

Loading for buildings —

Part 3: Code of practice for imposed roof loads

ICS 91.060.01; 91.080.20

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Document Sharing Hub

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

This British Standard, having been prepared under the direction of the Civil Engineering and Building Structures Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 May 1988

© BSI 11-1998

The following BSI references relate to the work on this standard:
Committee reference CSB/54
Draft for comment 86/13528 DC

ISBN 0 580 16577 9

Amendments issued since publication

Amd. No.	Date of issue	Comments
6033	August 1988	
9187	September 1996	
9452	May 1997	Indicated by a sideline in the margin

Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
Section 1. General	
1 Scope	1
2 Definitions	1
3 Symbols	1
4 Minimum impose roof loads	2
Section 2. Snow loads	
5 Snow load on the roof	4
6 Snow load on the ground	4
7 Snow load shape coefficients	6
8 Snow sliding down roofs	9
Appendix A Annual probabilities of exceedance different from 0.02	21
Appendix B Snow drift load calculations	21
Appendix C Addresses of advisory offices	21
Figure 1 — Basic snow load on the ground	5
Figure 2 — Snow load shape coefficients for flat or monopitch roofs	7
Figure 3 — Snow load shape coefficients for pitched roofs	10
Figure 4 — Snow load shape coefficients for curved roofs	11
Figure 5 — Snow load shape coefficients and drift lengths for valleys of multi-span pitched or curved roofs	13
Figure 6 — Snow load shape coefficients and drift lengths at abrupt changes of roof height	14
Figure 7 — Snow load shape coefficients and drift lengths for single pitch roofs abutting taller structures at 90°	16
Figure 8 — Snow load shape coefficients and drift lengths for intersecting pitched roofs	17
Figure 9 — Snow load shape coefficients and drift lengths for local projections and obstructions	19
Table 1 — Values of s_{alt} for corresponding values of s_b	4
Publications referred to	Inside back cover

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 $1 \text{ N} = 0.225 \text{ lbf}$ and $1 \text{ kN/m}^2 = 20.89 \text{ lbf/ft}^2$.

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.

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);	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 $0.6 [(60 - \alpha)/30] \text{ kN/m}^2$ 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
s_d	Snow load on roof;	d) a concentrated load of 0.9 kN .
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

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.