



# FEMA

Federal Insurance and Mitigation Administration

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## The 2018 International Building Code®: A Compilation of Wind Resistant Provisions

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### Usage Note

This document provides the wind resistant provisions of the 2018 International Building Code and is not intended to be a compilation of all the structural and non-structural provisions of the IBC. Where material that was not specific to wind was removed from a code section, “partial shown” is indicated. Where a “user note” or information that may be useful to the reader is provided, it is provided in blue text. A description of applicable figures to the wind resistant provisions are provided in italicized text and the figure can be seen in the full publication of the IBC.

### IBC® 2018 International Building Code

#### EFFECTIVE USE OF THE INTERNATIONAL BUILDING CODE

The IBC applies to all occupancies, including one- and two-family dwellings and townhouses that are not within the scope of the IRC. *[partial shown]* The IBC applies to all types of buildings and structures unless exempted.

### Arrangement and Format of the 2018 IBC

Before applying the requirements of the IBC, it is beneficial to understand its arrangement and format. The IBC, like other codes published by ICC, is arranged and organized to follow sequential steps that generally occur during a plan review or inspection.

Chapters	Subjects
1-2	Administration and definitions
3	Use and occupancy classifications
4, 31	Special requirements for specific occupancies or elements
5-6	Height and area limitations based on type of construction
7-9	Fire resistance and protection requirements
10	Requirements for evacuation
11	Specific requirements to allow use and access to a building for persons with disabilities
12-13, 27-30	Building systems, such as lighting, HVAC, plumbing fixtures, elevators
14-26	Structural components—performance and stability
32	Encroachment outside of property lines
33	Safeguards during construction
35	Referenced standards
Appendices A-N	Appendices

The following is a chapter-by-chapter synopsis of the scope and intent of the provisions of the International Building Code. *[partial shown]*

**User Note:** The chapters shown below are those that are highlighted in this document and provide wind resistant provisions.

**Chapter 1 Scope and Administration.** Chapter 1 establishes the limits of applicability of the code and describes how the code is to be applied and enforced. *[partial shown]*

**Chapter 2 Definitions.** An alphabetical listing of all defined terms is located in Chapter 2. Defined terms that are pertinent to a specific chapter or section are also found in that chapter or section with a reference back to Chapter 2 for the definition. *[partial shown]*

**Chapter 4 Special Detailed Requirements Based On Use and Occupancy.** Chapter 4 contains the requirements for protecting special uses and occupancies, which are supplemental to the remainder of the code. *[partial shown]*

The chapter includes requirements for buildings and conditions that apply to one or more groups, such as high-rise buildings, underground buildings or atriums. Special uses may also imply specific occupancies and operations, such as for Group H, hazardous materials, application of flammable finishes, drying rooms, organic coatings and combustible storage or hydrogen fuel gas rooms, all of which are coordinated with the IFC. Unique consideration is taken for special use areas, such as covered mall buildings, motor-vehicle-related occupancies, special amusement buildings and aircraft-related occupancies. Special facilities within other occupancies are considered, such as stages and platforms, motion picture projection rooms, children's play structures and storm shelters. *[partial shown]*

**Chapter 14 Exterior Walls.** *[partial shown]* This chapter addresses requirements for exterior walls of buildings. Minimum standards for wall covering materials, installation of wall coverings and the ability of the wall to provide weather protection are provided. The installation of each type of wall covering, be it wood, masonry, vinyl, metal composite material, or an exterior insulation and finish system, is critical to its long-term performance in protecting the interior of the building from the elements and the spread of fire.

**Chapter 15 Roof Assemblies and Rooftop Structures.** Chapter 15 provides standards for both roof assemblies as well as structures that sit on top of the roof of buildings. The criteria address roof construction and covering, including the weather-protective barrier at the roof and, in most circumstances, a fire-resistant barrier. The chapter is prescriptive in nature and is based on decades of experience with various traditional materials, but it also addresses newer products such as photovoltaic shingles. These prescriptive rules are very important for satisfying performance of one type of roof covering or another. Section 1510 addresses rooftop structures, including penthouses, tanks, towers and spires. Rooftop penthouses larger than prescribed in this chapter must be treated as a story under Chapter 5.

**Chapter 16 Structural Design.** Chapter 16 prescribes minimum structural loading requirements for use in the design and construction of buildings and structural components. It includes minimum design loads, assignment of risk categories and permitted design methodologies. Standards are provided for minimum design loads (live, dead, snow, wind, rain, flood, ice, and earthquake as well as the required load combinations). The application of these loads and adherence to the serviceability criteria will enhance the protection of life and property. The chapter references and relies on many nationally recognized design standards. A key standard is the *American Society of Civil Engineer's Minimum Design Loads for Buildings and Other Structures* (ASCE 7). Structural design must address the conditions of the site and location. Therefore, maps are provided of rainfall, seismic, snow and wind criteria in different regions.

**Chapter 17 Special Inspections and Tests.** Chapter 17 provides a variety of procedures and criteria for testing materials and assemblies, labeling materials and assemblies and special inspection of structural assemblies. This chapter expands on the inspections of Chapter 1 by requiring special inspection where indicated and, in some cases, structural observation. It also spells out additional responsibilities for the owner, contractor, design professionals and special inspectors. Proper assembly of structural components, proper quality of materials used and proper application of materials are essential to ensuring that a building, once constructed, complies with the structural and fire-resistance minimums of the code and the approved design. To determine this compliance often requires continuous or frequent inspection and testing. Chapter 17 establishes standards for special inspection, testing and reporting of the work to the building official.

**Chapter 18 Soils and Foundations.** Chapter 18 provides criteria for geotechnical and structural considerations in the selection, design and installation of foundation systems to support the loads from the structure above. The

chapter includes requirements for soils investigation and site preparation for receiving a foundation, including the allowed load-bearing values for soils and for protecting the foundation from water intrusion. Section 1808 addresses the basic requirements for all foundation types. Later sections address foundation requirements that are specific to shallow foundations and deep foundations. Due care must be exercised in the planning and design of foundation systems based on obtaining sufficient soils information, the use of accepted engineering procedures, experience and good technical judgment.

**Chapter 21 Masonry.** This chapter provides comprehensive and practical requirements for masonry construction. The provisions of Chapter 21 require minimum accepted practices and the use of standards for the design and construction of masonry structures. The provisions address: material specifications and test methods; types of wall construction; criteria for engineered and empirical designs; and required details of construction, including the execution of construction. Masonry design methodologies including allowable stress design, strength design and empirical design are covered by provisions of the chapter. Also addressed are masonry fireplaces and chimneys, masonry heaters and glass unit masonry. Fire-resistant construction using masonry is also required to comply with Chapter 7. Masonry foundations are also subject to the requirements of Chapter 18.

**Chapter 22 Steel.** Chapter 22 provides the requirements necessary for the design and construction of structural steel (including composite construction), cold-formed steel, steel joists, steel cable structures and steel storage racks. This chapter specifies appropriate design and construction standards for these types of structures. It also provides a road map of the applicable technical requirements for steel structures. Because steel is a noncombustible building material, it is commonly associated with Types I and II construction; however, it is permitted to be used in all types of construction. Chapter 22 requires that the design and use of steel materials be in accordance with the specifications and standards of the American Institute of Steel Construction, the American Iron and Steel Institute, the Steel Joist Institute, and the American Society of Civil Engineers.

**Chapter 23 Wood.** This chapter provides minimum requirements for the design of buildings and structures that use wood and wood-based products. The chapter is organized around three design methodologies: allowable stress design (ASD), load and resistance factor design (LRFD) and conventional light-frame construction. Included in the chapter are references to design and manufacturing standards for various wood and wood-based products; general construction requirements; design criteria for lateral force-resisting systems and specific requirements for the application of the three design methods. In general, only Type III, IV or V buildings may be constructed of wood.

**Chapter 24 Glass and Glazing.** This chapter establishes regulations for glass and glazing that, when installed in buildings and structures, are subjected to wind, snow and dead loads. Engineering and design requirements are included in the chapter. Additional structural requirements are found in Chapter 16. *[partial shown]*

**Chapter 25 Gypsum Board, Gypsum Panel Products and Plaster.** Chapter 25 contains the provisions and referenced standards that regulate the design, construction and quality of gypsum board, gypsum panel products and plaster. It also addresses reinforced gypsum concrete. These represent the most common interior and exterior finish materials in the building industry. This chapter primarily addresses quality-control-related issues with regard to material specifications and installation requirements. Most products are manufactured under the control of industry standards. The building official or inspector primarily needs to verify that the appropriate product is used and properly installed for the intended use and location. While often simply used as wall and ceiling coverings, proper design and application are necessary to provide weather resistance and required fire protection for both structural and nonstructural building components.

**Chapter 26 Plastic.** *[partial shown]* The use of plastics in building construction and components is addressed in Chapter 26. This chapter provides standards addressing foam plastic insulation, foam plastics used as interior

finish and trim, and other plastic veneers used on the inside or outside of a building. Plastic siding is regulated by Chapter 14. Sections 2606 through 2611 address the use of light-transmitting plastics in various configurations such as walls, roof panels, skylights, signs and as glazing. Requirements for the use of fiber-reinforced polymers, fiberglass-reinforced polymers and reflective plastic core insulation are also contained in this chapter.

Additionally, requirements specific to the use of wood-plastic composites and plastic lumber are contained in this chapter. The requirements and limitations of this chapter are necessary to control the use of plastic and foam plastic products such that they do not compromise the safety of building occupants.

**Chapter 31 Special Construction.** Chapter 31 contains a collection of regulations for a variety of unique structures and architectural features. Pedestrian walkways and tunnels connecting two buildings are addressed in Section 3104. Membrane and air-supported structures are addressed by Section 3102. Safeguards for swimming pool safety are addressed by way of reference to the *International Swimming Pool and Spa Code* (ISPSC) in Section 3109. Standards for temporary structures, including permit requirements are provided in Section 3103. Structures as varied as awnings, marquees, signs, telecommunication and broadcast towers and automatic vehicular gates are also addressed (see Sections 3105 through 3108 and 3110).

**Chapter 35 Referenced Standards.** *[partial shown]* The code contains numerous references to standards that are used to regulate materials and methods of construction. Chapter 35 contains a comprehensive list of all standards that are referenced in the code, including the appendices. Compliance with the referenced standard is necessary for compliance with this code. By providing specifically adopted standards, the construction and installation requirements necessary for compliance with the code can be readily determined. The basis for code compliance is, therefore, established and available on an equal basis to the building code official, contractor, designer and owner.

**Appendix I Patio Covers.** Appendix I provides standards applicable to the construction and use of patio covers. It is limited in application to patio covers accessory to dwelling units. Covers of patios and other outdoor areas associated with restaurants, mercantile buildings, offices, nursing homes or other nondwelling occupancies would be subject to standards in the main code and not this appendix.

**Appendix H Signs.** Appendix H gathers in one place the various code standards that regulate the construction and protection of outdoor signs. Whenever possible, the appendix provides standards in performance language, thus allowing the widest possible application.

## CHAPTER 1 SCOPE AND ADMINISTRATION

**[A]<sup>1</sup> 101.2 Scope.** The provisions of this code shall apply to the construction, *alteration*, relocation, enlargement, replacement, *repair*, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures.

**Exception:** Detached one- and two-family *dwelling*s and multiple single-family dwelling (townhouses) not more than three *stories above grade plane* in height with a separate *means of egress*, and their accessory structures not more than three *stories above grade plane* in height, shall comply with this code or the *International Residential Code*.

**[A] 101.2.1 Appendices.** Provisions in the appendices shall not apply unless specifically adopted.

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<sup>1</sup> The "[A]" indicates that the Administrative Code Development Committee is responsible for this portion of the code.

**[A] 101.4.7 Existing buildings.** The provisions of the *International Existing Building Code* shall apply to matters governing the *repair, alteration, change of occupancy, addition to and relocation* of existing buildings.

**[A] 107.2.4 Exterior wall envelope.** *Construction documents* for all buildings shall describe the *exterior wall envelope* in sufficient detail to determine compliance with this code. The *construction documents* shall provide details of the *exterior wall envelope* as required, including flashing, intersections with dissimilar materials, corners, end details, control joints, intersections at roof, eaves, or parapets, means of drainage, water-resistive membrane and details around openings.

