CHAPTER 7
SNOW LOADS

7.1 DEFINITIONS AND SYMBOLS

7.1.1 Definitions

ASCE DESIGN GROUND SNOW LOAD GEODATABASE: The ASCE database (version 2022-1.0) of geocoded values of risk-targeted design ground snow load values.

DRIFT: The accumulation of wind-driven snow that results in a local surcharge load on the roof structure at locations such as a parapet or roof step.

FLAT ROOF SNOW LOAD: Uniform load for flat roofs.

FREEZER BUILDINGS: Buildings in which the inside temperature is kept at or below freezing. Buildings with an air space between the roof insulation layer above and a ceiling of the freezer area below are not considered freezer buildings.

GROUND SNOW LOAD: The site-specific weight of the accumulated snow at the ground level used to develop roof snow loads on the structure.

MINIMUM SNOW LOAD: Snow load on low sloped roofs, including the roof snow load immediately after a single snowstorm without wind.

PONDING: Refer to definitions in Chapter 8, "Rain Loads."

PONDING INSTABILITY: Refer to definitions in Chapter 8, "Rain Loads."

R-VALUE: A measure of the resistance to heat flow through a roof component or assembly per unit area.

SLIPPERY SURFACE: Membranes with a smooth surface, for example, glass, metal, or rubber. Membranes with an embedded aggregate or mineral granule surface are not considered a slippery surface.

SLOPED ROOF SNOW LOAD: Uniform load on horizontal projection of a sloped roof, also known as the balanced load.

VENTILATED ROOF: Roof that allows exterior air to naturally circulate between the roof surface above and the insulation layer below. The exterior air commonly flows from the eave to the ridge.

7.1.2 Symbols

C_e = Exposure factor, as determined from Table 7.3-1

C_s = Slope factor, as determined from Figure 7.4-1

C_t = Thermal factor, as determined from Table 7.3-2

h = Vertical separation distance, feet (m), between the edge of a higher roof including any parapet and the edge of a lower adjacent roof excluding any parapet

h_b = Height of balanced snow load, determined by dividing p_s by γ, ft (m)

h_c = Clear height from top of balanced snow load to (1) closest point on adjacent upper roof, (2) top of parapet, or (3) top of a projection on the roof, ft (m)

h_d = Height of snow drift, ft (m)

h_{d1} or h_{d2} = Heights of snow drifts where two intersecting snow drifts can form, ft (m)

h_o = Height of obstruction above the surface of the roof, ft (m)

l_u = Length of the roof upwind of the drift, ft (m)

p_d = Maximum intensity of drift surcharge load, lb/ft^2 (kN/m^2)

p_f = Snow load on flat roofs ("flat" = roof slope $\leq 5°$), lb/ft^2 (kN/m^2)

p_g = Ground snow load, as determined from Figure 7.2-1 and Table 7.2-1; or a site-specific analysis, lb/ft^2 (kN/m^2)

p_m = Minimum snow load for low-slope roofs, lb/ft^2 (kN/m^2)

p_s = Sloped roof (balanced) snow load, lb/ft^2 (kN/m^2)

s = Horizontal separation distance between the edges of two adjacent buildings, ft (m)

S = Roof slope run for a rise of one

w = Width of snow drift, ft (m)

w_1 or w_2 = Widths of snow drifts where two intersecting snow drifts can form, ft (m)

W = Horizontal distance from eave to ridge, ft (m)

W_2 = Percent time wind speed is above 10 mph (4.6 m/s) during winter (October through April); winter wind parameter from Figure 7.6-1 and Table 7.2-1 for Alaska

γ = Snow density, as determined from Equation (7.7-1), lb/ft^3 (kN/m^3)

θ = Roof slope on the leeward side, degrees

7.2 GROUND SNOW LOADS, p_g

Ground snow loads, p_g, to be used in the determination of design snow loads shall be determined using the ASCE Design Ground Snow Load Geodatabase. A graphical representation of the data in the ASCE Design Ground Snow Load Geodatabase is shown in Figures 7.2-1A through 7.2-1D for the conterminous United States and Table 7.2-1 for Alaska. Where the results from the geodatabase indicate that a case study needs to be conducted for a specific location, the ground snow load determination for the location shall be based on an analysis of data available in the vicinity of the site, shall meet the reliability targets set forth in Table 1.3-1, and shall be approved by the Authority Having Jurisdiction.

> User Note: The ASCE Design Ground Snow Load Geodatabase of geocoded design ground snow load values for all four risk categories is available at https://asce7hazardtool.online/ or approved equivalent.

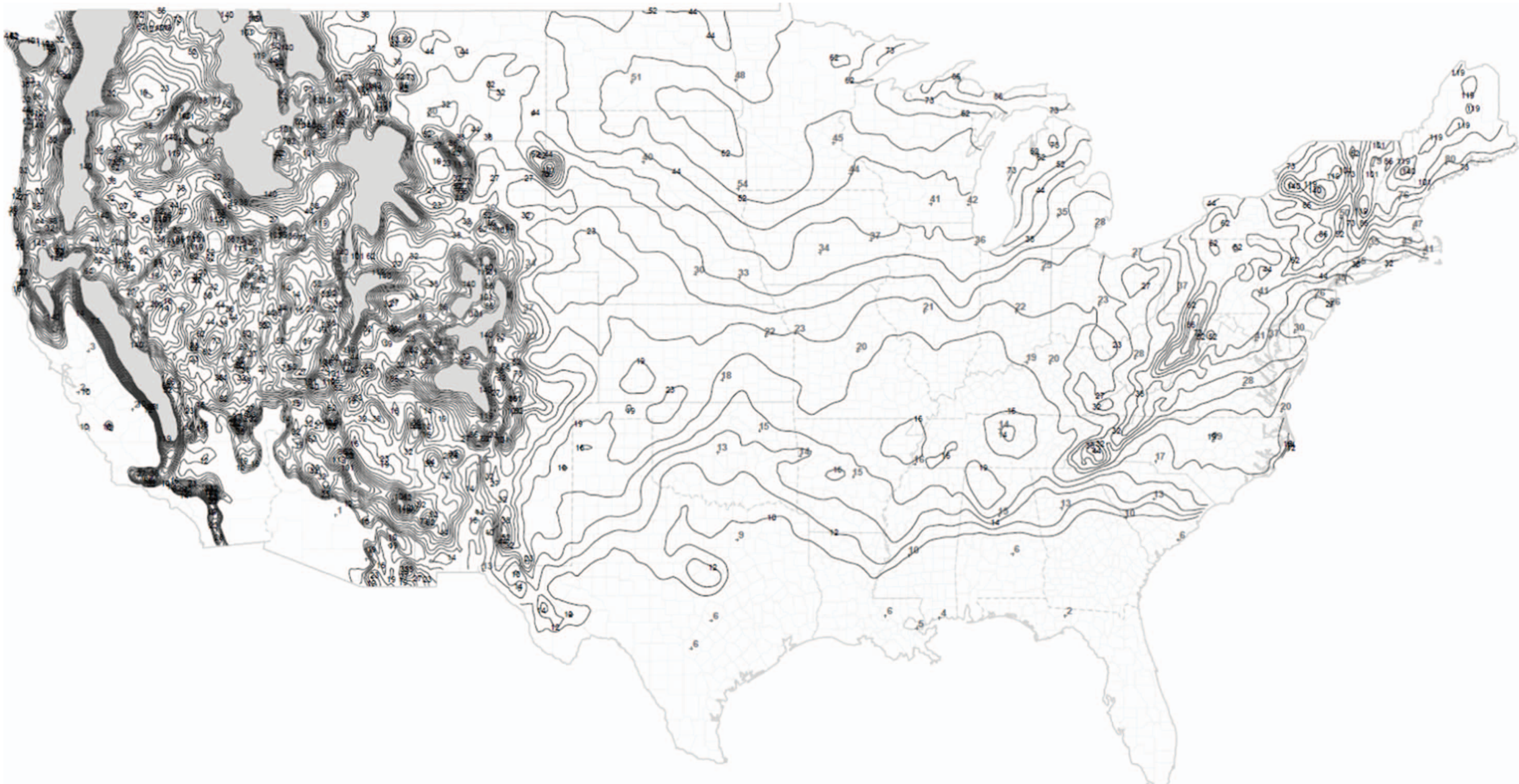


Figure 7.2-1A. Ground snow loads, p_g, for Risk Category I for the conterminous United States (lb/ft^2).

Note:

1. This figure is a representation of the Ground Snow Load Geodatabase of geocoded design ground snow load values, available at https://asce7hazardtool.online/.
2. Values for specific locations can most accurately be determined by accessing the Geodatabase.
3. Lines shown on the figure are contours separated by a constant ratio 1.18 with values of 10, 12, 14, 16, 19, 23, 27, 32, 38, 44, 52, 62, 73, 86, 101, 119, and 140 psf.
4. Values denoted with a "+" symbol indicate design ground snow loads at state capitals or other high-population locations.
5. Areas shown in gray represent areas with ground snow loads exceeding 140 psf. Ground snow load values for these locations can be determined from the Geodatabase.

