to the inlet of secondary drainage system when the primary drainage system is blocked (in other words, the static head), in inches (mm).

R = Rain load on the undeflected roof, in psf (kN/m^2). 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.

2024 IBC:

1611.1 Design rain loads. P

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 Equation 16-20. 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-minute 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 the risk categories given in Table 1611.1. 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*.

$$R = 5.2(d_s + d_h + d_p)$$ **(Equation 16-20)**

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).

d_p = Ponding head equal to the depth of water due to deflections of the roof subjected to unfactored rain load and unfactored *dead load*, 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).

R = Rain load, in pounds per square foot (kN/m^2).

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

RISK CATEGORY	DESIGN STORM RETURN PERIOD
I & II	100 years
III	200 years
IV	500 years

1611.2 Ponding instability

2021 IBC:

1611.2 Ponding instability.

Susceptible bays of roofs shall be evaluated for ponding instability in accordance with Chapters 7 and 8 of ASCE 7.

2024 IBC:

1611.2 Ponding instability.

Ponding instability on roofs shall be evaluated in accordance with ASCE 7.

1612.2 Design and construction

2021 IBC:

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.

2024 IBC:

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. Elevators, escalators, conveying systems and their components shall conform to ASCE 24 and ASME A17.1/CSA B44 as applicable.

Exception: *Temporary structures* complying with Section 3103.6.1.3.

1612.4 Flood hazard documentation

2021 IBC:

1612.4 Flood hazard documentation. P

The following documentation shall be prepared and sealed by a *registered design professional* and submitted to the *building official*:

1. For construction in *flood hazard areas* other than *coastal high hazard areas* or *coastal A zones*:
   1.1. The elevation of the *lowest floor*, including the basement, as required by the lowest floor elevation inspection in Section 110.3.3 and for the final inspection in Section 110.3.12.1.
   1.2. For fully enclosed areas below the *design flood elevation* where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, *construction documents* shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.
   1.3. For *dry floodproofed* nonresidential buildings, *construction documents* shall include a statement that the *dry floodproofing* is designed in accordance with ASCE 24 and shall include the flood emergency plan specified in Chapter 6 of ASCE 24.
2. For construction in *coastal high hazard areas* and *coastal A zones*:
   2.1. The elevation of the bottom of the lowest horizontal structural member as required by the *lowest floor* elevation inspection in Section 110.3.3 and for the final inspection in Section 110.3.12.1.
   2.2. *Construction documents* shall include a statement that the building is designed in accordance with ASCE 24, including that the pile or column foundation and building or structure to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and *flood loads* acting simultaneously on all building components, and other *load* requirements of Chapter 16.
   2.3. For breakaway walls designed to have a resistance of more than 20 psf (0.96 kN/m^2) determined using *allowable stress design*, *construction documents* shall include a statement that the breakaway wall is designed in accordance with ASCE 24.
   2.4 For breakaway walls where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.

2024 IBC:

1612.4 Flood hazard documentation. P

The following documentation shall be prepared and sealed by a *registered design professional* and submitted to the *building official*:

1. For construction in *flood hazard areas* other than *coastal high hazard areas* or *coastal A zones*:
   1.1. The elevation of the *lowest floor*, including the basement, as required by the *lowest floor* elevation inspection in Section 110.3.3 and for the final inspection in Section 110.3.12.1.
   1.2. For fully enclosed areas below the *design flood elevation* where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, *construction documents* shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.
   1.3. For *dry floodproofed* nonresidential *buildings*, *construction documents* shall include a statement that the *dry floodproofing* is designed in accordance with ASCE 24 and shall include the *flood* emergency plan specified in Chapter 6 of ASCE 24.
   1.4. For dry floodproofed nonresidential buildings, the elevation to which the building is dry floodproofed as required for the final inspection in Section 110.3.12.1.
2. For construction in *coastal high hazard areas* and *coastal A zones*:
   2.1. The elevation of the bottom of the lowest horizontal structural member as required by the *lowest floor* elevation inspection in Section 110.3.3 and for the final inspection in Section 110.3.12.1.
   2.2. *Construction documents* shall include a statement that the *building* is designed in accordance with ASCE 24, including that the pile or column foundation and *building* or *structure* to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and *flood loads* acting simultaneously on all building components, and other *load* requirements of Chapter 16.

