Ineqarnermut, Attaveqaasersuutinut Isorliunerusunullu Naalakkersuisoqarfik
Ministry of Housing, Infrastructure and Outlying Districts

EN 1991-1-3 GL NA:2025

National Annex to
Eurocode 1: Actions on structures –
Part 1-3: General actions – Snow loads

Foreword

This Greenlandic National Annex (GL NA) replaces EN 1991-1-3 GL NA:2024.

This Annex is based on DS/EN 1991-1-3 DK NA:2024.

Validity

This Annex is adapted to national, geographical and climatic conditions as well as national legislation and specifies how EN 1991-1-3:2007 including corrigenda and amendments are to be applied in Greenland.

The Annex provides Greenlandic national choices and complementary information. For any complementary information, it is specified whether it is normative or informative. Normative information comprises requirements to be followed.

The numbering in the Annex refers to the numbering in EN 1991-1-3:2007 or DS/EN 1991-1-3 DK NA:2024.

Overview of Greenlandic national choices and complementary information

Clause	Subject	Change
1.1(2)	Scope – Snow loads for altitudes above 1500m	National choice
1.1(3)	Scope – Application of Annex A	No exceptional loads are applied
1.1(4)	Scope – Application of Annex B	Not applicable
2(3)	Classification of actions – Definition of exceptional snow loads	No exceptional loads are applied
2(4)	Classification of actions – Conditions for the application of exceptional snow loads	No exceptional loads are applied
3.3(1)	Exceptional conditions	No exceptional loads are applied
3.3(2)	Exceptional conditions	No exceptional loads are applied
3.3(3)	Exceptional conditions	No exceptional loads are applied
4.1(1)a	Characteristic values – Fundamental value	National choice
4.1(1)b(P)	Characteristic values – Snow load on the ground of the location	National choice
4.1(1)c	Characteristic values – Snow load on the ground by exceptional conditions	National choice
4.1(1) NOTE 2	Characteristic values – European snow map	Not relevant
4.1(2)	Characteristic values – Statistical analysis of snow data	Not relevant
4.2(1)	Other representative values – Load combination factors	National choice
4.3(1)	Treatment of exceptional snow loads on the ground	No exceptional loads are applied
5.2(2)	Load arrangements – Application of Annex B	No exceptional loads are applied
5.2(5)	Load arrangements – Guidance on the determination of load arrangements in connection with artificial removal or redistribution of snow loads	No guidance. Removal of snow is not assumed in the design
5.2(6)	Load arrangements – accretion of ice	National choice
5.2(7)	Load arrangements – Exposure coefficient C_e	National choice
5.2(8)	Load arrangements –	No complementary guidance

	Thermal coefficient C_t	
5.3.1(1)	Snow load shape coefficients, General – Alternative load arrangements for snow drift	Complementary information, Normative
5.3.1(3) Table 5.2	Shape coefficients for roofs	Unchanged
5.3.1(3) NOTE	Shape coefficients for roofs Depth of the snow layer	Complementary information, Informative
5.3.2(3)	Mono-pitched roofs – drifted snow load arrangements	Unchanged. However, see Annex F
5.3.3(4)	Snow load shape coefficients, Pitched roofs	National choice
5.3.4(3)	Snow load shape coefficients, Multi-span roofs – Application of Annex B	No exceptional loads are applied
5.3.4(4)	Snow load shape coefficients, Multi-span roofs – Further guidance	No guidance
5.3.5(1) NOTE 1	Snow load shape coefficients, Cylindrical roofs – Upper limit of shape coefficients for cylindrical roofs	Unchanged.
5.3.5(1) NOTE 2	Snow load shape coefficients, Cylindrical roofs – Consideration of snow fences	National choice
5.3.5(3)	Snow load shape coefficients, Cylindrical roofs – Unevenly drifted snow load arrangement	National choice
5.3.6	Snow load shape coefficients, Roofs abutting and close to taller construction works as well as drifting at projections and obstructions	The entire section is replaced by a new section
5.3.6(1) NOTE 1	Snow load shape coefficients, Roofs abutting and close to taller construction works – Range for μ_w	See new paragraph above
5.3.6(1) NOTE 2	Snow load shape coefficients, Roofs abutting and close to taller construction works – Range for drift length	See new paragraph above
5.3.6(3)	Snow load shape coefficients, Roofs abutting and close to taller construction works – Drifted snow	See new paragraph above
6.2	Local effects	Complementary information, Normative

Annex A Table A.1 NOTE 2	Design situations and load arrangements to be used for different locations	Not relevant. No exceptional loads are applied
Annex B	Snow load shape coefficients for exceptional snow drifts	No exceptional loads are applied
Annex C	European ground snow load map	Not applicable
Annex D	Adjustment of ground snow load according to return period	Unchanged.
Annex E	Bulk snow weight density	Annex can be applied. The recommended values are applied
Annex F	Alternative drifted snow load arrangements	Complementary information, Normative
Annex G	Roof valleys	Complementary information, Normative
Annex H	Shape coefficients for snow drifting on balconies	Complementary information, Normative

National choices

1.1(2) Scope
Snow loads for altitudes 1 500 m above sea level should be agreed with the local building authority for individual projects.

2(3) Classification of actions – Definition of exceptional snow loads
Exceptional snow loads are not applied.

2(4) Classification of actions – Conditions for the application of exceptional snow loads
Exceptional snow loads are not applied.

