British Standard

A single copy of this British Standard is licensed to

Sheffield University

14 March 2003

This is an uncontrolled copy. Ensure use of the most current version of this document by searching British Standards Online at bsonline.techindex.co.uk

BRITISH STANDARD

BS 5268-7.6: 1990

Incorporating Amendment No. 1

Structural use of timber —

Part 7: Recommendations for the calculation basis for span tables —

Section 7.6 Purlins supporting rafters

UDC [624.011.1 + 674.038.5+691.1.11]:[692.421.2 + 694.5]:001.4

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Civil Engineering and Building Structures Standards Policy Committee (CSB/-) to Technical Committee CSB/32 upon which the following bodies were represented:

British Woodworking Federation
Building Employers' Confederation
Chartered Institute of Building
Department of the Environment (Building Research Establishment, Princes Risborough Laboratory)
Department of the Environment for Northern Ireland
Department of the Environment (Housing and Construction Industries)
Department of the Environment (Property Services Agency)
Health and Safety Executive
Incorporated Association of Architects and Surveyors
Institute of Clerks of Works of Great Britain Inc.
Institute of Wood Science
Institution of Civil Engineers
Institution of Structural Engineers
International Truss Plate Association
National House-building Council
Royal Institute of British Architects
Royal Institution of Chartered Surveyors
Timber Research and Development Association
Timber Trade Federation
Coopted members

This British Standard, having been prepared under the direction of the Civil Engineering and Building Structures Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 30 April 1990

The following BSI references relate to the work on this standard:
Committee reference CSB/32
Draft for comment 87/10398 DC

ISBN 0 580 17775 0

Amendments issued since publication

Amd. No.	Date of issue	Comments
6902	February 1992	Indicated by a sideline in the margin

Contents

Foreword

This Section of BS 5268 has been prepared under the direction of the Civil Engineering and Building Structures Standards Policy Committee.

The general principles for the design of structural timber components are given in BS 5268-2 and using these principles it is possible for span tables to be prepared for a wide range of components.

Experience has shown that different interpretations of these principles has led to inconsistencies in span tables prepared by different compilers. It is the purpose of BS 5268-7 to eliminate these differences by recommending the design equations and the loading to be used in the preparation of span tables. Part 7 is intended to ensure that different organizations produce span tables on a consistent basis in the future, and is not necessarily intended for use by designers for individual designs carried out in their day-to-day work, where simplified procedures may produce adequate designs. This Section deals with purlins supporting rafters.

Other Sections of BS 5268-7, published or in preparation, are as follows.

— *Section 7.1: Domestic floor joists;*

— *Section 7.2: Joists for flat roofs;*

— *Section 7.3: Ceiling joists;*

— *Section 7.4: Ceiling binders;*

— *Section 7.5: Rafters;*

— *Section 7.7: Purlins supporting sheeting or decking.*

BS 5268-2 gives grade stresses for very many combinations of species and grade and it is considered impractical to publish in a British Standard span tables for all possible combinations of species, grades and sizes. BS 5268-7 is therefore restricted to the basis of the calculations.

The solution of the design equations for many combinations of geometry and material is most conveniently undertaken by computer. A program written by the Timber Research and Development Association (TRADA), was used to prepare Appendix A and Appendix B. For users wishing to prepare their own span tables or computer programs, Appendix A gives a sample calculation. Appendix A gives span tables for three typical species/grade combinations. Although the presentation of span tables is not covered in BS 5268-7, it is recommended that tables for predetermined purlin centres and loading follow this format.

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 and ii, 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.

1 Scope

This Section of BS 5268 recommends a calculation basis for the permissible clear span of purlins used in traditional pitched roof construction, i.e. not including trussed rafter roofs. The method of calculation is for purlins formed from solid timber and supported by external or internal walls or by purlin struts. The major axis of the purlin is perpendicular to the rafter slope (see Figure 1); other orientations of the purlin are not covered by this Section of BS 5268. The uniform and concentrated loads of BS 6399-1 are considered. Provision is made for a uniformly distributed snow load derived from BS 6399-3.

A typical example of roof construction is given in Figure 1.

This Section of BS 5268 is applicable to the species and grades of timber given in BS 5268-2.

