

Mind-numbing Secrets of ASCE 7-Chapter 6: Wind Loads

The Great Secrets are revealed! No need to grovel before your favorite structural engineer and beg for hidden information locked away from your grubby hands (giving them money works better than begging--experienced voice). Herein, we reveal what is behind that favorite IBC 2006 adage, "*designed in accordance to ASCE 7.*"

First, we have an acronym that is used liberally: *MWFRS*, which means, Main Wind-Force Resisting System. This, along with all the components and cladding, is the scope of the design for wind loads.

Next, we have three procedures for determining the design wind loads:

- 1) **Method 1-Simplified Procedure** that must meet a bevy of requirements in *Section 6.4.1.1* and *Section 6.4.1.2*
- 2) **Method 2-Analytical Procedure** as specified in *Section 6.5*
- 3) **Method 3-Wind Tunnel Procedure** as specified in *Section 6.6*

Design Coefficients (selected for relevance)

A = effective wind area, in ft^2

B = horizontal dimension of building measured normal to wind direction

C_f = force coefficient to be used in determination of wind loads for other structures

C_p = external pressure coefficient to be used in determination of wind loads for open buildings

F = design wind force for other structures, in lbs.

G = gust effect factor

G_f = gust effect factor for MWFRSs of flexible buildings and other structures

GC_p = product of external pressure coefficient and gust-effect factor to be used in determination of wind loads for buildings

GC_{pf} = product of the equivalent external pressure coefficient and gust-effect factor to be used in determination of wind loads for MWFRS of low-rise buildings

GC_{pi} = product of internal pressure coefficient and gust-effect factor to be used in determination of wind loads for buildings

h = mean roof height of a building or height of other structure and eave height if roof angle is less than or equal to 10° , in feet.

I = importance factor

K_d = wind directionality factor in Table 6-4

K_h = velocity pressure exposure coefficient evaluated at height $z = h$

K_z = velocity pressure exposure coefficient evaluated at height z

K_{zt} = topographic factor as defined in *Section 6.5.7*

L = horizontal dimension of building measured parallel to the wind direction, in feet

p = design pressure to be used in determination of wind loads for buildings, in lb/ft^2 (Note: there are many subscripts for p)

q = velocity pressure, in lb/ft^2

q_z = velocity pressure evaluated at height z above ground, in lb/ft^2

q_h = velocity pressure for internal pressure determination, in lb/ft^2

V = basic wind speed obtained from Figure

λ = adjustment factor for building height and exposure from Figures 6-2 and 6-3

Method 1-Simplified Procedure

The design procedure for **Method 1** is broken down in *Section 6.4.2-Design Procedure* with the following steps:

- 1) The basic wind speed V shall be determined in accordance with *Section 6.5.4*. The wind shall be assumed to come from any horizontal direction
- 2) An importance factor I shall be determined in accordance with *Section 6.5.5*
- 3) An exposure category shall be determined in accordance with *Section 6.5.6*
- 4) A height and exposure adjustment, λ , shall be determined from *Figure 6-2*.

Much of this is table-driven, including the references to the three sections. If the building meets all the requirements for **Method 1**, the design procedure is pretty much "plug-and-play" as a whole series of charts with a sample building make up the combined section of *Figure 6-2*.

Method 2-Analytical Procedure

This is the beast. Almost all of Chapter 6 is devoted to **Method 2** and a plethora of formulas and tables that define the information for using this method. Obviously, the details are far beyond the scope of the Lateral Forces exam, but *Section 6.5.3-Design Procedure* reveals the basic coefficients behind design wind loads. Here are the steps as follows:

- 1) The basic wind speed V and wind directionality factor K_d shall be determined in accordance with *Section 6.5.4*
- 2) An importance factor I shall be determined in accordance with *Section 6.5.5*
- 3) An exposure category or exposure categories and velocity pressure exposure coefficient K_z or K_h , as applicable, shall be determined for each wind direction in accordance with *Section 6.5.6*
- 4) A topographic factor K_{zt} shall be determined in accordance with *Section 6.5.7*
- 5) A gust effect factor G or G_f , as applicable, shall be determined in accordance with *Section 6.5.8*
- 6) An enclosure classification shall be determined in accordance with *Section 6.5.9*
- 7) Internal pressure coefficient GC_{pi} shall be determined in accordance with *Section 6.5.11.1*
- 8) External pressure coefficients C_p or GC_{pf} , or force coefficients C_f , as applicable shall be determined in accordance with *Section 6.5.11.2* or *Section 6.5.11.3*
- 9) Velocity pressure q_z or q_h , as applicable, shall be determined in accordance with *Section 6.5.10*
- 10) Design wind load p or F shall be determined in accordance with *Sections 6.5.12-6.5.15*, as applicable

As mentioned, each section listed for the design procedure is chock-full of various formulas for a myriad of conditions and types of buildings. It is highly unlikely that the Lateral Forces exam will pull a random formula from *Section 6.5* since coinciding tables are required to solve the equations.

Method 3-Wind Tunnel Procedure

This is the end-all, final say and applies for any building or structure. Basically, if you have need and money to do this type of procedure, you have carte-blanche since the engineers will create extensive computer or physical models for testing.

I think we've had enough of ASCE 7--Chapter 6 at this point.