4.1(1)a. Characteristic values – Basic values
The basic value of the characteristic snow load on the ground, s_{k0}, is determined on the basis of a 50-year return period, and shall as a minimum be:

- 1,0 kN/m^2 in Northwest Greenland and Kangerlussuaq
- 3,0 kN/m^2 in East Greenland
- 1,8 kN/m^2 in the rest of Greenland.

4.1(1)b(P) Characteristic values – Snow load on the ground for the actual location
The characteristic value of snow load on the ground, s_k, is determined for the actual location based on the basic value, s_{k0}, taking into account that snow loads may vary considerably due to local orography and will increase with altitude above sea level and distance from the coast.

When the altitude above sea level, h, is less than or equal to the altitude limit, h_g, s_k is taken as equal to the basic value, s_{k0}.
For $h > h_g$, $s_k = s_{k0} + n\,\Delta s_k$, where $n = (h - h_g)/100$. n is rounded up to the nearest integer.

Everywhere the height limit, h_g, can be taken as 150 m. Δs_k is taken as a minimum of 0,5 kN/m^2.

When the distance to the open sea and coastline along large fjords is more than 5000 m, s_k is increased by 0,5 kN/m^2 as determined above.

For buildings where the main structures belong to a medium consequence class (CC2) with a building width ≤ 12 m, a return period of 10 years can be applied, and thus the characteristic snow load on the ground can be approximately multiplied by 0,8.

The characteristic snow load on the ground, s_k, for the actual location is taken as 0,9 kN/m^2 with a maximum of 6,0 kN/m^2.

4.1(1)c Characteristic values - Snow load on the ground in exceptional conditions
The characteristic snow loads on the ground in exceptional conditions are determined for the particular project, with $s_k >= 1,8$ kN/m^2.

4.2(1) Other representative values – Load combination factors
Values equal to load combination factors specified in EN 1990 GL NA should be chosen.

5.2(6) General – Accretion of ice
The effect of local accretion of ice should be taken into account for the snow load, e.g. accretion of ice from many thaw/freeze changes, heat from the building roof, rain on snow or solar radiation melting the snow into ice and thereby increasing the snow load. The specific weight of the snow should be assessed in the current situation.

NOTE: The significance of accretion of ice for the snow load can be substantial at long periods of snow drifts, or where the accretion of ice may block roof drains from meltwater. For the calculation of local snow loads where accretion of ice may occur, the specific weight of snow should be taken as at least 4 kN/m^3.

5.2(7) Load arrangements – Exposure coefficient C_e
The exposure coefficient, C_e, depends on the topography of the surroundings and the size of the structure and is determined by:

$$C_e = C_{top} C_s$$

where

C_{top}	is the topography coefficient
C_s	is the size coefficient.

The coefficient C_{top} is determined on the basis of an assessment of the topographical conditions for the location in question, and is found from Table 5.1.a GL NA.

Table 5.1.a NA – Recommended values of C_{top} for different topographies

Topography	C_{top}
Windswept coast [a)]	0,6
Windswept inland [b)]	0,8
Normal [c)]	1,0
Sheltered [c)]	1,2

[a)] *Windswept coastal topography:* Flat unobstructed areas up to 2 km from the sea or open skerries that are exposed on all sides without, or with only little, shelter afforded by terrain or higher construction works.

[b)] *Windswept inland topography*:as *Windswept coastal topography* more than 2 km from the sea or open skerries.

[c)] *Normal topography*: Areas where there is no significant removal of snow by wind on construction works because of terrain or other construction works.

[d)] *Sheltered topography*: Areas in which the considered construction is considerably lower than the surrounding terrain and/or surrounded by higher construction works.

The coefficient C_s is obtained from:

For sheltered topography:

$$C_s = 1,0$$

For windswept and normal topographies, where l_1 and l_2 are the lengths of the longer and shorter sides, respectively, of the building:

For $2h > l_1$ (cf. Figure 5.0.b GL NA):

$$C_s = 1{,}0$$

for $2h \leq l_1$ (cf. Figure 5.0.b GL NA):

$$C_s = 1 \qquad \text{for } l_2 \leq 10h$$
$$C_s = 1 + 0{,}025 \cdot \frac{l_2 - 10h}{h} \qquad \text{for } 10h < l_2 < 20h$$
$$C_s = 1{,}25 \qquad \text{for } l_2 \geq 20h$$

