

1609.6.1.1 Main windforce-resisting systems. For the design of main windforce-resisting systems, the building must meet all of the following conditions:

1. The building is a simple diaphragm building as defined in Section 1609.2.
2. The building is not classified as a flexible building as defined in Section 1609.2.
3. The building does not have response characteristics making it subject to across wind loading, vortex shedding, instability due to galloping or flutter; and does not have a site location for which channeling effects or buffeting in the wake of upwind obstructions warrant special consideration.
4. The building structure has no expansion joints or separations.
5. The building is regular shaped and has an approximately symmetrical cross section in each direction with roof slopes not exceeding 45 degrees (0.78 rad.).

1609.6.1.2 Components and cladding. For the design of components and cladding, the building must meet all of the following conditions:

1. The building does not have response characteristics making it subject to across wind loading, vortex shedding, instability due to galloping or flutter; and does not have a site location for which channeling effects or buffeting in the wake of upwind obstructions warrant special consideration.
2. The building is regular shaped with roof slopes not exceeding 45 degrees (0.78 rad.) for gable roofs, or 27 degrees (0.47 rad.) for hip roofs.

1609.6.2 Design procedure.

1. The basic wind speed, V , shall be determined in accordance with Section 1609.3. The wind shall be assumed to come from any horizontal direction.
2. An importance factor I_w shall be determined in accordance with Section 1609.5.
3. An exposure category shall be determined in accordance with Section 1609.4.
4. A height and exposure adjustment coefficient, λ , shall be determined from Table 1609.6.2.1(4).

1609.6.2.1 Main windforce-resisting system. Simplified design wind pressures, p_s , for the main windforce-resisting systems represent the net pressures (sum of internal and external) to be applied to the horizontal and vertical projections of building surfaces as

shown in Figure 1609.6.2.1. For the horizontal pressures (Zones A, B, C, D), p_s is the combination of the windward and leeward net pressures. p_s shall be determined from Equation 16-34).

$$p_s = \lambda I_w p_{s30} \tag{Equation 16-34}$$

where:

- λ = Adjustment factor for building height and exposure from Table 1609.6.2.1(4).
- I_w = Importance factor as defined in Section 1609.5
- p_{s30} = Simplified design wind pressure for Exposure B, at $h = 30$ feet (9144 mm), and for $I_w = 1.0$, from Table 1609.6.2.1(1).

1609.6.2.1.1 Minimum pressures. The load effects of the design wind pressures from Section 1609.6.2.1 shall not be less than assuming the pressures, p_s , for Zones A, B, C and D all equal to +10 psf (0.48 kN/m²), while assuming Zones E, F, G, and H all equal to 0 psf.

1609.6.2.2 Components and cladding. Net design wind pressures, p_{net} , for the components and cladding of buildings represent the net pressures (sum of internal and external) to be applied normal to each building surface as shown in Figure 1609.6.2.2. The net design wind pressure, p_{net} shall be determined from Equation 16-35:

