

CHAPTER 5 SNOW LOADS

5.1 Scope and Procedure

As a snow load, (1) snow load on the roof, (2) partial snow load on the roof, (3) other snow loads shall be defined. Snow load on the roof is defined as the product of the snow load on the ground for the region considered and a shape coefficient. When the snow load on the roof is certainly controlled through some devices or technique, it could be reduced.

5.2 Snow Load on the Ground

5.2.1 Equations for snow load on the ground

Snow load on the ground S_0 (kN/m^2) is determined from the following equation:

$$S_0 = k_{\text{env}} d_0 p_0 \quad (5.1)$$

where

k_{env} : environmental coefficient, as defined in 5.2.4,

d_0 : basic snow depth (m) on the ground, as defined in 5.2.2,

p_0 : equivalent unit weight for ground snow, as defined in 5.2.3.

The value $d_0 p_0$ could be defined with special consideration for the data of precipitation and temperature.

5.2.2 Basic snow depth on the ground

Basic snow depth on the ground d_0 is defined as the annual maximum value for the whole season with a return period of 100 years, and is estimated from meteorological data of the ground snow depth observed for a certain period.

5.2.3 Equivalent unit weight for ground snow

Equivalent unit weight for ground snow p_0 (kN/m^3) is given by the following equation:

$$p_0 = 0.72 \sqrt{d_0 / d_{\text{ref}}} + 2.32 \quad (5.2)$$

where

d_0 : basic snow depth (m) on the ground,

d_{ref} : reference snow depth (1 m).

5.2.4 Environmental coefficient

Environmental coefficient k_{env} is generally defined as unity. When the snow depth on the ground is estimated to locally increase because of geographical, man-made and natural features, k_{env} should be correspondingly larger than unity.

5.3 Ground Snow Load with Accumulation for n Days

5.3.1 Equation for ground snow load with accumulation for n days

When the roof snow is certainly controlled, snow load on the ground S_n is determined from the following equation:

$$S_n = k_{\text{env}} d_n p_n \quad (5.3)$$

where

k_{env} : environmental coefficient, as defined in 5.2.4,

d_n : basic snow depth (m) on the ground when the snow load on the roof is controlled, as defined in 5.3.2,

p_n : equivalent unit weight for ground snow with roof snow control, as defined in 5.3.3.

5.3.2 Basic snow depth with accumulation for n days

Basic snow depth on the ground d_n is defined as the annual maximum value of snow accumulation for n days with a return period of 100 years, and is estimated from meteorological data of the ground snow depth observed for a certain period. The length of evaluation period n (day) for snow accumulation is decided with the performance and reliability of the roof snow control system.

5.3.3 Equivalent unit weight for ground snow with roof snow control

Equivalent unit weight for ground snow with roof snow control p_n is equal to p_0 .

5.4 Snow Load on the Roof

5.4.1 Equation for snow load on the roof

Snow load on the roof is given by the following equation:

$$S = \mu_0 S_0 \quad (5.4)$$

where

μ_0 : shape coefficient defined in 5.4.2.

5.4.2 Shape coefficient

Shape coefficient μ_0 is defined by the following equation:

$$\mu_0 = \mu_b + \mu_d + \mu_s \quad (5.5)$$

where

μ_b : basic shape coefficient defined in 5.4.2 (1)

μ_d : shape coefficient for irregular distribution caused by snow drift defined in 5.4.2 (2)

μ_s : shape coefficient for irregular distribution caused by sliding defined in 5.4.2 (3)

Shape coefficient for large or special shaped buildings should be defined after special field research or experiments.

(1) Basic shape coefficient

Basic shape coefficient μ_b is given in Figure 5.1. In the figure, wind speed V (m/s) means the average wind speed in January through February. For a fractional value of V , μ_b should be determined by the interpolation.

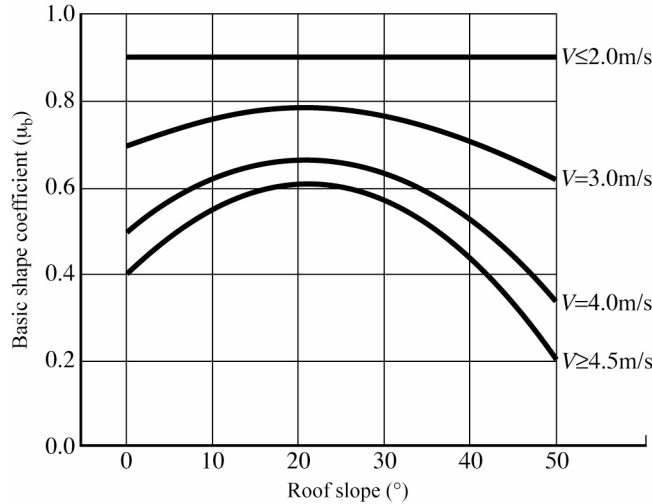


Figure 5.1 Relation between μ_b and roof slope.