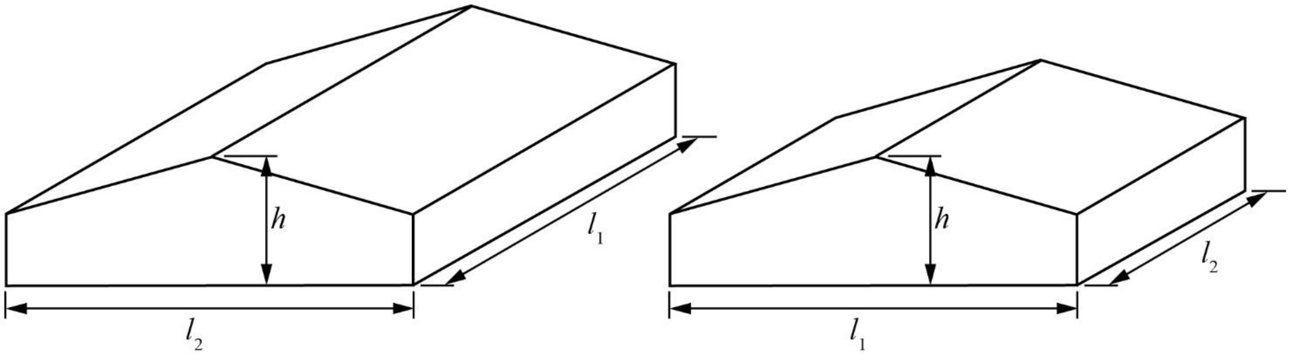

Figure 5.0.b NA – Building dimensions

5.3.3(4) Snow load shape coefficients, Pitched roofs
For structures exposed to wind and snow, an additional load arrangement is taken into account by applying a snow load shape coefficient of zero for the windward side and μ_w for the leeward side of the roof as shown in Figure 5.2.b GL NA. The load arrangement allows for an exceptional amount of drifted snow due to wind on the leeward side of the roof when all of the conditions mentioned below are fulfilled:

- The height of the windward side of the building does not exceed 10 m;
- 2 times the ridge height, h, is smaller than the crosswind dimension of the building, l, i.e. $2h < l$
- The depth of the building, b, is larger than the ridge height of the building, h, see Figure 5.2.b Gl NA, i.e. $b > h$
- The windward terrain is an open area which corresponds to a maximum terrain roughness of category II according to EN 1991-1-4 (Table 4.1) at a distance of 400 m.

The rules in clause 5.3.3(4) are not to be combined with the rules for roof valleys specified in Annex G.

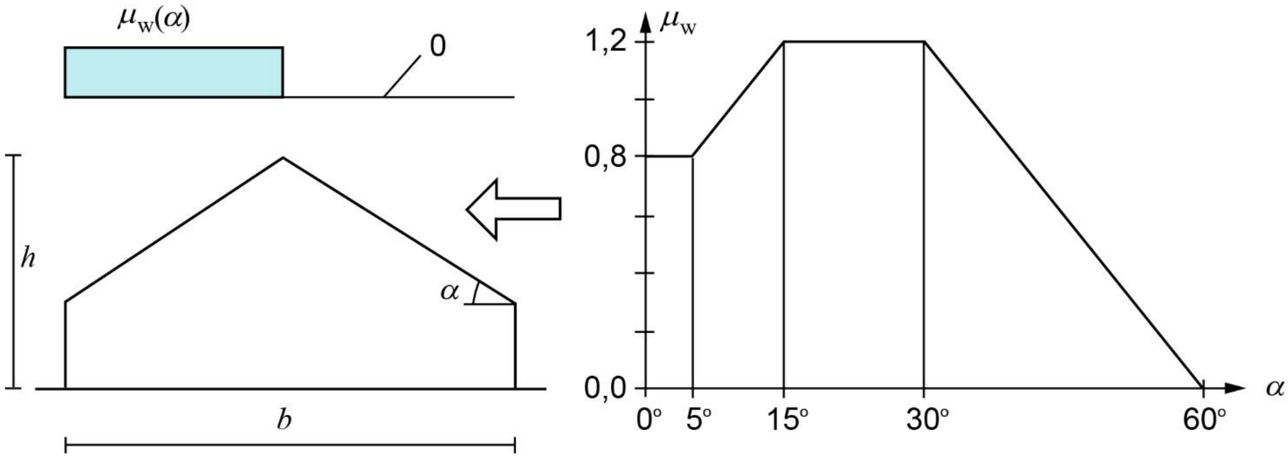

Figure 5.2.b GL NA – Snow load shape coefficient for leeward side depending on roof slope

The shape coefficient, μ_w, obtained from Figure 5.2.b GL NA, may be calculated using the following expressions:

$\mu_w = 0{,}8$	for $0^\circ \leq \alpha \leq 5^\circ$
$\mu_w = 0{,}6 + 0{,}04\alpha$	for $5^\circ < \alpha < 15^\circ$
$\mu_w = 1{,}2$	for $15^\circ \leq \alpha \leq 30^\circ$
$\mu_w = 2{,}4 - 0{,}04\alpha$	for $30^\circ < \alpha < 60^\circ$
$\mu_w = 0$	for $60^\circ \leq \alpha$

5.3.5(1) NOTE 2 Snow load shape coefficients, Cylindrical roofs – Consideration of snow fences
Where snow fences or other structural parts prevent snow from sliding down the roof, the snow load should be increased.

5.3.5(3) Snow load shape coefficients, Cylindrical roofs – Drifted snow load arrangement
For cylindrical roofs, the drifted snow load arrangement in figure 5.6 in EN 1991-1-3:2007 is supplemented by the following load arrangement shown in Figure 5.5.b GL NA and Figure 5.5.c GL NA.

For $\beta_0 < 60^\circ$, triangular drifting distribution is assumed, taken as zero at the ridge, and using the shape coefficients μ_4 and $\mu_4/2$ respectively, at the line separating the roof and the vertical faces. For $\beta_0 > 60^\circ$, triangular drifting distribution is assumed, taken as zero at the ridge, and using the shape coefficients μ_4 and $\mu_4/2$ respectively, where $\beta = 60^\circ$. For $\beta > 60^\circ$, the shape factor is 0.