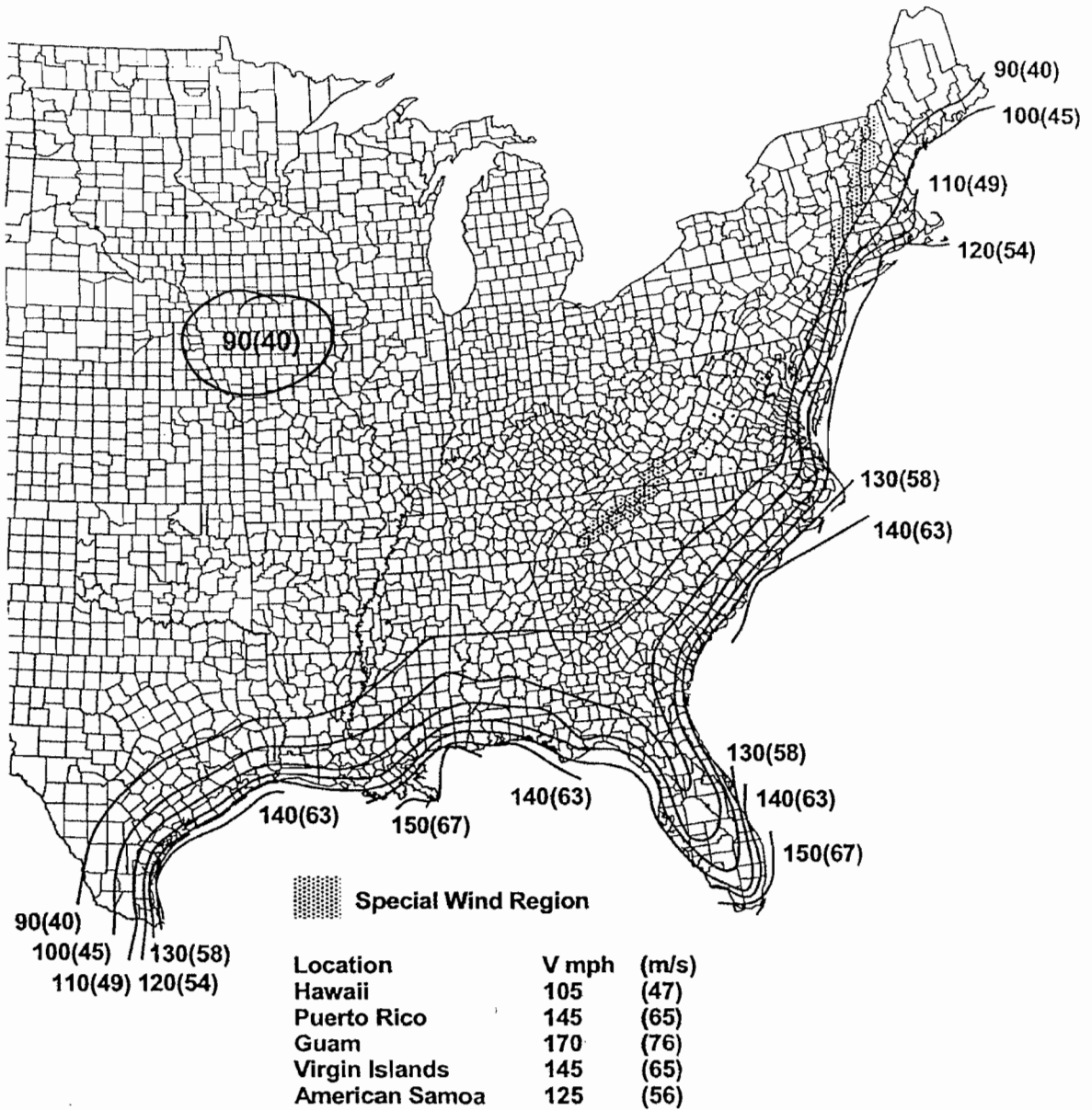
$$p_{net} = \lambda I_w p_{net30} \tag{Equation 16-35}$$

where:

- λ = Adjustment factor for building height and exposure from Table 1609.6.2.1(4).
- I_w = Importance factor as defined in Section 1609.5.
- p_{net30} = Net design wind pressure for Exposure B, at $h = 30$ feet (9144 mm), and for $I_w = 1.0$, from Tables 1609.6.2.1(2) and 1609.6.2.1(3).

1609.6.2.2.1 Minimum pressures. The positive design wind pressures, p_{net} , from Section 1609.6.2.2 shall not be less than +10 psf (0.48 kN/m²), and the negative design wind pressures, p_{net} , from Section 1609.6.2.2 shall not be less than -10 psf (-0.48 kN/m²).

1609.6.2.3 Load case. Members that act as both part of the main windforce-resisting system and as components and cladding shall be designed for each separate load case.



Notes:

1. Values are nominal design **3-second gust wind speeds in miles per hour (m/s)** at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

FIGURE 1609—continued
BASIC WIND SPEED (3-SECOND GUST)

TABLE 1609.6.2.1(3)
ROOF OVERHANG NET DESIGN WIND PRESSURE (COMPONENT AND CLADDING), p_{net30} (Exposure B at $h = 30$ feet with $I_w = 1.0$) (psf)

