unobstructed eave is a potential source of sliding snow.

The final resting place of any snow that slides off a higher roof onto a lower roof will depend on the size, position, and orientation of each roof (Taylor 1983). Distribution of sliding loads might vary from a uniform 5-ft (1.5-m) wide load, if a significant vertical offset exists between the two roofs, to a 20-ft (6.1-m) wide uniform load, where a low-slope upper roof slides its load onto a second roof that is only a few feet (about a meter) lower or where snow drifts on the lower roof create a sloped surface that promotes lateral movement of the sliding snow.

In some instances a portion of the sliding snow may be expected to slide clear of the lower roof. Nevertheless, it is prudent to design the lower roof for a substantial portion of the sliding load to account for any dynamic effects that might be associated with sliding snow.

Snow guards are needed on some roofs to prevent roof damage and eliminate hazards associated with sliding snow (Tobiasson et al. 1996). When snow guards are added to a sloping roof, snow loads on the roof can be expected to increase. Thus, it may be necessary to strengthen a roof before adding snow guards. When designing a roof that will likely need snow guards in the future, it may be appropriate to use the “all other surfaces” curves in Fig. 7-2 not the “unobstructed slippery surfaces” curves.

C7.10 RAIN-ON-SNOW SURCHARGE LOAD

The ground snow-load measurements on which this standard is based contain the load effects of light rain on snow. However, because heavy rains percolate down through snow packs and may drain away, they might not be included in measured values. Where p_g is greater than 20 lb/ft^2 (0.96 kN/m^2), it is assumed that the full rain-on-snow effect has been measured and a separate rain-on-snow surcharge is not needed. The temporary roof load contributed by a heavy rain may be significant. Its magnitude will depend on the duration and intensity of the design rainstorm, the drainage characteristics of the snow on the roof, the geometry of the roof, and the type of drainage provided. Loads associated with rain on snow are discussed in Colbeck (1977a and 1977b) and O’Rourke and Downey (2001).

Calculated rain-on-snow loading in O’Rourke and Downey (2001) show that the surcharge is an increasing function of eave to ridge distance and a decreasing function of roof slope. That is, rain-on-snow surcharges are largest for wide, low-sloped roofs. The minimum slope reflects that functional relationship.

The following example illustrates the evaluation of the rain-on-snow surcharge. Consider a monoslope roof with slope of 1/4 on 12 and a width of 100 ft with $C_e = 1.0$, $C_t = 1.1$, $I = 1.2$, and $p_g = 15$ psf (0.72 kN/m^2). Because $C_s = 1.0$ for a slope of 1/4 on 12, $p_s = 0.7(1.0)(1.1)(1.0)(1.2)(15) = 14$ psf (0.67 kN/m^2). Because the roof slope 1.19° is less than 100/50 = 2.0, the 5 psf (0.24 kN/m^2) surcharge is added to p_s, resulting in a design load of 19 psf (0.91 kN/m^2). Because the slope is less than 15°, the minimum load from 7.34 is $I \times p_g = 1.2(15) = 18$ psf (0.86 kN/m^2). Hence the rain on snow modified load controls.

C7.11 PONDING INSTABILITY

Where adequate slope to drain does not exist, or where drains are blocked by ice, snow meltwater and rain may pond in low areas. Intermittently heated structures in very cold regions are particularly susceptible to blockages of drains by ice. A roof designed without slope or one sloped with only 1/8 in./ft (0.6°) to internal drains probably contains low spots away from drains by the time it is constructed. When a heavy snow load is added to such a roof, it is even more likely that undrained low spots exist. As rainwater or snow meltwater flows to such low areas, these areas tend to deflect increasingly, allowing a deeper pond to form. If the structure does not possess enough stiffness to resist this progression, failure by localized overloading can result. This mechanism has been responsible for several roof failures under combined rain and snow loads.

It is very important to consider roof deflections caused by snow loads when determining the likelihood of ponding instability from rain-on-snow or snow meltwater.

Internally drained roofs should have a slope of at least 1/4 in./ft (1.19°) to provide positive drainage and to minimize the chance of ponding. Slopes of 1/4 in./ft (1.19°) or more are also effective in reducing peak loads generated by heavy spring rain on snow. Further incentive to build positive drainage into roofs is provided by significant improvements in the performance of waterproofing membranes when they are sloped to drain.

Rain loads and ponding instability are discussed in detail in Chapter 8.