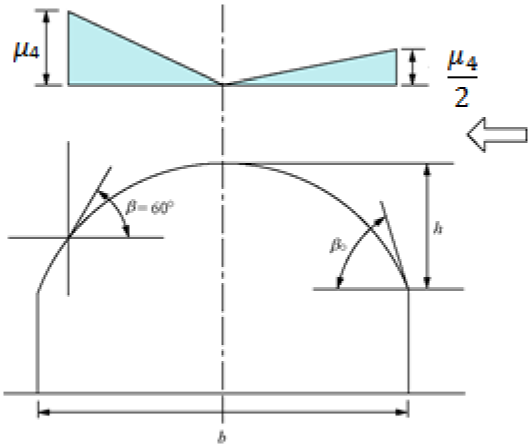

Figure 5.5.b GL NA – Snow load shape coefficient for a cylindrical roof slope β_0 > 60º

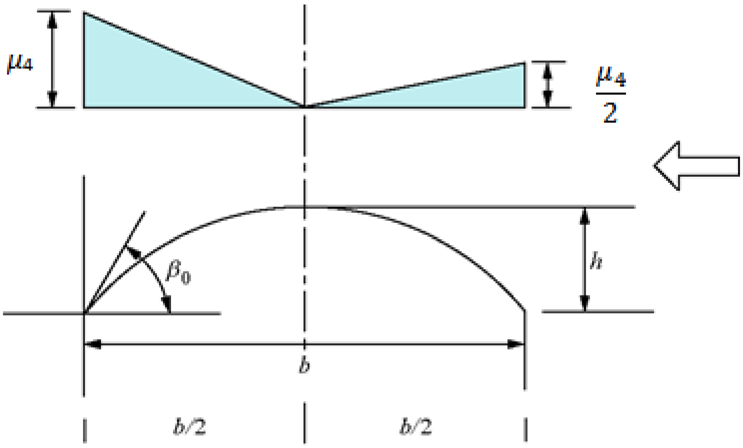

Figure 5.5.c GL NA – Snow load shape coefficient for a cylindrical roof slope $\beta_0 \leq$ 60º

5.3.6 Snow load shape coefficients. Roofs abutting and close to taller construction works as well as drifting at projections and obstructions

(1)GL NA The structure which is afforded shelter from the wind is illustrated in Figure 5.6.a GL NA. It is assumed that $\alpha_w > -5°$ and $\alpha_l > -5°$. Global shelters have a decisive effect on the wind flow around the entire structure. Local shelters only affect the wind flow around the shelter. The rules given in this section apply when 2 times the height of the shelter is smaller than the horizontal crosswind dimension of the shelter. If this condition is not fulfilled, the wind will primarily flow around the shelter and drifting will be reduced.

NOTE: Equivalent rules also apply to smaller buildings abutting or close to cylindrical buildings.

(2)GL NA The parameter a determines whether the shelter is local ($a \leq 0,2$) or global ($a \geq 0,4$) and is obtained using the expression

$$a = \max\left\{\frac{h_{sw}^2}{b_w h_w}, \frac{b_w}{25h_w}\right\}$$

where (see also Figure 5.6.a GL NA):

h_w	is the height of the windward face; h_w is not taken as lower than 1,5 m.
b_w	is the distance from the height of the windward face of the shelter.
h_{sw}	is the height of the face of the shelter for $\alpha_{sw} \leq 60°$. For $\alpha_{sw} = 90°$, h_{sw} is taken as the ridge height. For 60 ° < α_{sw} < 90°, h_{sw} is obtained by interpolation.

(3)GL NA Snow load shape coefficients for structures with shelters are given by the following expression and are shown in Figure 5.6.a GL NA:

μ_2 is taken from Table 5.2 of EN 1991-1-3, Annex A1, and applying the roof slopes considered

$$\mu_3 = \mu_s + \mu_w \tag{5.7}$$

where

μ_s	is the snow load shape coefficint due to snow sliding from the upper roof;
μ_w	is the snow load shape coefficient due to the effect of wind. This shape coefficient depends on the specific weight density of the snow, γ, which for this calculation is taken as 2 kN/m^3.

(4)GL NA For the **windward face** of a shelter, the following applies, see Figure 5.6.a GL NA:

$l_{sw} = \min\{b_w; 2h_{sw}\}$	however 5 m $\leq l_{Sw} \leq$ 15 m
$\mu_{ww} = h_{sw} \frac{\gamma}{s_k}$	however, $\mu_{ww} \geq \mu_1$
$\mu_{ww} \leq 2$	for $a \leq 0{,}2$
$\mu_{ww} \leq 10a$	for $0{,}2 < a < 0{,}4$
$\mu_{ww} \leq 4$	for $a \geq 0{,}4$

(5)GL NA For the **leeward face** of a shelter, the following applies for $h_{sl} > 0{,}5$ m, see Figure 5.6.a GL NA:

$l_{sl} = 5\ h_{sl}$	however 5 m $\leq l_{sl} \leq$ 15 m og $l_{sl} \leq b_1$
$\mu_{wl} = h_{sl} \frac{\gamma}{s_k}$	however $\mu_1 \leq \mu_{wl} \leq 2$
$\mu_{wl} = \mu_1$	if $h_{sl} < 0{,}5$ m
$\mu_{sl} = 0$	if $h_{sl} < 0{,}5$ m
$\mu_{sl} = 0$	for $\alpha_{sl} \leq 15°$
$\mu_{sl} = \mu_1(\alpha_{sl})\ b_{sl} / l_{sl}$	for $\alpha_{sl} > 15°$

NOTE: For low values of h_{sw}, the load case in Annex F, F(3), may govern the design.