	ZONE	EFFECTIVE WIND AREA (sq. ft.)	BASIC WIND SPEED V (mph—3-second gust)							
			90	100	110	120	130	140	150	170
Roof 0 to 7 degrees	2	10	-21.0	-25.9	-31.4	-37.3	-43.8	-50.8	-58.3	-74.9
	2	20	-20.6	-25.5	-30.8	-36.7	-43.0	-49.9	-57.3	-73.6
	2	50	-20.1	-24.9	-30.1	-35.8	-42.0	-48.7	-55.9	-71.8
	2	100	-19.8	-24.4	-29.5	-35.1	-41.2	-47.8	-54.9	-70.5
	3	10	-34.6	-42.7	-51.6	-61.5	-72.1	-83.7	-96.0	-123.4
	3	20	-27.1	-33.5	-40.5	-48.3	-56.6	-65.7	-75.4	-96.8
	3	50	-17.3	-21.4	-25.9	-30.8	-36.1	-41.9	-48.1	-61.8
	3	100	-10.0	-12.2	-14.8	-17.6	-20.6	-23.9	-27.4	-35.2
Roof > 7 to 27 degrees	2	10	-27.2	-33.5	-40.6	-48.3	-56.7	-65.7	-75.5	-96.9
	2	20	-27.2	-33.5	-40.6	-48.3	-56.7	-65.7	-75.5	-96.9
	2	50	-27.2	-33.5	-40.6	-48.3	-56.7	-65.7	-75.5	-96.9
	2	100	-27.2	-33.5	-40.6	-48.3	-56.7	-65.7	-75.5	-96.9
	3	10	-45.7	-56.4	-68.3	-81.2	-95.3	-110.6	-126.9	-163.0
	3	20	-41.2	-50.9	-61.6	-73.3	-86.0	-99.8	-114.5	-147.1
	3	50	-35.3	-43.6	-52.8	-62.8	-73.7	-85.5	-98.1	-126.1
	3	100	-30.9	-38.1	-46.1	-54.9	-64.4	-74.7	-85.8	-110.1
Roof > 27 to 45 degrees	2	10	-24.7	-30.5	-36.9	-43.9	-51.5	-59.8	-68.6	-88.1
	2	20	-24.0	-29.6	-35.8	-42.6	-50.0	-58.0	-66.5	-85.5
	2	50	-23.0	-28.4	-34.3	-40.8	-47.9	-55.6	-63.8	-82.0
	2	100	-22.2	-27.4	-33.2	-39.5	-46.4	-53.8	-61.7	-79.3
	3	10	-24.7	-30.5	-36.9	-43.9	-51.5	-59.8	-68.6	-88.1
	3	20	-24.0	-29.6	-35.8	-42.6	-50.0	-58.0	-66.5	-85.5
	3	50	-23.0	-28.4	-34.3	-40.8	-47.9	-55.5	-63.8	-82.2
	3	100	-22.2	-27.4	-33.2	-39.5	-46.4	-53.8	-61.7	-79.3

For SI: 1 foot = 304.8 mm, 1 degree = 0.0174 rad, 1 mile per hour = 0.45 m/s, 1 pound per square foot = 47.9 N/m².

Note: For effective areas between those given above, the load is permitted to be interpolated, otherwise use the load associated with the lower effective area.

From p. 290
TABLE 1609.6.2.1(4)
ADJUSTMENT FACTOR FOR BUILDING HEIGHT AND EXPOSURE, (λ)

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

For SI: 1 foot = 304.8 mm.

a. All table values shall be adjusted for other exposures and heights by multiplying by the above coefficients.