Figure 7.2-1B. Ground snow loads, p_g, for Risk Category II for the conterminous United States (lb/ft^2).

Note:

1. This figure is a representation of the Ground Snow Load Geodatabase of geocoded design ground snow load values, available at https://asce7hazardtool.online/.
2. Values for specific locations can most accurately be determined by accessing the Geodatabase.
3. Lines shown on the figure are contours separated by a constant ratio 1.18 with values of 10, 12, 14, 16, 19, 23, 27, 32, 38, 44, 52, 62, 73, 86, 101, 119, and 140 psf.
4. Values denoted with a "+" symbol indicate design ground snow loads at state capitals or other high-population locations.
5. Areas shown in gray represent areas with ground snow loads exceeding 140 psf. Ground snow load values for these locations can be determined from the Geodatabase.

Figure 7.2-1C. Ground snow loads, p_g, for Risk Category III for the conterminous United States (lb/ft^2).

Note:

1. This figure is a representation of the Ground Snow Load Geodatabase of geocoded design ground snow load values, available at https://asce7hazardtool.online/.
2. Values for specific locations can most accurately be determined by accessing the Geodatabase.
3. Lines shown on the figure are contours separated by a constant ratio 1.18 with values of 10, 12, 14, 16, 19, 23, 27, 32, 38, 44, 52, 62, 73, 86, 101, 119, and 140 psf.
4. Values denoted with a "+" symbol indicate design ground snow loads at state capitals or other high-population locations.
5. Areas shown in gray represent areas with ground snow loads exceeding 140 psf. Ground snow load values for these locations can be determined from the Geodatabase.

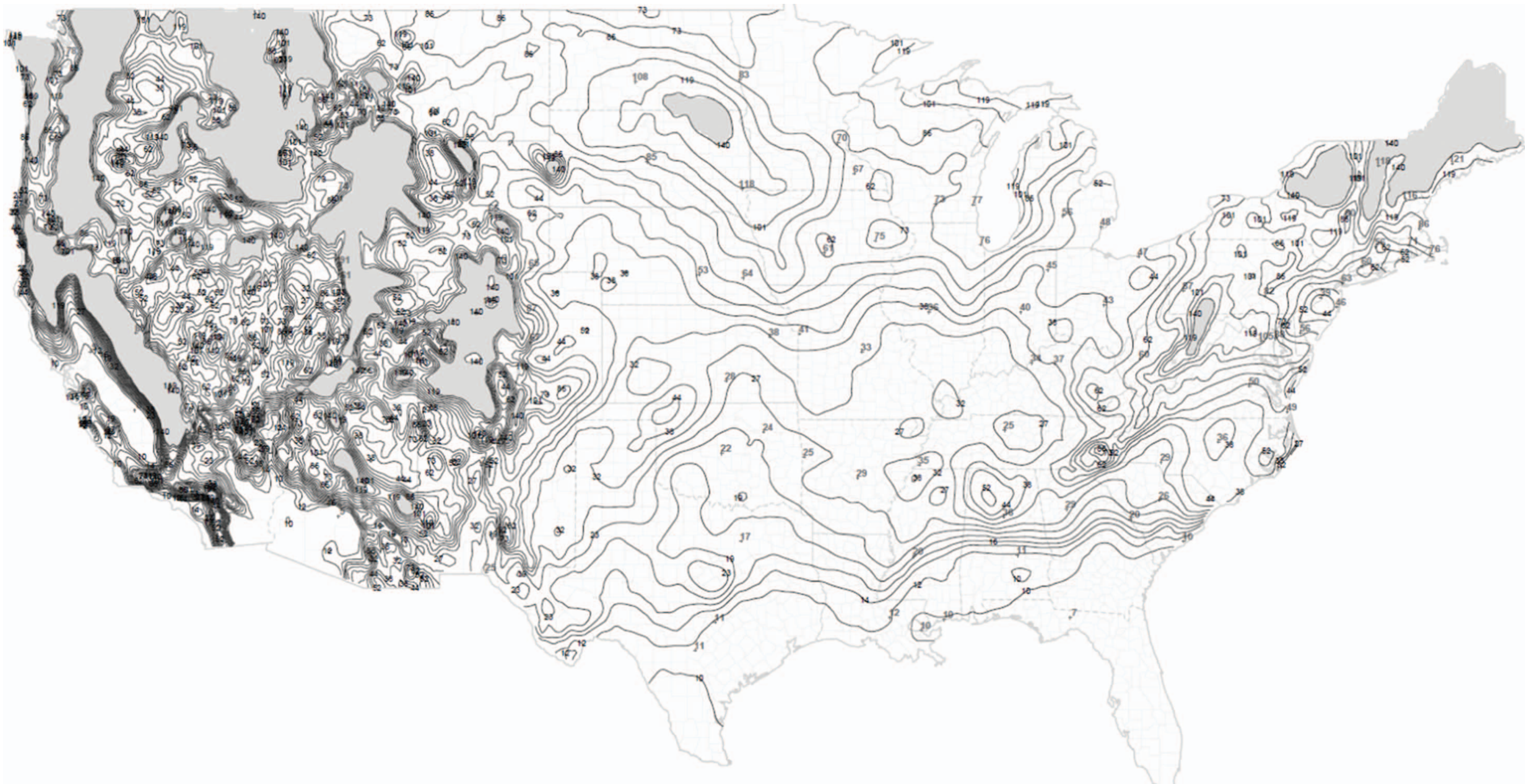


Figure 7.2-1D. Ground snow loads, p_g, for Risk Category IV for the conterminous United States (lb/ft^2).

Note:

1. This figure is a representation of the Ground Snow Load Geodatabase of geocoded design ground snow load values, available at https://asce7hazardtool.online/.
2. Values for specific locations can most accurately be determined by accessing the Geodatabase.
3. Lines shown on the figure are contours separated by a constant ratio 1.18 with values of 10, 12, 14, 16, 19, 23, 27, 32, 38, 44, 52, 62, 73, 86, 101, 119, and 140 psf.
4. Values denoted with a "+" symbol indicate design ground snow loads at state capitals or other high-population locations.
5. Areas shown in gray represent areas with ground snow loads exceeding 140 psf. Ground snow load values for these locations can be determined from the Geodatabase.

Table 7.2-1. Ground Snow Loads, p_g, and Winter Wind Parameter, W_2, for Alaskan Locations.

City/Town	Elevation (ft)	Ground Snow Load, $p_g^{1,2,4}$ (lb/ft^2) Risk Category I	II	III	IV	Winter Wind Parameter, W_2
Adak	100	32	40	46	50	0.7
Anchorage/Eagle River[3]	500	64	80	92	100	0.2
Arctic Village	2,100	38	48	55	60	0.2
Bethel	100	51	64	74	80	0.7
Bettles	700	102	128	147	160	0.2
Cantwell	2,100	109	136	156	170	0.3
Cold Bay	100	45	56	64	70	0.8
Cordova	100	128	160	184	200	0.3
Deadhorse	100	32	40	46	50	0.6
Delta Junction	400	51	64	74	80	0.5
Dillingham	100	141	176	202	220	0.5
Emmonak	100	128	160	184	200	0.7
Fairbanks	1,200	77	96	110	120	0.1
Fort Yukon	400	64	80	92	100	0.2
Galena	200	77	96	110	120	0.3
Girdwood	200	179	224	258	280	0.2
Glennallen	1,400	58	72	83	90	0.2
Haines	100	237	296	340	370	0.7
Holy Cross	100	154	192	221	240	0.2
Homer[3]	500	58	72	83	90	0.5
Iliamna	200	102	128	147	160	0.5
Juneau	100	90	112	129	140	0.5
Kaktovik	100	58	72	83	90	0.6
Kenai/Soldotna	200	83	104	120	130	0.4
Ketchikan	100	38	48	55	60	0.5
Kobuk	200	115	144	166	180	0.6
Kodiak	100	45	56	64	70	0.6
Kotzebue	100	77	96	110	120	0.6
McGrath	400	83	104	120	130	0.2
Nenana	400	96	120	138	150	0.2
Nikiski	200	102	128	147	160	0.4
Nome	100	90	112	129	140	0.6
Palmer/Wasilla	500	64	80	92	100	0.2
Petersburg	100	122	152	175	190	0.2
Point Hope	100	58	72	83	90	0.6
Saint Lawrence Island	100	122	152	175	190	0.8
Saint Paul Island	100	51	64	74	80	0.9
Seward	100	77	96	110	120	0.5
Sitka	100	64	80	92	100	0.4
Talkeetna	400	154	192	221	240	0.2
Tok	1,700	45	56	64	70	0.2
Umiat	300	38	48	55	60	0.2
Unalakleet	100	45	56	64	70	0.7
Unalaska	100	96	120	138	150	0.6
Utqiaġvik (Barrow)	100	32	40	46	50	0.6
Valdez	100	205	256	294	320	0.3
Wainwright	100	32	40	46	50	0.6
Whittier	100	346	432	497	540	0.3
Willow	300	102	128	147	160	0.2
Yakutat	100	179	224	258	280	0.3

Notes: To convert lb/ft^2 to kN/m^2, multiply by 0.0479. To convert feet to meters, multiply by 0.3048.