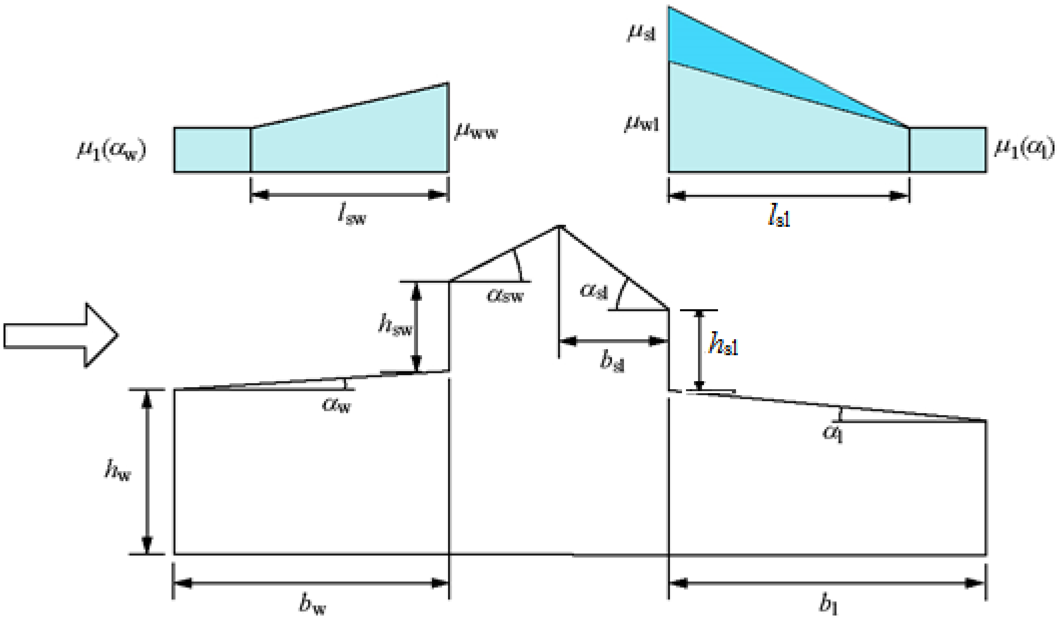

Figure 5.6.a GL NA – Structure with shelter where the windward face height is h_{sw}, and the leeward face height is h_{sl}

(6) If the leeward side of a roof has several local shelters, the leeward load shall be increased in certain cases. This is taken into account by applying an additional load arrangement when all of the conditions mentioned below are fulfilled:

- The height of the windward side of the building does not exceed 10 m;
- 2 times the ridge height, *h*, is smaller than the crosswind dimension of the building, *l*, see Figure 5.7.a GL NA, i.e. $2h < l$;
- the shelters are at least 0,5 m high;
- the free distance, l_v, between shelters is between 3 and 7 times their width, *v*;
- The shelters are located on the leeward side.

The snow load shape coefficient, μ_w, for the additional load arrangement is obtained from:

$\mu_w = 1{,}0$ for $0° \leq \alpha \leq 35°$
$\mu_w = 1 - (\alpha\text{-}35°)/25°$ for $35° < \alpha < 60°$
$\mu_w = 0$ for $60° \leq \alpha$

This load is applied to the leeward face of the shelters, see Figure 5.7.a GL NA.

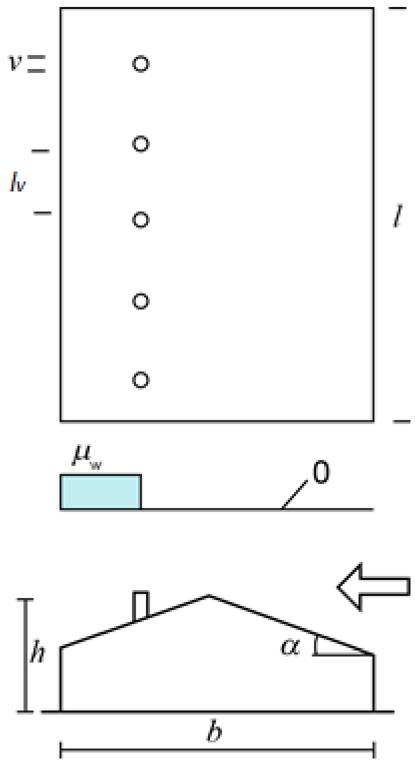

Figure 5.7.a GL NA – Closely spaced local shelters

If the free distance between the shelters is 10 times the shelter width, ($l_v \geq 10v$), the load case in Figure 5.7.a GL NA may be disregarded. If the free distance is between 7 and 10 times the shelter width, ($7v < l_v < 10v$), the shape coefficient, μ_w, is determined by linear interpolation.

If the free distance is 0, the shape coefficient, μ_w, is determined by applying the rules in clause 5.3.6(5). If the free distance is between 0 and 3 times the shelter width, ($0 < l_v < 3v$), the shape coefficient, μ_w, is determined by linear interpolation.

The rules regarding local shelters are not to be combined neither with the rules in clause 5.3.3(4), nor the rules for roof valleys specified in Annex G.