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

2 Definitions

For the purposes of this Section BS 5268 the definitions given in BS 6100-4 and BS 6100-2.1 apply, together with the following. Reference should also be made to clause **2** of BS 5268-2:1988.

2.1
grade stress

stress that can safely be permanently sustained by material of a specific section size and of a particular strength class or species and grade

2.2
load-sharing system

assembly of pieces or members that are constrained to act together to support a common load

2.3
permissible stress

stress that can safely be sustained by a structural material under a particular condition

NOTE For the purposes of this Section of BS 5268, it is the product of the grade stress and the appropriate modification factors for section size, service and loading.

2.4
strength class

classification of timber based on particular values of grade stress

2.5
bearing length

length at each end of the purlin in contact with the support

2.6
notional bearing length

bearing length required for the calculation of permissible clear spans

2.7
effective span

span from centre-to-centre of the minimum bearing lengths at each end

2.8
permissible effective span

lowest value of effective span found from the calculations for bending strength, shear strength and deflection

2.9
permissible clear span

permissible unsupported span of a purlin, measured between the faces of the supports at its two ends

NOTE Permissible clear span is equal to permissible effective span less the minimum bearing length.

2.10
point load

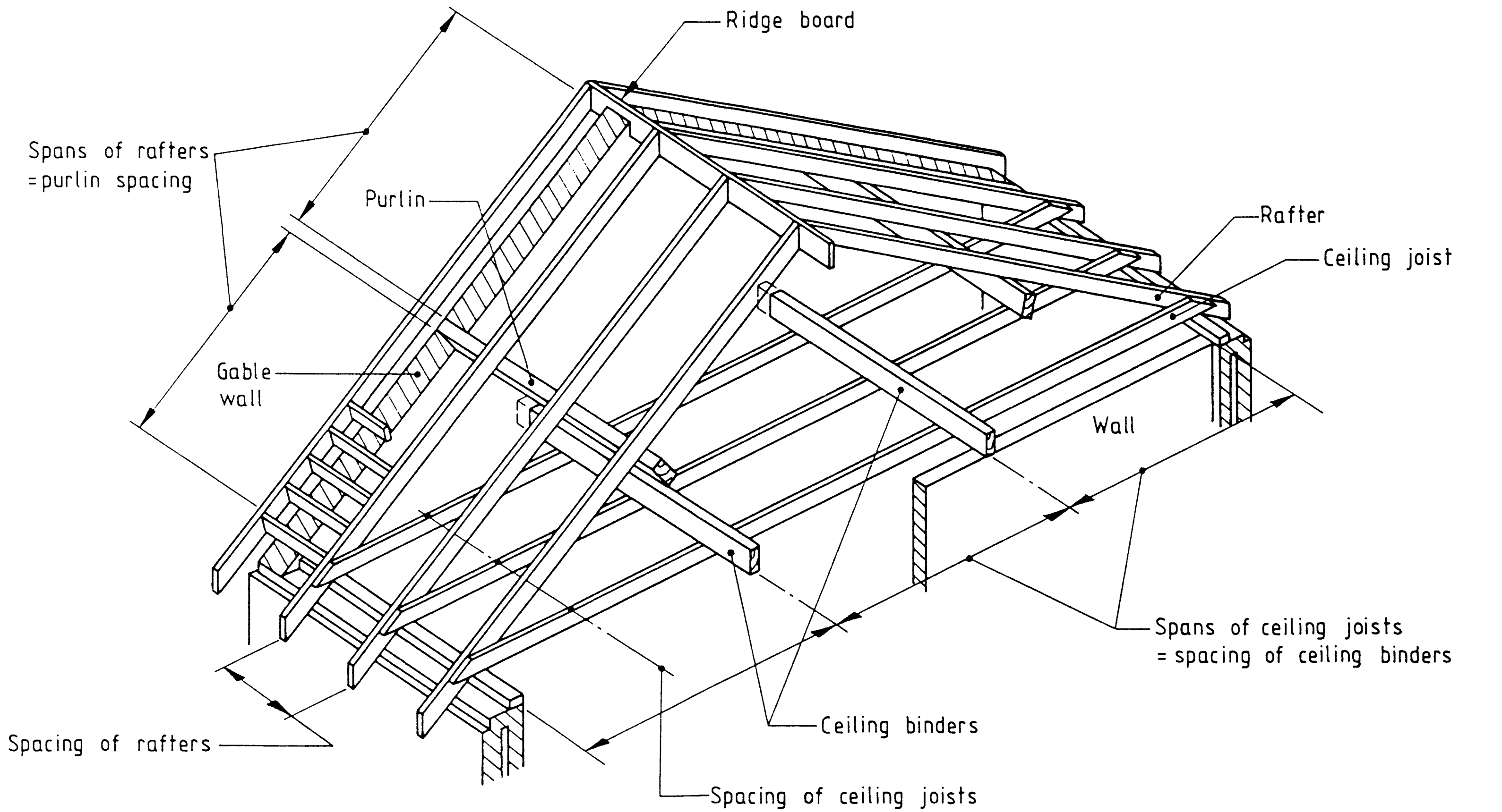
concentrated load required by BS 6399-1, regarded as acting at a point for calculation purposes