1. Statutory requirements of the Authority Having Jurisdiction are not included in this state ground snow load table.
2. For locations where there is substantial change in altitude over the city/town, the load applies at and below the cited elevation within the jurisdiction and up to 100 ft above the cited elevation, unless otherwise noted.
3. For locations in Anchorage/Eagle River and Homer above the cited elevation, the ground snow load shall be increased by 15% for every 100 ft above the cited elevation.

Snow loads are zero for Hawaii, except in mountainous regions, as determined by the Authority Having Jurisdiction.

EXCEPTION: The snow load provisions of this chapter need not be considered for roofs or roof members with no potential for drift accumulation or unbalanced snow loading where the ground snow load, p_g, is less than the factored roof live load used in design. For all other roofs or roof members, the snow load provisions in this chapter do not need to be considered in either of the following situations:

- The ground snow load, p_g, is less than or equal to 10 lb/ft^2 (0.48 kN/m^2) and the length of the roof upwind from any potential drifting location, l_u, is less than or equal to 100 ft (30.48 m).
- The ground snow load, p_g, is less than or equal to 5 lb/ft^2 (0.24 kN/m^2) and the length of the roof upwind from any potential drifting location, l_u, is less than or equal to 300 ft (91.44 m).

The ground snow load, p_g, shall be used as the balanced snow load for snow accumulation surfaces, such as decks, balconies, and other near-ground level surfaces or roofs of subterranean spaces, whose height above the ground surface is less than the depth of the ground snow, h_g ($h_g = p_g/\gamma$).

7.3 FLAT ROOF SNOW LOADS, p_f

The flat roof snow load, p_f, shall be calculated in lb/ft^2 (kN/m^2) using the following formula:

$$p_f = 0.7 C_e C_t p_g \tag{7.3-1}$$

7.3.1 Exposure Factor, C_e The value for C_e shall be determined from Table 7.3-1.

7.3.2 Thermal Factor, C_t The value for C_t shall be determined from Tables 7.3-2 and 7.3-3.

For values of P_g and R_{roof} that fall between those shown in Table 7.3-3, linear interpolation may be used to determine the value of C_t.

7.3.3 Minimum Snow Load for Low-Slope Roofs, p_m A minimum roof snow load, p_m, shall only apply to monoslope, hip, and gable roofs with slopes less than 15 degrees and to curved roofs where the vertical angle from the eaves to the crown is less than 10 degrees. The minimum roof snow load for low-slope roofs shall be obtained as follows.

Where p_g is equal to or less than the value of the minimum snow load upper limit, $p_{m,\max}$, shown in Table 7.3-4:

$$p_m = p_g$$

Where p_g is greater than the value of the minimum snow load upper limit, $p_{m,\max}$, shown in Table 7.3-4:

$$p_m = p_{m,\max}$$

This minimum roof snow loads hall be a separate uniform load case. It need not be used in determining, or in combination with, drift, sliding, unbalanced, or partial loads.

7.4 SLOPED ROOF SNOW LOADS, p_s

Snow loads acting on a sloping surface shall be assumed to act on the horizontal projection of that surface. The sloped roof (balanced) snow load, p_s, shall be obtained by multiplying the flat roof snow load, p_f, by the roof slope factor, C_s:

$$p_s = C_s p_f \tag{7.4-1}$$

Table 7.3-1. Exposure Factor, C_e.

	Exposure of Roof[a]		
Surface Roughness Category	Fully Exposed[b]	Partially Exposed	Sheltered
B (see Section 26.7)	0.9	1.0	1.2
C (see Section 26.7)	0.9	1.0	1.1
D (see Section 26.7)	0.8	0.9	1.0
Above the tree line in windswept mountainous areas	0.7	0.8	N/A
In Alaska, in areas where trees do not exist within a 2 mi (3 km) radius of the site	0.7	0.8	N/A

The terrain category and roof exposure condition chosen shall be representative of the anticipated conditions during the life of the structure. An exposure factor shall be determined for each roof of a structure.

[a] Partially Exposed: All roofs not Fully Exposed or Sheltered. Fully Exposed: Roofs exposed on all sides with no shelter[b] afforded by terrain, higher structures, or trees. Roofs that contain several large pieces of mechanical equipment, parapets that extend above the height of the balanced snow load (h_b), or other obstructions are not in this category. Sheltered: Roofs located tight in among conifers that qualify as obstructions.

[b] Obstructions within a distance of $10h_o$ provide "shelter," where h_o is the height of the obstruction above the roof level. If the only obstructions are a few deciduous trees that are leafless in winter, the "fully exposed" category shall be used. Note that these are heights above the roof. Heights used to establish the Exposure Category in Section 26.7 are heights above the ground.

Table 7.3-2. Thermal Factor, C_t.

Thermal condition[a]	C_t
All structures except as indicated as follows	See Table 7.3-3
Unheated structures, open-air structures, structures kept just above freezing [40 to 50 °F (4 to 10 °C)], and other structures with cold, ventilated roofs meeting the minimum requirements of the applicable energy code	1.2
Freezer building	1.3
Continuously heated greenhouses[b] with a roof having a thermal resistance (R-value) less than 2.0 h·ft^2·°F/Btu (0.4 m^2·K/W) or a thermal transmittance (U-factor) greater than 0.5 Btu/h·ft^2·°F (2.5 W/m^2·K)	0.85

[a] These conditions shall be representative of the anticipated conditions during winters for the life of the structure.

[b] Greenhouses with a constantly maintained interior temperature of 50°F (10°C) or more, at any point 3 ft (0.9 m) above the floor level during winters and having either a maintenance attendant on duty at all times or a temperature alarm system to provide warning in the event of a heating failure.

Table 7.3-3. Thermal Factor, C_t, for Heated Structures with Unventilated Roofs.[a]

R_{roof} (h·ft²·°F/Btu [m²·K/W])	U_{roof} (Btu/h·ft²·°F [W/m²·K])	P_g (psf [kPa])						
		≤10 [0.48]	20 [0.96]	30 [1.44]	40 [1.92]	50 [2.40]	60 [2.88]	≥70 [3.36]
≤20 [3.52]	≥0.050 [0.284]	1.20	1.11	1.05	1.01	1.00	1.00	1.00
30 [5.28]	0.033 [0.189]	1.20	1.17	1.14	1.13	1.12	1.11	1.10
40 [7.04]	0.025 [0.142]	1.20	1.19	1.17	1.16	1.16	1.15	1.15
50 [8.80][b]	0.020 [0.114][b]	1.20	1.20	1.19	1.19	1.19	1.18	1.18

[a] For values of P_g and R_{roof} that fall between those shown in the table, linear interpolation may be used to determine the value of C_t.
[b] For values of $R_{roof} > 50$ h·ft²·°F/Btu (8.80 m²·K/W) or $U_{roof} < 0.020$ Btu/h·ft²·°F (0.114 W/m²·K), C_t should be taken as equal to 1.2.

Table 7.3-4. Minimum Snow Loads for Low-Slope Roofs.

Risk Category	$p_{m,max}$
I	25 lb/ft² (1.20 kN/m²)
II	30 lb/ft² (1.44 kN/m²)
III	35 lb/ft² (1.68 kN/m²)
IV	40 lb/ft² (1.92 kN/m²)

Values of C_s for warm roofs, cold roofs, curved roofs, and multiple roofs are determined from Sections 7.4.1 through 7.4.4. The thermal factor, C_t, from Table 7.3-2 determines if a roof is "cold" or "warm." "Slippery surface" values shall be used only where the roof's surface is unobstructed and sufficient space is available below the eaves to accept all the sliding snow. A roof shall be considered unobstructed if no objects exist on it that prevent snow on it from sliding. Roof areas with snow retention devices shall not be considered unobstructed. Slippery surfaces shall include metal, slate, glass, and bituminous, rubber, and plastic membranes with a smooth surface. Membranes with an embedded aggregate or mineral granule surface shall not be considered smooth. Asphalt shingles, wood shingles, and shakes shall not be considered slippery.

7.4.1 Slope Factor, C_s The slope factor, C_s, shall be determined using Figure 7.4-1, as outlined in Table 7.4-1.

7.4.2 Slope Factor for Curved Roofs Portions of curved roofs that have a slope exceeding 70 degrees shall be considered free of snow load (i.e., $C_s = 0$). Balanced loads shall be determined from the balanced load diagrams in Figure 7.4-2, with C_s determined from the appropriate curve in Figure 7.4-1.