**TABLE 1604.5
CLASSIFICATION OF BUILDINGS AND OTHER STRUCTURES FOR IMPORTANCE FACTORS**

CATEGORY ^a	NATURE OF OCCUPANCY	SEISMIC FACTOR I_E	SNOW FACTOR I_S	WIND FACTOR I_W
I	Buildings and other structures that represent a low hazard to human life in the event of failure including, but not limited to: <ul style="list-style-type: none"> • Agricultural facilities • Certain temporary facilities • Minor storage facilities 	1.00	0.8	0.87 ^b
II	Buildings and other structures except those listed in Categories I, III and IV	1.00	1.0	1.00
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure including, but not limited to: <ul style="list-style-type: none"> • Buildings and other structures where more than 300 people congregate in one area • Buildings and other structures with elementary school, secondary school or day care facilities with an occupant load greater than 250 • Buildings and other structures with an occupant load greater than 500 for colleges or adult education facilities • Health care facilities with an occupant load of 50 or more resident patients but not having surgery or emergency treatment facilities • Jails and detention facilities • Any other occupancy with an occupant load greater than 5,000 • Power-generating stations, water treatment for potable water, waste water treatment facilities and other public utility facilities not included in Category IV • Buildings and other structures not included in Category IV containing sufficient quantities of toxic or explosive substances to be dangerous to the public if released 	1.25	1.1	1.15
IV	Buildings and other structures designed as essential facilities including, but not limited to: <ul style="list-style-type: none"> • Hospitals and other health care facilities having surgery or emergency treatment facilities • Fire, rescue and police stations and emergency vehicle garages • Designated earthquake, hurricane or other emergency shelters • Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response • Power-generating stations and other public utility facilities required as emergency backup facilities for Category IV structures • Structures containing highly toxic materials as defined by Section 307 where the quantity of the material exceeds the maximum allowable quantities of Table 307.7(2) • Aviation control towers, air traffic control centers and emergency aircraft hangars • Buildings and other structures having critical national defense functions • Water treatment facilities required to maintain water pressure for fire suppression 	1.50	1.2	1.15

a. For the purpose of Section 1616.2, Categories I and II are considered Seismic Use Group I, Category III is considered Seismic Use Group II and Category IV is equivalent to Seismic Use Group III.

b. In hurricane-prone regions with $V > 100$ miles per hour, I_w shall be 0.77.

TABLE 1609.6.2.1(1)
SIMPLIFIED DESIGN WIND PRESSURE (MAIN WINDFORCE-RESISTING SYSTEM), p_{z30} (Exposure B at $h = 30$ feet with $I_w = 1.0$) (psf)