The *construction documents* shall include manufacturer's installation instructions that provide supporting documentation that the proposed penetration and opening details described in the *construction documents* maintain the weather resistance of the *exterior wall envelope*. The supporting documentation shall fully describe the *exterior wall* system that was tested, where applicable, as well as the test procedure used.

## CHAPTER 2

### SECTION 202 DEFINITIONS

**[BF]<sup>2</sup> EXTERIOR WALL.** A wall, bearing or nonbearing, that is used as an enclosing wall for a building, other than a *fire wall*, and that has a slope of 60 degrees (1.05 rad) or greater with the horizontal plane.

**[BF] EXTERIOR WALL COVERING.** A material or assembly of materials applied on the exterior side of *exterior walls* for the purpose of providing a weather-resisting barrier, insulation or for aesthetics, including but not limited to, *veneers, siding, exterior insulation and finish systems, architectural trim* and embellishments such as *cornices, soffits, facias, gutters and leaders*.

**[BF] EXTERIOR WALL ENVELOPE.** A system or assembly of *exterior wall* components, including *exterior wall* finish materials, that provides protection of the building structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment.

**[BS]<sup>3</sup> HURRICANE-PRONE REGIONS.** Areas vulnerable to hurricanes defined as:

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

**[BS] MAIN WIND FORCE-RESISTING SYSTEM.** An assemblage of structural elements assigned to provide support and stability for the overall structure. The system generally receives wind loading from more than one surface.

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

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<sup>2</sup> The "[BF]" indicates that the Fire Safety Code Development Committee is responsible for this portion of the code.

<sup>3</sup> The "[BS]" indicates that the Structural Code Development Committee is responsible for this portion of the code.



**[BG]<sup>4</sup> STORM SHELTER.** A building, structure or portions thereof, constructed in accordance with ICC 500 and designated for use during a severe wind storm event, such as a hurricane or tornado.

**Community storm shelter.** A storm shelter not defined as a "Residential storm shelter."

**Residential storm shelter.** A storm shelter serving occupants of *dwelling units* and having an *occupant load* not exceeding 16 persons.

**[BS] SUBSTANTIAL DAMAGE.** Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

**[BS] SUBSTANTIAL IMPROVEMENT.** Any *repair*, reconstruction, rehabilitation, *alteration*, *addition* or other improvement of a building or structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the improvement or repair is started. If the structure has sustained *substantial damage*, any *repairs* are considered substantial improvement regardless of the actual *repair* work performed. The term does not, however, include either:

1. Any project for improvement of a building required to correct existing health, sanitary or safety code violations identified by the *building official* and that are the minimum necessary to assure safe living conditions.
2. Any *alteration* of a historic structure provided that the *alteration* will not preclude the structure's continued designation as a historic structure.

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

1. Within 1 mile (1.61 km) of the coastal mean high-water line where the basic design wind speed,  $V$ , is 130 mph (58 m/s) or greater; or
2. In areas where the basic design wind speed is 140 mph (63.6 m/s) or greater.

For *Risk Category II* buildings and structures and *Risk Category III* buildings and structures, except health care facilities, the wind-borne debris region shall be based on Figure 1609.3.(1). For *Risk Category IV* buildings and structures and *Risk Category III* health care facilities, the wind-borne debris region shall be based on Figure 1609.3(2).

**[BS] WIND SPEED,  $V$ .** Basic design wind speeds.

**[BS] WIND SPEED,  $V_{asd}$ .** Allowable stress design wind speeds.

## CHAPTER 4 SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY

### SECTION 423 STORM SHELTERS

**423.1 General.** This section applies to the construction of storm shelters constructed as separate detached buildings or constructed as rooms or spaces within buildings for the purpose of providing protection from storms that produce high winds, such as tornadoes and hurricanes during the storm. Such structures shall be designated to be hurricane shelters, tornado shelters, or combined hurricane and tornado shelters. Design of facilities for use as

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<sup>4</sup> The "[BG]" indicates that the General Code Development Committee is responsible for this portion of the code.

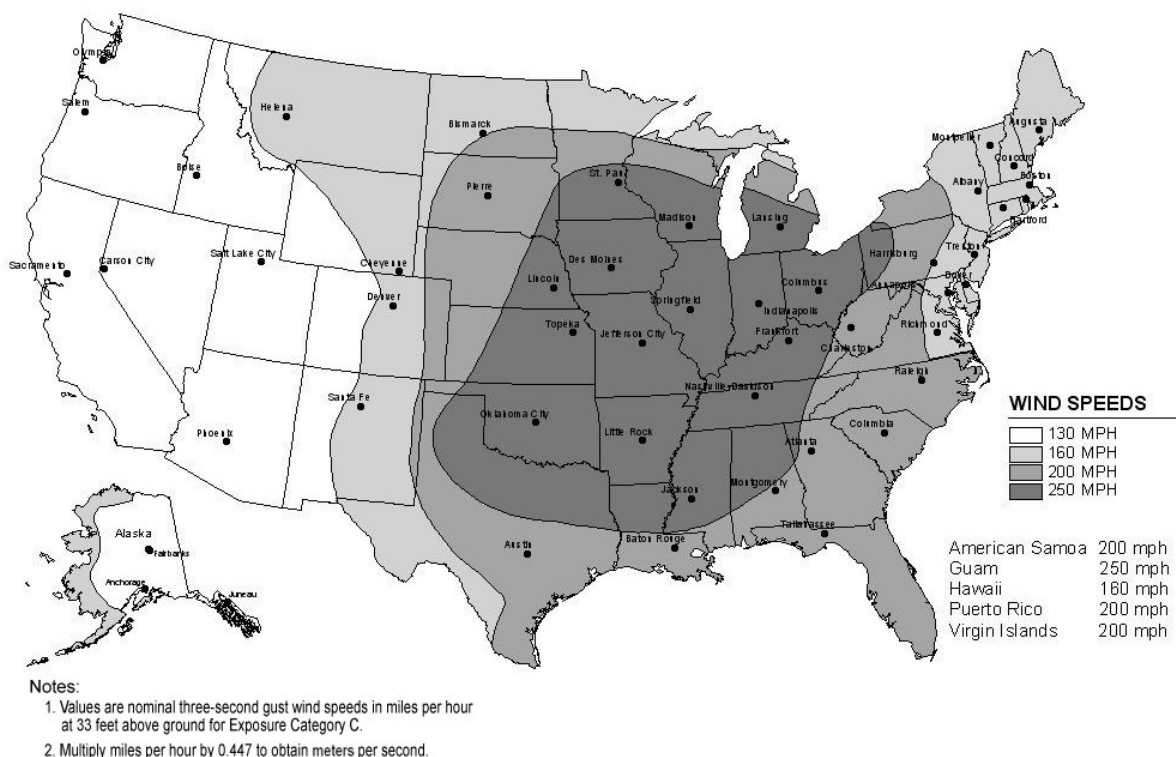
emergency shelters after the storm are outside the scope of ICC 500 and shall comply with Table 1604.5 as a Risk Category IV Structure.

### 423.2 Construction

In addition to other applicable requirements in this code, storm shelters shall be constructed in accordance with ICC 500. Buildings or structures that are also designated as emergency shelters shall also comply with Table 1604.5 as Risk Category IV structures.

**User Note:** Highlights of ICC 500-2014, ICC/NSSA Standard for the Design and Construction of Storm Shelters can be found at <https://www.fema.gov/medialibrary/assets/documents/110209>.

**423.3 Critical emergency operations.** In areas where the shelter design wind speed for tornados in accordance with Figure 304.2(1) of ICC 500 is 250 MPH, 911 call stations, emergency operation centers and fire, rescue, ambulance, and police stations shall comply with Table 1604.5 as a Risk Category IV structure and shall be provided with a storm shelter constructed in accordance with ICC 500.



**User Note:** The image above is the Tornado Shelter Wind Speed Map found in ICC 500-2014.

**423.4 Group E occupancies.** In areas where the shelter design wind speed for tornados is 250 MPH in accordance with Figure 304.2(1) of ICC 500, all Group E occupancies with an aggregate occupant load of 50 or more shall have a storm shelter constructed in accordance with ICC 500.

#### Exception:

1. Group E day care facilities.
2. Group E occupancies accessory to places of religious worship.



### 3. Buildings meeting the requirements for shelter design in ICC 500.

**423.4.1 Required occupant capacity.** The required occupant capacity of the storm shelter shall include all of the buildings on the site and shall be the greater of the following:

1. The total occupant load of the classrooms, vocational rooms and offices in the Group E occupancy.
2. The occupant load of any indoor assembly space that is associated with the Group E occupancy.

**Exceptions:**

1. Where a new building is being added on an existing Group E site, and where the new building is not of sufficient size to accommodate the required occupant capacity of the storm shelter for all of the buildings on the site, the storm shelter shall at a minimum accommodate the required occupant capacity for the new building.
2. Where approved by the code official, the required occupant capacity of the shelter shall be permitted to be reduced by the occupant capacity of any existing storm shelters on the site.

**423.4.2 Location.** Storm shelters shall be located within the buildings they serve or shall be located where the maximum distance of travel from not fewer than one exterior door of each building to a door of the shelter serving that building does not exceed 1,000 feet (305 m).

## CHAPTER 14 EXTERIOR WALLS

**[BS] 1402.3 Structural.** *Exterior walls*, and the associated openings, shall be designed and constructed to resist safely the superimposed loads required by Chapter 16.

**1403.8 Plastics.** Plastic panel, apron or spandrel walls as defined in this code shall not be limited in thickness, provided that such plastics and their assemblies conform to the requirements of Chapter 26 and are constructed of *approved* weather-resistant materials of adequate strength to resist the wind loads for cladding specified in Chapter 16.

**1403.9 Vinyl siding.** Vinyl siding shall be certified and labeled as conforming to the requirements of ASTM D 3679 by an *approved* quality control agency.

**User Note:** ASTM D 3679 includes wind resistance criteria.

**1403.12 Polypropylene siding.** *Polypropylene siding* shall be certified and labeled as conforming to the requirements of ASTM D7254 and those of Section 1403.12.1 or 1403.12.2 by an approved quality control agency. *Polypropylene siding* shall be installed in accordance with the requirements of Section 1404.18 and in accordance with the manufacturer's instructions. *Polypropylene siding* shall be secured to the building so as to provide weather protection for the *exterior walls* of the building.

**User Note:** ASTM D7254 includes wind resistance criteria.

**[BS] 1404.11.1 [Metal Veneers] Attachment.** Exterior metal veneer shall be securely attached to the supporting masonry or framing members with corrosion-resistant fastenings, metal ties or by other *approved* devices or methods. The spacing of the fastenings or ties shall not exceed 24 inches (610 mm) either vertically or horizontally, but where units exceed 4 square feet (0.4 m<sup>2</sup>) in area there shall be not less than four attachments per unit. The metal attachments shall have a cross-sectional area not less than provided by W 1.7 wire. Such

attachments and their supports shall be designed and constructed to resist the wind loads as specified in Section 1609 for components and cladding.

**1404.13 Exterior windows and doors.** Windows and doors installed in *exterior walls* shall conform to the testing and performance requirements of Section 1709.5.

**1404.13.1 Installation.** Windows and doors shall be installed in accordance with *approved* manufacturer's instructions. Fastener size and spacing shall be provided in such instructions and shall be calculated based on maximum loads and spacing used in the tests.

**[BS] 1404.14 Vinyl siding.** Vinyl siding conforming to the requirements of this section and complying with ASTM D 3679 shall be permitted on *exterior walls* of buildings located in areas where  $V_{asd}$  as determined in accordance with Section 1609.3.1 does not exceed 100 miles per hour (45 m/s) and the building height is less than or equal to 40 feet (12 192 mm) in Exposure C. Where construction is located in areas where  $V_{asd}$  as determined in accordance with Section 1609.3.1 exceeds 100 miles per hour (45 m/s), or building heights are in excess of 40 feet (12 192 mm), tests or calculations indicating compliance with Chapter 16 shall be submitted. Vinyl siding shall be secured to the building so as to provide weather protection for the *exterior walls* of the building.

