

Chapter 2

Code Requirements for Wind and Seismic Forces

2.1 SCOPE

This chapter presents a comprehensive summary of out-of-plane wall load provisions and design criteria for both seismic and wind forces as presented in the 2006/2009 IBC and ASCE/SEI 7-05. The provisions and criteria in this chapter are organized by element type (i.e., structural wall, nonstructural wall, parapet and anchorage) and seismic requirements are grouped by SDC. The presentation of the material in this chapter assumes that the design professional has some experience calculating wind and seismic forces for main wind-force resisting systems and seismic-force resisting systems and focuses only on provisions specific to localized out-of-plane wall behavior. Wind force and detailing requirements are presented using procedures applicable to components and cladding as necessary for out-of-plane wall behavior even though these walls may serve as part of the main wind-force resisting system in the orthogonal direction. Seismic force and detailing requirements are presented for structural walls, nonstructural walls, parapets and anchorage connections. All equations and sections referenced in this chapter refer to ASCE/SEI 7-05 unless stated otherwise.

2.2 COMPONENTS AND CLADDING WIND LOAD DETERMINATION METHODS

This book presents wind components and cladding load determination methodologies in accordance with the 2006/2009 IBC and ASCE/SEI 7-05. Four methods are available to the design professional:

- 1.** Method 1—Simplified Procedure (Section 6.4 of ASCE/SEI 7-05).
- 2.** Method 2—Analytical Procedure (Section 6.5 of ASCE/SEI 7-05).
- 3.** Method 2A—Alternate All-Heights Procedure (Section 1609.6 of the 2009 IBC).
- 4.** Method 3—Wind Tunnel Procedure (Section 6.6 of ASCE/SEI 7-05).

Methods 1, 2 and 2A are presented in this chapter.

2.3 METHOD 1—SIMPLIFIED PROCEDURE

According to Section 6.4.1.2 of ASCE/SEI 7-05, Method 1—Simplified Procedure can be used for the determination of components and cladding wind loads when all of the following conditions are satisfied:

- 1.** Mean roof height $h \leq 60$ ft.
- 2.** Building is enclosed (Section 6.2) and conforms to wind-borne debris provisions (Section 6.5.9.3).
- 3.** Building is regular-shaped (Section 6.2).
- 4.** Building is not subject to across wind loading, vortex shedding, or instability due to galloping or flutter, and is not situated such that channeling effects or buffeting in the wake of upwind obstructions warrant special consideration.
- 5.** Building has a flat roof, gable roof (roof angle $\theta \leq 45^\circ$ from horizontal) or hip roof ($\theta \leq 27^\circ$).

The procedure to determine the net wind pressure, p_{net} [pounds per square foot (psf)], acting on a wall surface on the exterior of a building is presented in Section 6.4.2.2 of ASCE/SEI 7-05 as follows:

$$p_{\text{net}} = \lambda K_{zt} I p_{\text{net}30}$$

where:

λ = adjustment factor (Figure 6-3)

K_{zt} = topographic factor determined at h (Section 6.5.7.2)

I = importance factor (Table 6-1)

$p_{\text{net}30}$ = net design wind pressure (psf) from Figure 6-3 (Exposure B, $h = 30$ feet, $I = 1.0$)

The Simplified Procedure provides the net wind pressure, p_{net} , as the sum of positive and negative pressures acting simultaneously on both sides of a wall. The default pressure, $p_{\text{net}30}$, is the value that applies when (1) Exposure B applies in accordance with Section 6.5.6.3, (2) the mean roof height $h = 30$ feet and (3) $I = 1.0$. For other exposures and mean roof

heights, the end of Figure 6-3 presents a separate table that provides an adjustment factor, λ . Section 6.4.2.2.1 requires that the absolute value of positive and negative net wind pressures, p_{net} , be greater than or equal to 10 psf (i.e., minimum unfactored net wind pressure on components and cladding is 10 psf). Although the Simplified Procedure does account for overhangs, parapets subject to out-of-plane wind loads require design pressure determination using Method 2 or 2A.

2.4 METHOD 2—ANALYTICAL PROCEDURE

According to Section 6.5.1 of ASCE/SEI 7-05, Method 2—Analytical Procedure can be used for the determination of components and cladding wind loads when both of the following conditions are satisfied:

- 1.** Building is regular-shaped (Section 6.2).
- 2.** Building is not subject to across wind loading, vortex shedding, or instability due to galloping or flutter, and is not situated such that channeling effects or buffeting in the wake of upwind obstructions warrant special consideration.

Buildings with $h \leq 60$ ft

The procedure to determine the wind pressure, p (psf), acting on a wall surface on the exterior of a building when the mean roof height, h , is less than or equal to 60 feet ($h \leq 60$ feet) is presented in Section 6.5.12.4.1 of ASCE/SEI 7-05 as follows:

$$p = q_h[(GC_p) - (GC_{pi})]$$

where:

q_h = velocity pressure (psf) calculated at $z = h$ (ft)

GC_p = external pressure coefficient (Figure 6-11A)

GC_{pi} = internal pressure coefficient (Figure 6-5)

The procedure for buildings with $h \leq 60$ feet is simplified and independent of the elevation of the actual wall element. Section 6.1.4.2 requires that the design wind pressure for components and cladding of buildings be greater than or equal to 10 psf (i.e., minimum unfactored net wind pressure on components and cladding is 10 psf).