Foreword
This national annex (NA) is a revision of DS/EN 1991-1-3 DK NA 2010-05 and replaces the latter on 2012-11-01. During a transition period until 2013-03-01, this NA as well as DS/EN 1991-1-3 DK NA 2010-05 are applicable.

Previous versions, addenda and an overview of all National Annexes can be found at www.Eurocodes.dk

This NA lays down the conditions for the implementation in Denmark of DS/EN 1991-1-3 for construction works in conformity with the Danish Building Act or the building legislation. Other parties can put this NA into effect by referring thereto.

This NA specifies the national choices prescribed in Denmark.

This NA includes:

- an overview of possible national choices and clauses containing complementary information;
- national choices;
- complementary (non-contradictory) information which may assist the user of the Eurocode;
- new text replacing clauses 5.3.6 and 6.2, respectively.

The numbering refers to the clauses of the Eurocode where choices are allowed and/or complementary information is given. To the extent possible, the heading/subject is identical to the heading of the clause in the Eurocode, followed by a clarification, as appropriate.
Overview of possible national choices and complementary information;

The list below identifies the clauses where national choices are possible and the applicable/not applicable informative annexes. Furthermore, clauses giving complementary information are identified. Complementary information is given at the end of this document.

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**NOTE** -

- **Unchanged**: No national choice is made and recommendations, if any, in the Eurocode are followed.
- **No choice made**: The Eurocode does not recommend values/choices, but allows the option of determining national values/choices. No values/choices have been determined/made.
- **Not relevant**: Not applicable in Denmark.
National choices

4.1 (1) NOTE 1 Characteristic values - Snow load on the ground
Characteristic ground snow load value \( s_k = 1,0 \) kN/m\(^2\).

4.2 (1) Other representative values - Load combination factors
Values equal to those specified in the Danish National Annex to DS/EN 1990 are chosen.

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:

\[
C_e = C_{\text{top}} C_s
\]

where

- \( C_{\text{top}} \) is the topography coefficient;
- \( C_s \) is the size coefficient.

The coefficient \( C_{\text{top}} \) is obtained using Table 5.1.a NA

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

<table>
<thead>
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<th>Topography</th>
<th>( C_{\text{top}} )</th>
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<td>Windswept a)</td>
<td>0.8</td>
</tr>
<tr>
<td>Normal b)</td>
<td>1.0</td>
</tr>
<tr>
<td>Sheltered c)</td>
<td>1.25</td>
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</table>

a) Windswept topography: flat unobstructed areas exposed on all sides without, or little shelter afforded by terrain, higher construction works or trees. The topography can be taken as windswept when the structure is at least 15 m higher than local shelters in the surrounding terrain. It is particularly decisive to evaluate the conditions in the case of exposure to wind from eastern directions – see Figure 5.3.c NA.

b) Normal topography: areas where there is no significant removal of snow by wind on construction works because of terrain, other construction works or trees.

c) Sheltered topography: areas in which the construction being considered is considerably lower than the surrounding terrain or surrounded by high trees and/or by higher construction works.

The coefficient \( C_s \) is obtained by:

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 5.1.b NA):

\[
C_s = 1.0
\]

For \( 2h \leq l_1 \) (cf. Figure 5.1.b NA):

\[
\begin{align*}
C_s &= 1 \\
C_s &= 1 + 0.025 \cdot \frac{l_2-10h}{h} 
\text{ for } l_2 \leq 10h \\
C_s &= 1.25 
\text{ for } 10h < l_2 < 20h \\
C_s &= 1.0 
\text{ for } l_2 \geq 20h
\end{align*}
\]

\[\text{Figure 5.1.b NA – Building dimensions}\]

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 shape factor of zero for the windward side and \( \mu_w \) for the leeward side of the roof as shown in Figure 5.3.b 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 orientation of the building shall be as shown in Figure 5.3.c NA;
- 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 5.3.c NA, i.e. \( 2h < l \);
- the depth of the building, \( b \), is larger than the ridge height of the building, \( h \), see Figure 5.3.b NA, i.e. \( b > h \);
- the windward terrain is an open area which corresponds to a terrain roughness of category II according to DS/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.
The shape coefficient, $\mu_w$, obtained from Figure 5.3.b 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 $60^\circ \leq \alpha$

Figure 5.3.c NA – Drifted snow on leeward side of the roof (hatched area) is assumed to occur only when the windward side faces directions from NNE to SE, corresponding to significant drifting when wind comes from easterly directions only.
5.3.5(1) NOTE 1 Snow load shape coefficients. Cylindrical roofs - Upper limit of shape coefficients for cylindrical roofs
The following upper value is used: $\mu_3 = 2.0$.

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 DS/EN 1991-1-3:2007 is supplemented by the following load arrangement shown in Figure 5.6.b NA and Figure 5.6.c NA.

For $\beta_0 \leq 60^\circ$, triangular drifting distribution is assumed, taken as zero at the ridge and using the shape coefficients $\mu_3$ and $\mu_3/2$, 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 $\mu_3$ and $\mu_3/2$, respectively, where $\beta = 60^\circ$. For $\beta > 60^\circ$, the shape coefficient is 0.

Figure 5.6.b NA – Snow load shape coefficient for a cylindrical roof slope $\beta_0 > 60^\circ$
5.3.6 Snow load shape coefficients. Roofs abutting and close to taller construction works as well as drifting at projections and obstructions

(1) NA The structure afforded shelter from the wind is illustrated in Figure 5.7.1 NA. 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 clause 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 be reduced.