**[BS] 1404.14.1 Application.** The siding shall be applied over sheathing or materials listed in Section 2304.6. Siding shall be applied to conform to the *water-resistive barrier* requirements in Section 1402. Siding and accessories shall be installed in accordance with *approved* manufacturer's instructions. Unless otherwise specified in the *approved* manufacturer's instructions, nails used to fasten the siding and accessories shall have a minimum 0.313-inch (7.9 mm) head diameter and 1/8-inch (3.18 mm) shank diameter. The nails shall be corrosion resistant and shall be long enough to penetrate the studs or nailing strip at least 3/4 inch (19 mm). For cold-formed steel light-frame construction, corrosion-resistant fasteners shall be used. Screw fasteners shall penetrate the coldformed steel framing not fewer than three exposed threads. Other fasteners shall be installed in accordance with the approved construction documents and manufacturer's instructions. Where the siding is installed horizontally, the fastener spacing shall not exceed 16 inches (406 mm) horizontally and 12 inches (305 mm) vertically. Where the siding is installed vertically, the fastener spacing shall not exceed 12 inches (305 mm) horizontally and 12 inches (305 mm) vertically.

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

**[BS] 1404.17 Fastening.** Weather boarding and wall coverings shall be securely fastened with aluminum, copper, zinc, zinc-coated or other *approved* corrosion-resistant fasteners in accordance with the nailing schedule in Table 2304.10.1 or the *approved* manufacturer's instructions. Shingles and other weather coverings shall be attached with appropriate standard-shingle nails to furring strips securely nailed to studs, or with *approved* mechanically bonding nails, except where sheathing is of wood not less than 1-inch (25 mm) nominal thickness or of wood structural panels as specified in Table 2308.6.3(3).

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

## SECTION 1406 METAL COMPOSITE MATERIALS (MCM)

**1406.4 Structural design.** MCM systems shall be designed and constructed to resist wind loads as required by Chapter 16 for components and cladding.

**1406.5 Approval.** Results of *approved* tests or an engineering analysis shall be submitted to the *building official* to verify compliance with the requirements of Chapter 16 for wind loads.

## SECTION 1407 EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS)

**[BS] 1407.3 Structural design.** The underlying structural framing and substrate shall be designed and constructed to resist loads as required by Chapter 16.

**1407.4 Weather resistance.** EIFS shall comply with Section 1402 and shall be designed and constructed to resist wind and rain in accordance with this section and the manufacturer's application instructions.

## SECTION 1408 HIGH-PRESSURE DECORATIVE EXTERIOR-GRADE COMPACT LAMINATES (HPL)

**[BS] 1408.4 Structural design.** HPL systems shall be designed and constructed to resist wind loads as required by Chapter 16 for components and cladding.

**1408.5 Approval.** Results of approved tests or an engineering analysis shall be submitted to the building official to verify compliance with the requirements of Chapter 16 for wind loads.

**1408.6 Weather resistance.** HPL systems shall comply with Section 1402 and shall be designed and constructed to resist wind and rain in accordance with this section and the manufacturer's instructions.

## CHAPTER 15 ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

### SECTION 1504 PERFORMANCE REQUIREMENTS

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

**1504.1.1 Wind resistance of asphalt shingles.** Asphalt shingles shall be tested in accordance with ASTM D 7158. Asphalt shingles shall meet the classification requirements of Table 1504.1.1 for the appropriate maximum basic wind speed. Asphalt shingle packaging shall bear a label to indicate compliance with ASTM D 7158 and the required classification in Table 1504.1.1.

**Exception:** Asphalt shingles not included in the scope of ASTM D 7158 shall be tested and labeled in accordance with ASTM D 3161. Asphalt shingle packaging shall bear a label to indicate compliance with

ASTM D3161 and the required classification in Table 1504.1.1. *Table 1504.1.1. Provides the Classification of Asphalt Shingles.*

**1504.2 Wind resistance of clay and concrete tile.** Wind loads on clay and concrete tile roof coverings shall be in accordance with Section 1609.5.

**1504.2.1 Testing.** Testing of concrete and clay roof tiles shall be in accordance with Sections 1504.2.1.1 and 1504.2.1.2.

**1504.2.1.1 Overturning resistance.** Concrete and clay roof tiles shall be tested to determine their resistance to overturning due to wind in accordance with Chapter 15 and either SBCCI SSTD 11 or ASTM C1568.

**1504.2.1.2 Wind tunnel testing.** Where concrete and clay roof tiles do not satisfy the limitations in Chapter 16 for rigid tile, a wind tunnel test shall be used to determine the wind characteristics of the concrete or clay tile roof covering in accordance with SBCCI SSTD 11 and Chapter 15.

**1504.3 Wind resistance of nonballasted roofs.** Roof coverings installed on roofs in accordance with Section 1507 that are mechanically attached or adhered to the roof deck shall be designed to resist the design wind load pressures for components and cladding in accordance with Section 1609.5.2. The wind load on the roof covering shall be permitted to be determined using allowable stress design.

**1504.3.1 Other roof systems.** Built-up, modified bitumen, fully adhered or mechanically attached single-ply roof systems, metal panel roof systems applied to a solid or closely fitted deck and other types of membrane roof coverings shall be tested in accordance with FM 4474, UL 580 or UL 1897.

**1504.3.2 Structural metal panel roof systems.** Where the metal roof panel functions as the roof deck and roof covering and it provides both weather protection and support for loads, the structural metal panel roof system shall comply with this section. Structural standing-seam metal panel roof systems shall be tested in accordance with ASTM E 1592 or FM 4474. Structural through-fastened metal panel roof systems shall be tested in accordance with ASTM E 1592, FM 4474 or UL 580 .

#### Exceptions:

1. Metal roofs constructed of cold-formed steel shall be permitted to be designed and tested in accordance with the applicable referenced structural design standard in Section 2210.1.
2. Metal roofs constructed of aluminum shall be permitted to be designed and tested in accordance with the applicable referenced structural design standard in Section 2002.1.

**1504.3.3 Metal roof shingles.** Metal roof shingles applied to a solid or closely fitted deck shall be tested in accordance with ASTM D3161, FM 4474, UL 580 or UL 1897. Metal roof shingles tested in accordance with ASTM D3161 shall meet the classification requirements of Table 1504.1.1 for the appropriate maximum basic wind speed and the metal shingle packaging shall bear a label to indicate compliance with ASTM D3161 and the required classification in Table 1504.1.1.

**1504.4 Ballasted low-slope roof systems.** Ballasted low-slope (roof slope < 2:12) single-ply roof system coverings installed in accordance with Sections 1507.12 and 1507.13 shall be designed in accordance with Section 1504.8 and ANSI/SPRI RP-4.

**1504.5 Edge securement for low-slope roofs.** Low-slope built-up, modified bitumen and single-ply roof system metal edge securement, except gutters, shall be designed and installed for wind loads in accordance with Chapter

16 and tested for resistance in accordance with Test Methods RE-1, RE-2 and RE-3 of ANSI/SPRI ES-1, except basic design wind speed,  $V_{asd}$ , wind speed shall be determined from Figure 1609.3(1) through 1609.3(8) as applicable.

**1504.8 Surfacing and ballast materials in hurricane-prone regions.** For a building located in a hurricane-prone region as defined in Section 202, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site, the following materials shall not be used on the roof:

1. Aggregate used as surfacing for roof coverings.
2. Aggregate, gravel or stone used as ballast.

*Table 1504.8. Provides the maximum allowable mean roof height permitted for buildings with aggregate on the roof areas outside of a hurricane-prone region*

## SECTION 1507 REQUIREMENTS FOR ROOF COVERINGS

**1507.1.1 Underlayment.** Underlayment for asphalt shingles, clay and concrete tile, metal roof shingles, mineral surfaced roll roofing, slate and slate-type shingles, wood shingles, wood shakes, metal roof panels and photovoltaic shingles shall conform to the applicable standards listed in this chapter. Underlayment materials required to comply with ASTM D226, D1970, D4869 and D6757 shall bear a label indicating compliance with the standard designation and, if applicable, type classification indicated in Table 1507.1.1(1). Underlayment shall be applied in accordance with Table 1507.1.1(2). Underlayment shall be attached in accordance with Table 1507.1.1(3).

*User Note: Four exceptions are included in the standard. The first three provide allowable methods for enhanced water intrusion protection should the roof cover be damaged or blown off during a windstorm. The fourth simply states that an underlayment is not required for structural metal panels that do not require a substrate.*

**1507.2.6 [Shingle] Attachment.** Asphalt shingles shall have the minimum number of fasteners required by the manufacturer, but not less than four fasteners per strip shingle or two fasteners per individual shingle. Where the roof slope exceeds 21 units vertical in 12 units horizontal (21:12), shingles shall be installed as required by the manufacturer.

*User Note: Many manufacturers require 6 fasteners per strip shingle for high-wind installations. Wind resistance of most asphalt shingles depends on sealing of the top shingle to the shingle below. For very steep pitch roofs, it is unlikely that the shingles will properly seal. Consequently, manufacturers generally require hand tabbing for these installations.*

**1507.3.7 [Tile] Attachment.** Clay and concrete roof tiles shall be fastened in accordance with Table 1507.3.7.

*Table 1507.3.7. Provides clay and concrete roof tile attachment requirements*

**1507.17.8 [Photovoltaic Shingles] Wind resistance.** Photovoltaic shingles shall be tested in accordance with procedures and acceptance criteria in ASTM D 3161. Photovoltaic shingles shall comply with the classification requirements of Table 1504.1.1 for the appropriate maximum nominal design wind speed. Photovoltaic shingle packaging shall bear a label to indicate compliance with the procedures in ASTM D 3161 and the required classification from Table 1504.1.1.



*Table 1504.1.1. Provides ASTM classifications for asphalt shingles.*

**1507.4.4 [Metal Roof Panels] Attachment.** Metal roof panels shall be secured to the supports in accordance with the approved manufacturer's fasteners. In the absence of manufacturer recommendations, the following fasteners shall be used:

1. Galvanized fasteners shall be used for steel roofs.
2. Copper, brass, bronze, copper alloy or 300 series stainless-steel fasteners shall be used for copper roofs.
3. Stainless-steel fasteners are acceptable for all types of metal roofs.
4. Aluminum fasteners are acceptable for aluminum roofs attached to aluminum supports.

**User Note:** While this identifies the type of fastener, it does not provide the size or spacing of fasteners which must be adequate to resist the full wind uplift design loads for the corresponding roof pressure zone as defined in Chapter 16 or ASCE 7-16.

**1507.5.6 [Metal Roof Shingles] Attachment.** Metal roof shingles shall be secured to the roof in accordance with the *approved* manufacturer's installation instructions.

**1507.7.6 [Slate Shingles] Application.** Minimum headlap for slate shingles shall be in accordance with Table 1507.7.6. Slate shingles shall be secured to the roof with two fasteners per slate.

**1507.8.6 [Wood Shingles] Attachment.** Fasteners for wood shingles shall be corrosion resistant with a minimum penetration of  $\frac{3}{4}$  inch (19.1 mm) into the sheathing. For sheathing less than  $\frac{1}{2}$  inch (12.7 mm) in thickness, the fasteners shall extend through the sheathing. Each shingle shall be attached with not fewer than two fasteners.

**1507.9.7 [Wood Shakes] Attachment.** Fasteners for wood shakes shall be corrosion resistant with a minimum penetration of  $\frac{3}{4}$  inch (19.1 mm) into the sheathing. For sheathing less than  $\frac{1}{2}$  inch (12.7 mm) in thickness, the fasteners shall extend through the sheathing. Each shake shall be attached with not fewer than two fasteners.

**1507.17.7 [Photovoltaic Shingles] Attachment.** *Photovoltaic shingles* shall be attached in accordance with the manufacturer's installation instructions.

**1507.17.8 [Photovoltaic Shingles] Wind resistance.** *Photovoltaic shingles* shall be tested in accordance with procedures and acceptance criteria in ASTM D3161. *Photovoltaic shingles* shall comply with the classification requirements of Table 1504.1.1 for the appropriate maximum nominal design wind speed. *Photovoltaic shingle* packaging shall bear a *label* to indicate compliance with the procedures in ASTM D3161 and the required classification from Table 1504.1.1.

