Loading for buildings —

Part 3: Code of practice for imposed roof loads

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Sector Board for Building and Civil Engineering (B/-) to Technical Committee B/525/1, upon which the following bodies were represented:

British Constructional Steelwork Association Ltd.

British Iron and Steel Producers' Association

British Masonry Society

Concrete Society

Department of the Environment (Building Research Establishment)

Department of the Environment (Property and Building Directorate)

Highways Agency

Institution of Civil Engineers

Institution of Structural Engineers

National House Building Council

Royal Institute of British Architects

Steel Construction Institute

Amendments issued since publication

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Contents

Foreword

This Part of this British Standard Code of practice has been prepared under the direction of the Civil Engineering and Building Structures Standards Committee as a new Part to BS 6399 (formerly CP 3: Chapter V).

Imposed roof loads were previously included in BS 6399-1. This new Part of BS 6399 now gives more information on imposed roof loads and in particular gives snow loading data separately, allowing account to be taken of the variation of snow in the United Kingdom and the effect of redistribution of snow on roofs due to wind. Use of the uniformly distributed snow loads are subject to an overriding minimum requirement.

This code can be used for design using permissible stresses or partial factors. In the former case the values should be used directly while in the latter case they should be factored by an appropriate value depending upon whether an ultimate or serviceability limit state is being considered. The exception to this is the treatment of the load cases involving local drifting of snow, where it is recommended that these are treated as exceptional loads and used in design with reduced safety factors.

Section two of this Part of BS 6399 is broadly in agreement with ISO 4355-1981 "Bases for design of structures — Determination of snow loads on roofs", published by the International Organization for Standardization (ISO). However, one difference is that, in general, the uniform snow load condition and the drift snow load condition are treated as independent load cases. This is in recognition of the United Kingdom's maritime climate which means that for many parts of the country the maximum snow load condition is likely to result from a single fall of snow, rather than an accumulation over several months.

The treatment of snow drifting against obstructions in section two is similar to that given in BRE Digest 290, issued in October 1984, but now withdrawn. However, it should be noted that there are some differences as follows:

   a) the notation has changed to conform better to ISO 3898;

   b) there are increased restrictions on the amount of snow that can form in the drift;

   c) the drift loads are to be treated as exceptional loads.

The last point explains why the upper bound values for the snow load shape coefficients have apparently increased. (Digest 290 was drafted so that the drift loads could be treated as ultimate loads.)

The designer should be aware that the deposition and redistribution of snow on roofs are very complex phenomena. The type and record length of the ground snow data available and the paucity of observational data on roof snow loads make it extremely difficult to estimate snow load distributions reliably. This Code models the actual drift shapes and load intensities by simplified linear distributions, based on assumptions on the amount of snow available to drift and limitations on the drift height. Wherever possible, available observational data have been incorporated in the development of the design models.

In this Part of BS 6399 numerical values have been given in terms of SI units, details of which are to be found in BS 5555. Those concerned with the conversion and renovation of existing structures or buildings designed in terms of imperial units may find it useful to note that 1 N = 0.225 lbf and 1 kN/m^2 = 20.89 lbf/ft^2.

The full list of organizations that have taken part in the work of the Technical Committee is given on the Inside front cover.

Amendment 2 has been issued to address problems encountered with use.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 22, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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Section 1. General

1 Scope

This Part of BS 6399 gives minimum imposed roof loads for use in designing buildings and building components which are to be constructed and used in the UK and the Channel Islands. It applies to:

    a) new buildings and new structures;

    b) alterations and additions to existing buildings and existing structures.

Caution is necessary in applying the snow load calculations for sites at altitudes above 500 m and specialist advice should be obtained in such situations (see appendix C).

NOTE   The titles of the publications referred to in this code are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 6399 the following definitions apply.

2.1
imposed roof load (or imposed load on roof)

the load assumed to be produced by environmental effects on the roof, excluding wind loads, and by use of the roof either as a floor or for access for cleaning and maintenance

NOTE   The environmental effects included in the imposed roof load are those due to snow, rain, ice and temperature. Snow is treated specifically in this code while the minimum imposed roof load value allows for loads resulting from rain, ice and temperature. However, for certain cases in the UK specific consideration may have to be given to temperature effects, e.g. movement joints; these cases are not included in this code. The minimum imposed roof load value also allows for a certain build-up of water on the roof due to ponding, but it does not allow for the effect of drains becoming blocked. This can be caused by general debris or ice and consideration may need to be given in design to what happens to the drain water if this occurs. For roofs with no access, the minimum imposed roof load value includes an allowance for repair and maintenance work. For roofs with access, consideration needs to be given to how the roof may be used and, if necessary, an appropriate floor load as recommended in clause **5** of BS 6399-1:1996 should be used. The minimum imposed roof load specified does not include an allowance for loads due to services.

2.2
basic snow load

the load intensity of undrifted snow in a sheltered area at an assumed ground level datum of 100 m above mean sea level, estimated to have an annual probability of exceedance of 0.02

2.3
altitude of site

the height above mean sea level of the site where the building is to be located, or is already located for an existing building

2.4
site snow load

the load intensity of undrifted snow at ground level, at the altitude of the site

2.5
snow load shape coefficient

the ratio of the snow load on the roof to the undrifted snow load on the ground

2.6
snow load on roof

the load intensity of the snow on the roof

2.7
redistributed snow load

the snow load distribution resulting from snow having been moved from one location to another location on a roof by the action of the wind

2.8
exceptional snow load

the load intensity resulting from a snow deposition pattern which has an exceptionally infrequent likelihood of occurring and which is used in design with reduced safety factors

2.9
variably distributed load

a vertical load on a given area in plan of varying local load intensity

3 Symbols

For the purposes of this Part of BS 6399 the following symbols apply.

A Altitude of site in metres above mean sea level;

b_i Horizontal dimension, suffix $i = 1$, 2 or 3 to distinguish between several horizontal dimensions on the same diagram;

F_s Force per unit width exerted by a sliding mass of snow in the direction of slide;

h Assumed maximum height of snow in a local drift (valleys of multi-span roofs and the intersections);

h_{oi} Vertical height of obstruction, suffix $i = 1$, 2 or 3 to distinguish between several vertical heights on the same diagram;

l_{si} Horizontal length of snow drift, suffix $i = 1$, 2 or 3 to distinguish between several snow drifts on the same diagram;

s_{alt} Coefficient used in correcting basic snow load on the ground for altitude;

s_b Basic snow load (on the ground);

s_d Snow load on roof;

s_0 Site snow load (on the ground);

α Angle of pitch of roof measured from the horizontal;

β Equivalent slope for a curved roof;

δ Angle between the horizontal and a tangent to a curved roof at the eaves;

μ_i Snow load shape coefficient, suffix $i = 1, 2$, etc. to distinguish between shape coefficients at different locations.

4 Minimum imposed roof loads

4.1 General

In **4.2** and **4.3** "access" means access in addition to that necessary for cleaning and repair and "no access" means access for cleaning and repair only.

The effects of deflection under concentrated loads need only be considered when such deflection would adversely affect the finishes.

All roof slopes are measured from the horizontal and all loads should be applied vertically.

4.2 Minimum imposed load on roof with access

Where access is provided to a roof allowance should be made for an imposed load equal to or greater than that which produces the worst load effect from one of the following:

a) the uniformly distributed snow load; or

b) the redistributed snow load; or

c) a uniformly distributed load of 1.5 kN/m^2 measured on plan; or

d) a concentrated load of 1.8 kN.

Where the roof is to have access for specific usages the imposed loads for c) and d) above should be replaced by the appropriate imposed floor load as recommended in **5.1** of BS 6399-1:1996, including any reduction as appropriate as recommended in **6.3** of BS 6399-1:1996.

4.3 Minimum imposed load on roof with no access

4.3.1 *General.* Where no access is provided to a roof (other than that necessary for cleaning and maintenance), allowance should be made for an imposed load equal to or greater than that which produces the worst load effect from one of the following:

a) the uniformly distributed snow load; or

b) the redistributed snow load; or

c) a uniformly distributed load of 0.6 kN/m^2 measured on plan for roof slopes of 30° or less; or a uniformly distributed load of 0.6 $[(60 - \alpha)/30]$ kN/m^2 measured on plan for roof slopes (α) greater than 30° and less than 60°; or zero load for roof slopes equal to or greater than 60°; or

d) a concentrated load of 0.9 kN.

These loads assume that spreader boards will be used while any cleaning or maintenance work is in progress on fragile roofs. The recommendations of this clause may also be used where a ladder is permanently fixed to allow access to a roof for cleaning and maintenance only.