7.4.3 Slope Factor for Multiple Folded Plate, Sawtooth, and Barrel Vault Roofs Multiple folded plate, sawtooth, or barrel vault roofs shall have a $C_s = 1.0$, with no reduction in snow load because of slope (i.e., $p_s = p_f$).

7.4.4 Ice Dams and Icicles along Eaves Unventilated roofs that drain water over their eaves shall be capable of sustaining a uniformly distributed load of $2p_f$ on all overhanging portions if the structure's thermal factor, C_t, is equal to or less than 1.1 per Section 7.3.2. The load on the overhang shall be based on the flat

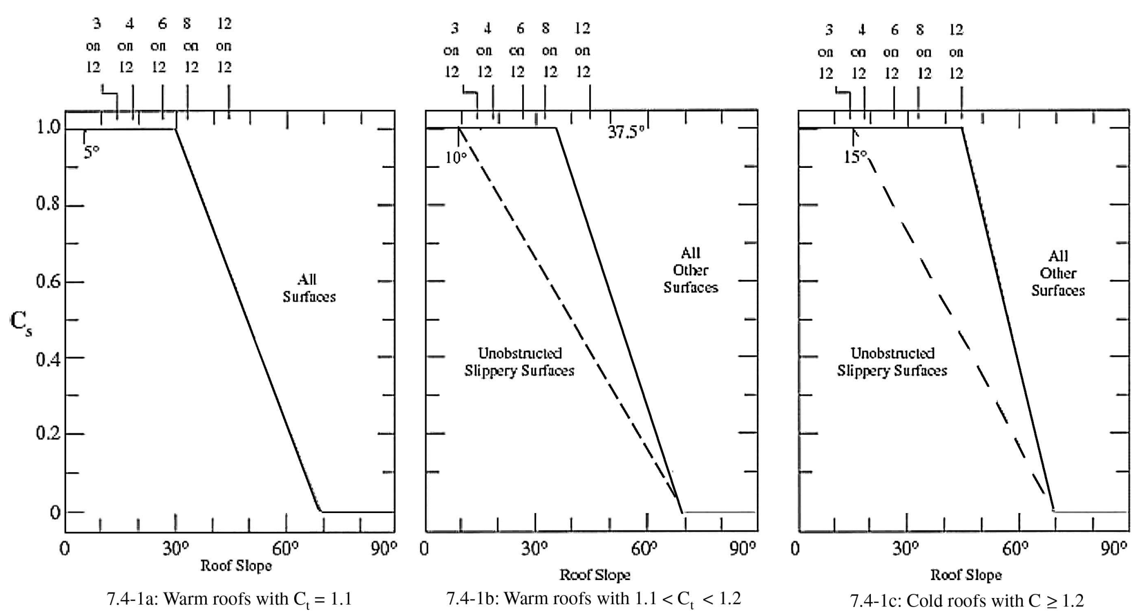


Figure 7.4-1. Graphs for determining slope factor, C_s.
Note: See Tables 7.3-2 and 7.3-3 for C_t definitions.

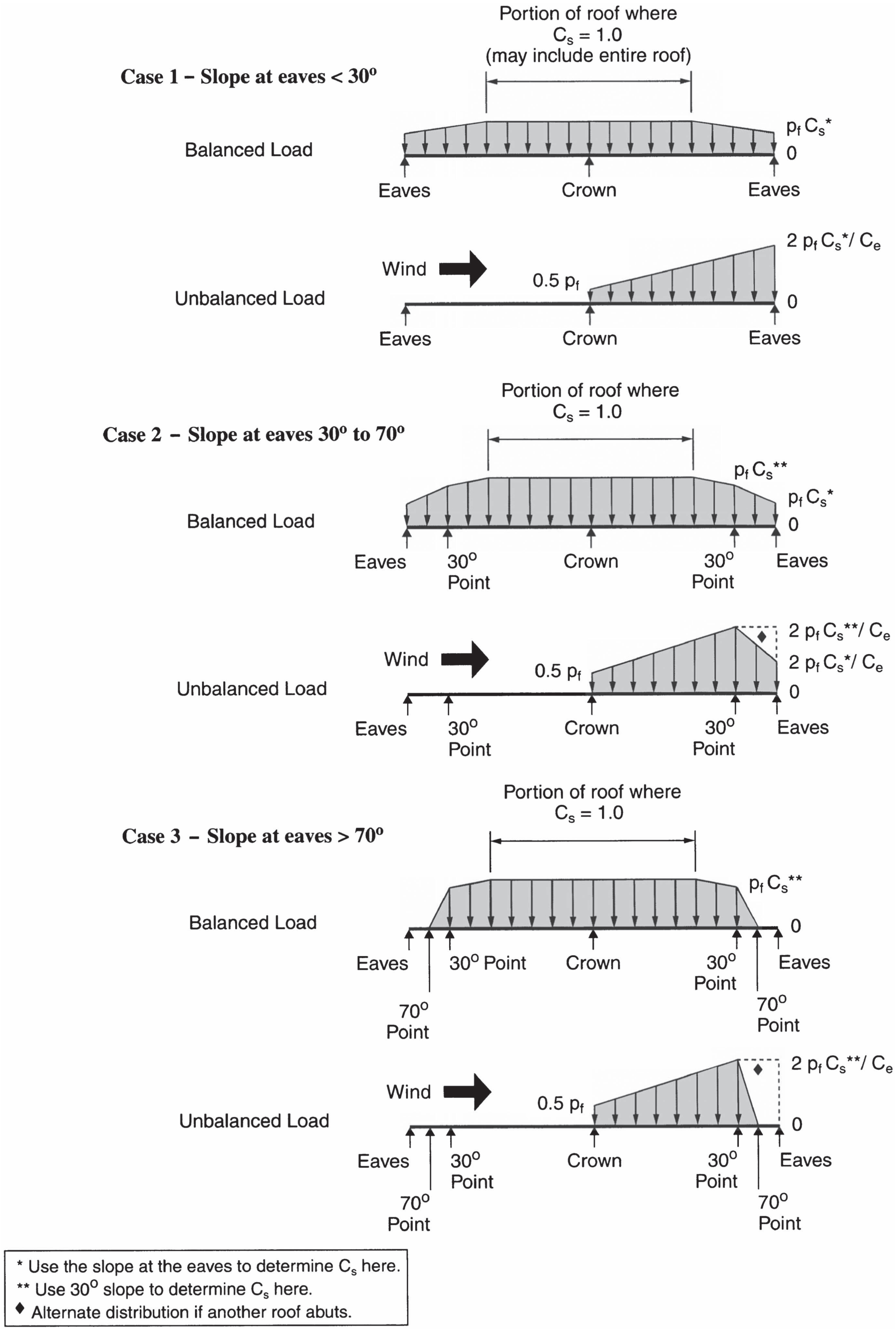


Figure 7.4-2. Balanced and unbalanced loads for curved roofs.

roof snow load for the heated portion of the roof upslope of the exterior wall. No other loads, except dead loads, shall be present on the roof when this uniformly distributed load is applied.

Where C_t is less than or equal to 1.1, the slope factor, C_s, shall be determined in accordance with Figure 7.4-1(a). Where C_t is greater than 1.1 and less than 1.2, the slope factor, C_s, shall be determined in accordance with Figure 7.4-1(b). Where C_t is equal to, or greater than, 1.2, the slope factor, C_s, shall be determined in accordance with Figure 7.4-1(c).

7.4.5 Sloped Roof Snow Loads for Air-Supported Structures Roof snow loading for air-supported structures with vinyl coated exterior fabric shall be as shown in Figure 7.4-3.

7.5 PARTIAL LOADING

The effect of having selected spans loaded with the balanced snow load, and remaining spans loaded with half the balanced snow load, shall be investigated as follows.

7.5.1 Continuous Beam Systems Continuous beam systems shall be investigated for the effects of the three loadings shown in Figure 7.5-1:

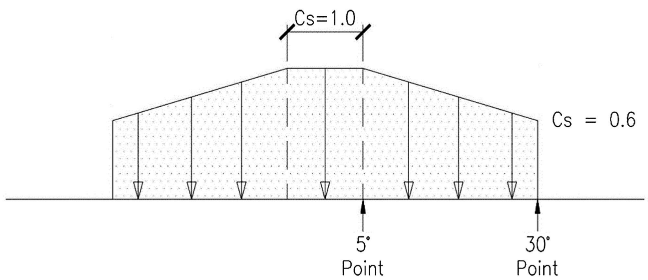


Figure 7.4-3. Sloped roof snow load for air-supported structures.

Case 1: Full balanced snow load on either exterior span and half the balanced snow load on all other spans.
Case 2: Half the balanced snow load on either exterior span and full balanced snow load on all other spans.
Case 3: All possible combinations of full balanced snow load on any two adjacent spans and half the balanced snow load on all other spans. For this case, there will be (n–1) possible combinations, where n equals the number of spans in the continuous beam system.