2.3. For breakaway walls designed to have a resistance of more than 20 psf (0.96 kN/m^2) determined using *allowable stress design* or a resistance to an ultimate load of more than 33 pounds per square foot (1.58 kN/m^2), *construction documents shall include a statement that the breakaway wall is designed in accordance with ASCE 24*.

2.4 For breakaway walls where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, *construction documents* shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.

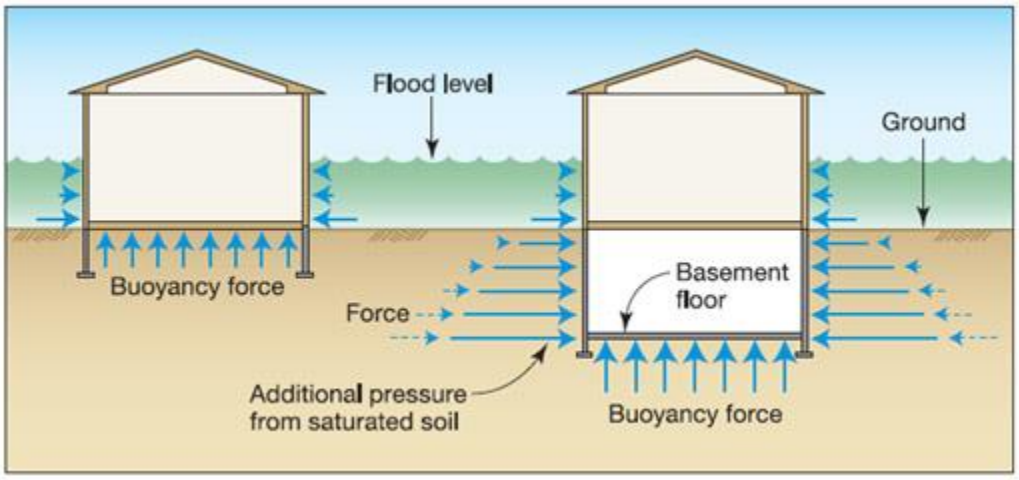


Figure 17: Sections showing surfaces that would need dry floodproofing applied.
Source: https://emilms.fema.gov/is_0280/groups/154.html, p.d.

1613.1 Scope (Earthquake Loads)

2021 IBC:

1613.1 Scope. P

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 0.4 g.
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.

2024 IBC:

1613.1 Scope. P

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.
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 3103.6.1.4.

1613.2 Determination of seismic design category

2021 IBC:

1613.2 Seismic ground motion values.

Seismic ground motion values shall be determined in accordance with this section.

1613.2.1 Mapped acceleration parameters.

The parameters S_S and S_1 shall be determined from the 0.2 and 1-second spectral response accelerations shown on Figures 1613.2.1(1) through 1613.2.1(10). Where S_1 is less than or equal to 0.04 and S_S is less than or equal to 0.15, the structure is permitted to be assigned *Seismic Design Category* A.

…

2024 IBC:

1613.2 Determination of seismic design category.

Structures shall be assigned to a *seismic design category* based on one of the following methods unless the authority having *jurisdiction* or geotechnical data determines that *Site Class* DE, E or F soils are present at the site:

1. Based on the structure *risk category* using Figures 1613.2(1) through 1613.2(7).
2. Determined in accordance with ASCE 7.

Where Site Class DE, E or F soils are present, the *seismic design category* shall be determined in accordance with ASCE 7.

Table 1: Site Classes per ASCE 7-22, Chapter 20

Site Class	Soil Type	Avg shear wave velocity to 30 m (ft/s)
A	Hard rock	> 5,000
B	Rock	3,000 to 5,000
BC	Soft Rock	2,100 to 3,000
C	Very Dense Sand or Hard Clay	1,450 to 2,100
CD	Dense Sand or Very Stiff Clay	1,000 to 1,450
D	Medium Dense sand or Stiff Clay	700 to 1,000
DE	Loose Sand or Medium Stiff Clay	500 to 700
E	Very Loose Sand or Soft Clay	< 500
F	Soils requiring site response analysis in accordance with ASCE 7-22, Section 21.1	Per ASCE 7-22, Section 20.3.1