Annex A

Annex A, Table A.1, Note 2 Design situations and load arrangements to be used for different locations – Application of Annex B (exceptional snow loads)

Exceptional snow falls or snow drifts are not assumed for Greenland; therefore no instructions are given for situations B1 and B3.

Annex B

The Annex is not applied.

Annex C

The Annex is not applied.

Annex D

The Annex can be applied.

Annex E

The Annex can be applied.

Complementary information
Normative

5.3.1(1) Snow load shape coefficients, General, Alternative snow drift load arrangements
NOTE: Furthermore, drifted snow loads shall include the specifications in Annex F.

6.2 Drifting at projections and obstructions
The entire section is replaced by a new Section 5.3.6

Annex F Alternative drifted snow load arrangements
(1)NA For structures susceptible to snow load variations, e.g. cantilevered structures and structures susceptible to torsion, a load situation should be examined where half of the snow load is taken as a fixed action and the other half of the snow load is taken as a free action.

(2)NA The same partial coefficient is applied for the fixed part and the free part of the snow load.

For cantilevered roofs, examples include the following load cases:

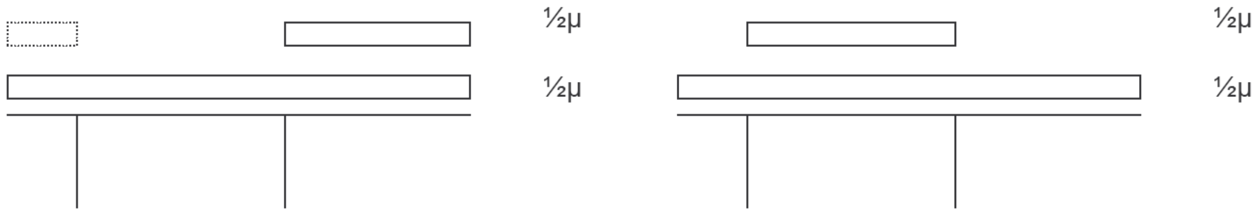

Figure F.1 GL NA – Structure with cantilever

For a structure susceptible to torsion, examples include the following load cases:

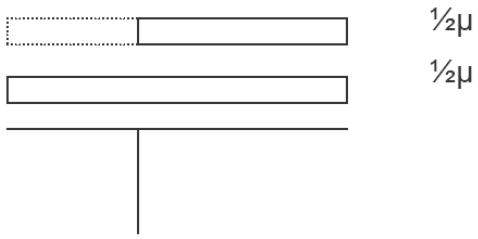

Figure F.2 NA – Structure susceptible to torsion

NB: $\mu = \mu_1$

(3)NA For a roof where the slope is reduced from α_2 to α_3, see Figure F.3A GL NA, the risk of snow loads due to drifting can be taken into account as illustrated in the figure. Case (ii) is equivalent to case (ii) in EN 1991-1-3, clause 5.3.4 (3), which is applied if $\alpha_0 < 0$.

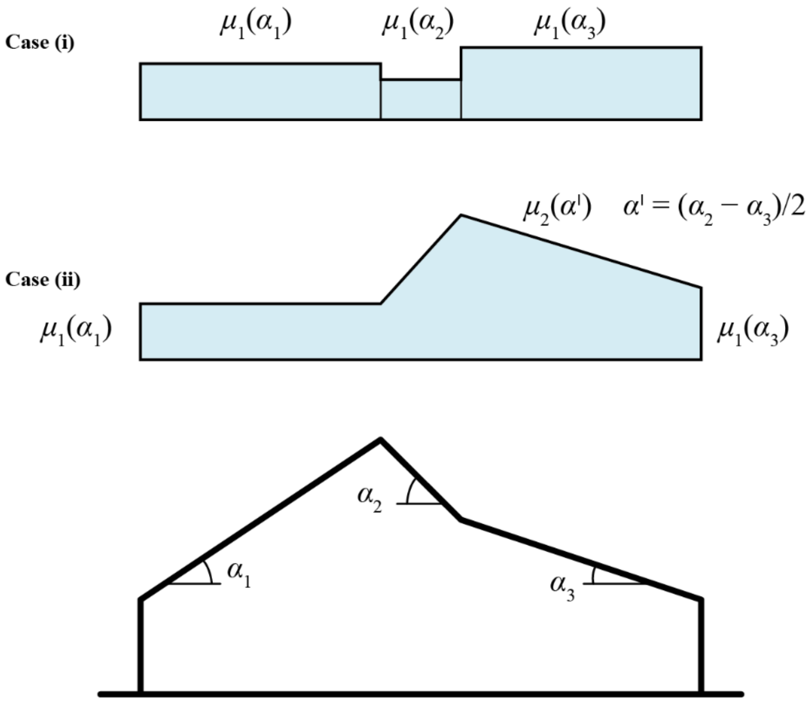

Figure F.3 GL NA – Snow load shape coefficients for roofs with change of slope

Annex G, Roof valleys
(1)NA At roof valleys, drifting may occur both at the windward and the leeward sides.

The rules given below apply for buildings where the horisontal projection of the roof valley $l \geq 10$ m, and where $b_1 \geq 2h_1$ or $b_2 \geq 2h_2$; the symbols appear from Figure G.1 NA.

(2)NA Drifting is assumed in the hatched area of Figure G.1 GL NA. Drifting may occur on both sides simultaneously or on one side only.

