positive pressure can occur in all roof structures, particularly as the distance from the windward edge increases and the wind streams reattach to the surface. These pressures can occur even for relatively flat or low slope roof structures. Experience and judgment from wind tunnel studies have been used to specify either zero or slightly negative pressures (–0.18) depending on the negative pressure coefficient. These values require the designer to consider a zero or slightly positive net wind pressure in the load combinations of Chapter 2.

Figure 27.4-2. Frame loads on dome roofs are adapted from the Eurocode (1995). The loads are based on data obtained in a modeled atmospheric boundary-layer flow that does not fully comply with requirements for wind-tunnel testing specified in this standard (Blessman 1971). Loads for three domes ($h_D/D = 0.5$, $f/D = 0.5$), ($h_D/D = 0$, $f/D = 0.5$), and ($h_D/D = 0$, $f/D = 0.33$) are roughly consistent with data of Taylor (1991), who used an atmospheric boundary layer as required in this standard. Two load cases are defined, one of which has a linear variation of pressure from A to B as in the Eurocode (1995) and one in which the pressure at A is held constant from 0° to 25°; these two cases are based on comparison of the Eurocode provisions with Taylor (1991). Case A (the Eurocode calculation) is necessary in many cases to define maximum uplift. Case B is necessary to properly define positive pressures for some cases, which cannot be isolated with current information, and which result in maximum base shear. For domes larger than 200 ft in diameter the designer should consider use of wind-tunnel testing. Resonant response is not considered in these provisions. Wind-tunnel testing should be used to consider resonant response. Local bending moments in the dome shell may be larger than predicted by this method due to the difference between instantaneous local pressure distributions and those predicted by Fig. 27.4-2. If the dome is supported on vertical walls directly below, it is appropriate to consider the walls as a “chimney” using Fig. 29.5-1.

Figure 27.4-3. The pressure and force coefficient values in these tables are unchanged from ANSI A58.1-1972. The coefficients specified in these tables are based on wind-tunnel tests conducted under conditions of uniform flow and low turbulence, and their validity in turbulent boundary-layer flows has yet to be completely established. Additional pressure coefficients for conditions not specified herein may be found in SIA (1956) and ASCE (1961).

C27.4.3 Open Buildings with Monoslope, Pitched, or Troughed Free Roofs

Figures 27.4-4 through 27.4-6 and 30.8-1 through 30.8-3 are presented for wind loads on MWFRSs and components and cladding of open buildings with roofs as shown, respectively. This work is based on the Australian Standard AS1170.2-2000, Part 2: Wind Actions, with modifications to the MWFRS pressure coefficients based on recent studies (Altman and Uematsu and Stathopoulos 2003).

Two load cases, A and B, are given in Figs. 27.4-4 through 27.4-6. These pressure distributions provide loads that envelop the results from detailed wind-tunnel measurements of simultaneous normal forces and moments. Application of both load cases is required to envelop the combinations of maximum normal forces and moments that are appropriate for the particular roof shape and blockage configuration.

The roof wind loading on open building roofs is highly dependent upon whether goods or materials are stored under the roof and restrict the wind flow. Restricting the flow can introduce substantial upward-acting pressures on the bottom surface of the roof, thus increasing the resultant uplift load on the roof. Figures 27.4-4 through 27.4-6 and 30.8-1 through 30.8-3 offer the designer two options. Option 1 (clear wind flow) implies little (less than 50 percent) or no portion of the cross-section below the roof is blocked. Option 2 (obstructed wind flow) implies that a significant portion (more than 75 percent is typically referenced in the literature) of the cross-section is blocked by goods or materials below the roof. Clearly, values would change from one set of coefficients to the other following some sort of smooth, but as yet unknown, relationship. In developing the provisions included in this standard, the 50 percent blockage value was selected for Option 1, with the expectation that it represents a somewhat conservative transition. If the designer is not clear about usage of the space below the roof or if the usage could change to restrict free air flow, then design loads for both options should be used.

C27.4.6 Design Wind Load Cases

Wind tunnel research (Isyumov 1983, Boggs et al. 2000, Isyumov and Case 2000, and Xie and Irwin 2000) has shown that torsional load is caused by nonuniform pressure on the different faces of the building from wind flow around the building, interference effects of nearby buildings and terrain, and by dynamic effects on more flexible buildings. Load Cases 2 and 4 in Fig. 27.4-8 specifies the torsional loading to 15 percent eccentricity under 75 percent of