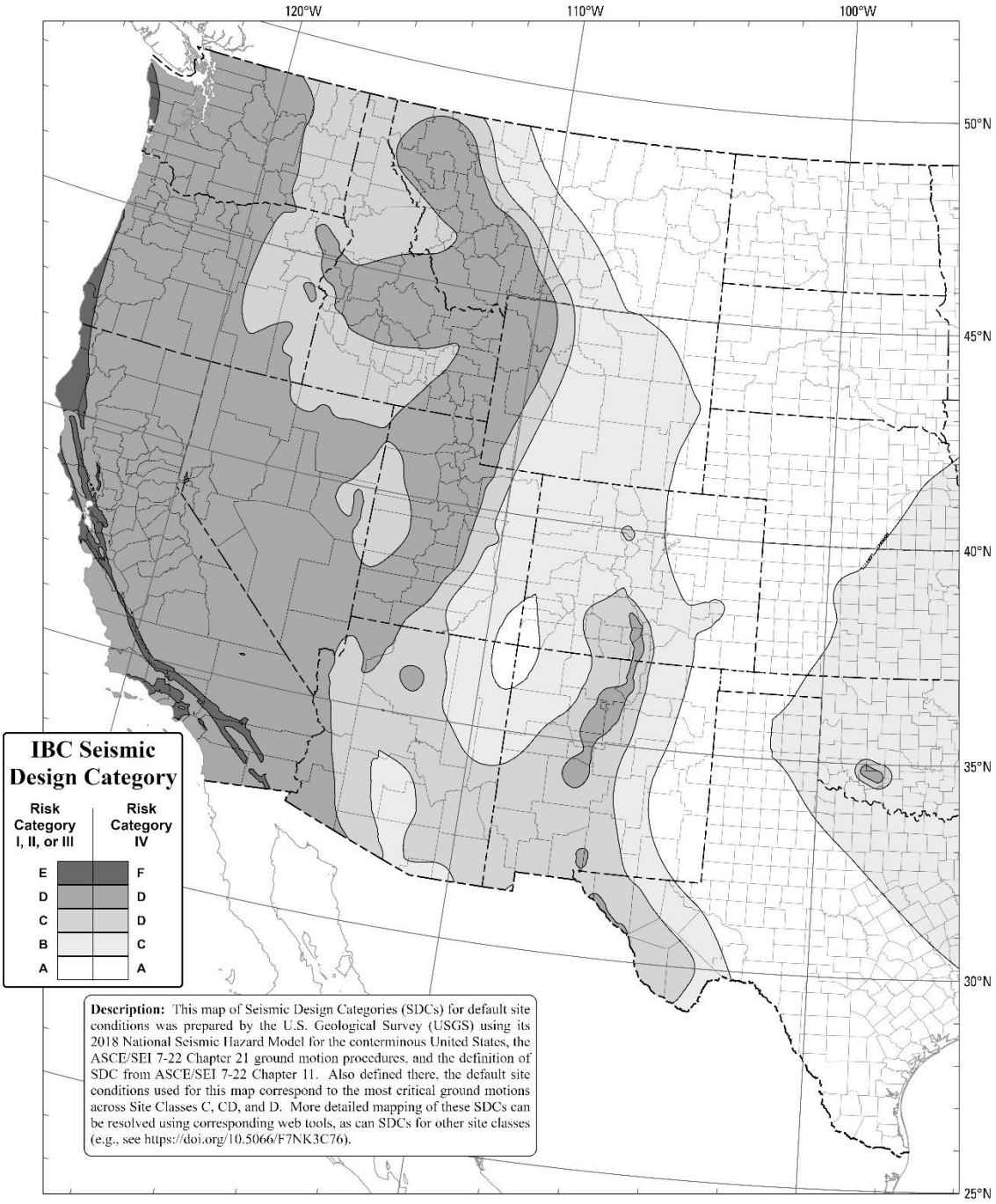
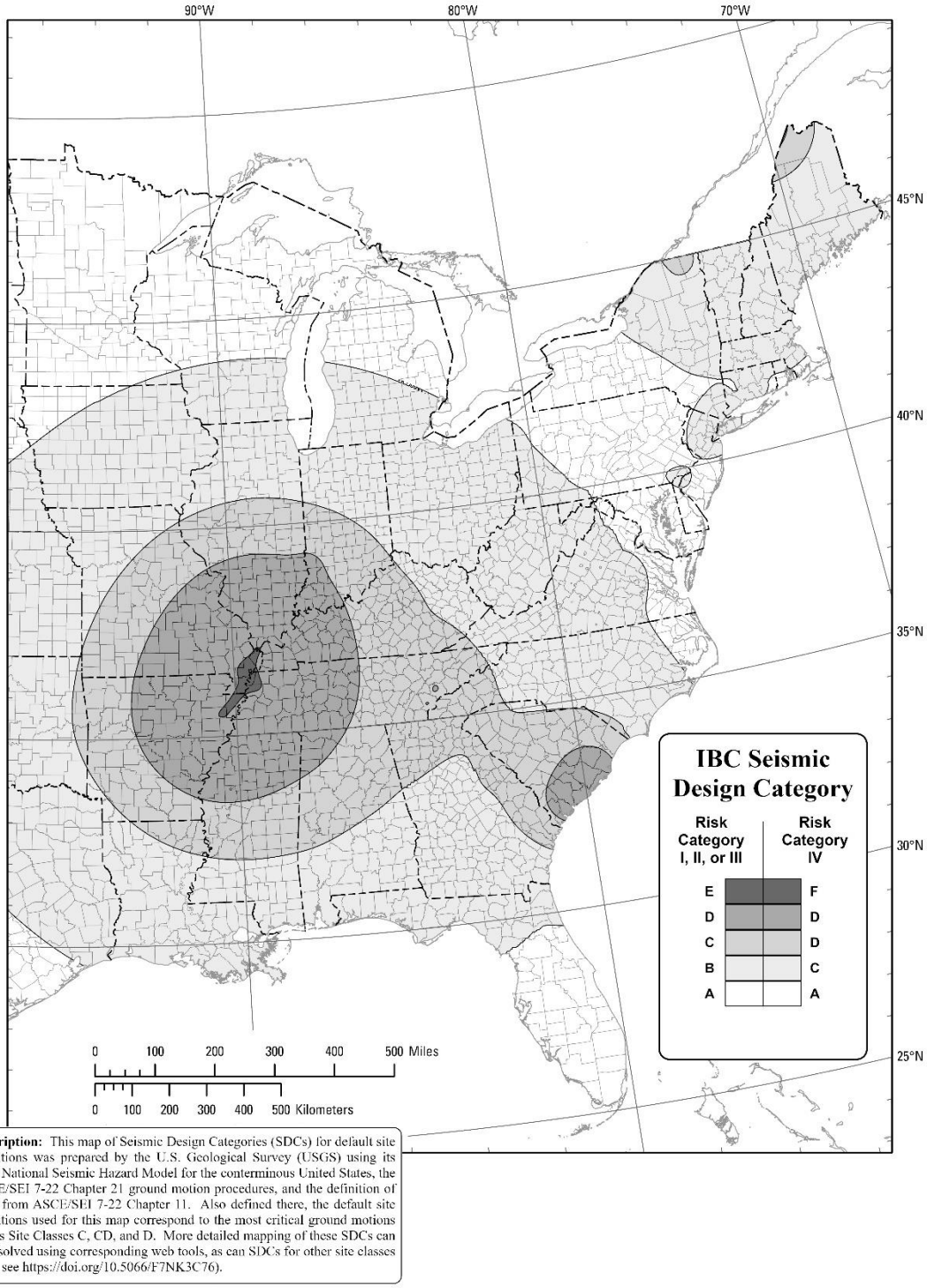