**1507.18.4.1 [Building-Integrated Photovoltaic Roof Panels - BIPV] High-wind attachment.** Underlayment applied in areas subject to high winds [ $V_{asd}$  greater than 110 mph (49 m/s) as determined in accordance with Section 1609.3.1] shall be applied in accordance with the manufacturer's instructions. Fasteners shall be applied along the overlap at not more than 36 inches (914 mm) on center. Underlayment installed where  $V_{asd}$  is not less than 120 mph (54 m/s) shall comply with ASTM D226, Type III, ASTM D4869, Type IV or ASTM D6757. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at the side laps. The underlayment shall be applied in accordance with Section 1507.2.8 except all laps shall be not less than 4 inches (102 mm). Underlayment shall be attached using cap nails or cap staples. Caps shall be metal or plastic with a nominal head diameter of not less than 1 inch (25.4 mm). Metal caps shall have a thickness of not less than 0.010 inch (0.25 mm). Power-driven metal caps shall have a thickness of not less than

0.010 inch (0.25 mm). Thickness of the outside edge of plastic caps shall be not less than 0.035 inch (0.89 mm). The cap nail shank shall be not less than 0.083 inch (2.11 mm) for ring shank cap nails and 0.091 inch (2.31 mm) for smooth shank cap nails. Staple gage shall be not less than 21 gage [0.02 inch (0.81 mm)]. Cap nail shank and cap staple legs shall have a length sufficient to penetrate through-the-roof sheathing or not less than  $\frac{3}{4}$  inch (19.1 mm) into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D1970 shall be permitted.

**1507.18.6 [BIPV] Attachment.** BIPV roof panels shall be attached in accordance with the manufacturer's installation instructions.

**1507.18.7 [BPIV] Wind resistance.** BIPV roof panels shall be tested in accordance with UL 1897. BIPV roof panel packaging shall bear a label to indicate compliance with UL 1897.

User Note: The 2016 edition of ASCE 7 will have specific criteria for rooftop PV. In lieu of using 1510.7.1, the ASCE 7-16 rooftop PV provisions are recommended when the 2016 edition becomes available. ASCE 7-16 will be available in early 2017 and ICC has elected to adopt ASCE 7-16 as the basis for structural loading in the 2018 International Building Code.

## SECTION 1511 REROOFING

User Note: This section addresses reroofing. The wind load/resistance criteria for reroofing are the same as for new construction.

## CHAPTER 16 STRUCTURAL DESIGN

### SECTION 1602 NOTATIONS

$W$  = Load due to wind pressure.

### SECTION 1604 GENERAL DESIGN REQUIREMENTS

**1604.3.1 Deflections.** The deflections of structural members shall not exceed the more restrictive of the limitations of Sections 1604.3.2 through 1604.3.5 or that permitted by Table 1604.3.

User Note: Table 1604.3 provides guidance on acceptable deflection limits for wind loads as well as other types of design loads. Footnote "f" for Table 1604.3 indicates that wind loads used to evaluate deflections can be taken as 42 percent of the design component and cladding loads or can be calculated directly using the 10-year mean return interval wind speed. The exception is for framing supporting glass where the requirements of Section 1604.3.7 govern.

**1604.3.7 Framing supporting glass.** The deflection of framing members supporting glass subjected to 0.6 times the "component and cladding" wind loads shall not exceed either of the following:

1.  $1/175$  of the length of span of the framing member, for framing members having a length not more than 13 feet 6 inches (4115 mm).
2.  $1/240$  of the length of span of the framing member +  $\frac{1}{4}$  inch (6.4 mm), for framing members having a length greater than 13 feet 6 inches (4115 mm).

User Note: The magnitude of design wind loads is based on the risk category assigned to the building. The following sections provide details on assigning a risk category. While a building is generally assigned the highest risk category for any occupancy, there is an exception for storm shelters (Risk Category IV) within a building unless the storm shelter is a designated emergency shelter as defined in Table 1604.5. Table 1604.5 provides a listing of risk categories versus the nature of the occupancy.

**1604.5 Risk category.** 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.

**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.

**1604.10 Loads on storm shelters.** Loads and load combinations on storm shelters shall be determined in accordance with ICC 500.

User Note: The IBC defers to ICC 500 for design of storm shelters.

## SECTION 1605 LOAD COMBINATIONS

Load combinations involving wind loads are provided in Section 1605.2 for strength or load and resistance factor design and in Section 1605.3 for allowable stress design. Except for wood design (Chapter 23) increases in allowable stresses are not allowed to be used with the load combinations specified in Section 1605.3.1. However, if alternative basic design load combinations specified in Section 1605.3.2 are used, it is permissible to use the allowable stress increases provided in the various material chapters in load combinations involving wind, with some restrictions specified in Section 1605.3.2.

## SECTION 1609 WIND LOADS

**User Notes: Definitions.**

**ALLOWABLE STRESS DESIGN (asd)** – defined in Chapter 2

**HURRICANE-PRONE REGIONS** – defined in Chapter 2

**WIND-BORNE DEBRIS REGION** – defined in Chapter 2

**STRENGTH DESIGN** – defined in Chapter 2

**Design Wind Speeds.** In the 2018 IBC, the basic design wind speed,  $V$ , corresponds to the design wind speed used to calculate wind loads for *strength design* (Section 1609.3). The 2018 IBC provides a method (Section

1609.3.1) for converting to the basic (strength) design wind speed to a wind speed appropriate for use in allowable stress design,  $V_{asd}$ .

**1609.1 Applications.** Buildings, structures and parts thereof shall be designed to withstand the minimum wind loads prescribed herein. Decreases in wind loads shall not be made for the effect of shielding by other structures.

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

**Exceptions:**

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

The wind speeds in Figures 1609.3(1) through 1609.3(8) are basic design wind speeds,  $V$ , and shall be converted in accordance with Section 1609.3.1 to allowable stress design wind speeds,  $V_{asd}$ , when the provisions of the standards referenced in Exceptions 4 and 5 are used.

**1609.1.1.1 Applicability.** The provisions of ICC 600 are applicable only to buildings located within Exposure B or C as defined in Section 1609.4. The provisions of ICC 600, AWC WFCM and AISI S230 shall not apply to buildings sited on the upper half of an isolated hill, ridge or escarpment meeting the following conditions:

1. The hill, ridge or escarpment is 60 feet (18 288 mm) or higher if located in Exposure B or 30 feet (9144 mm) or higher if located in Exposure C;
2. The maximum average slope of the hill exceeds 10 percent; and
3. The hill, ridge or escarpment is unobstructed upwind by other such topographic features for a distance from the high point of 50 times the height of the hill or 1 mile (1.61 km), whichever is greater.

**1609.2 Protection of openings.** In *wind-borne debris regions*, glazing in buildings shall be impact resistant or protected with an impact-resistant covering meeting the requirements of an *approved* impact-resistant standard or ASTM E 1996 and ASTM E 1886 referenced herein as follows:

1. Glazed openings located within 30 feet (9144 mm) of grade shall meet the requirements of the large missile test of ASTM E 1996.

2. Glazed openings located more than 30 feet (9144 mm) above grade shall meet the provisions of the small missile test of ASTM E 1996.

**Exceptions:**

1. Wood structural panels with a minimum thickness of  $\frac{7}{16}$  inch (11.1 mm) and maximum panel span of 8 feet (2438 mm) shall be permitted for opening protection in buildings with a mean roof height of 33 feet (10 058 mm) or less that are classified as a Group R-3 or R-4 occupancy. Panels shall be precut so that they shall be attached to the framing surrounding the opening containing the product with the glazed opening. Panels shall be predrilled as required for the anchorage method and shall be secured with the attachment hardware provided. Attachments shall be designed to resist the components and cladding loads determined in accordance with the provisions of ASCE 7, with corrosion-resistant attachment hardware provided and anchors permanently installed on the building. Attachment in accordance with Table 1609.2 with corrosion-resistant attachment hardware provided and anchors permanently installed on the building is permitted for buildings with a mean roof height of 45 feet (13 716 mm) or less where  $V_{asd}$  determined in accordance with Section 1609.3.1 does not exceed 140 mph (63 m/s).
2. Glazing in Risk Category I buildings, including greenhouses that are occupied for growing plants on a production or research basis, without public access shall be permitted to be unprotected.
3. Glazing in Risk Category II, III or IV buildings located over 60 feet (18 288 mm) above the ground and over 30 feet (9144 mm) above aggregate surface roofs located within 1,500 feet (458 m) of the building shall be permitted to be unprotected.

*Table 1609.1.2. Provides wind-borne debris protection fastening schedule for wood structural panels.*

**1609.2.2 Application of ASTM E 1996.** The text of Section 6.2.2 of ASTM E 1996 shall be substituted as follows:

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

**6.2.2.1** Wind Zone 1— $130 \text{ mph} \leq \text{basic design wind speed, } V < 140 \text{ mph}$ .

**6.2.2.2** Wind Zone 2— $140 \text{ mph} \leq \text{basic design wind speed, } V < 150 \text{ mph}$  at greater than one mile (1.6 km) from the coastline. The coastline shall be measured from the mean high water mark.

**6.2.2.3** Wind Zone 3— $150 \text{ mph} (58 \text{ m/s}) \leq \text{basic design wind speed, } V \leq 160 \text{ mph} (63 \text{ m/s})$ , or  $140 \text{ mph} (54 \text{ m/s}) \leq \text{basic design wind speed, } V \leq 160 \text{ mph} (63 \text{ m/s})$  and within one mile (1.6 km) of the coastline. The coastline shall be measured from the mean high water mark.

**6.2.2.4** Wind Zone 4—basic design wind speed,  $V > 160 \text{ mph} (63 \text{ m/s})$ .

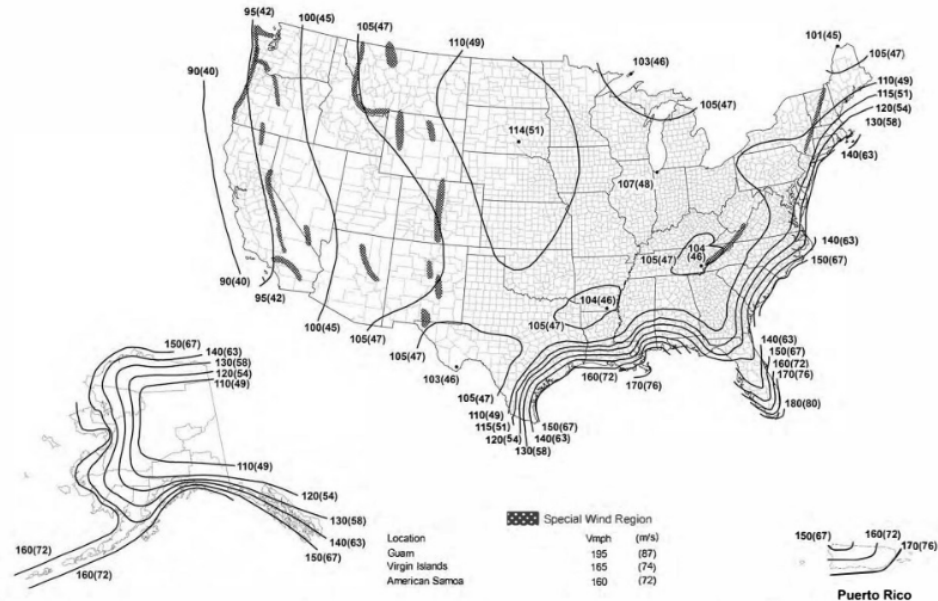
**1609.2.3 Garage doors.** Garage door glazed opening protection for wind-borne debris shall meet the requirements of an *approved* impact-resisting standard or ANSI/DASMA 115.

**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 Figure 1609.3(1) and through 8). 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) and 1609.3(5). 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) and 1609.3(6). 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) and 1609.3(7). 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) and 1609.3(8). 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.