If a cantilever is present in any of the above cases, it shall be considered to be a span.

Partial load provisions need not be applied to structural members that span perpendicular to the ridgeline in gable roofs with slopes between 1/2 on 12 (2.38 degrees) and 7 on 12 (30.3 degrees).

7.5.2 Other Structural Systems Areas sustaining only half the balanced snow load shall be chosen so as to produce the greatest effects on members being analyzed.

7.6 UNBALANCED ROOF SNOW LOADS

Balanced and unbalanced loads shall be analyzed separately. Winds from all directions shall be accounted for when establishing unbalanced loads.

7.6.1 Unbalanced Snow Loads for Hip and Gable Roofs For hip and gable roofs with a slope exceeding 7 on 12 (30.2 degrees), or with a slope less than 1/2 on 12 (2.38 degrees), unbalanced snow loads are not required to be applied. Roofs with an eave to ridge distance, W, of 20 ft (6.1 m) or less that have simply supported prismatic members spanning from ridge to eave shall be designed to resist an unbalanced uniform snow load on the leeward side equal to p_g. For these roofs, the windward side shall be unloaded. For all other gable roofs, the unbalanced load shall consist of $0.3p_s$ on the windward side, p_s on the leeward side plus a rectangular surcharge with magnitude $h_d\gamma/\sqrt{S}$ and horizontal extent from the ridge $8h_d\sqrt{S}/3$ where h_d is the drift height from Equation (7.6-1) with l_u equal to the eave to ridge distance for the windward portion of the roof, W.

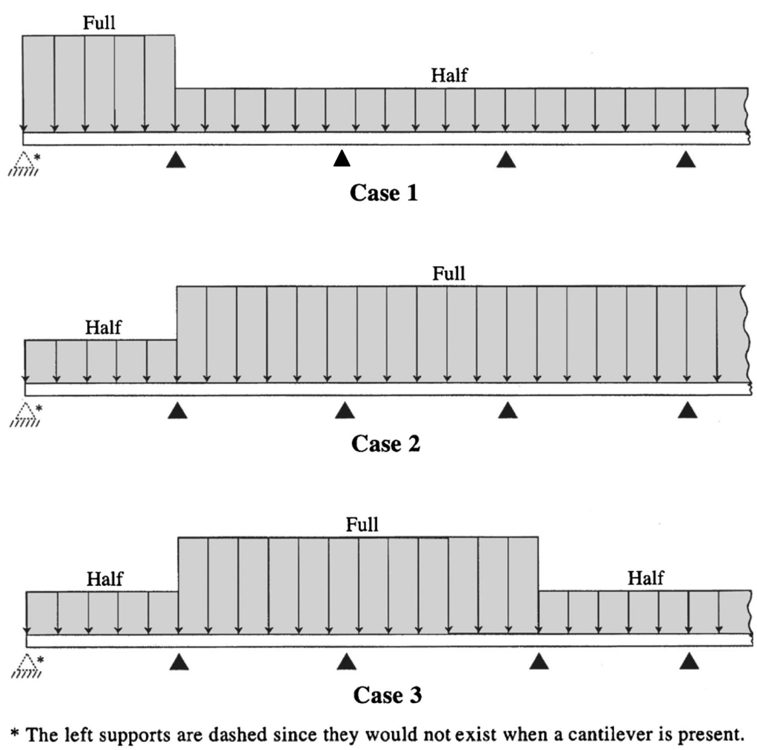


Figure 7.5-1. Partial loading diagrams for continuous beams.

The drift height h_d is given by

$$h_d = 1.5\sqrt{\frac{P_g^{0.74} l_u^{0.70} W_2^{1.7}}{\gamma}} \quad (7.6\text{-}1)$$

where the winter wind parameter W_2 for the site is given in Figure 7.6-1 and Table 7.2-1 for Alaska.

Balanced and unbalanced loading diagrams are presented in Figure 7.6-2.

User Note: The winter wind parameter W_2 is available at https://asce7hazardtool.on-line/.

7.6.2 Unbalanced Snow Loads for Curved Roofs Portions of curved roofs that have a slope exceeding 70 degrees shall be considered free of snow load. If the slope of a straight line from the eaves (or the 70-degree point, if present) to the crown is less than 10 degrees or greater than 60 degrees, unbalanced snow loads shall not be taken into account.

Unbalanced loads shall be determined according to the loading diagrams in Figure 7.4-2. In all cases, the windward side shall be considered free of snow. If the ground or another roof abuts a Case 2 or Case 3 (see Figure 7.4-2) curved roof at or within 3 ft (0.9 m) of its eaves, the snow load shall not be decreased between the 30 degree point and the eaves but shall remain constant at the 30-degree point value. This distribution is shown as a dashed line in Figure 7.4-2.

7.6.3 Unbalanced Snow Loads for Multiple Folded Plate, Sawtooth, and Barrel Vault Roofs Unbalanced loads shall be applied to folded plate, sawtooth, and barrel-vaulted multiple roofs with a slope exceeding 3/8 in. on 12 (1.79 degrees). According to Section 7.4.4, $C_s = 1.0$ for such roofs, and the balanced snow load equals p_f. The unbalanced snow load shall increase from one-half the balanced load at the ridge or crown (i.e., $0.5p_f$) to two times the balanced load given in Section 7.4.4 divided by C_e at the valley (i.e., $2p_f/C_e$). Balanced and unbalanced loading diagrams for a sawtooth roof are presented in Figure 7.6-3. However, the snow surface above the valley shall not be at an elevation higher than the snow above the ridge. Snow depths shall be determined by dividing the snow load by the density of that snow from Equation (7.7-1).

7.6.4 Unbalanced Snow Loads for Dome Roofs Unbalanced snow loads shall be applied to domes and similar rounded structures. Snow loads, determined in the same manner as for curved roofs in Section 7.6.2, shall be applied to the downwind 90 degree sector in plan view. At both edges of this sector, the load shall decrease linearly to zero over sectors of 22.5 degrees each. There shall be no snow load on the remaining 225 degree upwind sector.

7.7 DRIFTS ON LOWER ROOFS (AERODYNAMIC SHADE)

Roofs shall be designed to sustain localized loads from snowdrifts that form in the wind shadow of (1) higher portions of the same structure, and (2) adjacent structures and terrain features.

7.7.1 Lower Roof of a Structure Snow that forms drifts comes from a higher roof or, with the wind from the opposite direction, from the roof on which the drift is located. These two kinds of drifts ("leeward" and "windward," respectively) are shown in Figure 7.7-1. The geometry of the surcharge load due to snow drifting shall be approximated by a triangle, as shown in Figure 7.7-2. Drift loads shall be superimposed on the balanced snow load. If h_c/h_b is less than 0.2, drift loads are not required to be applied.

For leeward drifts, the drift height, h_d, shall be determined directly from Equation (7.6-1) using the length of the upper roof. However, the drift height need not be taken as larger than 60% of the length of the lower level roof. For windward drifts, the drift height shall be determined by substituting the length of the lower roof for l_u into Equation (7.6-1) and using three-quarters of h_d as the drift height. The larger of these two heights shall be used in design. For leeward drifts, if h_d is equal to or less than h_c, the drift width, w, shall equal $4h_d$ and the drift height shall equal h_d. If this height exceeds h_c, the drift width, w, shall equal $4h_d^2/h_c$ and the drift height shall equal h_c.

For leeward drifts, the drift width, w, shall not be greater than $8h_c$. For windward drifts, the drift width shall be taken as eight times the windward drift height or $(8(.75h_d) = 6h_d)$. If the drift width for either windward or leeward drifts, w, exceeds the width of the lower roof, the drift shall taper linearly to zero at the far end of the lower level roof. Windward and leeward drifts shall be checked independently to determine which controls the structural design of each member. The maximum intensity of the drift surcharge load, p_d, equals $h_d\gamma$, where snow density, γ, is defined in Equation (7.7-1):

$$\gamma = 0.13p_g + 14 \text{ but not more than } 30 \text{ lb/ft}^3 \quad (7.7\text{-}1)$$

$$\gamma = 0.426p_g + 2.2, \text{ but not more than } 4.7 \text{ kN/m}^3 \quad (7.7\text{-}1.\text{SI})$$

This density shall also be used to determine h_b by dividing p_s by γ (in SI: also multiply by 102 to get the depth in m).

7.7.2 Adjacent Structures If the horizontal separation distance between adjacent structures, s, is less than 20 ft (6.1 m) and less than six times the vertical separation distance ($s < 6\,h$), then the requirements for the leeward drift of Section 7.7.1 shall be used to determine the drift load on the lower structure. The height of the snow drift shall be the smaller of h_d, based on the length of the adjacent higher structure, and $(6h–s)/6$. The horizontal extent of the drift shall be the smaller of $6h_d$ or $(6h–s)$.