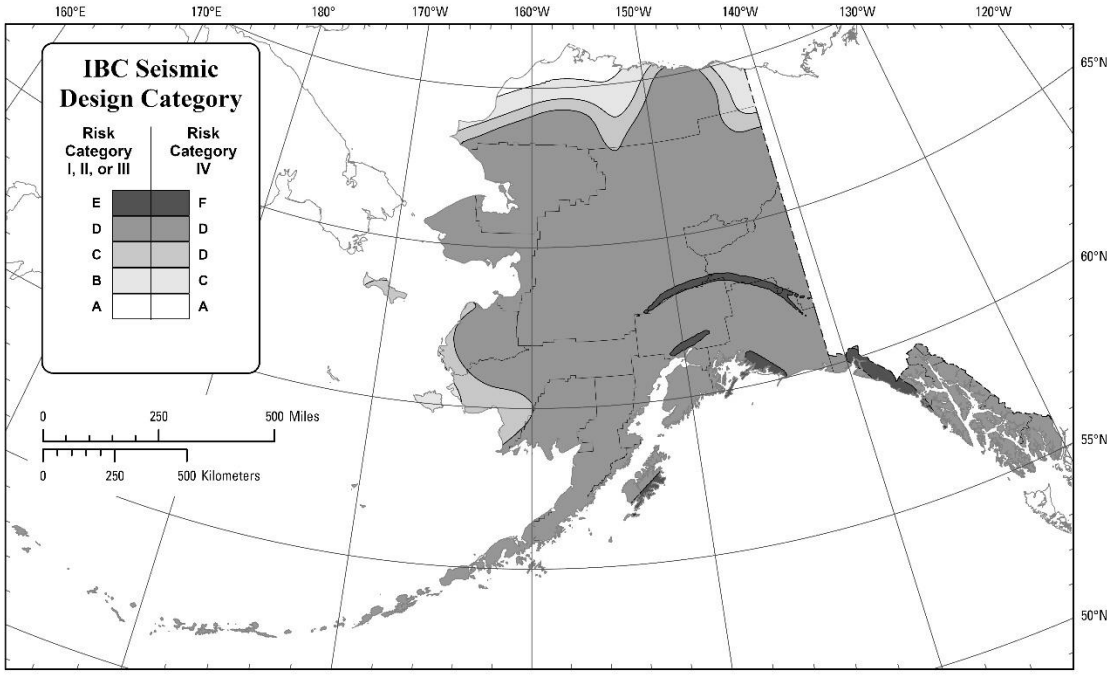