4.3.2 *Small buildings.* This subclause is an optional alternative to **4.3.1**, which means that the detailed calculations using snow load shape coefficients do not have to be carried out. It applies to any building, where no access is provided to the roof (other than that necessary for cleaning and maintenance), which has:

a) a roof area no larger than 200 m^2 in plan; or

b) a width no greater than 10 m and a pitched roof with no parapet;

provided that there are no other buildings within 1.5 m of its perimeter, and provided that the roof configuration also meets one of the following conditions:

1) the roof has no abrupt changes of height greater than 1 m, at which drifting could occur;

2) the area of a lower part of the roof, on which a drift could form, is not greater than 35 m^2.

For the purpose of this subclause the roof area is defined as the total covered area, in plan, of the entire building structure. Also, chimneys and dormers whose vertical elevation area, against which a drift could form, is less than 1 m^2 can be ignored as an abrupt change of height.

Providing the above conditions are met, an allowance should be made for an imposed load equal to or greater than that which produces the worst load effect from one of the following:

i) a uniformly distributed load of 1.25 times the site snow load s_0 (see **6.2**); or

ii) a uniformly distributed load of 0.75 kN/m^2; or

iii) a concentrated load of 0.9 kN.

For roof slopes (α) larger than 30° and less than 60° the values given by i) and ii) may be reduced by multiplying by $[(60 - \alpha)/30]$. For roof slopes larger than 60° the minimum uniformly distributed load requirement is zero.

4.4 Curved roofs

The minimum imposed load on a curved roof should be calculated in accordance with **4.3**. In evaluating **4.3.1** c), the roof should be divided into not less than five equal segments and the mean slope of each segment considered to be equivalent to the roof slope, α. The snow loads should be determined according to clause **7**.

4.5 Partial loading due to snow removal

In certain cases snow may be artificially removed from, or redistributed on, a roof, e.g. due to excessive heat loss through a small section of roof or manually to maintain access to a service door. This can result in more severe load imbalances occurring than those resulting from clause **5** (which have been derived for natural deposition patterns). To provide for these situations, if they are likely to occur and if other information is not available, a load case should be considered comprising the minimum imposed uniformly distributed load according to clause **4** on any portion of the roof area and zero load on the remainder of the area.

4.6 Roof coverings

A load of 0.9 kN on any square with a 125 mm side provides for loads incidental to maintenance on all self-supporting roof coverings, i.e. those not requiring structural support over their whole area. No loads incidental to maintenance are appropriate to glazing.

Section 2. Snow loads

5 Snow load on the roof

The snow load on the roof s_d (in kN/m^2) is determined by multiplying the estimated snow load on the ground at the site location and altitude (the site snow load) by a factor known as the snow load shape coefficient in accordance with the following equation:

$$s_d = \mu_i \, s_0$$

where

s_0 is the site snow load (in kN/m^2) (see clause **6**);

μ_i is the snow load shape coefficient μ_1, μ_2, etc. (see clause **7**).

Several snow load cases may have to be considered in design to check adequately for the different snow load patterns that can occur. Each load case may require the use of one or more different snow load shape coefficients. Depending upon the pattern being considered the snow load on the roof should be treated either as a uniformly distributed load or as a variably distributed load over all or part of the roof. It should be assumed to act vertically and refer to a horizontal projection of the area of the roof. For the redistributed snow load cases the distribution of the snow in the direction parallel to the obstruction is normally assumed to be uniform.

The snow load on the roof should be considered to be a medium term load for the majority of design in the UK, i.e. to have a notional duration of one month.

6 Snow load on the ground

6.1 Basic snow load (s_b)

The basic snow load on the ground has been assessed for the UK by statistical analysis of the snow depth records kept by the Meteorological Office and converted into a load by the use of a statistically derived conversion factor. The values are given as lines of equal load intensity (isopleths) on the map in Figure 1. They are corrected for an assumed ground level datum of 100 m above mean sea level and have an annual probability of exceedance of 0.02 (for other annual probabilities of exceedance see appendix A). For locations between the lines the load intensity should be obtained by interpolation.

NOTE   The sopleths in Figure 1 are derived from analysis of data from a limited number of recording stations and therefore unusual local effects may not be included. These include local shelter from the wind, which may result in increased local snow loads, and local configurations in mountainous areas, which may funnel the snow and give increased local loading. If the designer suspects that there may be unusual local conditions that may need to be taken into account, then the Meteorological Office or informed local sources should be consulted.

6.2 Site snow load (s_0)

The snow load at ground level increases as the altitude of the ground level increases. As the basic snow load on the ground is given for an assumed ground level altitude of 100 m, it is necessary to adjust the value for locations where the ground level is above 100 m. The site snow load s_0 (in kN/m^2) should be calculated from the following equations:

$$s_0 = s_b$$

for sites whose altitude is not greater than 100 m; or

$$s_0 = s_b + s_{alt}\,((A - 100)/100)$$

for sites whose altitude is above 100 m but not greater than 500 m

where

s_b is the basic snow load on the ground (in kN/m^2) (see **6.1**);

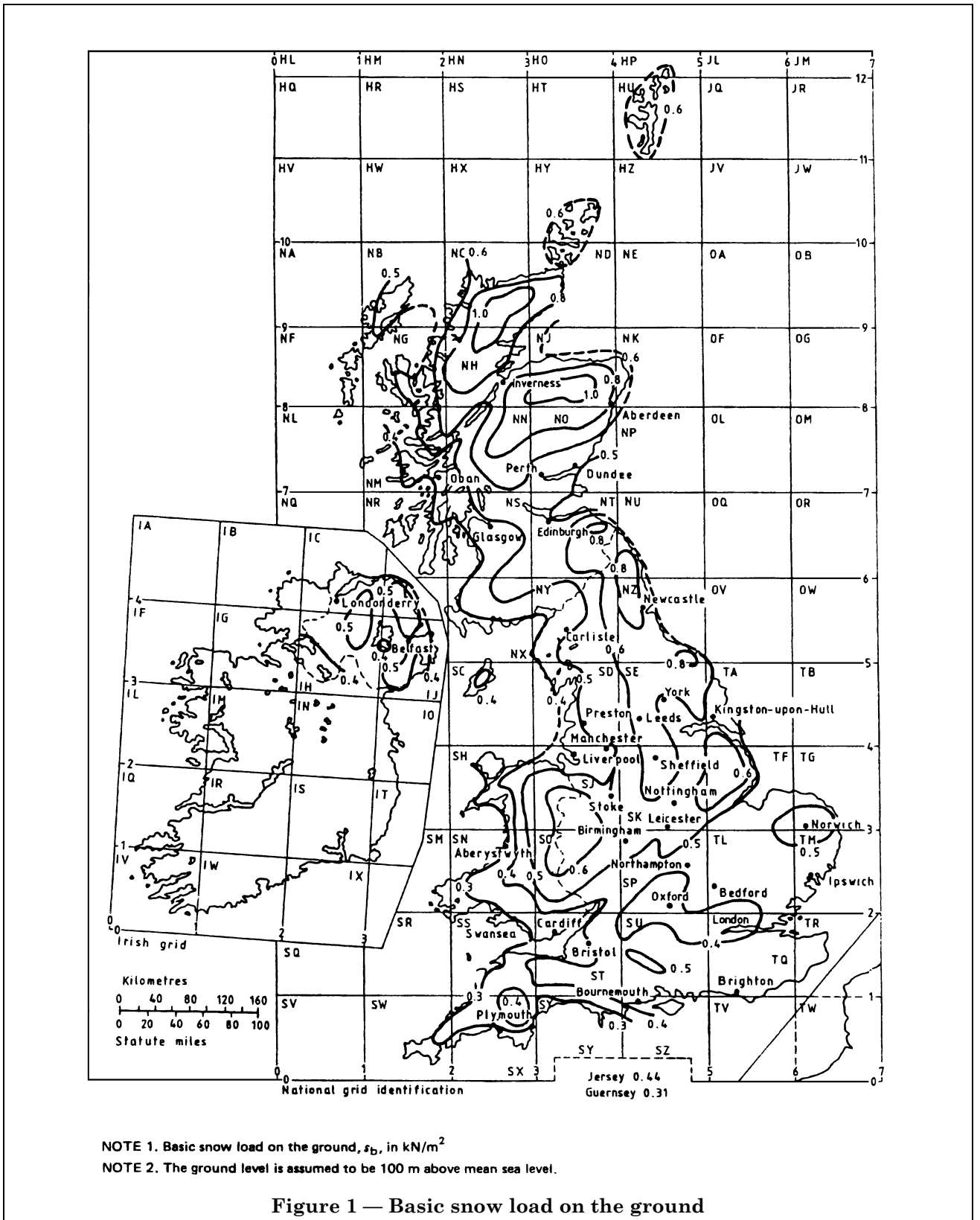$s_{alt} = 0.1 s_b + 0.09$ (alternatively see Table 1);

A is the altitude of the site (in metres).