For windward drifts, the requirements of Section 7.7.1 shall be used. The resulting drift is permitted to be truncated.

7.7.3 Intersecting Drifts Intersecting drifts shall be evaluated at reentrant corners, parapet wall corners, intersections of gable roof with the roof step wall of a taller roof and other similar geometries. Section 7.7.1 shall be used to determine the snow drift geometry for each direction. Where the two snowdrifts intersect, the larger of the two snowdrift depths shall govern, as shown in Figure 7.7-3. Intersecting snowdrift loads shall be considered to occur concurrently, except that the two drift loads need not be superimposed.

For leeward intersecting snowdrifts at reentrant corners, the length of the upper roof applicable for each snowdrift shall be used with l_u parallel to w_1 for the first drift and l_u parallel to w_2 for the second drift. For windward snowdrifts, the lengths of the lower roof shall be used for l_u.

7.8 ROOF PROJECTIONS AND PARAPETS

The method for windward drifts in Section 7.7.1 shall be used to calculate drift loads on all sides of roof projections and at parapet walls. The height of such drifts shall be taken as three-quarters the drift height from Equation 7.6-1 (i.e., $0.75h_d$). For parapet walls, l_u shall be taken equal to the length of the roof upwind of the wall. For roof projections, l_u shall be taken equal to the greater of the length of the roof upwind or downwind of the projection.

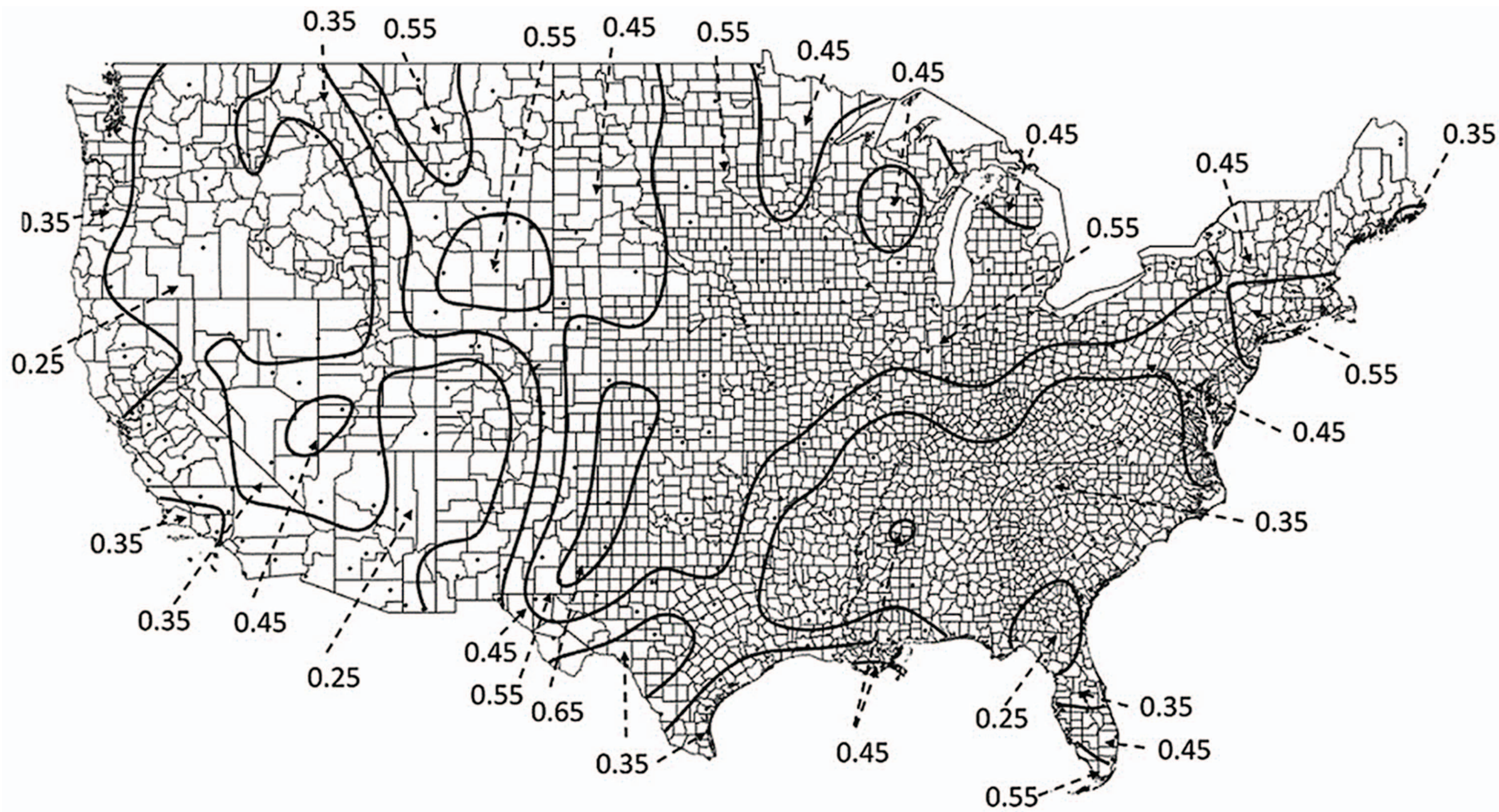


Figure 7.6-1. Map of winter wind parameter, W_2.
Note: The winter wind parameter W_2 is available at https://asce7hazardtool.on-line.

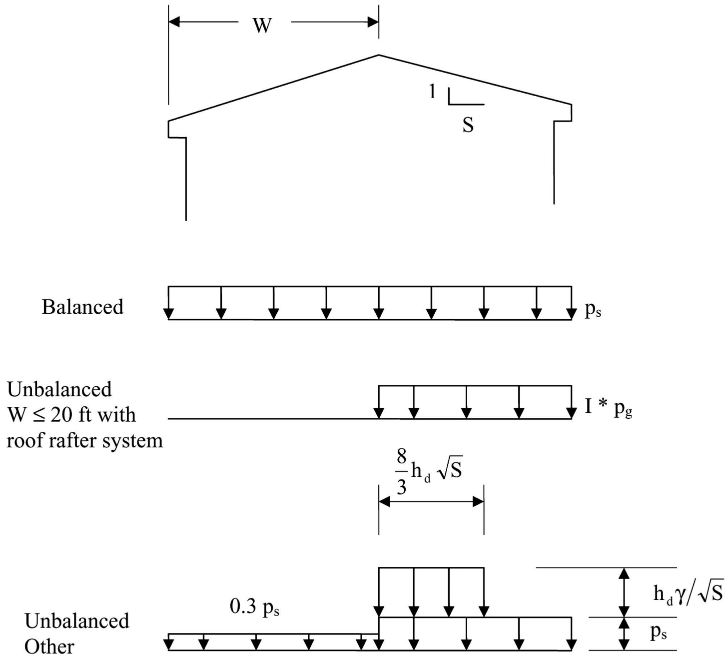
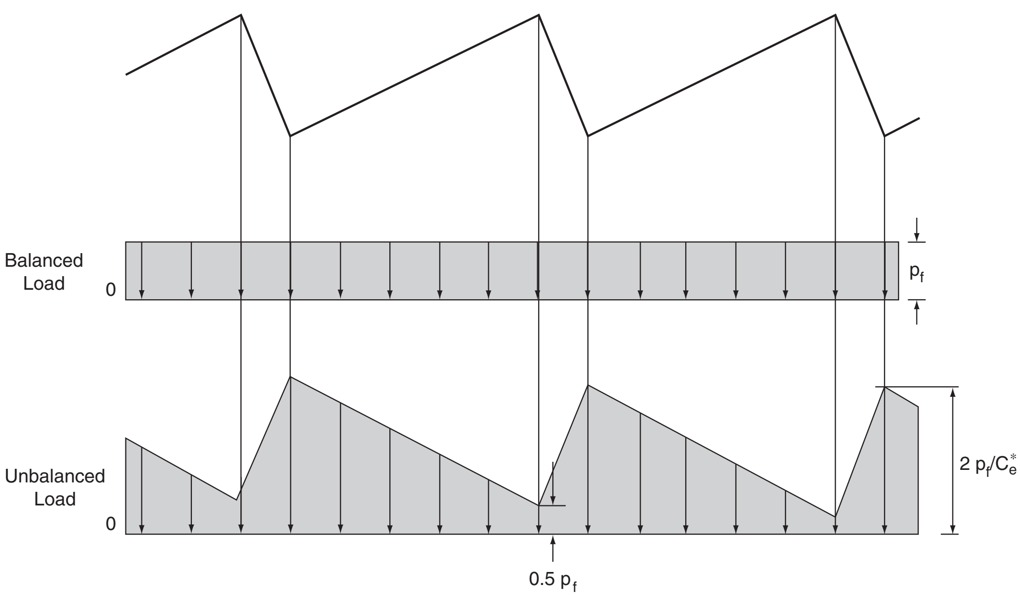


Figure 7.6-2. Balanced and unbalanced snow loads for hip and gable roofs.
Note: Unbalanced loads need not be considered for $\theta > 30.2°$ (7 on 12) or for $\theta < 2.38°$ (1/2 on 12).