FIGURE 1613.2(1)
SEISMIC DESIGN CATEGORIES FOR DEFAULT SITE CONDITIONS FOR THE CONTERMINOUS UNITED STATES (WESTERN)



Description: This map of Seismic Design Categories (SDCs) for default site conditions was prepared by the U.S. Geological Survey (USGS) using its 2018 National Seismic Hazard Model for the conterminous United States, the ASCE/SEI 7-22 Chapter 21 ground motion procedures, and the definition of SDC from ASCE/SEI 7-22 Chapter 11. Also defined there, the default site conditions used for this map correspond to the most critical ground motions across Site Classes C, CD, and D. More detailed mapping of these SDCs can be resolved using corresponding web tools, as can SDCs for other site classes (e.g., see https://doi.org/10.5066/F7NK3C76).

FIGURE 1613.2(2)
SEISMIC DESIGN CATEGORIES FOR DEFAULT SITE CONDITIONS FOR THE CONTERMINOUS UNITED STATES (EASTERN)



Description: This map of Seismic Design Categories (SDCs) for default site conditions was prepared by the U.S. Geological Survey (USGS) using its 2007 National Seismic Hazard Model for Alaska, the ASCE/SEI 7-22 Chapter 21 ground motion procedures, the FEMA P-2078 procedures for developing multi-period response spectra at non-conterminous U.S. sites, and the definition of SDC from ASCE/SEI 7-22 Chapter 11. Also defined there, the default site conditions used for this map correspond to the most critical ground motions across Site Classes C, CD, and D. More detailed mapping of these SDCs can be resolved using corresponding web tools, as can SDCs for other site classes (e.g., see https://doi.org/10.5066/F7NK3C76).