It is not necessary to make any correction for the height of the building. For sites whose altitude is above 500 m specialist advice should be sought (see clause **1** and appendix C).

NOTE   For simplicity of calculation it is assumed that the same value for the basic snow load on the ground should apply for altitudes between 0 and 100 m. If preferred the equation for altitudes greater than 100 m may be used for altitudes between 0 and 100 m; in these cases the correction term, $s_{alt}((A - 100)/100)$, will automatically be negative.

Table 1 — Values of s_{alt} for corresponding values of s_b

s_b	s_{alt}
kN/m^2	
0.30 to 0.34	0.12
0.35 to 0.44	0.13
0.45 to 0.54	0.14
0.55 to 0.64	0.15
0.65 to 0.74	0.16
0.75 to 0.84	0.17
0.85 to 0.94	0.18
0.95 to 1.00	0.19

NOTE 1. Basic snow load on the ground, s_b, in kN/m^2

NOTE 2. The ground level is assumed to be 100 m above mean sea level.

Figure 1 — Basic snow load on the ground

7 Snow load shape coefficients

7.1 General principles

Snow is naturally deposited in many different patterns on a roof depending upon the wind speed, the wind direction, the type of snow, the external shape of the roof and the position and height of any surrounding roofs or obstructions. Therefore, it is often necessary to consider several loading situations to ensure that all the critical load effects are determined.

The primary loading conditions to be considered are:

a) that resulting from a uniformly distributed layer of snow over the complete roof, likely to occur when snow falls when there is little or no wind;

b) those resulting from redistributed (or unevenly deposited) snow, likely to occur in windy conditions.

Condition b) can be caused by a redistribution of snow which affects the load distribution on the complete roof, e.g. snow transported from the windward slope of a pitched roof to the leeward side; usually modelled as a uniformly distributed load on the leeward side of the roof and zero load on the windward side. It can also be caused by redistribution of snow which affects the load distribution on only a local part of the roof, e.g. snow drifting behind a parapet; modelled as a variably distributed load. Both types of redistribution should be considered if appropriate. For a complex roof shape there may be several load cases associated with condition b).

In general, load cases should be considered to act individually and not together. In some circumstances more than one of the load cases will be applicable for the same location on the roof. When this arises they should be treated as alternatives.

NOTE   However, where, for example, on a lower roof area sheltered from all wind directions, there is the possibility of redistribution of snow from a higher roof to form a local drift on top of a uniform snow load distribution on this lower roof, it would be appropriate to consider the local drift load acting in combination with the uniform snow load on the lower roof.

Redistribution of snow should be considered to occur on any roof slope and at any obstruction, as it should be assumed that the wind can blow from any direction.

The equations given in Figure 2 to Figure 9 for determining the snow load shape coefficients are empirical; where they are associated with local drifting of snow they include a correction to allow for an increased weight density in the drift. Therefore, when using the equations the dimensions of the building and of the obstruction (b_1, h_{01}, l_{s1}, b_2, etc.) should be in metres and the site snow load should be in kN/m^2.

NOTE   The snow load shape coefficient, being a ratio of two loads, is non-dimensional. The equations of the form $2h_{0i}/s_0$ are correct, although apparently having the dimensions kN/m^3, because of the density correction. The correction is based on limited information which shows that the snow density is increased when the snow forms in drifts.

7.2 Single span roofs

7.2.1 *General.* These are flat, monopitch, pitched or curved roofs of single span. The snow load shape coefficients do not include any allowances for drifting at parapets or other obstructions as these should be treated independently (see **7.4**).

7.2.2 *Flat or monopitch roofs.* For these roofs it is necessary to consider a single load case resulting from a uniform layer of snow over the complete roof. The value of the snow load shape coefficient (μ_i) is dependent on the angle of the pitch of the roof measured from the horizontal (α) and should be obtained from Figure 2. This value is assumed to be constant over the complete roof area.

7.2.3 *Pitched roofs*

7.2.3.1 *General.* For this type of roof it is necessary to consider two load cases. For both cases the value of the snow load shape coefficient (μ_i) is dependent on the angle of pitch of the roof measured from the horizontal (α). For asymmetric pitched roofs, each side of the roof should be treated as one half of a corresponding symmetric roof.

7.2.3.2 *Case 1; uniform load.* This results from a uniform layer of snow over the complete roof. The value for the snow load shape coefficient should be obtained from Figure 3(a) ; this value is assumed to be constant over the complete roof area.

7.2.3.3 *Case 2; asymmetric load.* This results from transport of snow from one side of the ridge to the other side. This situation only needs to be considered for roof slopes greater than 15°. The value for the snow load shape coefficient for one slope of the roof should be zero, i.e. no snow load. The value for the snow load shape coefficient for the other slope should be obtained from Figure 3(b); this value is assumed to be constant over the loaded slope of the roof.
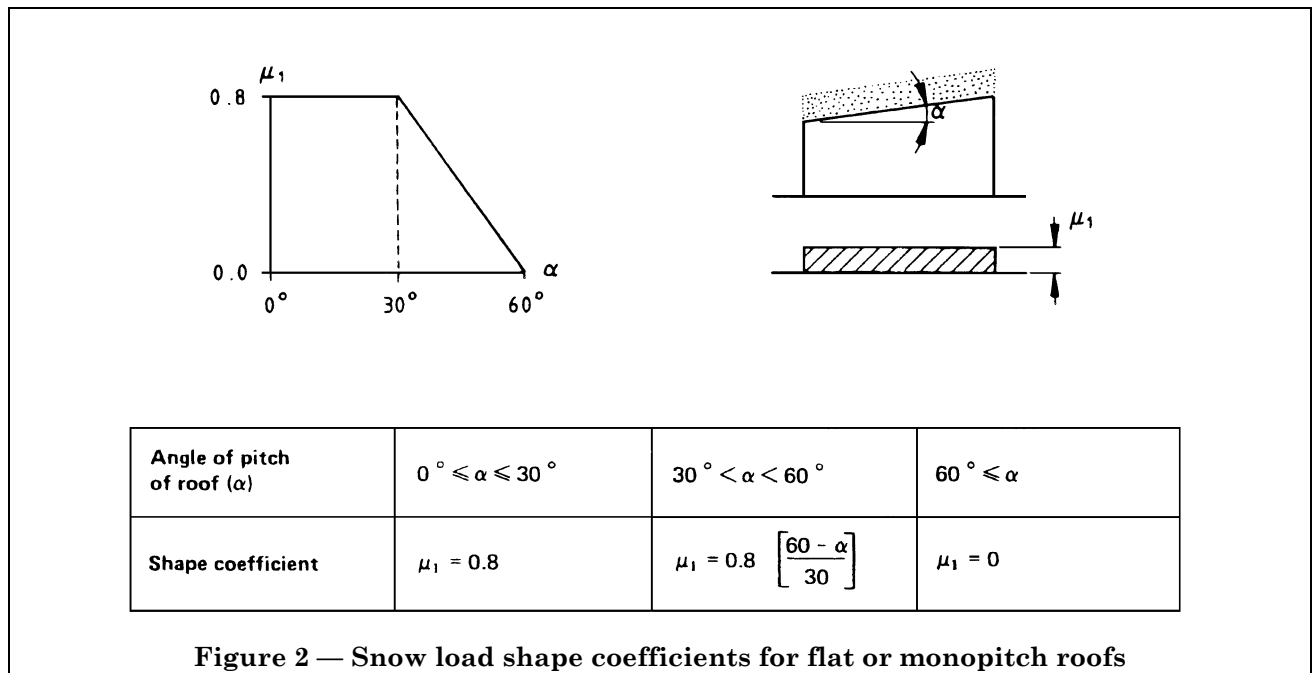
Figure 2 — Snow load shape coefficients for flat or monopitch roofs

Angle of pitch of roof (α)	$0° \leqslant \alpha \leqslant 30°$	$30° < \alpha < 60°$	$60° \leqslant \alpha$
Shape coefficient	$\mu_1 = 0.8$	$\mu_1 = 0.8 \left[\dfrac{60 - \alpha}{30} \right]$	$\mu_1 = 0$

7.2.4 *Curved roofs*

7.2.4.1 *General.* For this type of roof it is necessary to consider two load cases. For both cases the value of the snow load shape coefficient (μ_i) is dependent on an equivalent slope for the curved roof (β). In determining the equivalent slope it is necessary to distinguish between two types of curved roofs; type 1, where the angle between the horizontal and the tangent to the curved roof at the eaves (δ) is 60° or less; and type 2, where the angle is greater than 60°. For type 1 curved roofs the equivalent slope is the angle between the horizontal and a line drawn from the crown to the eaves. For type 2 curved roofs the equivalent slope is the angle between the horizontal and a line drawn from the crown to the point on the curved surface at which a tangent to the surface makes an angle of 60° with the horizontal.