* May be somewhat less; see Section 7.6.3

Figure 7.6-3. Balanced and unbalanced snow loads for a sawtooth roof.

EXCEPTION: Drift loads shall not be required where the side of the roof projection is less than 15 ft (4.6 m) or the clear distance between the height of the balanced snow load, h_b, and the bottom of the projection (including horizontal supports) is at least 2 ft (0.61 m).

7.9 SLIDING SNOW

The load caused by snow sliding off a sloped roof onto a lower roof shall be determined for slippery upper roofs with slopes greater than ¼ on 12, and for other (i.e., nonslippery) upper roofs with slopes greater than 2 on 12. The total sliding load per unit length of eave shall be $0.4p_f W$, where W is the horizontal distance from the eave to ridge for the sloped upper roof. The sliding load shall be distributed uniformly on the lower roof over a distance of 15 ft (4.6 m) from the upper roof eave. If the width of the lower roof is less than 15 ft (4.6 m), the sliding load shall be reduced proportionally.

The sliding snow load shall not be further reduced unless a portion of the snow on the upper roof is blocked from sliding onto the lower roof by snow already on the lower roof.

For separated structures, sliding loads shall be considered when $h/s > 1$ and $s < 15$ ft ($s < 4.6$ m). The horizontal extent of the sliding load on the lower roof shall be $15 - s$ with s in feet

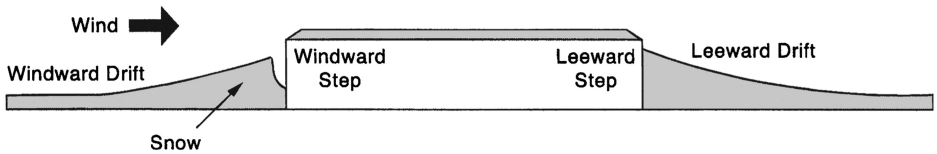


Figure 7.7-1. Drifts formed at windward and leeward steps.

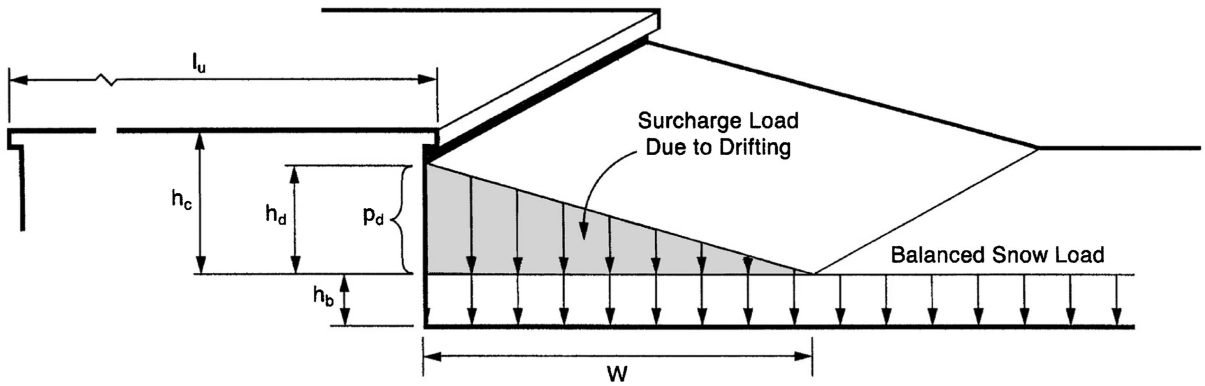


Figure 7.7-2. Configuration of snowdrifts on lower roofs.

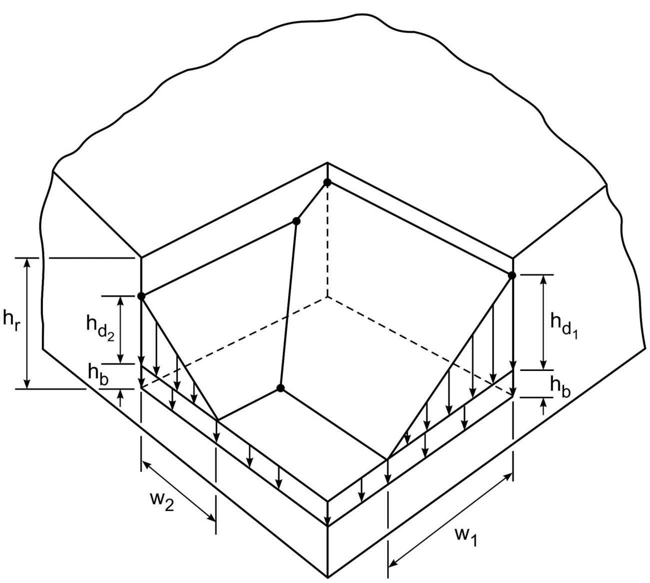


Figure 7.7-3. Configuration of intersecting snowdrifts at lower roof.

(4.6–s with s in meters), and the load per unit length shall be $0.4p_f W(15–s)/15$ with s in feet ($0.4p_f W(4.6–s)/4.6$ with s in meters).

Sliding loads shall be superimposed on the balanced snow load and need not be used in combination with drift, unbalanced, partial, or rain-on-snow loads.

7.10 RAIN-ON-SNOW SURCHARGE LOAD

For locations where p_g is less than, or equal to, the value of $p_{m,max}$ given in Table 7.3-4, but not zero, all roofs with slopes (in degrees) less than $W/50$ with W in ft (in SI: $W/15.2$ with W in m) shall include a 8 lb/ft^2 (0.38 kN/m^2) rain-on-snow surcharge load. This additional load applies only to the sloped roof (balanced) load case and need not be used in combination with drift, sliding, unbalanced, minimum, or partial loads.

7.11 PONDING INSTABILITY

Susceptible bays shall be designed to preclude ponding instability. Roof deflections caused by full snow loads shall be evaluated when determining the likelihood of ponding instability.

7.12 EXISTING ROOFS

Existing roofs shall be evaluated for increased snow loads caused by additions or alterations. Owners or agents for owners of an existing lower roof shall be advised of the potential for increased snow loads, where a higher roof is constructed within 20 ft (6.1 m). See footnote to Table 7.3-1 and Section 7.7.2.

7.13 SNOW ON OPEN-FRAME EQUIPMENT STRUCTURES

Open-frame equipment structures shall be designed for snow loads in accordance with Sections 7.13.1 through 7.13.4. The thermal factor, $C_t = 1.2$, shall be used in determination of snow loads for unheated open-frame equipment structures.

7.13.1 Snow at Top Level Flat roof snow loads (p_f) and drift loads shall be applied at the top level of the structure where there is flooring or elements that can retain snow. Open-frame members with a width of more than 8 in. (200 mm) shall be considered snow retaining surfaces. The top level shall be designed for snowdrifts, in accordance with Sections 7.7 and 7.9, where there are wind walls or equivalent obstructions.

7.13.2 Snow at Levels below the Top Level At all levels with flooring (grating, checkered plate, etc.) located below a level with flooring, the flat roof snow load shall be applied over a portion of that flooring level near any open edge in accordance with Figure 7.13-1. The flat roof snow load shall extend from the upwind edge of the flooring a horizontal distance equal to the vertical difference in elevation between the level in question and the next floor above.

7.13.3 Snow Loads on Pipes and Cable Trays Individual pipes and cable trays with a diameter (pipe) or width (tray) less than or equal to $0.73p_f/\gamma$ shall be designed for a triangular snow load in accordance with Figure 7.13-2(a). Individual pipes and cable trays with a diameter (pipe) or width (tray) greater than $0.73p_f/\gamma$ shall be designed for a trapezoidal snow load, in accordance with Figure 7.13-2(b). Snow loads on pipes are not required to be considered if the wintertime external surface temperature of the pipe is greater than 45 °F (7.2 °C).

Where the spacing between multiple adjacent pipes or cable trays at the same elevations is less than the height of the flat roof snow load (p_f/γ), an additional uniform cornice load of p_f shall be applied in the spaces between the pipes or cable trays, as shown in Figure 7.13-3. For $S_p \geq h$, the additional cornice loads need not be applied.

7.13.4 Snow Loads on Equipment and Equipment Platforms Snow loads on the structure shall include snow accumulation on equipment and equipment platforms that can retain snow. Snow accumulation need not be considered on equipment with a wintertime external surface temperature greater than 45°F (7.2°C).