FIGURE 1613.2(3) SEISMIC DESIGN CATEGORIES FOR DEFAULT SITE CONDITIONS FOR ALASKA

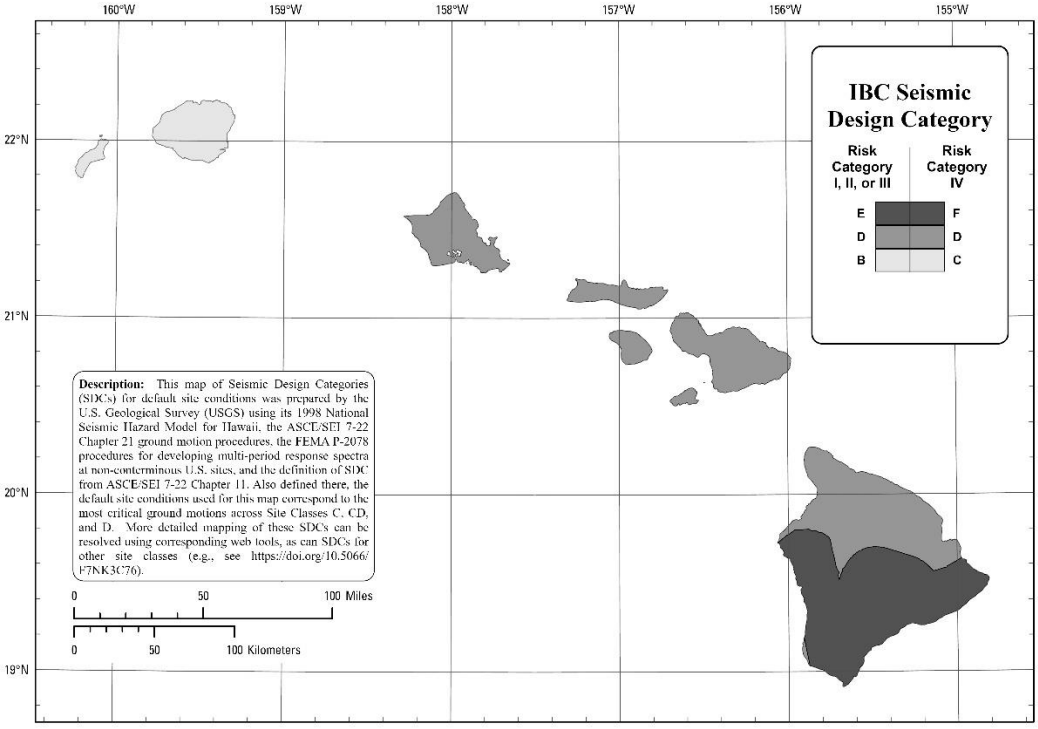
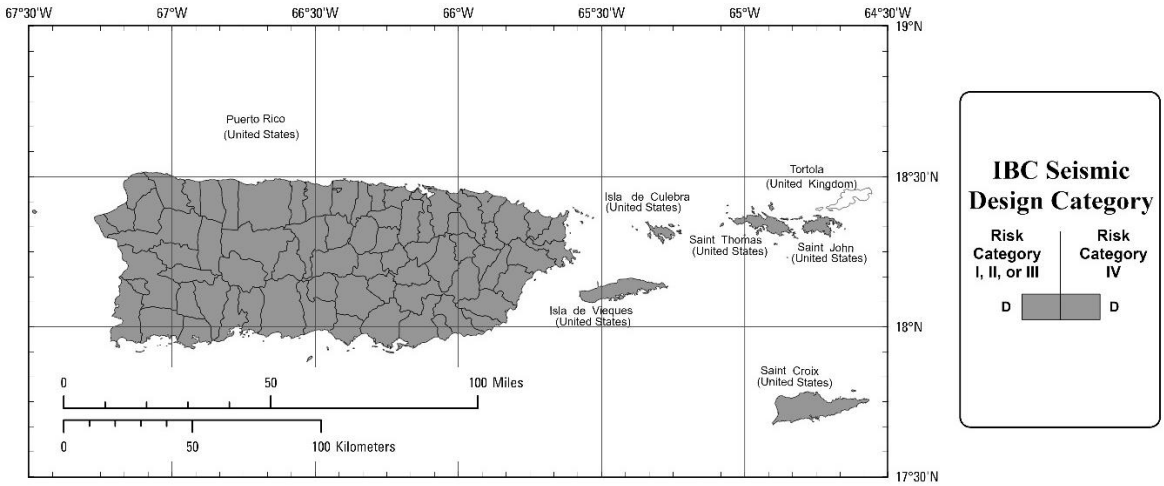


FIGURE 1613.2(4) SEISMIC DESIGN CATEGORIES FOR DEFAULT SITE CONDITIONS FOR HAWAII



Description: This map of Seismic Design Categories (SDCs) for default site conditions was prepared by the U.S. Geological Survey (USGS) using its 2003 National Seismic Hazard Model for Puerto Rico and the U.S. Virgin Islands, the ASCE/SEI 7-22 Chapter 21 ground motion procedures, the FEMA P-2078 procedures for developing multi-period response spectra at non-conterminous U.S. sites, and the definition of SDC from ASCE/SEI 7-22 Chapter 11. Also defined there, the default site conditions used for this map correspond to the most critical ground motions across Site Classes C, CD, and D.