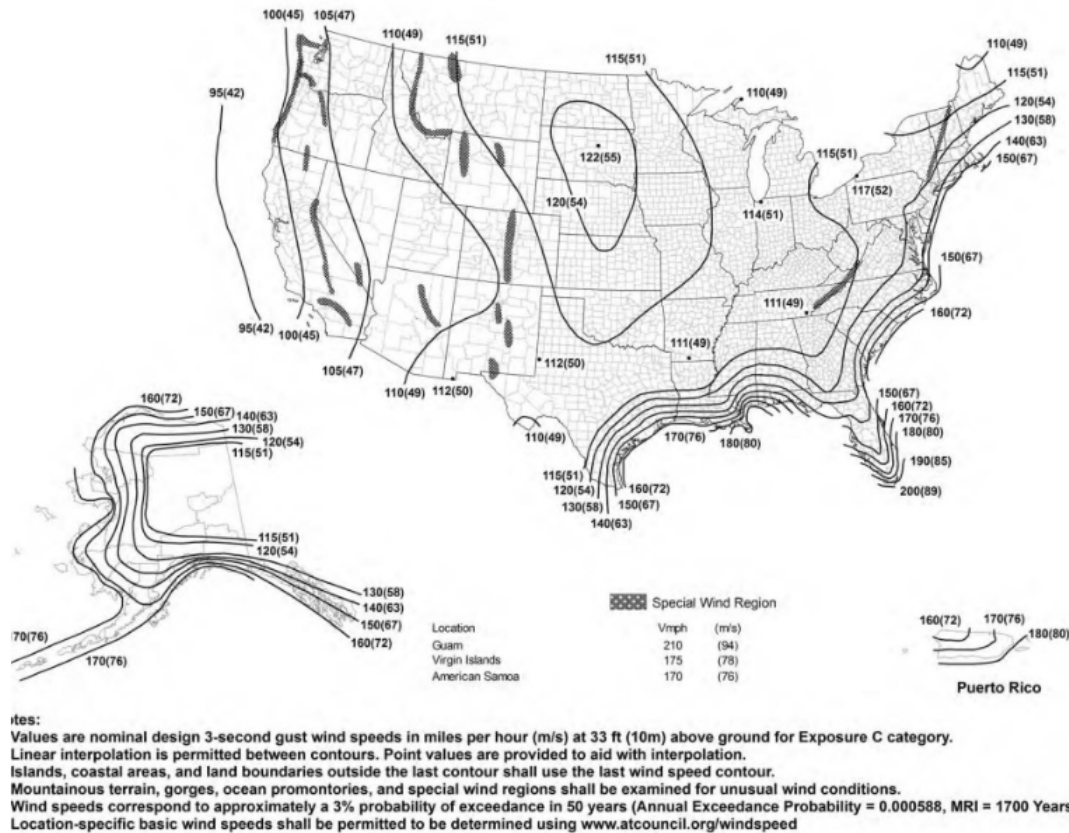
In nonhurricane-prone regions, when the basic design wind speed,  $V$ , is estimated from regional climatic data, the basic design wind speed,  $V$ , shall be determined in accordance with Chapter 26 of ASCE 7.



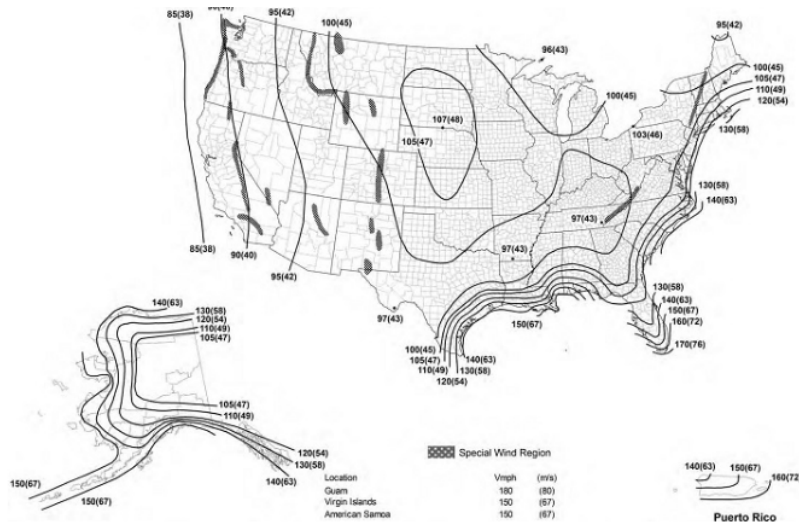
**Notes:**

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) 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.atccouncil.org/windspeed](http://www.atccouncil.org/windspeed)

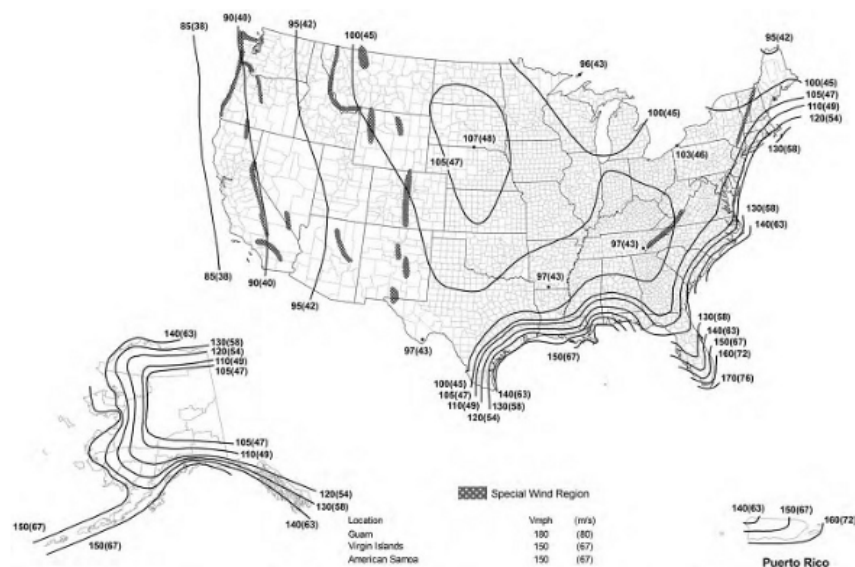
**FIGURE 1609.3(1). BASIC DESIGN WIND SPEEDS,  $V$ , FOR RISK CATEGORY II BUILDINGS AND OTHER STRUCTURES**



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

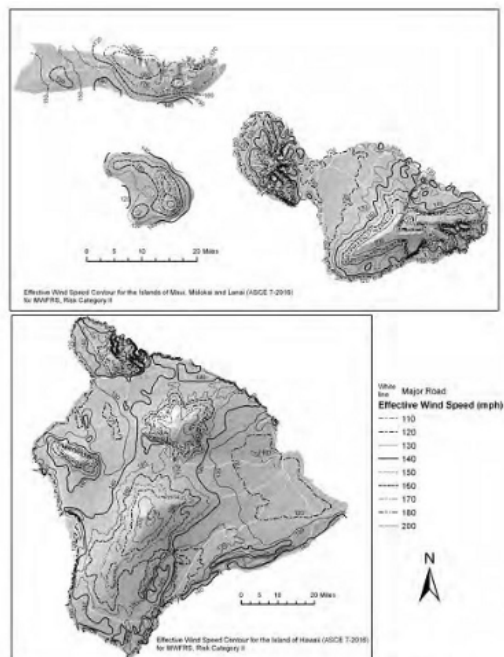


**FIGURE 1609.3(3). BASIC DESIGN WIND SPEEDS,  $V$ , FOR RISK CATEGORY IV BUILDINGS AND OTHER STRUCTURES**

**Notes:**

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) 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 15% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00333, MRI = 300 Years).
6. Location-specific basic wind speeds shall be permitted to be determined using [www.atcouncil.org/windspeed](http://www.atcouncil.org/windspeed)

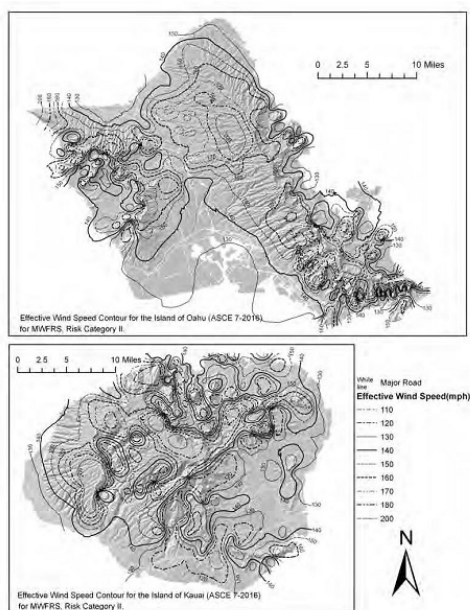
**FIGURE 1609.3(4). BASIC DESIGN WIND SPEEDS, V, FOR RISK CATEGORY I BUILDINGS AND OTHER STRUCTURES**



Basic Wind Speeds for Risk Category II Buildings and Other Structures (Hawaii).

## Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour at 33 ft (10m) above ground for Exposure C Category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. It is permitted to use the standard values of  $K_{zt}$  of 1.0 and  $K_d$  as given in Table 26.6-1 of ASCE 7.
5. Ocean promontories and local escarpments shall be examined for unusual wind conditions.
6. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).



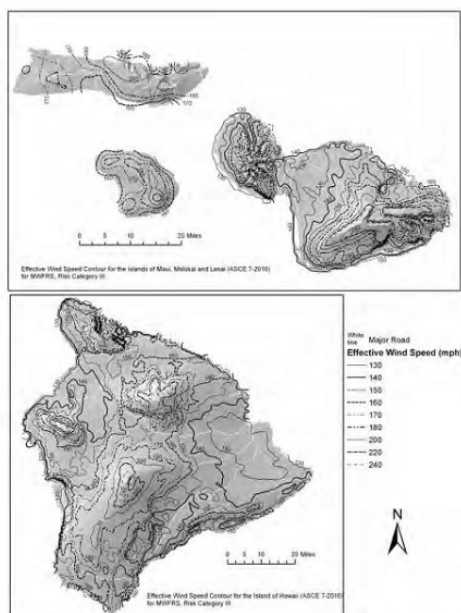
Basic Wind Speeds for Risk Category II Buildings and Other Structures (Hawaii).

## Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour at 33 ft (10m) above ground for Exposure C Category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. It is permitted to use the standard values of  $K_{zt}$  of 1.0 and  $K_d$  as given in Table 26.6-1 of ASCE 7.
5. Ocean promontories and local escarpments shall be examined for unusual wind conditions.
6. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).

## FIGURE 1609.3(5). BASIC DESIGN WIND SPEEDS, FOR RISK CATEGORY II BUILDINGS AND OTHER STRUCTURES IN HAWAII

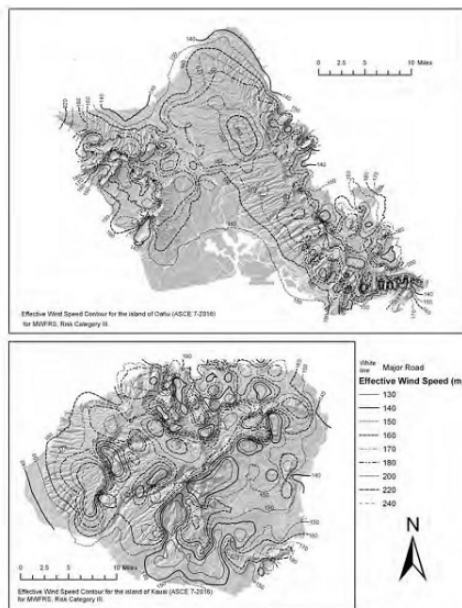




Basic Wind Speeds for Risk Category III Buildings and Other Structures (Hawaii).

## Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour at 33 ft (10m) above ground for Exposure C Category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. It is permitted to use the standard values of  $K_{zt}$  of 1.0 and  $K_d$  as given in Table 26.6-1 of ASCE 7.
5. Ocean promontories and local escarpments shall be examined for unusual wind conditions.
6. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).



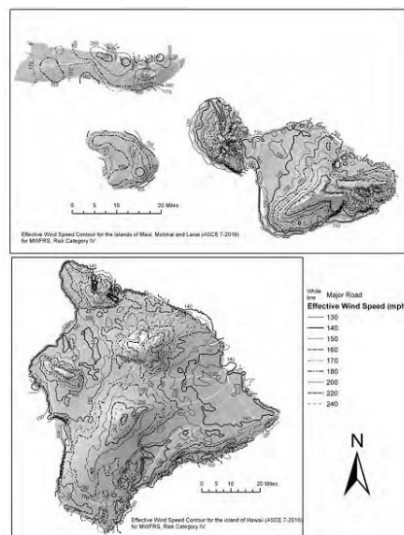
Basic Wind Speeds for Risk Category III Buildings and Other Structures (Hawaii).

## Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour at 33 ft (10m) above ground for Exposure C Category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. It is permitted to use the standard values of  $K_{zt}$  of 1.0 and  $K_d$  as given in Table 26.6-1 of ASCE 7.
5. Ocean promontories and local escarpments shall be examined for unusual wind conditions.
6. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).