7.2.4.2 *Case 1; uniform load.* This results from a uniform layer of snow over the roof. The value for the snow load shape coefficient should be obtained from Figure 4(a). This value is constant over the roof except for type 2 roofs where the portions of the roof where the tangents make an angle with the horizontal greater than 60° are assumed to be free of snow.

7.2.4.3 *Case 2; asymmetric load.* This results from transport of snow from one side of the curved roof to the other side. This situation only needs to be considered for equivalent roof slopes greater than 15°. The value for the snow load shape coefficient for one side of the roof should be zero, i.e. no snow load, while the values for the snow load shape coefficients for the other slope should be obtained from Figure 4(b) . The values for the snow load shape coefficients are assumed to be constant in the direction parallel to the eaves.

7.3 Multi-span roofs

This clause gives roof snow loads for multi-span pitched, multi-span convex-curved and northlight roofs.

To determine the uniform and asymmetric snow load cases, these structures may be divided into the single-span basic elements considered in **7.2**. The appropriate local drift loads as given **7.4** should also be considered.

NOTE   Local redistribution of snow on a multi-span roof is difficult to predict. The designer should exercise care, particularly with a structure sensitive to asymmetric loading (e.g. arched roof), to ensure that the load cases considered describe the critical loading conditions both for elements and for the structure as a whole.

7.4 Local drifting of snow on roofs

7.4.1 *General.* When considering load cases using snow load shape coefficients obtained from this subclause it should be assumed that they are exceptional snow loads and that there is no snow elsewhere on the roof. Appendix B explains the logical process behind the calculations.

The snow load on the roof calculated using the coefficients in this subclause should be assumed to be variably distributed. In the direction at 90° to the obstruction or valley it should decrease linearly to zero over the length of the drift. In the direction parallel to the obstruction or valley it should be uniform and assumed to extend along the complete length of the obstruction or valley, except where stated otherwise.

In some circumstances more than one local drift load case may be applicable for the same location on a roof in which case they should be treated as alternatives.

NOTE   In determining the upper bound values for these drift loads account has been taken of known cases of excessive, drifting of snow in the UK. However, it is recommended that they are treated as exceptional snow loads because of the rarity with which they are expected to occur. For design, it is suggested that these local drift loads are assigned a partial factor $\gamma_f = 1.05$.

7.4.2 *Valleys of multi-span roofs.* The appropriate snow load shape coefficients and drift lengths for local drifting of snow in valleys should be obtained from Figure 5 or the following:

Drift length:

$$l_{si} = b_i$$

Snow load shape coefficient:

μ_1 is the lesser of $2h/s_0$ and $2b_3/(l_{s1} + l_{s2})$

with the restriction $\mu_1 \leq 5$

and where all parameters are as defined in Figure 5 and below.

For roofs of more than two spans with approximately symmetrical and uniform geometry, b_3 should be taken as the horizontal dimension of three roof slopes (i.e. span × 1.5) and this snow load distribution should be considered applicable to every valley, although not necessarily simultaneously, (see below).

NOTE   If the structure is susceptible to asymmetric loading, the designer should also consider the possibility of drifts of differing severity in the valleys.

For roofs with non-uniform geometry, significant differences in ridge height and/or span may act as obstructions to the free movement of snow across the roof and influence the amount of snow theoretically available to form the drift. Care should be taken in the selection of b_3 (the greater length of building from which snow is available to be blown into the drift).

Where simultaneous drifts in several valleys of a multispan roof are being considered in the design of a structure as a whole, a maximum limit on the amount of drifted snow on the roof should be applied. The total snow load per metre width in all the simultaneous drifts should not exceed the product of the site snow load and the length of the building perpendicular to the valley ridges.

7.4.3 *Roofs abutting or close to taller structures.*

7.4.3.1 *Abrupt change of height.* This subclause applies where there is an abrupt change of height greater than 1 m, except that relatively slender obstructions (e.g. chimneys) exceeding 1 m in height but less than 2 m wide and door canopies projecting not more than 5 m from the building should be considered as local projections and obstructions with local drifting determined according to **7.4.5**. For parapets, see **7.4.3.3**.

The appropriate drift length and snow load shape coefficient for an abrupt change of height should be obtained from Figure 6 or from the following in which all parameters are as defined in Figure 6.

Drift length l_{s1} is the least value of $5h_{01}$, b_1 and 15 m.

Snow load shape coefficient μ_1 is the lesser of:

$(2h_{01})/s_0$ and $(2b)/l_{s1}$

where b is the larger value of b_1 and b_2

with the restriction: $\mu_1 \leq 8$

The snow load patterns implied in Figure 6 are also applicable for roofs close to, but not abutting, taller buildings, with the exception that it is only necessary to consider the load actually on the roof of interest, i.e. the load implied between the two buildings can be ignored.

NOTE   The effect of structures close to, but not abutting the roof under consideration will depend partly on the roof areas available from which snow can be blown into the drift and the difference in levels. However, as an approximate rule, it is only necessary to consider nearby structures when they are less than 1.5 m away.

7.4.3.2 *Single pitched roof with ridge at 90° to a taller structure.* For this case, the local drift from **7.4.3.1** should be modified according to Figure 7, which implies a non-uniform variation in the direction parallel to the obstruction.

7.4.3.3 *Parapets.* Local drifting against parapets should be determined in accordance with Figure 6 or from the following in which all parameters are defined in Figure 6.

Drift length l_{s1} is the least value of $5h_{01}$, b_1 and 15 m.

Snow load shape coefficient μ_1 is the lesser of:

$(2h_{01})/s_0$ and $(2b)/l_{s1}$

where b is the larger value of b_1 and b_2

with the restriction: $\mu_1 \le 8$

For drifting in a valley behind a parapet at a gable end the snow load at the face of the parapet should be assumed to decrease linearly from its maximum value in the valley to zero at the adjacent ridges, providing the parapet does not project much higher than the ridge.

NOTE   For the purpose of this subclause, when considering a parapet across the end of a valley the snow load at the ridge can be assumed to be zero providing that the parapet does not project more than 300 mm above the ridge.

7.4.4 *Tee intersections.* For intersecting pitched roofs the snow load shape coefficients and the drift lengths should be obtained from Figure 8. For this case the variation in the direction parallel to the obstruction is non-uniform.

7.4.5 *Local projections and obstructions.* The effect of drifting can be ignored if the vertical elevation area against which the drift could form is not greater than 1 m². The drifts which occur at local projections and obstructions affect a relatively small area of roof only. Included in this category is drifting against local obstructions not exceeding 1 m in height and also drifting on canopies (projecting not more than 5 m from the face of the building) over doors and over loading bays, irrespective of the height of the obstruction formed. A relatively tall, slender obstruction over 1 m high but not more than 2 m wide, may also be considered as a local projection. For that specific case, the height against which the drift may form, h_{0i} may be taken as the lesser of the projection width and the projection height. For parapets, see **7.4.3.3**.

The appropriate snow load shape coefficient at the face of the obstruction and the drift length should be obtained from Figure 9 or the following in which all parameters are as defined in Figure 9.

Drift length l_{s1} is the lesser value of $5h_{01}$ and b_1.
Snow load shape coefficient μ_1 is the lesser of:

$(2h_{01})/s_0$ and 5.

In addition, for door canopies projecting not more than 5 m from the building, the value of snow load shape coefficient should not exceed:

$(2b)/l_{s1}$

where b is the larger of b_1 and b_2 (see Figure 9).

8 Snow sliding down roofs

Under certain conditions snow may slide down a pitched or curved roof. The force F_s (in kN per metre width) exerted by a sliding mass of snow in the direction of slide is calculated from the following equation:
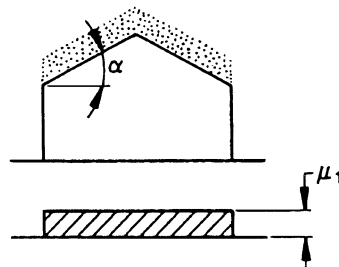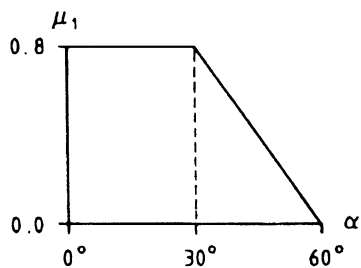
$F_s = s_d b \sin\alpha$

where

s_d is the snow load on the roof (in kN/m²);

b is the distance on plan from the gutter to the ridge (in metres);

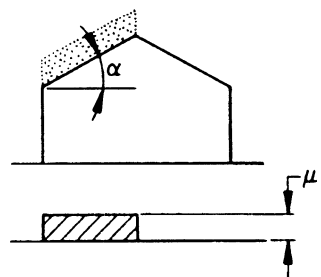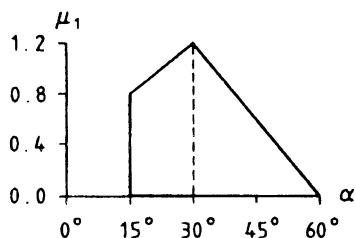α is the angle of pitch of the roof measured from the horizontal.

