Chapter C27

WIND LOADS ON BUILDINGS—MWFRS DIRECTIONAL PROCEDURE

The Directional Procedure is the former "buildings of all heights" provision in Method 2 of ASCE 7-05 for MWFRS. A simplified method based on this Directional Procedure is provided for buildings up to 160 ft in height. The Directional Procedure is considered the traditional approach in that 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.

PART 1: ENCLOSED, PARTIALLY ENCLOSED, AND OPEN BUILDINGS OF ALL HEIGHTS

C27.3.1 Velocity Pressure Exposure Coefficient

The velocity pressure exposure coefficient K_z can be obtained using the equation:

$$K_z = \begin{cases} 2.01\left(\dfrac{z}{z_g}\right)^{2/\alpha} & \text{for } 15 \text{ ft} \le z \le z_g \quad \text{(C27.3-1)} \\ 2.01\left(\dfrac{15}{z_g}\right)^{2/\alpha} & \text{for } z < 15 \text{ ft} \quad \text{(C67.3-2)} \end{cases}$$

in which values of α and z_g are given in Table 26.9-1. These equations are now given in Tables 27.3-1, 28.3-1, 29.3-1, and 30.3-1 to aid the user.

Changes were implemented in ASCE 7-98, including truncation of K_z values for Exposures A and B below heights of 100 ft and 30 ft, respectively, applicable to Components and Cladding and the Envelope Procedure. Exposure A was eliminated in the 2002 edition.

In the ASCE 7-05 standard, the K_z expressions were unchanged from ASCE 7-98. However, the possibility of interpolating between the standard exposures using a rational method was added in the ASCE 7-05 edition. One rational method is provided in the following text.

To a reasonable approximation, the empirical exponent α and gradient height z_g in the preceding expressions (Eqs. C27.3-1 and C27.3-2) for exposure coefficient K_z may be related to the roughness length z_0 (where z_0 is defined in Section C26.7) by the relations

$$\alpha = c_1 z_0^{-0.133} \qquad \text{(C27.3-3)}$$

and

$$z_g = c_2 z_0^{0.125} \qquad \text{(C27.3-4)}$$

where

Units of z_0, z_g	c_1	c_2
m	5.65	450
ft	6.62	1,273

The preceding relationships are based on matching the ESDU boundary layer model (Harris and Deaves 1981 and ESDU 1990 and 1993) empirically with the power law relationship in Eqs. C27.3-1 and C27.3-2, the ESDU model being applied at latitude 35° with a gradient wind of 75 m/s. If z_0 has been determined for a particular upwind fetch, Eqs. C27.3-1 through C27.3-4 can be used to evaluate K_z. The correspondence between z_0 and the parameters α and z_g implied by these relationships does not align exactly with that described in the commentary to ASCE 7-95 and 7-98. However, the differences are relatively small and not of practical consequence. The ESDU boundary layer model has also been used to derive the following simplified method (Irwin 2006) of evaluating K_z following a transition from one surface roughness to another. For more precise estimates the reader is referred to the original ESDU model (Harris and Deaves 1981 and ESDU 1990 and 1993).

In uniform terrain, the wind travels a sufficient distance over the terrain for the planetary boundary layer to reach an equilibrium state. The exposure coefficient values in Table 27.3-1 are intended for this condition. Suppose that the site is a distance x miles downwind of a change in terrain. The equilibrium value of the exposure coefficient at height z for the terrain roughness downwind of the change will be denoted by K_{zd}, and the equilibrium value for the terrain roughness upwind of the change will be denoted by K_{zu}. The effect of the change in terrain roughness on the exposure coefficient at the site can be represented by adjusting K_{zd} by an increment ΔK, thus arriving at a corrected value K_z for the site.

$$K_z = K_{zd} + \Delta K \qquad \text{(C27.3-5)}$$