FIGURE 1613.2(5) SEISMIC DESIGN CATEGORIES FOR DEFAULT SITE CONDITIONS FOR PUERTO RICO AND THE UNITED STATES VIRGIN ISLANDS

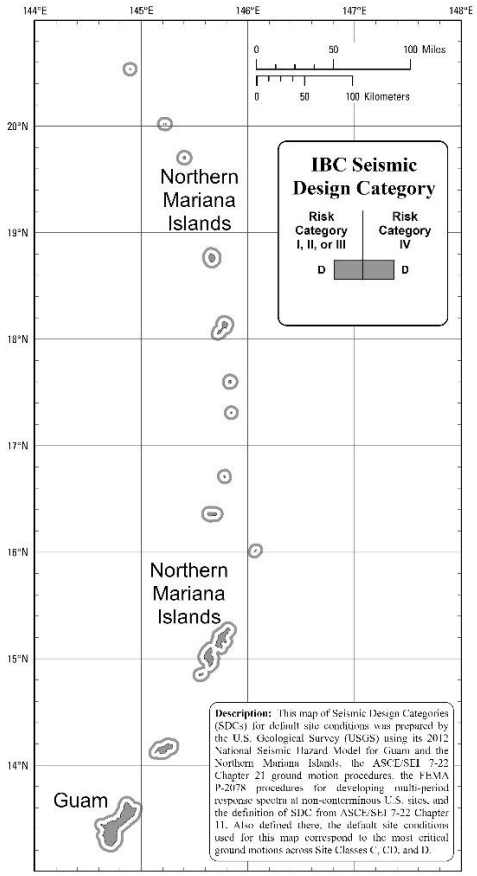
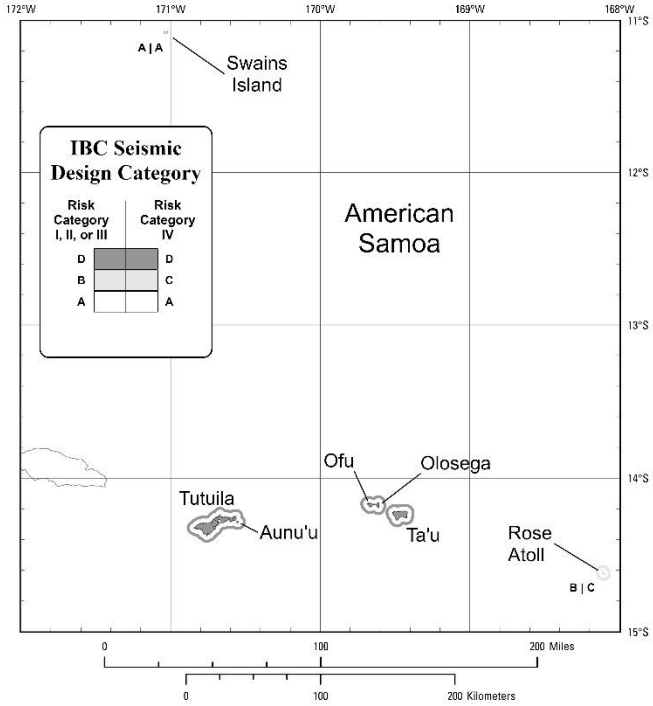


FIGURE 1613.2(6) SEISMIC DESIGN CATEGORIES FOR DEFAULT SITE CONDITIONS FOR GUAM AND THE NORTHERN MARIANA ISLANDS



Description: This map of Seismic Design Categories (SDCs) for default site conditions was prepared by the U.S. Geological Survey (USGS) using its 2012 National Seismic Hazard Model for American Samoa, the ASCE/SEI 7-22 Chapter 21 ground motion procedures, the FEMA P-2078 procedures for developing multi-period response spectra at non-conterminous U.S. sites, and the definition of SDC from ASCE/SEI 7-22 Chapter 11. Also defined there, the default site conditions used for this map correspond to the most critical ground motions across Site Classes C, CD, and D.

FIGURE 1613.2(7) SEISMIC DESIGN CATEGORIES FOR DEFAULT SITE CONDITIONS FOR AMERICAN SAMOA

1613.4 Ballasted photovoltaic panel systems

2021 IBC:

1613.3 Ballasted photovoltaic panel systems.

Ballasted, roof-mounted *photovoltaic panel systems* need not be rigidly attached to the roof or supporting structure. Ballasted non-penetrating systems shall be designed and installed only on roofs with slopes not more than one unit vertical in 12 units horizontal. Ballasted nonpenetrating systems shall be designed to resist sliding and uplift resulting from lateral and vertical forces as required by Section 1605, using a coefficient of friction determined by acceptable engineering principles. In structures assigned to *Seismic Design Category* C, D, E or F, ballasted nonpenetrating systems shall be designed to accommodate seismic displacement determined by nonlinear response-history or other *approved* analysis or shake-table testing, using input motions consistent with ASCE 7 lateral and vertical seismic forces for nonstructural components on roofs.