The appropriate value for s_d is obtained from clause **5**. It should be the most onerous value arising from uniformly distributed snow on the roof slope under consideration. It may result from either the uniform load case or the asymmetric load case.

This force should be taken into account in the design of snowguards or snowfences if snow is likely to slide off the roof endangering people or property below. It should also be taken into account in the design of any obstruction on a roof which may prevent snow sliding off the roof.

Angle of pitch of roof (α)	$0° \leqslant \alpha \leqslant 30°$	$30° < \alpha < 60°$	$60° \leqslant \alpha$
Shape coefficient	$\mu_1 = 0.8$	$\mu_1 = 0.8 \left[\dfrac{60 - \alpha}{30}\right]$	$\mu_1 = 0$

(a) Case 1; uniform load

Angle of pitch of roof (α)	$0° \leqslant \alpha \leqslant 15°$	$15° < \alpha \leqslant 30°$	$30° < \alpha < 60°$	$60° \leqslant \alpha$
Shape coefficient	$\mu_1 = 0$	$\mu_1 = 0.8 + 0.4 \left[\dfrac{\alpha - 15}{15}\right]$	$\mu_1 = 1.2 \left[\dfrac{60 - \alpha}{30}\right]$	$\mu_1 = 0$

(b) Case 2; asymmetric load

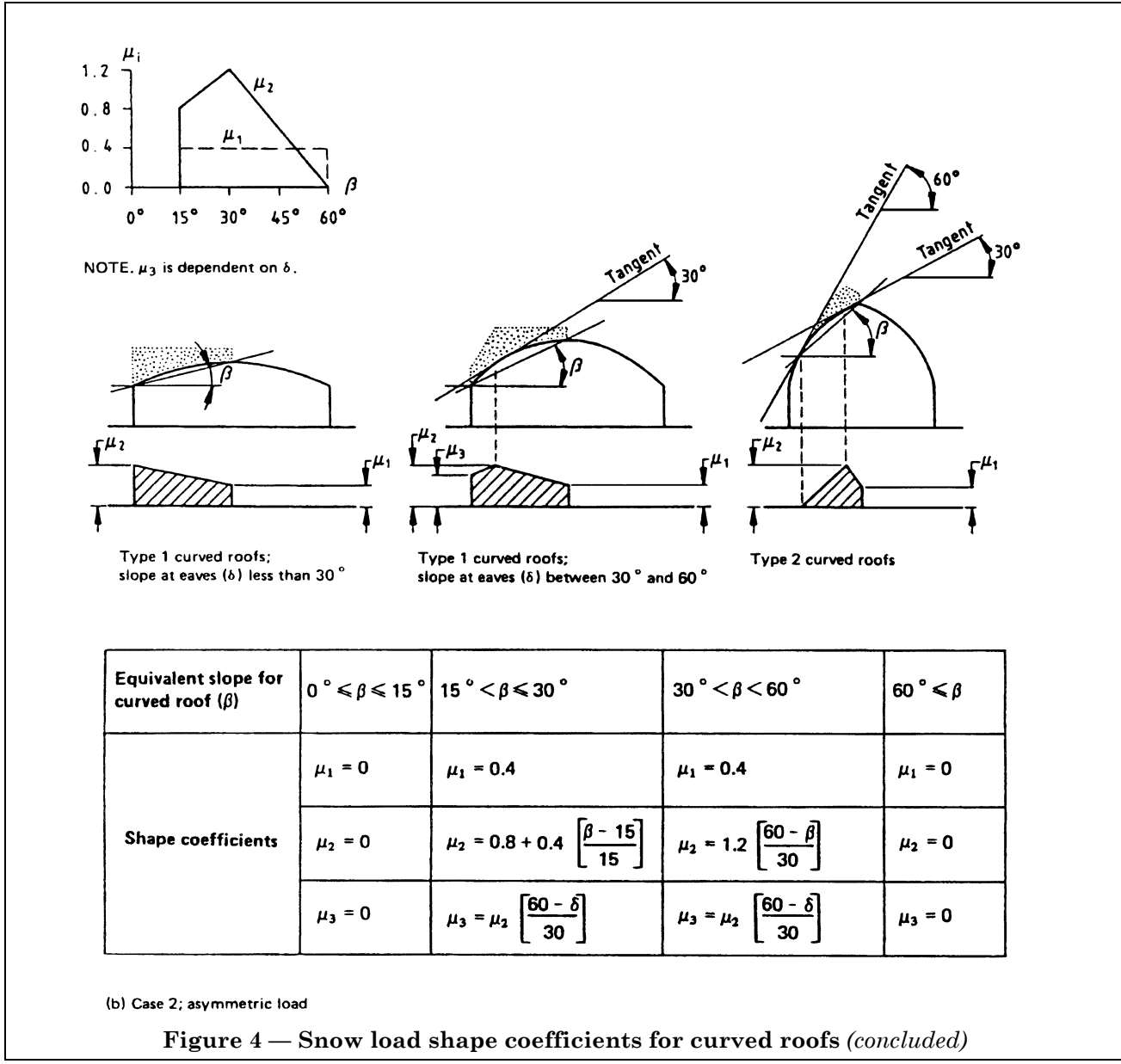**Figure 3 — Snow load shape coefficients for pitched roofs**

Equivalent slope for curved roof (β)	$0° \leqslant \beta \leqslant 30°$	$30° < \beta < 60°$	$60° \leqslant \beta$
Shape coefficient	$\mu_1 = 0.8$	$\mu_1 = 0.8 \left[\dfrac{60 - \beta}{30} \right]$	$\mu_1 = 0$

(a) Case 1; uniform load

Figure 4 — Snow load shape coefficients for curved roofs

NOTE. μ_3 is dependent on δ.

Type 1 curved roofs;
slope at eaves (δ) less than 30°

Type 1 curved roofs;
slope at eaves (δ) between 30° and 60°

Type 2 curved roofs

Equivalent slope for curved roof (β)	$0° \leqslant \beta \leqslant 15°$	$15° < \beta \leqslant 30°$	$30° < \beta < 60°$	$60° \leqslant \beta$
Shape coefficients	$\mu_1 = 0$	$\mu_1 = 0.4$	$\mu_1 = 0.4$	$\mu_1 = 0$
	$\mu_2 = 0$	$\mu_2 = 0.8 + 0.4 \left[\dfrac{\beta - 15}{15}\right]$	$\mu_2 = 1.2 \left[\dfrac{60 - \beta}{30}\right]$	$\mu_2 = 0$
	$\mu_3 = 0$	$\mu_3 = \mu_2 \left[\dfrac{60 - \delta}{30}\right]$	$\mu_3 = \mu_2 \left[\dfrac{60 - \delta}{30}\right]$	$\mu_3 = 0$