(3)NA Within the hatched area, the shape coefficient is increased from μ_2 to μ_3 as shown in Figure G.1.GL NA, where $\propto_2$ and $\propto_3$ are the shape coefficients according to 5.3.3(2). For $\propto_3$, the value of the larger of the angles of roof slope is applied.

NOTE 1: The rule applies to monopitch as well as pitched roofs.

NOTE 2: For structures that are not susceptible to asymmetric snow loads (e.g. structures not susceptible to torsion), it will be conservative to take the shape coefficient as μ_3 for the entire hatched area.

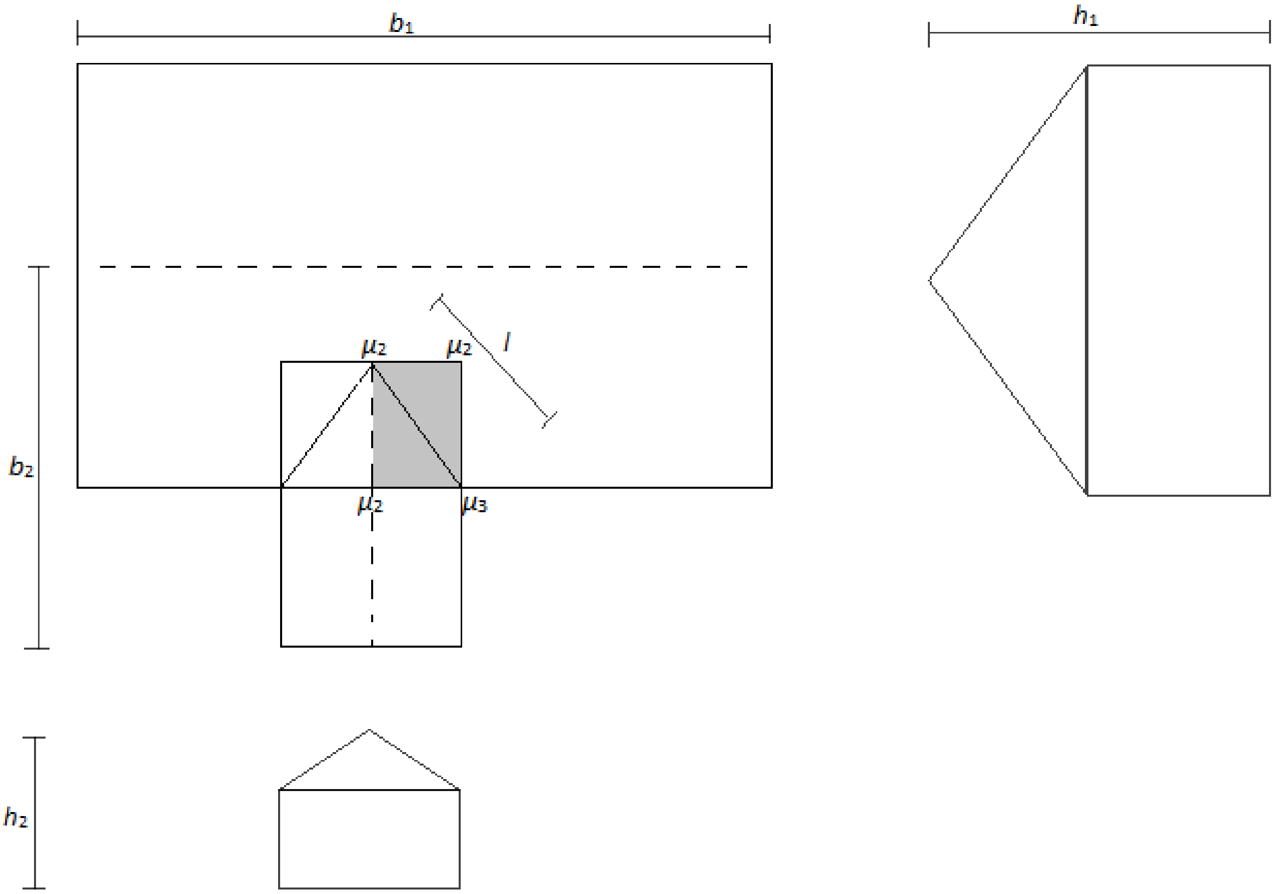

Figure G.1 GL NA – Structure with roof valleys. The area for which increased shape coefficients apply is marked

Annex H, Snow load shape coefficients for snow drifting on balconies

The sheltering character of the balcony depends on the geometry of the building and the balcony. A definition of geometric sizes of building and balcony is given in Figures H.1 GL NA and H.2 GL NA for a rectangular building with one balcony and several balconies, respectively.