2.11
rafter

member extending the full distance from eaves to ridge; may be continuous or jointed over the purlin, i.e. non-continuous

2.12
purlin

beam parallel to the eaves giving intermediate support to rafters



Span of purlins and ceiling binders not shown.

Figure 1 — Roof construction

3 Symbols

For the purposes of this Section of BS 5268, the following symbols apply.

NOTE The symbols used are generally in accordance with ISO 3898, published by the International Organization for Standardization supplemented by the recommendations of CIB-W18-1, published by the International Council for Building Research Studies and Documentation, which takes particular account of timber properties.

The symbols used are:

a	Distance (notional bearing length)
b	Breadth of purlin
b_s	Breadth of supported members (rafters)
E	Modulus of elasticity
F	Total load per metre length, applied to purlin in the direction perpendicular to the rafters
F_d	Dead load per square metre applied by mass of roofing material (excluding rafter and purlin self weights), measured on slope
F_i	Imposed uniformly distributed load per square metre, measured on plan
F_j	Self weight of purlin per metre length
F_s	Weight of supported members (rafters) per metre length
F_p	Point load
G	Shear modulus
h	Depth of purlin
h_s	Depth of supported members (rafters)
I	Second moment of area
K	Modification factor (always with a subscript)
L	Effective span
L_{adm}	Permissible effective span
L_{cl}	Permissible clear span
M	Bending moment
s	Spacing of purlins, centre-to-centre, measured on slope
s_s	Spacing of supported members (rafters), centre-to-centre
w	Deflection
Z	Section modulus
α	Roof slope (pitch)
ρ	Density
ρ_s	Density of supported members (rafters)
σ	Stress
τ	Shear stress

The following subscripts are used:

a) **Type of force, stress etc.**

c	Compression
m	Bending

b) **Significance**

adm	Permissible
cl	Clear
g	Grade
max	Maximum

c) **Geometry**

par or ∥ Parallel (to the grain)

tra or ⊥ Perpendicular (to the grain)

It is recommended that where more than one subscript is used, the categories should be separated by commas.

Subscripts may be omitted when the context in which the symbols are used is unambiguous, except in the case of modification factor *K*.

4 Design considerations

4.1 General

The design calculations recommended by this Section of BS 5268 are based on engineers' bending theory and are consistent with the recommendations of BS 5268-2. The design method ensures that the permissible bending and shear stresses as given in BS 5268-2 are not exceeded and that the deflection due to bending and shear does not exceed the recommended limit of 0.003 times the effective span (see **14.7** of BS 5268-2:1988).

NOTE A sample calculation is given in Appendix A and Table 1 to Table 3 in Appendix B contain specimen span tables.

4.2 Qualifying assumptions

The calculations given in this Section of BS 5268 are for single-span or two-span continuous purlins providing intermediate support for rafters. The major axis of the purlin is perpendicular to the rafter slope. The horizontal thrust at the eaves is assumed to be transmitted by the ceiling joists to the complementary rafter.

The rafters may be continuous or may consist of shorter lengths joined at the purlin. Since continuous rafters load the purlin more severely, this is the case considered. The formulae derived are based on rafters having two equal spans.