(b) Case 2; asymmetric load

Figure 4 — Snow load shape coefficients for curved roofs *(concluded)*
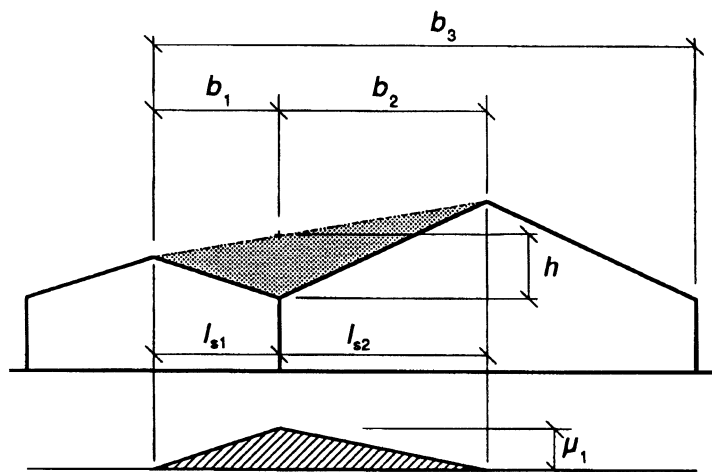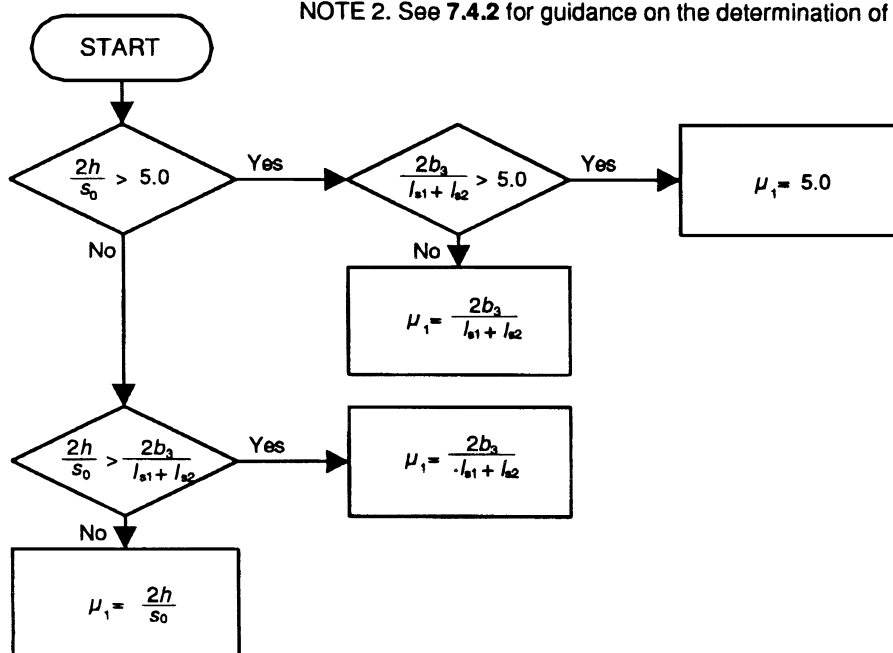
(a) Drift length

NOTE 1. Consider i to be 1 and i to be 2 separately.
NOTE 2. See **7.4.2** for guidance on the determination of b_3.

(b) Snow load shape coefficient

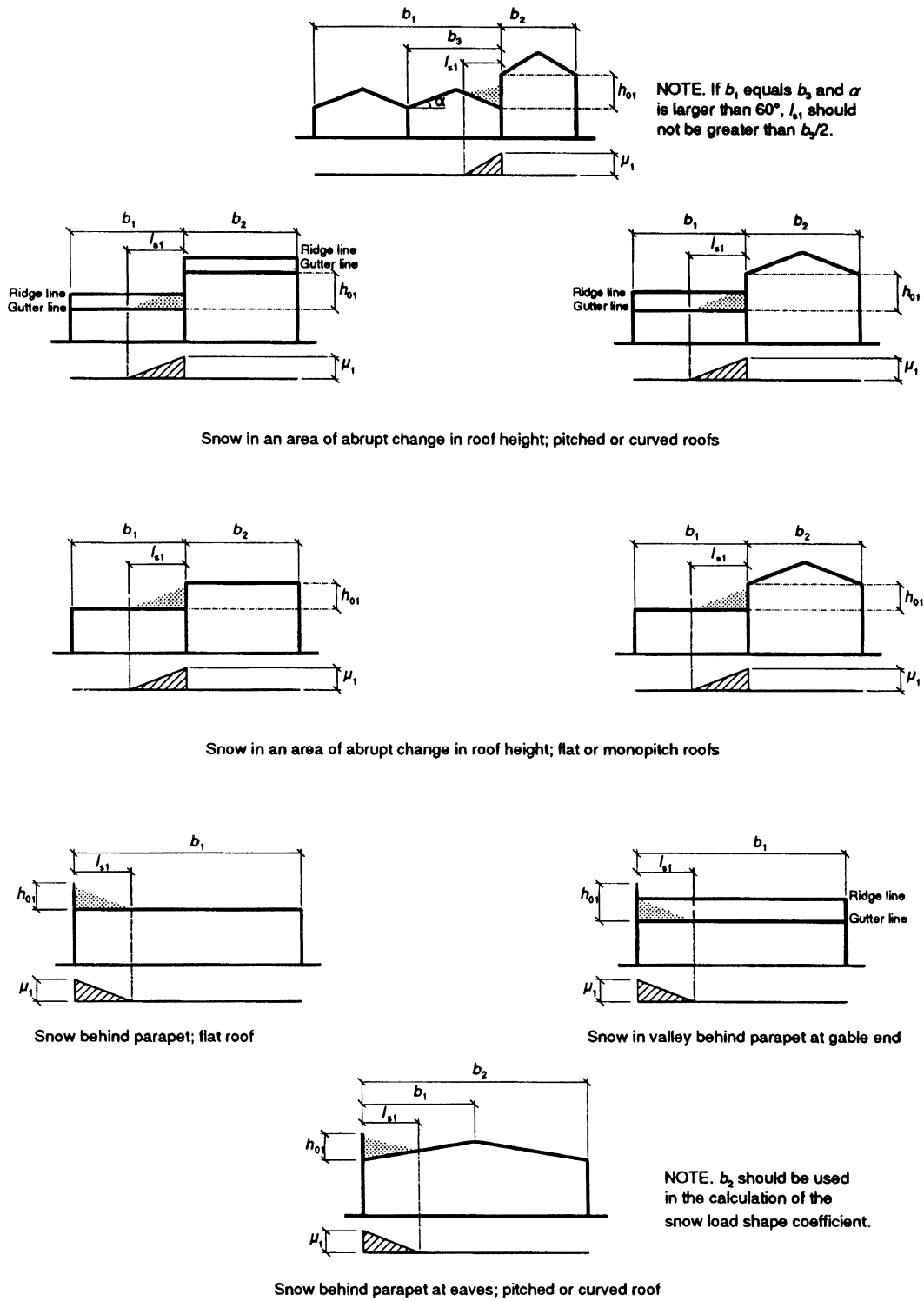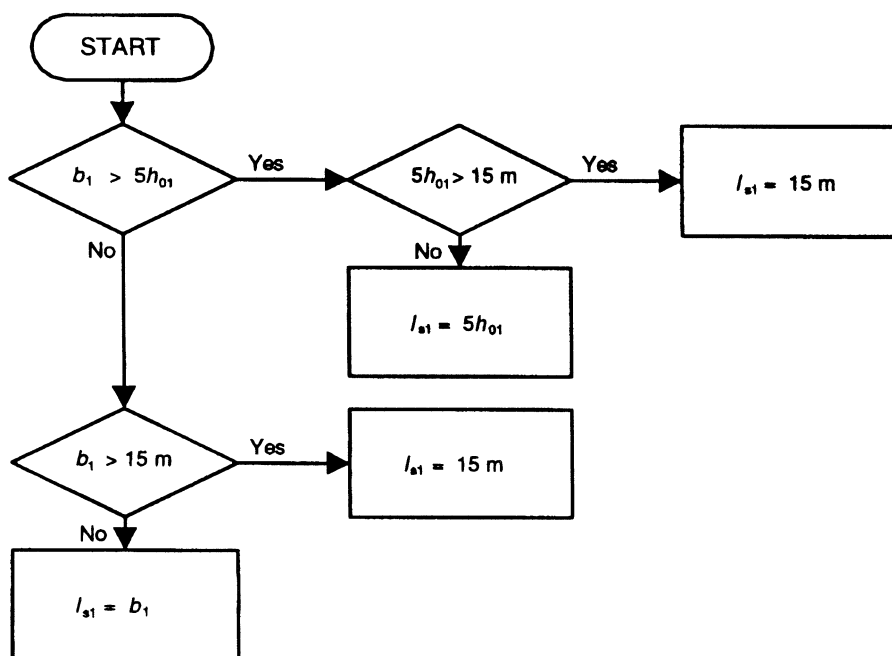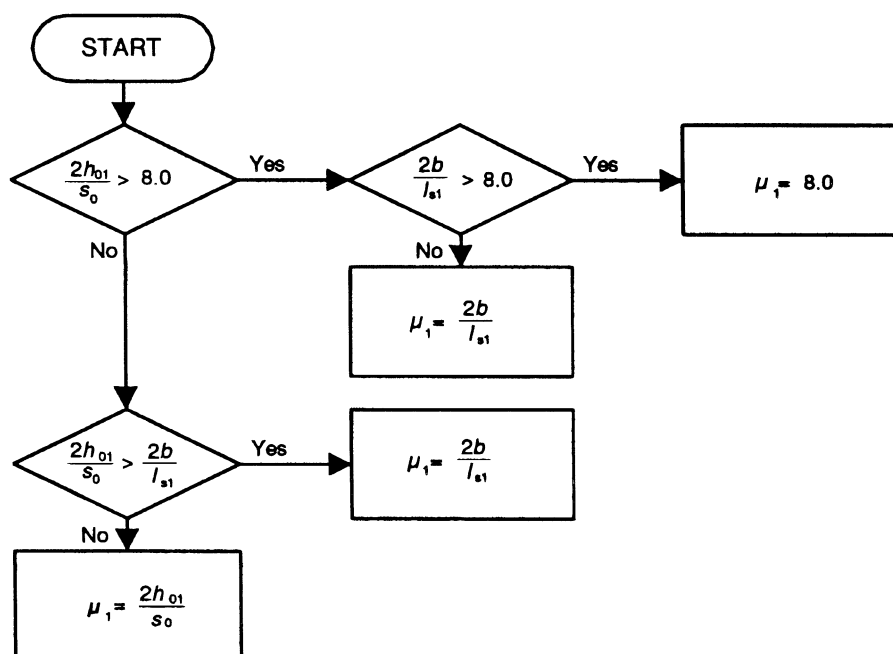**Figure 5 — Valleys of multi-span pitched or convex curved roofs**

NOTE. If b_1 equals b_3 and α is larger than 60°, l_{s1} should not be greater than $b_3/2$.