BASIC WIND SPEED (mph)	ROOF ANGLE (degrees)	ROOF RISE IN 12"	LOAD CASE	ZONES									
				Horizontal Pressures				Vertical Pressures				Overhangs	
				A	B	C	D	E	F	G	H	E_{OH}	G_{OH}
85 or less	0 to 5°	Flat	1	11.5	-5.9	7.6	-3.5	-13.8	-7.8	-9.6	-6.1	-19.3	-15.1
	10°	2	1	12.9	-5.4	8.6	-3.1	-13.8	-8.4	-9.6	-6.5	-19.3	-15.1
	15°	3	1	14.4	-4.8	9.6	-2.7	-13.8	-9.0	-9.6	-6.9	-19.3	-15.1
	20°	4	1	15.9	-4.2	10.6	-2.3	-13.8	-9.6	-9.6	-7.3	-19.3	-15.1
	25°	6	1	14.4	2.3	10.4	2.4	-6.4	-8.7	-4.6	-7.0	-11.9	-10.1
			2	—	—	—	—	-2.4	-4.7	-0.7	-3.0	—	—
30° to 45°	7 to 12	1	12.9	8.8	10.2	7.0	1.0	-7.8	0.3	-6.7	-4.5	-5.2	
		2	12.9	8.8	10.2	7.0	5.0	-3.9	4.3	-2.8	-4.5	-5.2	
90	0 to 5°	Flat	1	12.8	-6.7	8.5	-4.0	-15.4	-8.8	-10.7	-6.8	-21.6	-16.9
	10°	2	1	14.5	-6.0	9.6	-3.5	-15.4	-9.4	-10.7	-7.2	-21.6	-16.9
	15°	3	1	16.1	-5.4	10.7	-3.0	-15.4	-10.1	-10.7	-7.7	-21.6	-16.9
	20°	4	1	17.8	-4.7	11.9	-2.6	-15.4	-10.7	-10.7	-8.1	-21.6	-16.9
	25°	6	1	16.1	2.6	11.7	2.7	-7.2	-9.8	-5.2	-7.8	-13.3	-11.4
			2	—	—	—	—	-2.7	-5.3	-0.7	-3.4	—	—
30° to 45°	7 to 12	1	14.4	9.9	11.5	7.9	1.1	-8.8	0.4	-7.5	-5.1	-5.8	
		2	14.4	9.9	11.5	7.9	5.6	-4.3	4.8	-3.1	-5.1	-5.8	
100	0 to 5°	Flat	1	15.9	-8.2	10.5	-4.9	-19.1	-10.8	-13.3	-8.4	-26.7	-20.9
	10°	2	1	17.9	-7.4	11.9	-4.3	-19.1	-11.6	-13.3	-8.9	-26.7	-20.9
	15°	3	1	19.9	-6.6	13.3	-3.8	-19.1	-12.4	-13.3	-9.5	-26.7	-20.9
	20°	4	1	22.0	-5.8	14.6	-3.2	-19.1	-13.3	-13.3	-10.1	-26.7	-20.9
	25°	6	1	19.9	3.2	14.4	3.3	-8.8	-12.0	-6.4	-9.7	-16.5	-14.0
			2	—	—	—	—	-3.4	-6.6	-0.9	-4.2	—	—
30° to 45°	7 to 12	1	17.8	12.2	14.2	9.8	1.4	-10.8	0.5	-9.3	-6.3	-7.2	
		2	17.8	12.2	14.2	9.8	6.9	-5.3	5.9	-3.8	-6.3	-7.2	
110	0 to 5°	Flat	1	19.2	-10.0	12.7	-5.9	-23.1	-13.1	-16.0	-10.1	-32.3	-25.3
	10°	2	1	21.6	-9.0	14.4	-5.2	-23.1	-14.1	-16.0	-10.8	-32.3	-25.3
	15°	3	1	24.1	-8.0	16.0	-4.6	-23.1	-15.1	-16.0	-11.5	-32.3	-25.3
	20°	4	1	26.6	-7.0	17.7	-3.9	-23.1	-16.0	-16.0	-12.2	-32.3	-25.3
	25°	6	1	24.1	3.9	17.4	4.0	-10.7	-14.6	-7.7	-11.7	-19.9	-17.0
			2	—	—	—	—	-4.1	-7.9	-1.1	-5.1	—	—
30° to 45°	7 to 12	1	21.6	14.8	17.2	11.8	1.7	-13.1	0.6	-11.3	-7.6	-8.7	
		2	21.6	14.8	17.2	11.8	8.3	-6.5	7.2	-4.6	-7.6	-8.7	
120	0 to 5°	Flat	1	22.8	-11.9	15.1	-7.0	-27.4	-15.6	-19.1	-12.1	-38.4	-30.1
	10°	2	1	25.8	-10.7	17.1	-6.2	-27.4	-16.8	-19.1	-12.9	-38.4	-30.1
	15°	3	1	28.7	-9.5	19.1	-5.4	-27.4	-17.9	-19.1	-13.7	-38.4	-30.1
	20°	4	1	31.6	-8.3	21.1	-4.6	-27.4	-19.1	-19.1	-14.5	-38.4	-30.1
	25°	6	1	28.6	4.6	20.7	4.7	-12.7	-17.3	-9.2	-13.9	-23.7	-20.2
			2	—	—	—	—	-4.8	-9.4	-1.3	-6.0	—	—
30° to 45°	7 to 12	1	25.7	17.6	20.4	14.0	2.0	-15.6	0.7	-13.4	-9.0	-10.3	
		2	25.7	17.6	20.4	14.0	9.9	-7.7	8.6	-5.5	-9.0	-10.3	
130	0 to 5°	Flat	1	26.8	-13.9	17.8	-8.2	-32.2	-18.3	-22.4	-14.2	-45.1	-35.3
	10°	2	1	30.2	-12.5	20.1	-7.3	-32.2	-19.7	-22.4	-15.1	-45.1	-35.3
	15°	3	1	33.7	-11.2	22.4	-6.4	-32.2	-21.0	-22.4	-16.1	-45.1	-35.3
	20°	4	1	37.1	-9.8	24.7	-5.4	-32.2	-22.4	-22.4	-17.0	-45.1	-35.3
	25°	6	1	33.6	5.4	24.3	5.5	-14.9	-20.4	-10.8	-16.4	-27.8	-23.7
			2	—	—	—	—	-5.7	-11.1	-1.5	-7.1	—	—
30° to 45°	7 to 12	1	30.1	20.6	24.0	16.5	2.3	-18.3	0.8	-15.7	-10.6	-12.1	
		2	30.1	20.6	24.0	16.5	11.6	-9.0	10.0	-6.4	-10.6	-12.1	

continued

STRUCTURAL DESIGN

speeds determined by the local jurisdiction shall be in accordance with Section 6.5.4 of ASCE 7.