## FIGURE 1609.3(6). BASIC DESIGN WIND SPEEDS, FOR RISK CATEGORY III BUILDINGS AND OTHER STRUCTURES IN HAWAII

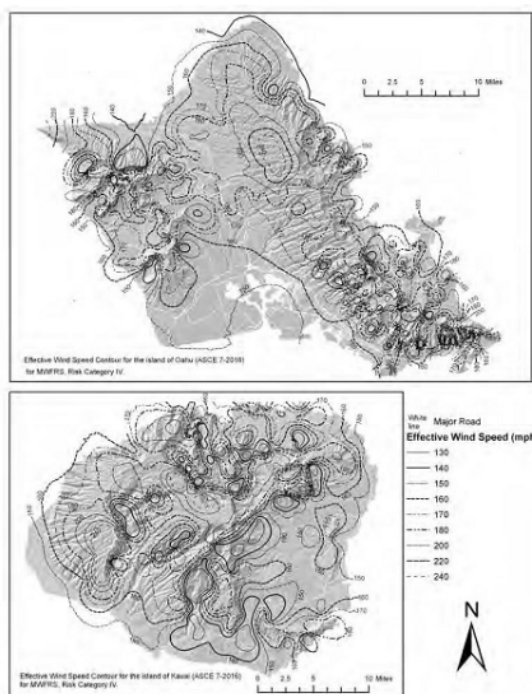




Basic Wind Speeds for Risk Category IV Buildings and Other Structures (Hawaii).

otes:

1. Values are nominal design 3-second gust wind speeds in miles per hour at 33 ft (10m) above ground for Exposure C Category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. It is permitted to use the standard values of  $K_{zt}$  of 1.0 and  $K_d$  as given in Table 26.6-1 of ASCE 7.
5. Ocean promontories and local escarpments shall be examined for unusual wind conditions.
6. Wind speeds correspond to approximately a 1.7% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).

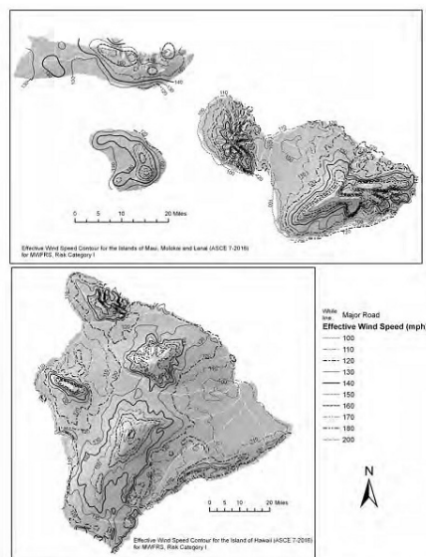


Basic Wind Speeds for Risk Category IV Buildings and Other Structures (Hawaii).

Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour at 33 ft (10m) above ground for Exposure C Category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. It is permitted to use the standard values of  $K_{zt}$  of 1.0 and  $K_d$  as given in Table 26.6-1 of ASCE 7.
5. Ocean promontories and local escarpments shall be examined for unusual wind conditions.
6. Wind speeds correspond to approximately a 1.7% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).

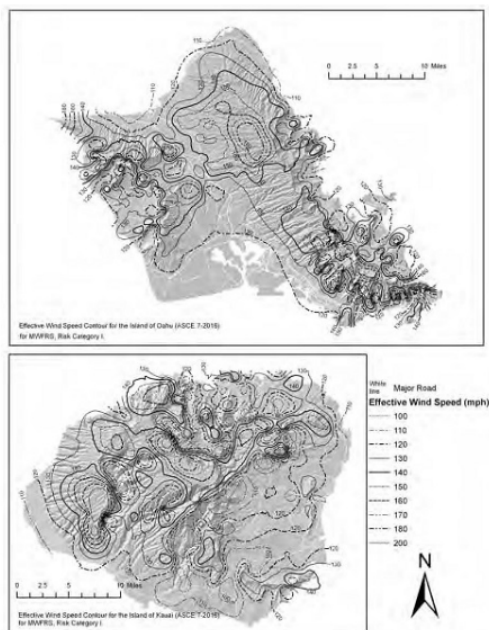
## FIGURE 1609.3(7). BASIC DESIGN WIND SPEEDS, FOR RISK CATEGORY IV BUILDINGS AND OTHER STRUCTURES IN HAWAII



Basic Wind Speeds for Risk Category I Buildings and Other Structures (Hawaii).

## Notes:

- 1.Values are nominal design 3-second gust wind speeds in miles per hour at 33 ft (10m) above ground for Exposure C Category.
- 2.Linear interpolation between contours is permitted.
- 3.Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
- 4.It is permitted to use the standard values of  $K_{zt}$  of 1.0 and  $K_d$  as given in Table 26.6-1 of ASCE 7.
- 5.Ocean promontories and local escarpments shall be examined for unusual wind conditions.
- 6.Wind speeds correspond to approximately a 15% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).



Basic Wind Speeds for Risk Category I Buildings and Other Structures (Hawaii).

## Notes:

- 1.Values are nominal design 3-second gust wind speeds in miles per hour at 33 ft (10m) above ground for Exposure C Category.
- 2.Linear interpolation between contours is permitted.
- 3.Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
- 4.It is permitted to use the standard values of  $K_{zt}$  of 1.0 and  $K_d$  as given in Table 26.6-1 of ASCE 7.
- 5.Ocean promontories and local escarpments shall be examined for unusual wind conditions.
- 6.Wind speeds correspond to approximately a 15% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).

## FIGURE 1609.3(8). BASIC DESIGN WIND SPEEDS, FOR RISK CATEGORY I BUILDINGS AND OTHER STRUCTURES IN HAWAII

**1609.3.1 Wind speed conversion.** When required, the basic design wind speeds of Figures 1609.3(1) through 1609.3(8) shall be converted to allowable stress design wind speeds,  $V_{asd}$ , using Table 1609.3.1 or Equation 16-33.

**(Equation 16-33)**  $V_{asd} = V\sqrt{0.6}$

where:

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

$V$  = Basic design wind speeds determined from Figures 1609.3(1) through 1609.3(8).

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

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

For SI: 1 mile per hour = 0.44 m/s.

- Linear interpolation is permitted.
- $V_{asd}$  = allowable stress design wind speed applicable to methods specified in Exceptions 1 through 5 of Section 1609.1.1.
- $V$  = basic design wind speeds determined from Figures 1609.3(1) through 1609.3(8).

**1609.4 Exposure category.** For each wind direction considered, an exposure category that adequately reflects the characteristics of ground surface irregularities shall be determined for the site at which the building or structure is to be constructed. Account shall be taken of variations in ground surface roughness that arise from natural topography and vegetation as well as from constructed features.

**1609.4.1 Wind directions and sectors.** For each selected wind direction at which the wind loads are to be evaluated, the exposure of the building or structure shall be determined for the two upwind sectors extending 45 degrees (0.79 rad) either side of the selected wind direction. The exposures in these two sectors shall be determined in accordance with Sections 1609.4.2 and 1609.4.3 and the exposure resulting in the highest wind loads shall be used to represent winds from that direction.

**1609.4.2 Surface roughness categories.** A ground surface roughness within each 45-degree (0.79 rad) sector shall be determined for a distance upwind of the site as defined in Section 1609.4.3 from the following categories, for the purpose of assigning an exposure category as defined in Section 1609.4.3.

**Surface Roughness B.** Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.

**Surface Roughness C.** Open terrain with scattered obstructions having heights generally less than 30 feet (9144 mm). This category includes flat open country, and grasslands.

**Surface Roughness D.** Flat, unobstructed areas and water surfaces. This category includes smooth mud flats, salt flats and unbroken ice.

**1609.4.3 Exposure categories.** An exposure category shall be determined in accordance with the following:

**Exposure B.** For buildings with a mean roof height of less than or equal to 30 feet (9144 mm), Exposure B shall apply where the ground surface roughness, as defined by Surface Roughness B, prevails in the upwind direction for a distance of at least 1,500 feet (457 m). For buildings with a mean roof height greater than 30 feet (9144 mm), Exposure B shall apply where Surface Roughness B prevails in the upwind direction for a distance of at least 2,600 feet (792 m) or 20 times the height of the building, whichever is greater.

**Exposure C.** Exposure C shall apply for all cases where Exposure B or D does not apply.

**Exposure D.** Exposure D shall apply where the ground surface roughness, as defined by Surface Roughness D, prevails in the upwind direction for a distance of at least 5,000 feet (1524 m) or 20 times the height of the building, whichever is greater. Exposure D shall apply where the ground surface roughness immediately upwind of the site is B or C, and the site is within a distance of 600 feet (183 m) or 20 times the building height, whichever is greater, from an Exposure D condition as defined in the previous sentence.

**1609.5 Roof systems.** Roof systems shall be designed and constructed in accordance with Sections 1609.5.1 through 1609.5.3, as applicable.

**1609.5.1 Roof deck.** The roof deck shall be designed to withstand the wind pressures determined in accordance with ASCE 7.

**1609.5.2 Roof coverings.** Roof coverings shall comply with Section 1609.5.1.

**Exception:** Rigid tile roof coverings that are air permeable and installed over a roof deck complying with Section 1609.5.1 are permitted to be designed in accordance with Section 1609.5.3.

Asphalt shingles installed over a roof deck complying with Section 1609.5.1 shall comply with the wind-resistance requirements of Section 1504.1.1.

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

$$M_a = q_h C_L b L L_a [1.0 - G C_p] \quad \text{(Equation 16-34)}$$

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 1504.2.1.

$G C_p$  = 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 ( $\text{kN/m}^2$ ) 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.

## SECTION 1612 FLOOD LOADS

**User Note:** This section provided for reference to the concept of substantial damage and does not include any wind provisions.

**1612.1 General.** Within *flood hazard areas* as established in Section 1612.3, all new construction of buildings, structures and portions of buildings and structures, including substantial improvement and restoration of substantial damage to buildings and structures, shall be designed and constructed to resist the effects of flood hazards and flood loads. For buildings that are located in more than one *flood hazard area*, the provisions associated with the most restrictive *flood hazard area* shall apply.



## CHAPTER 17 SPECIAL INSPECTIONS AND TESTS

### SECTION 1704 SPECIAL INSPECTIONS AND TESTS, CONTRACTOR RESPONSIBILITY AND STRUCTURAL OBSERVATION

**1704.3.3 Wind requirements in the statement of special inspections.** Where Section 1705.11 specifies *special inspection* for wind resistance, the statement of *special inspections* shall identify the main windforce-resisting systems and wind-resisting components that are subject to *special inspections*.

**1704.6.3 Special observations for wind resistance.** Structural observations shall be provided for those structures sited where  $V$  is 130 mph (58m/sec) or greater and the structure is classified as *Risk Category* III or IV.

**1705.11 Special inspections for wind resistance.** *Special inspections* for wind resistance specified in Sections 1705.11.1 through 1705.11.3, unless exempted by the exceptions to Section 1704.2, are required for buildings and structures constructed in the following areas:

1. In wind Exposure Category B, where  $V_{\text{asd}}$  as determined in accordance with Section 1609.3.1 is 120 miles per hour (52.8 m/sec) or greater.
2. In wind Exposure Category C or D, where  $V_{\text{asd}}$  as determined in accordance with Section 1609.3.1 is 110 mph (49 m/sec) or greater.

**1705.11.1 Structural wood.** *Continuous special inspection* is required during field gluing operations of elements of the main windforce-resisting system. *Periodic special inspection* is required for nailing, bolting, anchoring and other fastening of elements of the main windforce-resisting system, including wood shear walls, wood diaphragms, drag struts, braces and hold-downs.

**Exception:** *Special inspections* are not required for wood shear walls, shear panels and diaphragms, including nailing, bolting, anchoring, and other fastening to other elements of the main windforce-resisting system, where the specified fastener spacing at panel edges is more than 4 inches (102 mm) on center.

**1705.11.2 Cold-formed steel light-frame construction.** *Periodic special inspection* is required for welding operations of elements of the main windforce-resisting system. *Periodic special inspection* is required for screw attachment, bolting, anchoring and other fastening of elements of the main windforce-resisting system, including shear walls, braces, diaphragms, collectors (drag struts) and hold-downs.

**Exception:** *Special inspections* are not required for cold-formed steel light-frame shear walls and diaphragms, including screwing, bolting, anchoring and other fastening to components of the windforce resisting system, where either of the following applies:

1. The sheathing is gypsum board or fiberboard.
2. The sheathing is wood structural panel or steel sheets on only one side of the shear wall, shear panel or diaphragm assembly and the fastener spacing of the sheathing is more than 4 inches (102 mm) on center (o.c.).

