C7.12 EXISTING ROOFS

Numerous existing roofs have failed when additions or new buildings nearby caused snow loads to increase on the existing roof. A prior (1988) edition of this standard mentioned this issue only in its commentary where it was not a mandatory provision. The 1995 edition moved this issue to the standard.

The addition of a gable roof alongside an existing gable roof as shown in Fig. C7-1 most likely explains why some such metal buildings failed in the South during the winter of 1992–1993. The change from a simple gable roof to a multiple folded plate roof increased loads on the original roof as would be expected from Section 7.6.3. Unfortunately, the original roofs were not strengthened to account for these extra loads and they collapsed.

If the eaves of the new roof in Fig. C7-1 had been somewhat higher than the eaves of the existing roof, the exposure factor C_e for the original roof may have increased, thereby increasing snow loads on it. In addition, drift loads and loads from sliding snow would also have to be considered.

C7.13 OTHER ROOFS AND SITES

Wind tunnel model studies, similar tests employing fluids other than air, for example water flumes, and other special experimental and computational methods have been used with success to establish design snow loads for other roof geometries and complicated sites (Irwin et al. 1992, Isyumou et al. 1992, and O'Rourke and Weitman 1992). To be reliable, such methods must reproduce the mean and turbulent characteristics of the wind and the manner in which snow particles are deposited on roofs then redistributed by wind action. Reliability should be demonstrated through comparisons with situations for which full-scale experience is available.

Examples. The following three examples illustrate the method used to establish design snow loads for some of the situations discussed in this standard. Additional examples are found in O'Rourke and Wrenn (2004).

Example 1: Determine balanced and unbalanced design snow loads for an apartment complex in a suburb of Hartford, Connecticut. Each unit has an 8-on-12 slope unventilated gable roof. The building length is 100 ft (30.5 m) and the eave to ridge distance, W, is 30 ft (9.1 m). Composition shingles clad the roofs. Trees will be planted among the buildings.

Flat-Roof Snow Load:

$$p_f = 0.7C_eC_tI_sp_g$$

where

p_g = 30 lb/ft^2 (1.44 kN/m^2) (from Fig. 7-1)
C_e = 1.0 (from Table 7-2 for Terrain Category B and a partially exposed roof)
C_t = 1.0 (from Table 7-3); and
I_s = 1.0 (from Table 1.5-2).

Thus:

$p_f = (0.7)(1.0)(1.0)(1.0)(30) = 21$ lb/ft^2 (balanced load)
in SI: $p_f = (0.7)(1.0)(1.0)(1.0)(1.44) = 1.01$ kN/m^2

Because the roof slope is greater than 15°, the minimum roof snow load, p_m, does not apply (see Section 7.3.4).

Sloped-Roof Snow Load:

$p_s = C_sp_f$ where $C_s = 0.91$ (from solid line, Fig. 7-2a)

Thus:

$p_s = 0.91(21) = 19$ lb/ft^2
(in SI: $p_s = 0.91(1.01) = 0.92$ kN/m^2)

Unbalanced Snow Load: Because the roof slope is greater than 1/2 on 12 (2.38º), unbalanced loads must be considered. For p_g = 30 psf (1.44 kN/m^2) and $W = l_u$ = 30 ft (9.14 m), h_d = 1.86 ft (0.56 m) from Fig. 7-9 and γ = 17.9 pcf (2.80 kN/m^3) from Eq. 7-3. For an 8 on 12 roof, $S = 1.5$ and hence the intensity of the drift surcharge, $h_d\gamma/\sqrt{S}$, is 27.2 psf (1.31 kN/m^2) and its horizontal extent $8\sqrt{S}\,h_d/3$ is 6.1 ft (1.87 m).

Rain on Snow Surcharge: A rain-on-snow surcharge load need not be considered because p_g > 20 psf (0.96 kN/m^2) (see Section 7.10). See Fig. C7-5 for both loading conditions.

Example 2: Determine the roof snow load for a vaulted theater that can seat 450 people, planned for a suburb of Chicago, Illinois. The building is the tallest structure in a recreation-shopping complex surrounded by a parking lot. Two large deciduous trees are located in an area near the entrance. The building has an 80-ft (24.4-m) span and 15-ft (4.6-m) rise circular arc structural concrete roof covered with insulation and aggregate surfaced built-up roofing. The unventilated roofing system has a thermal resistance of 20 ft^2 hr °F/Btu (3.5 K m^2/W). It is expected that the structure will be exposed to winds during its useful life.