In nonhurricane-prone regions, when the basic wind speed is estimated from regional climatic data, the basic wind speed shall be not less than the wind speed associated with an annual probability of 0.02 (50-year mean recurrence interval), and the estimate shall be adjusted for equivalence to a 3-second gust wind speed at 33 feet (10 m) above ground in exposure Category C. The data analysis shall be performed in accordance with Section 6.5.4 of ASCE 7.

1609.3.1 Wind speed conversion. When required, the 3-second gust wind velocities of Figure 1609 shall be converted to fastest-mile wind velocities using Table 1609.3.1.

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. For a site located in the transition zone between categories, the category resulting in the largest wind forces shall apply. Account shall be taken of variations in ground surface roughness that arise from natural topography and vegetation as well as from constructed features. For any given wind direction, the exposure in which a specific building or other structure is sited shall be assessed as being one of the following categories. When applying the simplified wind load method of Section 1609.6, a single exposure category shall be used based upon the most restrictive for any given wind direction.

1. **Exposure A.** This exposure category is no longer used in ASCE 7.
2. **Exposure B.** Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger. Exposure B shall be assumed unless the site meets the definition of another type of exposure.
3. **Exposure C.** Open terrain with scattered obstructions, including surface undulations or other irregularities, having heights generally less than 30 feet (9144 mm) extending more than 1,500 feet (457.2 m) from the building site in any quadrant. This exposure shall also apply to any building located within Exposure B-type terrain where the building is directly adjacent to open areas of Exposure C-type terrain in any quadrant for a distance of more than 600 feet (182.9 m). This category includes flat open

country, grasslands and shorelines in hurricane-prone regions.

4. **Exposure D.** Flat, unobstructed areas exposed to wind flowing over open water (excluding shorelines in hurricane-prone regions) for a distance of at least 1 mile (1.61 km). Shorelines in Exposure D include inland waterways, the Great Lakes and coastal areas of California, Oregon, Washington and Alaska. This exposure shall apply only to those buildings and other structures exposed to the wind coming from over the water. Exposure D extends inland from the shoreline a distance of 1,500 feet (460 m) or 10 times the height of the building or structure, whichever is greater.

1609.5 Importance factor. Buildings and other structures shall be assigned a wind load importance factor, I_w , in accordance with Table 1604.5.

1609.6 Simplified wind load method.

1609.6.1 Scope. The procedures in Section 1609.6 shall be permitted to be used for determining and applying wind pressures in the design of enclosed buildings with flat, gabled and hipped roofs and having a mean roof height not exceeding the least horizontal dimension or 60 feet (18 288 mm), whichever is less, subject to the limitations of Sections 1609.6.1.1 and 1609.6.1.2. If a building qualifies only under Section 1609.6.1.2 for design of its components and cladding, then its main windforce-resisting system shall be designed in accordance with Section 1609.1.1.

Exception: The provisions of Section 1609.6 shall not apply to buildings sited on the upper half of an isolated hill or escarpment meeting all of the following conditions:

1. The hill 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.
3. The hill 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 less.