(2) Shape coefficient for irregular distribution caused by snow drift

1) Shape coefficient for irregular distribution caused by snow drift μ_d in the troughs of M-shaped roofs, multiple pitched roofs and multispans roofs are given in Table 5.1. At the ridge, μ_d should be zero. At the halfway point, μ_d is calculated by linear interpolation. For a fractional value of V , μ_d should be determined by interpolation.

2) For multilevel roofs, distribution of shape coefficient for the lower level roof should be determined from Figure 5.2. In the figure, μ_d at point O is given in Table 5.2. For a fractional value of V , μ_d should be determined by interpolation.

Table 5.1 μ_d in the troughs of M-shaped roof, multiple pitched roof and multispans roof

Roof slope	M-shaped and multiple pitched roofs				multispans roof			
	average wind speed in Jan. through Feb.				average wind speed in Jan. through Feb.			
	<2 m/s	3 m/s	4 m/s	4.5 m/s<	<2 m/s	3 m/s	4 m/s	4.5 m/s<
< 10°	0	0	0	0	0	0	0	0
25°	0	0	0.15	0.20	0.10	0.20	0.35	0.55
40°	0	0.20	0.35	0.45	0.10	0.30	0.45	0.70
50° <	0	0.30	0.55	0.70	0.10	0.40	0.65	0.80

Table 5.2 μ_d for multilevel roofs

average wind speed in Jan. through Feb.	<2 m/s	3 m/s	4 m/s	4.5 m/s<
μ_d	0.10	0.30	0.50	0.60

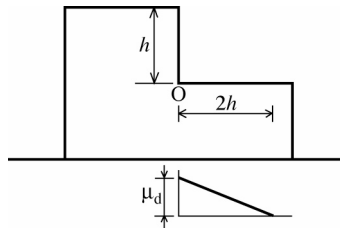


Figure 5.2 μ_d for multilevel roofs

(3) Shape coefficient for irregular distribution caused by sliding

Shape coefficient for irregular distribution caused by sliding μ_s on M-shaped roofs, multiple pitched roofs and multispan roofs is determined from either equation (5.6) or (5.7) according to the roof slope. μ_s is positive in the troughs of these roofs and negative at the ridge. At the halfway point, μ_s is determined by the linear interpolation. When the slope of the roof is between those defined in equation (5.6) and equation (5.7), μ_s is determined from the sliding performance of the roofing materials.

1) When roof slope is smaller than 10 degrees,

$$\mu_s = 0 \tag{5.6}$$

2) When roof slope is larger than 25 degrees,

$$\mu_s = \mu_b \tag{5.7}$$

5.5 Snow Load on the Roof with Snow Control

5.5.1 Equation for snow load on the roof

Snow load on the roof with snow control is given by the following equation:

$$S = \mu_n S_n - S_c \tag{5.8}$$

where

μ_n : shape coefficient with snow control corresponding to μ_0 defined in section 5.9

S_n : ground snow load with accumulation for n days (kN/m^2) defined in 5.3.1

S_c : controlled snow load (kN/m^2) defined in 5.5.2

5.5.2 Controlled snow load

Controlled snow load, S_c , is generally determined after field research and experiments investigating the capacity of sliding or melting devices, where S_c is the differential between initial snow load expected when heavy snow fall starts and removed snow load by the device whose performance is guaranteed even during heavy snow fall.

5.6 Partial Snow Load on the Roof

Partial snow load should be considered to exist on the roof as following cases:

- (1) A case when snow load on the roof partially increases because of snowdrift caused by projecting structures.
- (2) A case at the eaves or gable ends, snow load on the roof partially increases because of snow eaves.
- (3) A case when snow is sliding from upper roofs to the eaves or lower levels of multilevel roofs. Distance and impact should also be considered.

5.7 Other Snow Loads

The following should be considered as additional snow loads.

- (1) When side pressure from snow drifts on the outside wall of the building might not be negligible, it should be considered.
- (2) When the building might be buried under snow, snow load caused by sedimentation should be considered.
- (3) When snow adheres to the building or snow covers the building, snow load caused by adhering or covering snow should be considered.
- (4) When snow blows into balconies or outside corridors and the load might not be negligible, it should be considered.
- (5) For the high rise building or the structures with large roof, the effect of snowdrift on the surrounding buildings should be considered.
- (6) Regarding points for disaster prevention should be considered.