Chapter C28

WIND LOADS ON BUILDINGS – MWFRS (ENVELOPE PROCEDURE)

The Envelope Procedure is the former "low-rise buildings" provision in Method 2 of ASCE 7-05 for MWFRS. The simplified method in this chapter is derived from the MWFRS provisions of Method 1 in ASCE 7-05 for simple diaphragm buildings up to 60 ft in height.

PART 1: ENCLOSED AND PARTIALLY ENCLOSED LOW-RISE BUILDINGS

C28.3.1 Velocity Pressure Exposure Coefficient
See commentary to Section C27.3.1.

C28.3.2 Velocity Pressure
See commentary to Section C27.3.2.

Loads on Main Wind-Force Resisting Systems: The pressure coefficients for MWFRS are basically separated into two categories:

1. Directional Procedure for buildings of all heights (Fig. 27.4-1) as specified in Chapter 27 for buildings meeting the requirements specified therein.
2. Envelope Procedure for low-rise buildings (Fig. 28.4-1) as specified in Chapter 28 for buildings meeting the requirements specified therein.

In generating these coefficients, two distinctly different approaches were used. For the pressure coefficients given in Fig. 27.4-1, the more traditional approach was followed and the pressure coefficients reflect the actual loading on each surface of the building as a function of wind direction, namely, winds perpendicular or parallel to the ridge line.

For low-rise buildings, however, the values of (GC_{pf}) represent "pseudo" loading conditions that, when applied to the building, envelop the desired structural actions (bending moment, shear, thrust) independent of wind direction. To capture all appropriate structural actions, the building must be designed for all wind directions by considering in turn each corner of the building as the windward or reference corner shown in the eight sketches of Fig. 28.4-1. At each corner, two load patterns are applied, one for each wind direction range. The end zone creates the required structural actions in the end frame or bracing. Note also that for all roof slopes, all eight load cases must be considered individually to determine the critical loading for a given structural assemblage or component thereof. Special attention should be given to roof members, such as trusses, which meet the definition of MWFRS but are not part of the lateral resisting system. When such members span at least from the eave to the ridge or support members spanning at least from eave to ridge, they are not required to be designed for the higher end zone loads under MWFRS. The interior zone loads should be applied. This is due to the enveloped nature of the loads for roof members.

To develop the appropriate "pseudo" values of (GC_{pf}), investigators at the University of Western Ontario (Davenport et al. 1978) used an approach that consisted essentially of permitting the building model to rotate in the wind tunnel through a full 360° while simultaneously monitoring the loading conditions on each of the surfaces (Fig. C28.4-1). Both Exposures B and C were considered. Using influence coefficients for rigid frames, it was possible to spatially average and time average the surface pressures to ascertain the maximum induced external force components to be resisted. More specifically, the following structural actions were evaluated:

1. Total uplift.
2. Total horizontal shear.
3. Bending moment at knees (two-hinged frame).
4. Bending moment at knees (three-hinged frame).
5. Bending moment at ridge (two-hinged frame).

The next step involved developing sets of "pseudo" pressure coefficients to generate loading conditions that would envelop the maximum induced force components to be resisted for all possible wind directions and exposures. Note, for example, that the wind azimuth producing the maximum bending moment at the knee would not necessarily produce the maximum total uplift. The maximum induced external force components determined for each of the preceding five categories were used to develop the coefficients. The end result was a set of coefficients that represent fictitious loading conditions but that