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

(2) 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

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

where (see also Figure 5.7.1 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 $\alpha_{sw} \leq 60^\circ$. For $\alpha_{sw} = 90^\circ$, $h_{sw}$ is taken as the ridge height. For $60^\circ < \alpha_{sw} < 90^\circ$, $h_{sw}$ is obtained by interpolation.

(3) NA Snow load shape coefficients for structures with shelters are given by the following expressions and are shown in Figure 5.7.1 NA:

$$ \mu_1 \text{ is obtained from Figure 5.1 of DS/EN 1991-1-3, applying the roof slopes considered} $$

$$ \mu_2 = \mu_s + \mu_w \quad (5.7) $$

where
\( \mu_s \) is the snow load shape coefficient due to snow sliding from the upper roof;

\( \mu_w \) is the snow load shape coefficient due to wind. This shape coefficient depends on the specific weight density of snow, \( \gamma \), which is taken as 2 kN/m\(^3\) for this calculation.

(4)NA For the **windward** face of a shelter the following applies, see Figure 5.7.aNA:

\[
\begin{align*}
l_{sw} &= \min\{b_w;2h_{sw}\} \quad \text{but } 5 \text{ m} \leq l_{sw} \leq 15 \text{ m} \\
\mu_{ww} &= \frac{h_{sw}}{s_k} \quad \text{but } \mu_{ww} \geq \mu_1 \\
\mu_{ww} &\leq 2 \quad \text{for } a \leq 0,2 \\
\mu_{ww} &\leq 10a \quad \text{for } 0,2 < a < 0,4 \\
\mu_{ww} &\leq 4 \quad \text{for } a \geq 0,4
\end{align*}
\]

(5)NA For the **leeward** face of a shelter the following applies, see Figure 5.7.aNA:

\[
\begin{align*}
l_{sl} &= 5 \ h_{sl} \quad \text{but } 5 \text{ m} \leq l_{sl} \leq 15 \text{ m} \\
\mu_{wl} &= \frac{h_{sl}}{s_k} \quad \text{but } \mu_1 \leq \mu_{wl} \leq 2 \\
\mu_{sl} &= 0 \quad \text{if } h_{sl} < 0,5 \text{ m} \\
\mu_{sl} &= 0 \quad \text{for } \alpha_{sl} \leq 15^\circ \\
\mu_{sl} &= \mu_1(\alpha_{sl}) \frac{b_{sl}}{l_{sl}} \quad \text{for } \alpha_{sl} > 15^\circ
\end{align*}
\]

NOTE - For low values of \( h_{sw} \), the load case in Annex F, F(3), may govern the design.
(6) NA 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 orientation of the building shall be as shown in Figure 5.3.c NA;
- the height of the windward face 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 5.8.a NA, i.e. $2h < l$;
- the shelters are at least 0.5 m high;
- the free distance between shelters is between 3 and 7 times their width, $v$;
- shelters are located on the leeward side.

The shape coefficient, $\mu_w$, for the additional load arrangement is obtained from:

$$
\mu_w = \begin{cases} 
1.0 & \text{for } 0^\circ \leq \alpha \leq 35^\circ \\
1 - (\alpha - 35)/25 & \text{for } 35^\circ < \alpha < 60^\circ \\
0 & \text{for } 60^\circ \leq \alpha 
\end{cases}
$$

The load is applied to the leeward face of the shelters, see Figure 5.8.a NA.
If the free distance is larger than 10 times the shelter width, the wind conditions around each shelter does not depend on the other local shelters, and the rules given in clause 5.3.6 are applied for each individual shelter. These rules are also applicable where the free distance between the local shelters is 0.

Intermediary free distances between the local shelters are determined by interpolation.

The rules regarding local shelters are 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, 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 Denmark; therefore no instructions are given for cases B1 and B3.
Complementary (non-contradictory) information

5.3.1(1) Shape coefficients. General. Alternative snow drift load arrangements

"NOTE – Drifted snow loads are furthermore to include the specifications in Annex F”.

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 case is 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 NA Structure with cantilever](image)

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

![Figure F.2 NA Structure susceptible to torsion](image)

NB: $\mu = \mu_1$

(3)NA For a roof where the slope is reduced from $\alpha_2$ to $\alpha_3$, see Figure F.3 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 5.3.4 (3), which is applied if $\alpha_3 < 0$. 

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Annex G Roof valleys

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

(2) NA The shape coefficient for the hatched area in Figure G.1 NA is increased by 100% compared with the shape coefficient $\mu_1$ according to 5.3.3(2) for the slope considered. When drifting at the leeward side of the roof is assumed, cf. 5.3.3(4), the shape coefficient $\mu_w$ illustrated in Figure 5.3.b NA in increased by 50%.
(3)NA When the direction of the wind is along a long roof surface, drifting may occur also at the windward face of the side wing. When the distance $a_2$ in Figure G.2 NA is larger than $5h_1$ ($h_1$ being the vertical distance from the overhanging eaves of the main building to the ridge of the side wing, see Figure G.2 NA), drifting of snow is taken as $\mu_w = 2$ at the windward side of global shelters, and $l_s = 2h_1$.

Figure G.2 NA Structure with roof valleys. The area for which increased shape coefficients apply is marked.