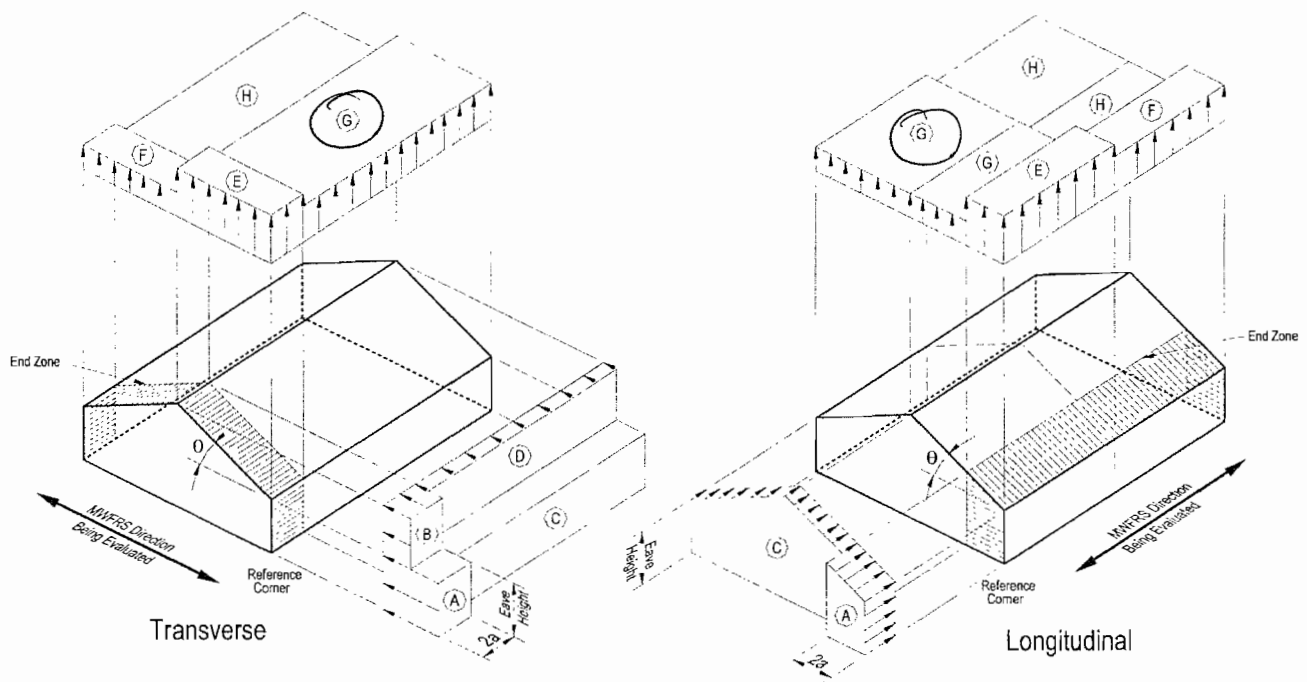
TABLE 1609.3.1
EQUIVALENT BASIC WIND SPEEDS^{a,b,c}

V_{3S}	85	90	100	105	110	120	125	130	140	145	150	160	170
V_{fm}	70	75	80	85	90	100	105	110	120	125	130	140	150

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

- a. Linear interpolation is permitted.
- b. V_{3S} is the 3-second gust wind speed (mph).
- c. V_{fm} is the fastest mile wind speed (mph).

USE



**FIGURE 1609.6.2.1
MAIN WINDFORCE LOADING DIAGRAM**

For SI: 1 foot = 304.8 mm, 1 degree = 0.0174 rad.

Notes:

1. Pressures are applied to the horizontal and vertical projections for Exposure B, at $h = 30$ feet, for $I_w = 1.0$. Adjust to other exposures and heights with adjustment factor λ .
2. The load patterns shown shall be applied to each corner of the building in turn as the reference corner.
3. For the design of the longitudinal MWFRS, use $\theta = 0^\circ$, and locate the Zone E/F, G/H boundary at the mid-length of the building.
4. Load Cases 1 and 2 must be checked for $25^\circ < \theta \leq 45^\circ$. Load Case 2 at 25° is provided only for interpolation between 25° to 30° .
5. Plus and minus signs signify pressures acting toward and away from the projected surfaces, respectively.
6. For roof slopes other than those shown, linear interpolation is permitted.
7. The total horizontal load shall not be less than that determined by assuming $p_s = 0$ in Zones B and D.
8. The zone pressures represent the following:
 - Horizontal pressure zones — Sum of the windward and leeward net (sum of internal and external) pressures on vertical projection of:
 - A – End zone of wall
 - B – End zone of roof
 - C – Interior zone of wall
 - D – Interior zone of roof
 - Vertical pressure zones — Net (sum of internal and external) pressures on horizontal projection of:
 - E – End zone of windward roof
 - F – End zone of leeward roof
 - G – Interior zone of windward roof
 - H – Interior zone of leeward roof
9. Where Zone E or G falls on a roof overhang on the windward side of the building, use E_{OH} and G_{OH} for the pressure on the horizontal projection of the overhang. Overhangs on the leeward and side edges shall have the basic zone pressure applied.
10. Notation:
 - a : 10 percent of least horizontal dimension or $0.4h$, whichever is smaller, but not less than either 4 percent of least horizontal dimension or 3 feet.
 - h : Mean roof height, in feet (meters), except that eave height shall be used for roof angles $< 10^\circ$.
 - θ : Angle of plane of roof from horizontal, in degrees.