7.14 ALTERNATE PROCEDURE

In lieu of the requirements specified in Sections 7.3 through 7.13, the design snow loads shall be permitted to be determined by thermal performance studies and scale-model studies in wind tunnels or water flumes conducted in accordance with the requirements of ASCE 49 and this section. Snow loads determined using these studies shall be based on the ground snow loads outlined in Section 7.2 and shall be derived to be consistent with the reliability targets outlined in Chapter 1.

7.14.1 Limitations on Snow Loads Derived from Scale Model Studies Snow loads derived based on scale-model studies shall not be taken as less than 80% of those specified in Sections 7.2 through 7.13 unless an independent peer review

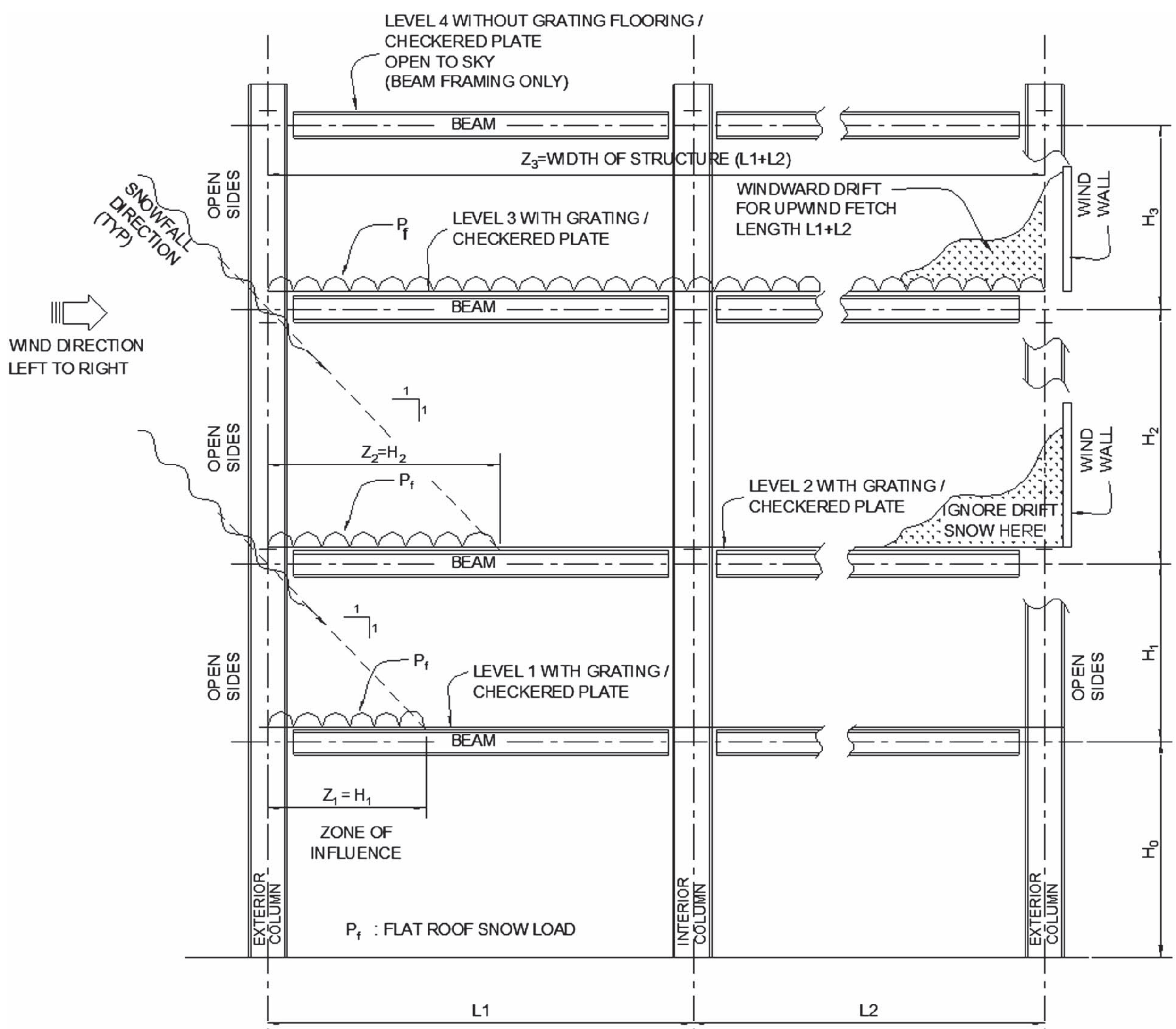
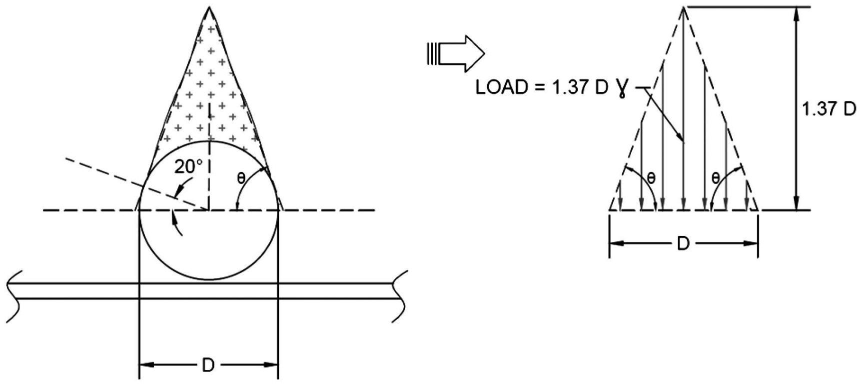
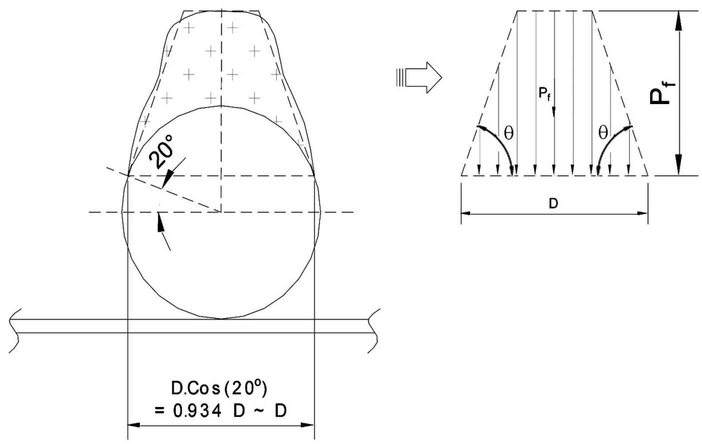


Figure 7.13-1. Open-frame equipment structures.



(a)



(b)

Figure 7.13-2. Snow load on individual pipes and cable trays with diameter or width (a) less than, or equal to, $0.73p_f/\gamma$, and (b) greater than $0.73p_f/\gamma$.

Note: D, pipe diameter $+2x$ insulation thickness (as applicable); P_f, flat roof snow load; θ, assumed angle of repose = 70 degrees.

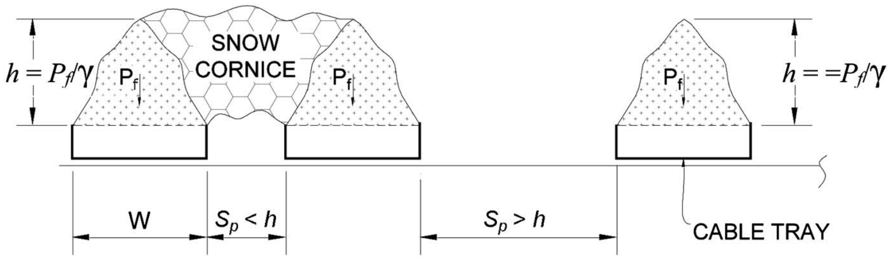


Figure 7.13-3. Snow load on multiple cable trays/pipes at same elevation.

is conducted in accordance with Section 1.3.1.3.4. When an independent peer review is conducted, the design snow loads shall not be taken as less than 60% of those specified in Sections 7.2 through 7.13.

7.14.2 Consideration of Thermal Performance in Model Studies If the study includes an assessment of the thermal performance of the building or structure, the roof insulation value shall not be taken as less than R20 [U=0.05 Btu/(h ft^2 °F)] and the internal temperature shall not be taken as greater than 70 °F, with the exception of continuously heated greenhouses as outlined in Table 7.3-2, where the expected thermal properties and internal temperatures may be considered. In lieu of modeling the thermal performance, the thermal factor outlined in Section 7.3.2 is permitted to be applied to the scale model snow load.

7.15 CONSENSUS STANDARDS AND OTHER REFERENCED DOCUMENTS

This section lists the consensus standards and other documents that shall be considered part of this standard to the extent referenced in this chapter.

ASCE 49, *Wind Tunnel Testing for Buildings and Other Structures*, ASCE, 2020.

Cited in: Section 7.14