Snow in an area of abrupt change in roof height; pitched or curved roofs

Snow in an area of abrupt change in roof height; flat or monopitch roofs

Snow behind parapet; flat roof

Snow in valley behind parapet at gable end

NOTE. b_2 should be used in the calculation of the snow load shape coefficient.

Snow behind parapet at eaves; pitched or curved roof

Figure 6 — Snow load shape coefficients and drift lengths at abrupt changes in roof height and parapets

START

$b_1 > 5h_{01}$ — Yes → $5h_{01} > 15$ m — Yes → $l_{s1} = 15$ m

(from $b_1 > 5h_{01}$) No ↓

(from $5h_{01} > 15$ m) No ↓ $l_{s1} = 5h_{01}$

$b_1 > 15$ m — Yes → $l_{s1} = 15$ m

No ↓

$l_{s1} = b_1$

(a) Drift length

START

$\dfrac{2h_{01}}{s_0} > 8.0$ — Yes → $\dfrac{2b}{l_{s1}} > 8.0$ — Yes → $\mu_1 = 8.0$

(from $\frac{2h_{01}}{s_0} > 8.0$) No ↓

(from $\frac{2b}{l_{s1}} > 8.0$) No ↓ $\mu_1 = \dfrac{2b}{l_{s1}}$

$\dfrac{2h_{01}}{s_0} > \dfrac{2b}{l_{s1}}$ — Yes → $\mu_1 = \dfrac{2b}{l_{s1}}$

No ↓

$\mu_1 = \dfrac{2h_{01}}{s_0}$

(b) Snow load shape coefficient   NOTE. b is larger value of b_1 and b_2.
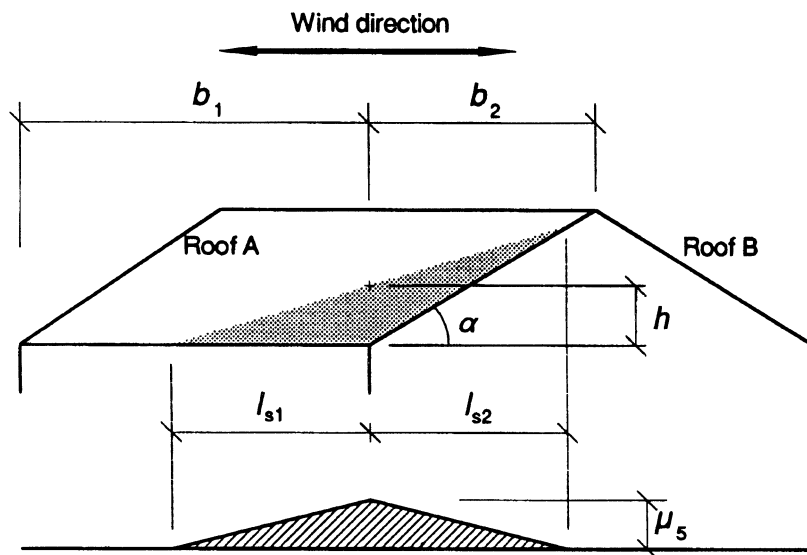
Figure 6 — Snow load shape coefficients and drift lengths at abrupt changes in roof height and parapets *(concluded)*
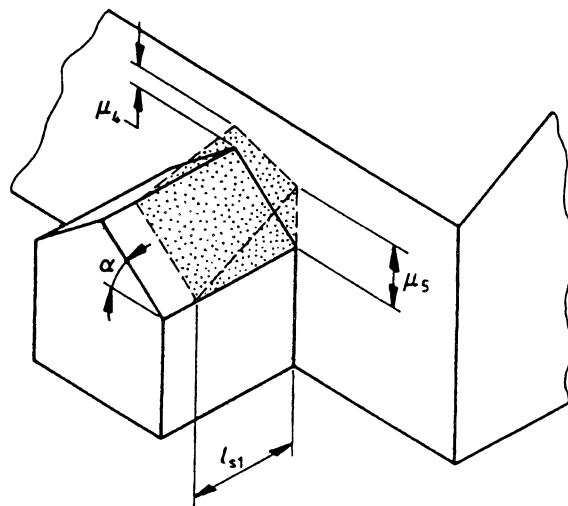
NOTE. α is pitch of roof on which drift forms;
μ_1 is snow load shape coefficient from figure 6;
μ_4 is shape coefficient at ridge;
μ_5 is shape coefficient at eaves;
l_{s1} is drift length from figure 6.

Angle of pitch of roof (α)	$0° \leqslant \alpha \leqslant 15°$	$15° < \alpha \leqslant 30°$	$30° < \alpha < 60°$	$60° \leqslant \alpha$
Shape coefficients	$\mu_4 = \mu_1$	$\mu_4 = \mu_1 \left[\dfrac{30-\alpha}{15}\right]$	$\mu_4 = 0$	$\mu_4 = 0$
	$\mu_5 = \mu_1$	$\mu_5 = \mu_1$	$\mu_5 = \mu_1 \left[\dfrac{60-\alpha}{30}\right]$	$\mu_5 = 0$

Figure 7 — Snow load shape coefficients and drift lengths for single pitch roofs abutting taller structures at 90°

NOTE1. The design should also be checked assuming a wind direction parallel to the ridge of roof B.

NOTE2. The snow depth at the eaves, h, can be determined graphically, or can be calculated from

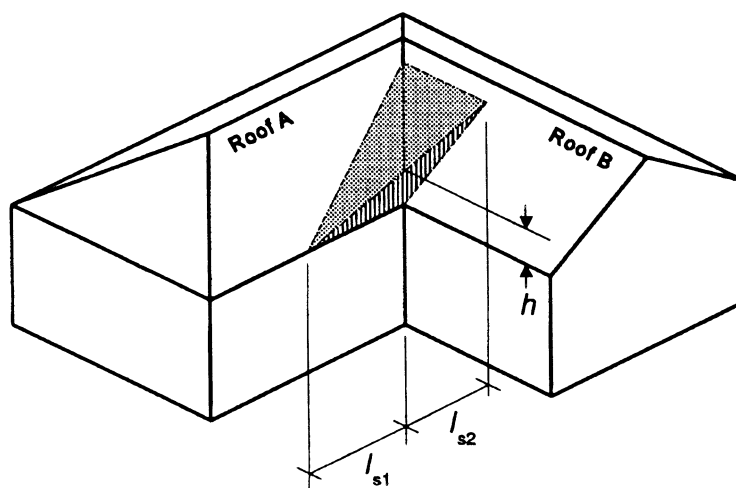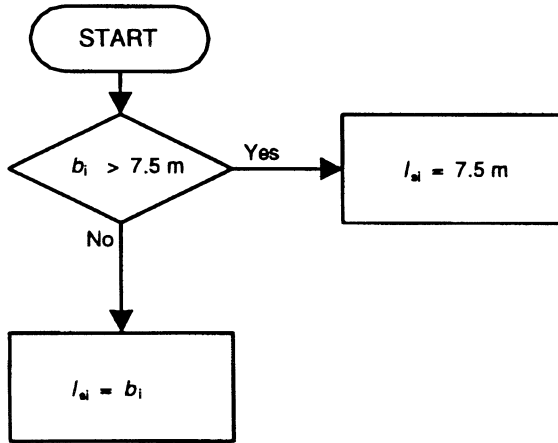$$h = \tan(\alpha) \; \frac{l_{s1} \; l_{s2}}{l_{s1} + l_{s2}}$$

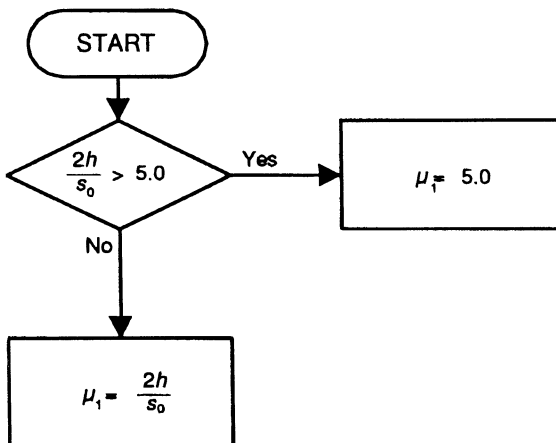**Figure 8 — Snow load shape coefficients and drift lengths for intersecting pitched roofs**

START

$b_i > 7.5$ m —— Yes ——► $l_{si} = 7.5$ m

No

$l_{si} = b_i$

(a) Drift length

NOTE. Consider i to be 1 and i to be 2 separately.