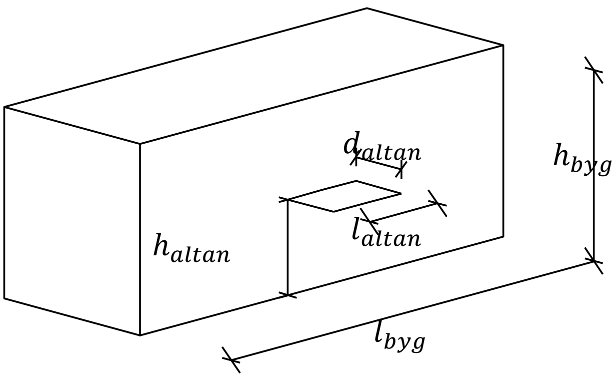

Figure H.1 GL NA – Geometry of rectangular building with one balcony

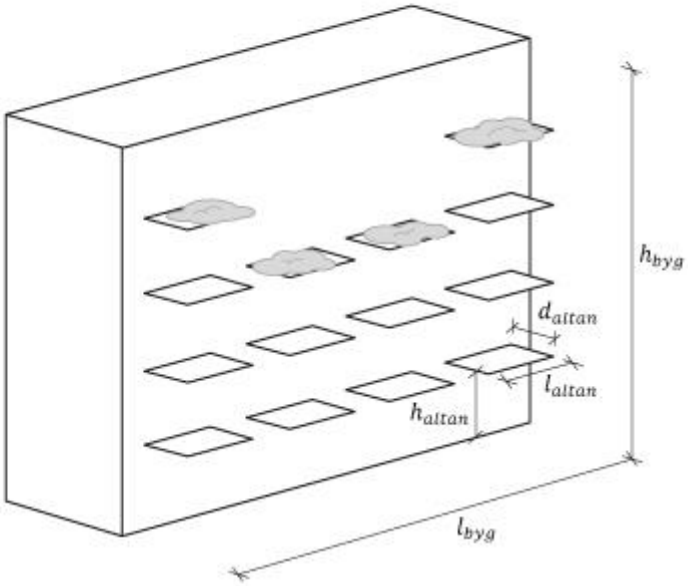

Figure H.2 GL NA – Geometry of rectangular building with several balconies

In general, it is assumed that the face of the building without balconies is flat and that the cantilevered length of the balcony $d_{altan} < 4\text{m}$.

For snow drifting on balconies, $\mu_{ww} = 2$ can be used when one of the following conditions is met:

- For faces or gables where $l_{byg} < 2 \cdot h_{byg}$. This is because the wind primarily flows around the building rather than down the face, and subsequently around the building.
- On corner balconies, because here increased wind speeds occur.
- For balconies located at a height of 3/4 of the building and above.

For those balconies where the above is not met, $\mu_{ww} = 2$ can still be used under the following conditions:

$$l_{altan} \leq 4 \cdot d_{altan} \quad (2)$$

$$l_{altan} \leq \frac{1}{4} \cdot l_{byg} \quad (3)$$

$$\sum_{i=1}^{n} l_{altan,i} \leq \frac{2}{3} \cdot l_{byg} \quad (4)$$

where n in (4) is the number of balconies at the considered height above ground such that the sum becomes equal to the total length of the balconies at that height. An example for $n = 3$ is shown in Figure H.3 GL NA The total length of the balconies is assumed to just comply with the requirement (4)

$$\sum_{i=1}^{n} l_{altan,i} = l_{a1} + l_{a2} + l_{a3} = \frac{2}{3} \cdot l_{byg}$$

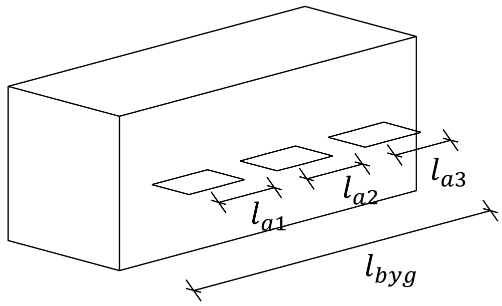

Figure H.3 GL NA Several balconies on building. For clarity, balconies at other heights are not included in the illustration.

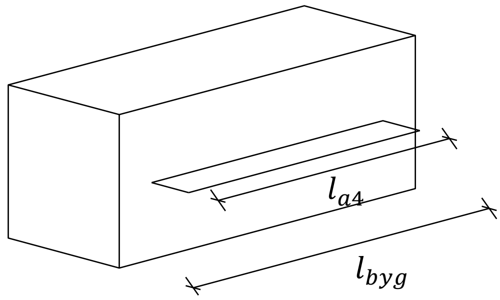

Figure H.4 GL NA Elongated balcony on a building.

If the above conditions (2) - (4) are not met, the balcony is considered to be a global shelter, and snow drifting on balconies gives shape coefficients larger than 2. An elongated balcony as illustrated in Figure H.4 GL NA will not normally meet the above specifications, whereby $\mu_{ww} > 2$.
The snow on a balcony will at most be taken as equivalent to a snow height equal to the height of the balcony guard. For a guard height of 1,2 m and a specific weight of snow of γ =2,0 kN/m^3, the maximum shape coefficient may be determined from

$$\mu_{ww} = h_{guard} \cdot \frac{\gamma}{s_k} = 1{,}2\text{m} \cdot \frac{2{,}0\text{kN/m}^3}{1{,}0\text{kN/m}^2} = 2{,}40$$

If the height of the guard is increased, the maximum shape coefficient will also be increased but will not exceed $\mu_{ww} = 4$, similar to that of a global shelter.
It will always be acceptable to apply a characteristic snow load equal to the smaller of 4,0 kN/m^2 and the guard height multiplied by 2,0 kN/m^3, with the guard height not being taken as less than 1,2 m.

Complementary information
Informative

5.3.1(3) Snow load shape coefficients, General, Thickness of snow layer
NOTE: The thickness of snow layers can be estimated from the snow load and a specific weight for snow of about 2,5 kN/m^3.