Chapter C29

WIND LOADS (MWFRS)—OTHER STRUCTURES AND BUILDING APPURTENANCES

C29.3.1 Velocity Pressure Exposure Coefficient

See commentary, Section C27.3.1.

C29.3.2 Velocity Pressure

See commentary, Section C27.3.2.

Figure 29.4-1. The force coefficients for solid freestanding walls and signs in Fig. 29.4-1 date back to ANSI A58.1-1972. It was shown by Letchford (2001) that these data originated from wind tunnel studies performed by Flachsbart in the early 1930s in smooth uniform flow. The current values in Fig. 29.4-1 are based on the results of boundary layer wind tunnel studies (Letchford 1985, 2001, Holmes 1986, Letchford and Holmes 1994, Ginger et al. 1998a and 1998b, and Letchford and Robertson 1999).

A surface curve fit to Letchford's (2001) and Holmes's (1986) area averaged mean net pressure coefficient data (equivalent to mean force coefficients in this case) is given by the following equation:

$$C_f = \{1.563 + 0.008542\ln(x) - 0.06148y + 0.009011[\ln(x)]^2 - 0.2603y^2 - 0.08393y[\ln(x)]\}/0.85$$

where $x = B/s$ and $y = s/h$.

The 0.85 term in the denominator modifies the wind tunnel-derived force coefficients into a format where the gust effect factor as defined in Section 26.9 can be used.

Force coefficients for Cases A and B were generated from the preceding equation, then rounded off to the nearest 0.05. That equation is only valid within the range of B/s and s/h ratios given in the figure for Case A and B.

Of all the pertinent studies, only Letchford (2001) specifically addressed eccentricity (i.e., Case B). Letchford reported that his data provided a reasonable match to Cook's (1990) recommendation for using an eccentricity of 0.25 times the average width of the sign. However, the data were too limited in scope to justify changing the existing eccentricity value of 0.2 times the average width of the sign, which is also used in the latest Australian/New Zealand Standard (Standards Australia 2002).

Case C was added to account for the higher pressures observed in both wind tunnel (Letchford 1985, 2001, Holmes 1986, Letchford and Holmes 1994, Ginger et al. 1998a and 1998b, and Letchford and Robertson 1999) and full-scale studies (Robertson et al. 1997) near the windward edge of a freestanding wall or sign for oblique wind directions. Linear regression equations were fit to the local mean net pressure coefficient data (for wind direction 45°) from the referenced wind tunnel studies to generate force coefficients for square regions starting at the windward edge. Pressures near this edge increase significantly as the length of the structure increases. No data were available on the spatial distribution of pressures for structures with low aspect ratios ($B/s < 2$).

The sample illustration for Case C at the top of Fig. 29.4-1 is for a sign with an aspect ratio $B/s = 4$. For signs of differing B/s ratios, the number of regions is equal to the number of force coefficient entries located below each B/s column heading.

For oblique wind directions (Case C), increased force coefficients have been observed on above-ground signs compared to the same aspect ratio walls on ground (Letchford 1985, 2001 and Ginger et al. 1998a). The ratio of force coefficients between above-ground and on-ground signs (i.e., $s/h = 0.8$ and 1.0, respectively) is 1.25, which is the same ratio used in the Australian/New Zealand Standard (Standards Australia 2002). Note 5 of Fig. 29.4-1 provides for linear interpolation between these two cases.

For walls and signs on the ground ($s/h = 1$), the mean vertical center of pressure ranged from $0.5h$ to $0.6h$ (Holmes 1986, Letchford 1989, Letchford and Holmes 1994, Robertson et al. 1995, 1996, and Ginger et al. 1998a) with $0.55h$ being the average value. For above-ground walls and signs, the geometric center best represents the expected vertical center of pressure.

The reduction in C_f due to porosity (Note 2) follows a recommendation (Letchford 2001). Both wind tunnel and full-scale data have shown that return corners significantly reduce the net pressures in the region near the windward edge of the wall or sign (Letchford and Robertson 1999).

C29.4.2 Solid Attached Signs

Signs attached to walls and subject to the geometric limitations of Section 29.4.2 should