2024 IBC:

1613.4 Ballasted photovoltaic panel systems.

Ballasted, roof-mounted *photovoltaic panel systems* need not be rigidly attached to the roof or supporting *structure*. Ballasted, unattached PV panel systems shall be designed and installed only on roofs with slopes not more than 1 unit vertical in 12 units horizontal. Ballasted, unattached *PV panel systems* shall be designed to accommodate sliding in accordance with ASCE 7 Chapter 13.

Figure 18: A ballasted photovoltaic panel system which is held down with blocks.
Source: commons.wikimedia.org/wiki/File:Tonto_Apache_Tribe_Hotel_Solar_Project,_Arizona_(27426181242).jpg, p.d.

1613.5 Elevators, escalators and other conveying systems

The following subsection was added in 2024 IBC.

2024 IBC:

1613.5 Elevators, escalators and other conveying systems.

Elevators, escalators and other conveying systems and their components shall satisfy the seismic requirements of ASCE 7 and ASME A17.1/CSA B44 as applicable.

1613.6 Automatic sprinkler systems

The following subsection was added in 2024 IBC.

2024 IBC:

1613.6 Automatic sprinkler systems.

Where required, automatic sprinkler systems, including anchorage and bracing, shall comply with ASCE 7 and Section 903.3.1.1.

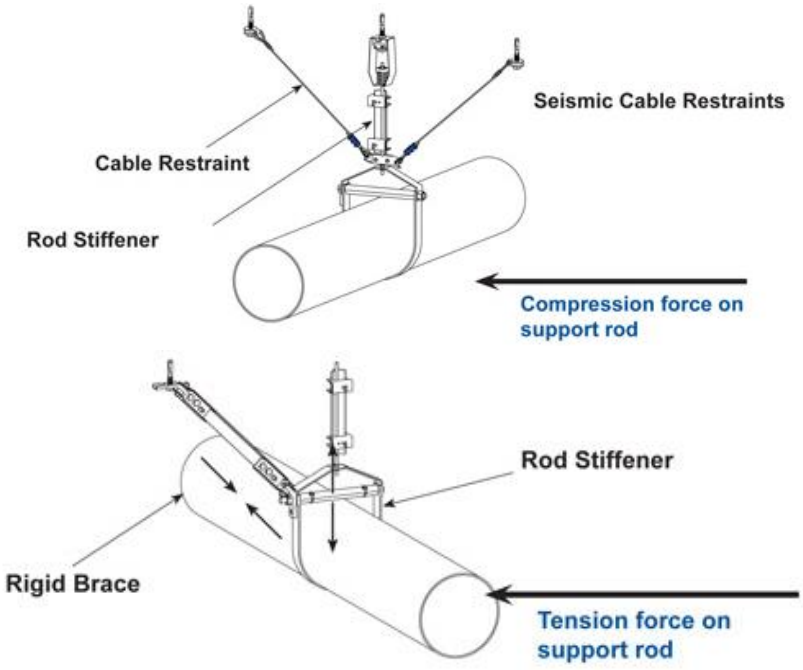


Figure 19: Example pipe supports with seismic restraints and bracing.
Source: https://kineticsnoise.com/seismic-wind-restraint

Helpful References

2021 IBC:
https://codes.iccsafe.org/content/IBC2021P2

2024 IBC:
https://codes.iccsafe.org/content/IBC2024P1

2024 IBC, Chapter 16:
https://codes.iccsafe.org/content/IBC2024P1/chapter-16-structural-design#IBC2024P1_Ch16

Significant Changes to 2024 International Codes:
https://www.larimer.gov/building/2024-building-codes-are-coming/significant-changes-2024-international-codes

Ghosh S. K. (2024) “Significant Changes in ASCE 7-22”. SEAU Presentation, February 20, 2024 S. K. Ghosh Associates LLC. https://seau.org/images/meeting/022024/seau_2024_asce_7_22_updates.pdf