**1705.11.3 Wind-resisting components.** *Periodic special inspection* is required for fastening of the following systems and components:

1. Roof covering, roof deck and roof framing connections.
2. Exterior wall covering and wall connections to roof and floor diaphragms and framing.

**1709.5.2 Exterior windows and door assemblies not provided for in Section**

**1709.5.1.** Exterior window and door assemblies shall be tested in accordance with ASTM E 330. Structural performance of garage doors and rolling doors shall be determined in accordance with either ASTM E 330 or ANSI/DASMA 108, and shall meet the acceptance criteria of ANSI/DASMA 108. Exterior window and door assemblies containing glass shall comply with Section 2403. The design pressure for testing shall be calculated in accordance with Chapter 16. Each assembly shall be tested for 10 seconds at a load equal to 1.5 times the design pressure.

**CHAPTER 18 SOILS AND FOUNDATIONS****SECTION 1810 DEEP FOUNDATIONS****1810.3.3.1.5 Uplift capacity of a single deep foundation element. [partial shown]**

**Exception:** Where uplift is due to wind or seismic loading, the minimum factor of safety shall be two where capacity is determined by an analysis and one and one-half where capacity is determined by load tests.

**1810.3.3.1.6 Allowable uplift load of grouped deep foundation elements.** For grouped deep foundation elements subjected to uplift, the allowable uplift load for the group shall be calculated by a generally accepted method of analysis. Where the deep foundation elements in the group are placed at a center-to-center spacing less than three times the least horizontal dimension of the largest single element, the allowable working uplift load for the group is permitted to be calculated as the lesser of:

1. The proposed individual allowable uplift load times the number of elements in the group.
2. Two-thirds of the effective weight of the group and the soil contained within a block defined by the perimeter of the group and the length of the element, plus two-thirds of the ultimate shear resistance along the soil block.

**CHAPTER 21 MASONRY****SECTION 2109 EMPIRICAL DESIGN OF ADOBE MASONRY****2109.1.1 [General] Limitations. [partial shown]**

Section A.1.2.2 of TMS 402/ACI 530/ASCE 5 shall be modified as follows:

A.1.2.2 – Wind. Empirical requirements shall not apply to the design or construction of masonry for buildings, parts of buildings, or other structures to be located in areas where  $V_{asd}$  as determined in accordance with Section 1609.3.1 of the International Building Code exceeds 110 mph.

**CHAPTER 22 STEEL****SECTION 2205 STRUCTURAL STEEL**

**2205.1 General.** The design, fabrication and erection of *structural steel elements* in buildings, structures and portions thereof shall be in accordance with AISC 360.

## SECTION 2207 STEEL JOISTS

**2207.2 Design.** The *registered design professional* shall indicate on the *construction documents* the steel joist and steel joist girder designations from the specifications listed in Section 2207.1; and shall indicate the requirements for joist and joist girder design, layout, end supports, anchorage, bridging design that differs from the SJI specifications listed in Section 2207.1, bridging termination connections and bearing connection design to resist uplift and lateral loads. These documents shall indicate special requirements as follows: *[partial shown]*

1. Special loads including:

1.3. Net uplift loads.

1.5. End moments.

1.6. Connection forces.

## SECTION 2211 COLD-FORMED STEEL LIGHT-FRAME CONSTRUCTION

**2211.1 Structural framing.** For cold formed steel light frame construction, the design and installation of the following structural framing systems, including their members and connections, shall be in accordance with AISI S240, and sections 2211.1.1. through 2211.1.3 as applicable:

1. Floor and roof systems.

2. Structural walls.

3. Shear walls, strap-braced walls and diaphragms that resist in-plane lateral loads.

4. Trusses.

## CHAPTER 23 WOOD

### SECTION 2303 MINIMUM STANDARDS AND QUALITY

**2303.4.1.1 Truss design drawings.** *[partial shown]* Truss design drawings shall include, at a minimum, the information specified below:

5. Design loads as applicable, including; *[partial shown]*

5.6. Environmental design criteria and loads (wind, rain, snow, seismic, etc.).

8. Maximum reaction force and direction, including maximum uplift reaction forces where applicable

**2303.4.4 Anchorage.** The design for the transfer of loads and anchorage of each truss to the supporting structure is the responsibility of the *registered design professional*.

### SECTION 2304 GENERAL CONSTRUCTION REQUIREMENTS

**2304.3 Wall framing.** The framing of exterior and interior walls shall be in accordance with the provisions specified in Section 2308 unless a specific design is furnished.

**2304.3.2 Framing over openings.** Headers, double joists, trusses or other *approved* assemblies that are of adequate size to transfer loads to the vertical members shall be provided over window and door openings in load-bearing walls and partitions.

**2304.6 Exterior wall sheathing.** Wall sheathing on the outside of exterior walls, including gables, and the connection of the sheathing to framing shall be designed in accordance with the general provisions of this code and shall be capable of resisting wind pressures in accordance with Section 1609.

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

*Table 2304.6.1. Provides the maximum allowable stress design wind speed permitted for wood structural panel wall sheathing for listed sheathing thicknesses and fastening schedules.*

**2304.8.2 Structural roof sheathing.** Structural roof sheathing shall be designed in accordance with the general provisions of this code and the special provisions in this section.

Roof sheathing conforming to the provisions of Table 2304.8(1), 2304.8(2), 2304.8(3) or 2304.8(5) shall be deemed to meet the requirements of this section. Wood structural panel roof sheathing shall be of a type manufactured with exterior glue (Exposure 1 or Exterior).

**2304.10 Connectors and fasteners.** Connectors and fasteners shall comply with the applicable provisions of Sections 2304.10.1 through 2304.10.7.

**2304.10.1 Fastener requirements.** Connections for wood members shall be designed in accordance with the appropriate methodology in Section 2302.1. The number and size of fasteners connecting wood members shall be not less than that set forth in Table 2304.10.1.

**2304.10.6 Load path.** Where wall framing members are not continuous from the foundation sill to the roof, the members shall be secured to ensure a continuous load path. Where required, sheet metal clamps, ties or clips shall be formed of galvanized steel or other approved corrosion-resistant material not less than 0.0329-inch (0.836 mm) base metal thickness.

**2304.10.7 Framing requirements.** *[Partial shown]* Column-and-post end connections shall be fastened to resist lateral and net induced uplift forces.

**2304.11.1.3 Roof framing.** Minimum dimensions of roof framing shall be in accordance with Table 2304.11. Every roof girder and not less than every alternate roof beam shall be anchored to its supporting member to resist forces as required in Chapter 16.

**2304.11.4 Roof decks.** Roofs shall be without concealed spaces and roof decks shall be constructed in accordance with Section 2304.11.4.1 or 2304.11.4.2. Other types of decking shall be an alternate that provides equivalent fire resistance and structural properties. *[partial shown]*

## SECTION 2305 GENERAL DESIGN REQUIREMENTS FOR LATERAL FORCE-RESISTING SYSTEMS

**2305.1 General.** Structures using wood-frame shear walls or wood-frame diaphragms to resist wind, seismic or other lateral loads shall be designed and constructed in accordance with AF&PA SDPWS and the applicable provisions of Sections 2305, 2306 and 2307.

**2305.1.1 Openings in shear panels.** Openings in shear panels that materially affect their strength shall be detailed on the plans and shall have their edges adequately reinforced to transfer all shearing stresses.

## SECTION 2306 ALLOWABLE STRESS DESIGN

**2306.2 Wood-frame diaphragms.** Wood-frame diaphragms shall be designed and constructed in accordance with AWC SDPWS. Where panels are fastened to framing members with staples, requirements and limitations of AWC SDPWS shall be met and the allowable shear values set forth in Table 2306.2(1) or 2306.2(2) shall be permitted. The allowable shear values in Tables 2306.2(1) and 2306.2(2) are permitted to be increased 40 percent for wind design.

*Table 2306.2(1). Provides allowable shear values for wood structural panel diaphragms utilizing staples with framing of douglas fir-larch, or southern pine for wind or seismic loading.*

*Table 2306.2(2). Provides allowable shear values for wood structural panel blocked diaphragms utilizing multiple rows of staples with framing of douglas fir-larch or southern pine for wind or seismic loading.*

**2306.3 Wood-frame shear walls.** Wood-frame shear walls shall be designed and constructed in accordance with AWC SDPWS. Where panels are fastened to framing members with staples, requirements and limitations of AWC SDPWS shall be met and the allowable shear values set forth in Table 2306.3(1), 2306.3(2) or 2306.3(3) shall be permitted. The allowable shear values in Tables 2306.3(1) and 2306.3(2) are permitted to be increased 40 percent for wind design. Panels complying with ANSI/APA PRP-210 shall be permitted to use design values for Plywood Siding in the AWC SDPWS.

*Table 2306.3(1). Provides for the allowable shear values for wood structural panel shear walls utilizing staples with framing of douglas fir-larch or southern pine for wind or seismic loading.*

*Table 2306.3(2). Provides for allowable shear values for wind or seismic loading on shear walls of fiberboard sheathing board construction utilizing staples for Type V construction only.*

*Table 2306.3(3). Provides for allowable shear values for wind or seismic forces for shear walls of lath and plaster or gypsum board wood framed wall assemblies utilizing staples.*

## SECTION 2308 CONVENTIONAL LIGHT-FRAME CONSTRUCTION

**2308.2.4 Basic wind speed.**  $V$  shall not exceed 130 miles per hour (57 m/s) (3-second gust).

### Exceptions:

1.  $V$  shall not exceed 140 mph (61.6 m/s) (3-second gust) for buildings in Exposure Category B that are not located in a *hurricane-prone region*.
2. Where  $V$  exceeds 130 mph (3-second gust), the provisions of either AWC WFCM or ICC 600 are permitted to be used.

**User Note:** This chapter contains a significant amount of prescriptive guidance. However, the guidance is limited to locations outside hurricane prone regions where the basic design wind speed,  $V$ , is less than or equal to 140 mph for exposure category B.

**2308.2.6 Risk category limitation.** The use of the provisions for *conventional light-frame construction* in this section shall not be permitted for *Risk Category IV* buildings assigned to *Seismic Design Category B, C, D or F*.



**2308.7.5 Wind uplift.** The roof construction shall have rafter and truss ties to the wall below. Resultant uplift loads shall be transferred to the foundation using a continuous load path. The rafter or truss to wall connection shall comply with Tables 2304.10.1 and 2308.7.5.

*Table 2308.7.5. Provides the required rating of approved uplift connectors.*

## SECTION 2309 WOOD FRAME CONSTRUCTION MANUAL

**2309.1 Wood Frame Construction Manual.** Structural design in accordance with the AWC WFCM shall be permitted for buildings assigned to Risk Category I or II subject to the limitations of Section 1.1.3 of the AWC WFCM and the load assumptions contained therein. Structural elements beyond these limitations shall be designed in accordance with accepted engineering practice.

## CHAPTER 24 GLASS AND GLAZING

### SECTION 2404 WIND, SNOW, SEISMIC AND DEAD LOADS ON GLASS

**2404.1 Vertical glass.** Glass sloped 15 degrees (0.26 rad) or less from vertical in windows, curtain and window walls, doors and other exterior applications shall be designed to resist the wind loads due to basic design wind speed,  $V$ , in Section 1609 for components and cladding. *[partial shown]* The load resistance of glass under uniform load shall be determined in accordance with ASTM E 1300.

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

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

where:

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

$F_{ga}$  = Short duration load on the glass as determined in accordance with ASTM E 1300.

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

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

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

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

where:

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

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

$$= 13 t_g \text{ (For SI: } 0.0245 t_g \text{)}.$$

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

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

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

$S$  = Snow load, psf (kN/m<sup>2</sup>) as determined in Section 1608.

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

$W_i$  = Inward wind force, psf (kN/m<sup>2</sup>) due to ultimate design wind speed,  $V_{ult}$ , as calculated in Section 1609.

$W_o$  = Outward wind force, psf (kN/m<sup>2</sup>) due to ultimate design wind speed,  $V_{ult}$ , as calculated in Section 1609.

$\theta$  = Angle of slope from horizontal.

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

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

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

where:

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

$F_{ga}$  = Short duration load resistance of the glass as determined in accordance with ASTM E 1300 for Equations 24-2 and 24-3; or the long duration load resistance of the glass as determined in accordance with ASTM E 1300 for Equation 24-4.