Angle of pitch of roof (α)	$0° \leq \alpha \leq 30°$	$30° < \alpha < 60°$	$60° \leq \alpha$
Shape coefficients	$\mu_5 = \mu_1$	$\mu_5 = \mu_1 \left[\dfrac{60 - \alpha}{30} \right]$	$\mu_5 = 0$

where μ_1 is determined from the following flow chart

START

$\dfrac{2h}{s_0} > 5.0$ —— Yes ——► $\mu_1 = 5.0$

No
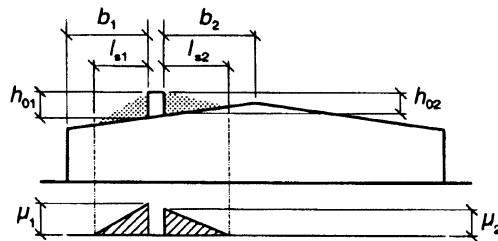
$\mu_1 = \dfrac{2h}{s_0}$

(b) Snow load shape coefficient

Figure 8 — Snow load shape coefficients and drift lengths for intersecting pitched roofs *(concluded)*
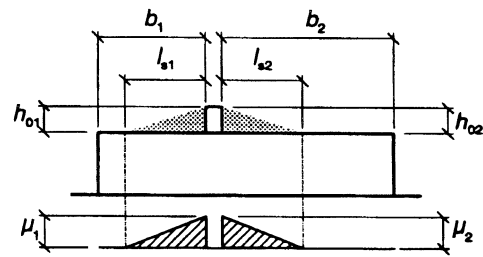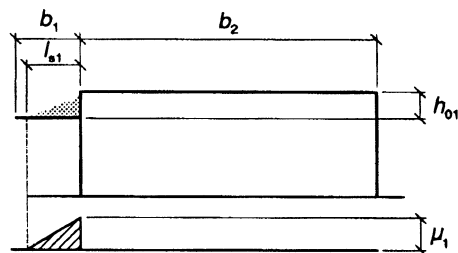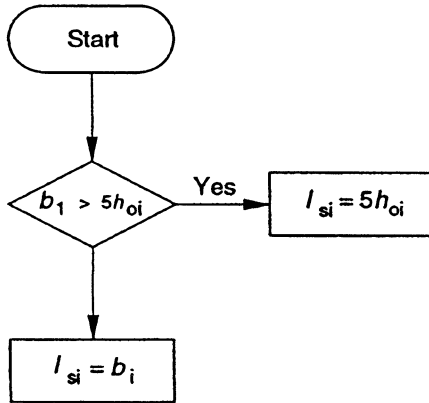
Significant obstruction on flat roof

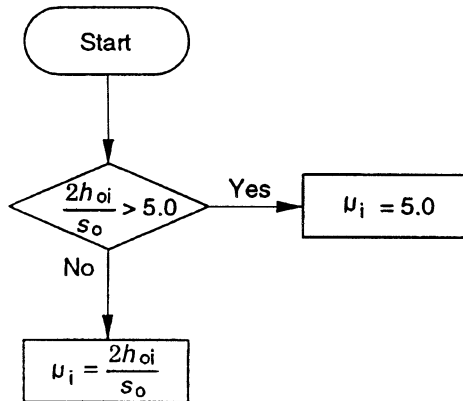Significant obstruction on pitched or curved roof

Snow on door canopy

Figure 9 — Snow load shape coefficients and drift lengths for local projections and obstructions

Start

$b_1 > 5h_{oi}$ → Yes → $l_{si} = 5h_{oi}$

$l_{si} = b_i$

NOTE. If appropriate consider i to be 1 and i to be 2 separately.
NOTE. For local obstructions, not more than 2 m wide, the value of h_{oi} may be taken as the lesser of the height of the obstruction or the width of the obstruction perpendicular to the wind.

(a) Drift length

Start

$\dfrac{2h_{oi}}{s_o} > 5.0$ → Yes → $\mu_i = 5.0$

No

$\mu_i = \dfrac{2h_{oi}}{s_o}$

IN ADDITION, for door canopies projecting not more than 5 m from the building, μ_1 should not exceed $2b/l_{s1}$ where b is the larger of b_1 and b_2.

NOTE. For local obstructions, not more than 2 m wide, the value of h_{oi} may be taken as the lesser of the height of the obstruction or the width of the obstruction perpendicular to the wind.

(b) Snow load shape coefficient

Figure 9 — Snow load shape coefficients and drift lengths for local projections and obstructions *(concluded)*

Appendix A Annual probabilities of exceedance different from 0.02

Site snow loads with an annual probability of exceedance of 0.02 (as given by **6.2**) will be appropriate for the design of most structures. However, a lower probability of exceedance should be considered for the design of:

— a structure where greater than normal reliability is required;

— a structure where damage due to snow loading would result in great financial loss or unacceptable impaired usage of the building.

Where site snow loads with a probability of exceedance different from 0.02 are considered appropriate, the designer should consult the Advisory Offices listed in appendix C for guidance.

Appendix B Snow drift load calculations

This appendix briefly describes the general process adopted for determining the maximum local load intensity resulting from snow in a drift at a change in roof height. It is included for designers who wish to understand the parameters which influence the magnitude of the snow loads associated with drifting of snow. It is not intended for use in calculating snow load shape coefficients.

Up to three basic checks are made as follows.

a) It is first assumed that the drift forms to the top of the obstruction and the density of the snow increases from that of the fallen snow on the ground. This check takes the general form of limiting the snow load shape coefficient to:

$\rho h_{oi}/s_o$

where

ρ is the weight density of the snow in the drift (2 kN/m^3 assumed);

h_{oi} is the height of the obstruction (in metres);

s_o is the site snow load (in kN/m^2).

b) In some cases, a check is then made to ensure that there is sufficient snow available on the roof to form a drift to the top of the obstruction. This check takes the general form of limiting the snow load shape coefficient to:

$2b_i/l_{si}$

where

b_i is the length of the building from which snow will be blown into the drift (in metres);

l_{si} is the length of the drift (in metres).

c) Finally an over-riding maximum value for the amount of snow is applied by arbitrarily assuming that the local load cannot be larger than the snow load on the ground increased by a certain multiplicative factor. The factor is usually 5 or 8 depending upon the severity of drifting likely to occur for the design configuration being considered.

Appendix C Addresses of advisory offices

The addresses of advisory offices of the Meteorological Office are as follows.

For England and Wales;

Meteorological Office,

Met 0 3,

London Road,

BRACKNELL,

Berkshire,

RG12 2SZ.

Tel: 01344 420242 Extn. 2299

For Scotland;

Meteorological Office.

231 Corstorphine Road,

EDINBURGH,

EH12 7BB.

Tel: 0131 344 9721 Extn. 524

For Northern Ireland;

Meteorological Office,

Progressive House,

1 College Square East,

BELFAST,

BT 1 6BQ.

Tel: Belfast 28457

The address of the advisory service of the Building Research Establishment is as follows.

Building Research Advisory Service,

Building Research Establishment,

Building Research Station,

Garston, WATFORD,

WD2 7JR.

Tel: 01923 664664

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Publications referred to

BS 5555, *Specification for SI units and recommendations for the use of their multiples and of certain other units*[1].

BS 6399, *Loading for buildings*.

BS 6399-1,*Code of practice for dead and imposed loads*.

BS 6399-2, *Wind loads*.

CP 3, *Code of basic data for the design of buildings*[1].

CP 3: Chapter V, *Loading*.

ISO 3898, *Bases for design of structures — Notations — General symbols*[1].

ISO 4355, *Bases for design of structures — Determination of snow loads on roofs*[1].

BRE Digest 290, *Loads on roofs from snow drifting against vertical obstructions and in valleys*[2].

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[1] Referred to in the foreword only.

[2] Withdrawn.

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