### 2404.3 Wired, patterned and sandblasted glass. *[partial shown]*

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

$$0.6F_{gw} < 0.5 F_{ge} \quad \text{(Equation 24-6)}$$

where:

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

$F_{ge}$  = Nonfactored load from ASTM E 1300 using a thickness designation for monolithic glass that is not greater than the thickness of wired glass.

**2404.3.2 Sloped wired glass.** Wired glass sloped more than 15 degrees (0.26 rad) from vertical in skylights, sun-spaces, sloped roofs and other exterior applications shall be designed to resist the most critical of the combinations of loads from Section 2404.2.

For Equations 24-2 and 24-3:

$$F_g < 0.5 F_{ge} \quad \text{(Equation 24-7)}$$

For Equation 24-4:

$$F_g < 0.3 F_{ge} \quad \text{(Equation 24-8)}$$

where:

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

$F_{ge}$  = Nonfactored load in accordance with ASTM E 1300.

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

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

where:

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

$F_{ge}$  = Nonfactored load in accordance with ASTM E 1300. The value for patterned glass shall be based on the thinnest part of the glass. Interpolation between nonfactored load charts in ASTM E 1300 shall be permitted.

**2404.3.4 Sloped patterned glass.** Patterned glass sloped more than 15 degrees (0.26 rad) from vertical in skylights, sunspaces, sloped roofs and other exterior applications shall be designed to resist the most critical of the combinations of loads from Section 2404.2.

For Equations 24-2 and 24-3:

$$F_g < 1.0 F_{ge} \quad \text{(Equation 24-10)}$$

For Equation 24-4:

$$F_g < 0.6 F_{ge} \quad \text{(Equation 24-11)}$$

where:

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

$F_{ge}$  = Nonfactored load in accordance with ASTM E 1300. The value for patterned glass shall be based on the thinnest part of the glass. Interpolation between the nonfactored load charts in ASTM E 1300 shall be permitted.

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

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

where:

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

$F_{ge}$  = Nonfactored load in accordance with ASTM E 1300. The value for sandblasted glass is for moderate levels of sandblasting.

**2405.5 Unit skylights and tubular daylighting devices.** Unit skylights and tubular daylighting devices shall be tested and labeled as complying with AAMA/WDMA/CSA 101/I.S./A440. The *label* shall state the name of the manufacturer, the *approved* labeling agency, the product designation and the performance grade rating as specified in AAMA/WDMA/CSA 101/I.S.2/A440. Where the product manufacturer has chosen to have the performance grade of the skylight rated separately for positive and negative design pressure, then the label shall state both performance grade ratings as specified in AAMA/WDMA/CSA 101/I.S.2/A440 and the skylight shall comply with Section 2405.5.2. Where the skylight is not rated separately for positive and negative pressure, then the performance grade rating shown on the label shall be the performance grade rating determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 for both positive and negative design pressure and the skylight shall conform to Section 2405.5.1.

**2405.5.1 Skylights rated for the same performance grade for both positive and negative design pressure.** The design of skylights shall be based on Equation 24-13.

$$F_g \leq PG \quad \text{(Equation 24-13)}$$

where:

$F_g$  = Maximum load on the skylight determined from Equations 24-2 through 24-4 in Section 2404.2.

$PG$  = Performance grade rating of the skylight.

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

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

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

where:

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

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

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

For  $0.6W_o \geq D$ ,

where:

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

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

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

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

For  $0.6 W_o < D$ , where:

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

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

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

$F_{go} = 0$ .

## SECTION 2407 GLASS IN HANDRAILS AND GUARDS

**2407.1.4 [Materials] Glazing in wind-borne debris regions.** Glazing installed in in-fill panels or balusters in *wind-borne debris regions* shall comply with the following:

**2407.1.4.2 Glass supporting top rail.** When the top rail is supported by glass, the assembly shall be tested according to the impact requirements of Section 1609.2. The top rail shall remain in place after impact.

## CHAPTER 25 GYPSUM BOARD, GYPSUM PANEL PRODUCTS AND PLASTER

### SECTION 2505 SHEAR WALL CONSTRUCTION

**2505.1 Resistance to shear (wood framing).** Wood-frame shear walls sheathed with gypsum board, gypsum panel products or lath and plaster shall be designed and constructed in accordance with Section 2306.3 and are permitted to resist wind and seismic loads. *[partial shown]*

**2505.2 Resistance to shear (steel framing).** Cold-formed steel-frame shear walls sheathed with gypsum board or gypsum panel products and constructed in accordance with the materials and provisions of Section 2211.1.1 are permitted to resist wind and seismic loads. *[partial shown]*

## CHAPTER 26 PLASTIC

### SECTION 2601 GENERAL

**2603.10 Wind resistance.** Foam plastic insulation complying with ASTM C 578 and ASTM C 1289 and used as exterior wall sheathing on framed wall assemblies shall comply with ANSI/FS 100 for wind pressure resistance.

**2603.11 Cladding attachment over foam sheathing to masonry or concrete wall construction.** Cladding shall be specified and installed in accordance with Chapter 14 and the cladding manufacturer's installation instructions or an approved design. Foam sheathing shall be attached to masonry or concrete construction in accordance with the insulation manufacturer's installation instructions or an approved design. Furring and furring attachments through foam sheathing shall be designed to resist design loads determined in accordance with Chapter 16, including support of cladding weight as applicable. Fasteners used to attach cladding or furring through foam sheathing to masonry or concrete substrates shall be approved for application into masonry or concrete material and shall be installed in accordance with the fastener manufacturer's installation instructions.

#### Exceptions:

1. Where the cladding manufacturer has provided approved installation instructions for application over foam sheathing and connection to a masonry or concrete substrate, those requirements shall apply.
2. For exterior insulation and finish systems, refer to Section 1407.
3. For anchored masonry or stone veneer installed over foam sheathing, refer to Section 1404.



**2603.12 Cladding attachment over foam sheathing to cold-formed steel framing.** Cladding shall be specified and installed in accordance with Chapter 14 and the cladding manufacturer's approved installation instructions, including any limitations for use over foam plastic sheathing, or an approved design. Where used, furring and furring attachments shall be designed to resist design loads determined in accordance with Chapter 16. In addition, the cladding or furring attachments through foam sheathing to framing shall meet or exceed the minimum fastening requirements of Sections 2603.12.1 and 2603.12.2, or an approved design for support of cladding weight.

**Exceptions:**

1. Where the cladding manufacturer has provided approved installation instructions for application over foam sheathing, those requirements shall apply.
2. For exterior insulation and finish systems, refer to Section 1407.
3. For anchored masonry or stone veneer installed over foam sheathing, refer to Section 1404.

**2603.13 Cladding attachment over foam sheathing to wood framing.** Cladding shall be specified and installed in accordance with Chapter 14 and the cladding manufacturer's installation instructions. Where used, furring and furring attachments shall be designed to resist design loads determined in accordance with Chapter 16. In addition, the cladding or furring attachments through foam sheathing to framing shall meet or exceed the minimum fastening requirements of Section 2603.13.1 or 2603.13.2, or an approved design for support of cladding weight.

**Exceptions:**

1. Where the cladding manufacturer has provided approved installation instructions for application over foam sheathing, those requirements shall apply.
2. For exterior insulation and finish systems, refer to Section 1407.
3. For anchored masonry or stone veneer installed over foam sheathing, refer to Section 1404.

## **SECTION 2606 LIGHT-TRANSMITTING PLASTICS**

**2606.5 Structural requirements.** Light-transmitting plastic materials in their assembly shall be of adequate strength and durability to withstand the loads indicated in Chapter 16. Technical data shall be submitted to establish stresses, maximum unsupported spans and such other information for the various thicknesses and forms used as deemed necessary by the *building official*.

**2606.6 Fastening.** Fastening shall be adequate to withstand the loads in Chapter 16. Proper allowance shall be made for expansion and contraction of light-transmitting plastic materials in accordance with accepted data on the coefficient of expansion of the material and other material in conjunction with which it is employed.

## **CHAPTER 31 SPECIAL CONSTRUCTION**

### **SECTION 3102 MEMBRANE STRUCTURES**

**3102.7 Engineering design.** The structure shall be designed and constructed to sustain dead loads; loads due to tension or inflation; live loads including wind, snow or flood and seismic loads and in accordance with Chapter 16.

## SECTION 3105 AWNINGS AND CANOPIES

**3105.2 Design and construction.** *[partial shown]* Awnings and canopies shall be designed and constructed to withstand wind or other lateral loads and live loads as required by Chapter 16 with due allowance for shape, open construction and similar features that relieve the pressures or loads. Structural members shall be protected to prevent deterioration.

## SECTION 3108 TELECOMMUNICATION AND BROADCAST TOWERS

**[BS] 3108.1 General.** Towers shall be designed and constructed in accordance with the provisions of TIA-222. *[partial shown]* In Section 2.6.6.2 of TIA 222, the horizontal extent of Topographic Category 2, escarpments, shall be 16 times the height of the escarpment.

## SECTION 3111 SOLAR ENERGY SYSTEMS

**3111.1.1 Wind resistance.** Rooftop-mounted photovoltaic panels and modules and solar thermal collectors shall be designed in accordance with Section 1609.

*User Note: The 2016 edition of ASCE 7 provides specific wind load criteria for rooftop PV. Use of the ASCE 7-16 rooftop PV wind load provisions is recommended Because those provisions did not make it into the 2018 IBC.*

## CHAPTER 35 REFERENCED STANDARDS

Standard Reference Number	Title	Referenced in Code Section Number
AMCA	Air Movement and Control Association International	30 West University Drive Arlington Heights, IL 60004
540-13	Test Method for Louvers Impacted by Wind Borne Debris	1609.1.2.1
ASCE/SEI	American Society of Civil Engineers Structural Engineering Institute	1801 Alexander Bell Drive Reston, VA 20191-4400
7-16	Minimum Design Loads for Buildings and Other Structures with Supplement No. 1	<i>[See 2018 IBC Chapter 35]</i>
49-07	Wind Tunnel Testing for Buildings and Other Structures	1609.1.1

Standard Reference Number	Title	Referenced in Code Section Number
55-16	Tensile Membrane Structures	3102.2
ASTM	ASTM International	100 Barr Harbor Drive West Conshohocken, PA 194282959
D 3161/D 3161M13	Test Method for a Wind Resistance of Asphalt Shingles (Fan Induced Method)	1504.1.1 1507.17.8 , 1504.3.3
E1996-14A	Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes	1609.1.2, 1609.1.2.2
FM	Factory Mutual Global Research Standards Laboratories Department	1301 Atwood Avenue, P.O. Box 7500 Johnston, RI 02919
4474 (2011)	American National Standard for Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures	1504.3.1, 1504.3.2 1504.3.3
ICC	International Code Council, Inc.	500 New Jersey Ave, NW 6th Floor Washington, DC 20001
ICC 600-14	Standard for Residential Construction in High-wind Regions	1609.1.1, 1609.1.1.1, 2308.2.1

Standard Reference Number	Title	Referenced in Code Section Number
SBCCI SSTD 1197	Test Standard for Determining Wind Resistance of Concrete or Clay Roof Tiles	
SBCA	Structural Building Components Association	6300 Enterprise Lane Madison, WI 53719
ANSI/FS 100-12	Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies	2603.10
ANSI/SPRI/ FM4435-ES-1-11	Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems	1504.5
ANSI/SPRI RP-413	Wind Design Guide for Ballasted Single-ply Roofing Systems	1504.4
UL	UL LLC	333 Pfingsten Road Northbrook, IL 60062-2096
580-2006	Test for Uplift Resistance of Roof Assemblies- with Revisions through July 2009	1504.3.1, 1504.3.2
1897-12	Uplift Tests for Roof Covering Systems	1504.3.1
WDMA	Window and Door Manufacturers Association	2025 M Street, NW Suite 800 Washington, DC 20036-3309
AAMA/WDMA/CSA 101/I.S.2/A440-11	Specifications for Windows, Doors and Unit Skylights	1709.5.1, 2405.5

## APPENDIX H SIGNS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

### SECTION H105 DESIGN AND CONSTRUCTION

**H105.3 Wind load.** Signs shall be designed and constructed to withstand wind pressure as provided for in Chapter 16.

## APPENDIX I PATIO COVERS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

### SECTION I105 STRUCTURAL PROVISIONS

**I105.1 Design loads.** *[partial shown]* Such patio covers shall be designed to resist the minimum wind and seismic loads set forth in this code.

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