The uniformly distributed dead and imposed loads are as given in BS 6399-1 and BS 6399-3 for pitched roofs. It is assumed that the spacing of the rafters is such that the load applied by the rafters to the purlin may be taken as uniformly distributed. The 0.9 kN concentrated load is applied only once to the purlin and not simultaneously in any other position.

The purlins are treated as solid timber members acting alone, with no provision for load sharing. In accordance with **14.7** of BS 5268-2:1988, the minimum value of modulus of elasticity is used in the calculations.

Lateral support should be provided in accordance with **14.8** of BS 5268-2:1988.

The bearing length required at each end of the binder, calculated in accordance with **5.6**, may not be sufficient for practical construction purposes.

4.3 Loading

The design calculations provide for roof loads which consist of the following.

a) *Imposed load*

1) For a roof slope of 30° or less: a uniformly distributed snow load (e.g. 0.75 kN/m^2) measured on plan or a 0.9 kN concentrated vertical load, whichever governs the design.

The concentrated load is assumed to act in the position that produces maximum stress or deflection. However, the effect of deflection under the concentrated load needs to be considered only when it would affect the finishes.

2) For a roof slope greater than 30° and not exceeding 75°: an imposed load obtained by linear interpolation between the values at 30° roof slope (e.g. 0.75 kN/m^2) and zero for a 75° roof slope. No concentrated load is applied.

The imposed distributed load should be considered as a medium term load. The imposed point load should be considered as a short term load as given in Table 8 of BS 5268-3:1985.

b) *Dead load.* Dead load per square metre on slope, F_d (in kN/m^2), to provide for the mass of roofing materials, insulation etc. Weights of materials are given in BS 648.

c) *Weight of rafters*. Weight per metre length of rafter, F_s (in kN/m), to provide for the weight of the rafters supported by the purlin. The timber densities (in kg/m^3) given in Tables 9 and 92 of BS 5268-2:1988 should be used.

d) *Self weight*. Self weight per metre length, F_j (in kN/m), to provide for the weight of the purlin. The timber densities (in kg/m^3) given in Tables 9 and 92 of BS 5268-2:1988 should be used.

4.4 Design loads

Three loading conditions should be considered.

a) *Uniform imposed load condition,* the loading consisting of uniformly distributed imposed load, dead load and member self weight. The loading should be considered as medium term.

b) *Point imposed load condition,* the loading consisting of a concentrated imposed load plus uniformly distributed dead load and member self weight; this condition may be omitted for roof slopes greater than 30°. This loading should be considered as short term.

c) *Long term load condition,* the loading consisting of uniformly distributed dead load and member self weight with no imposed load. This loading should be considered as long term.

For the uniform imposed load condition, the total load per metre length of rafter, F (in kN/m), resolved perpendicular to the rafter, is given by the equation

$$F = (F_i \cos^2\alpha + F_d \cos\alpha)\left(\frac{s_s}{1000}\right) + F_s \cos\alpha \qquad (1)$$

For the point imposed load condition, the load resolved perpendicular to the rafter is given by:

$F_p \cos\alpha = 0.9 \cos\alpha$ kN

acting together with uniform dead load and self weight

$$F_d \cos\alpha \left(\frac{s_s}{1000}\right) + F_s \cos\alpha \text{ kN/m} \qquad (2)$$

For the long term load condition, i.e. dead load and self weight alone, F (in kN/m), the load resolved perpendicular to the rafter, is given by the equation

$$F = F_d \cos\alpha \left(\frac{s_s}{1000}\right) + F_s \cos\alpha \qquad (3)$$

where

α is the roof slope (pitch);
F_i is the imposed load (in kN/m^2) measured on plan;
s_s is the rafter spacing (in mm);
F_d is the dead load (in kN/m^2) measured on slope;
F_s is the self weight of the rafter (in kN/m).

The value of F_s (in kN/m) may be found from the equation

$$F_s = 9.80665 \times 10^{-9} \times \rho b_s h_s \qquad (4)$$

where

ρ is the timber density (in kg/m^3);
b_s is the rafter breadth (in mm);
h_s is the rafter depth (in mm).

For the uniform imposed load condition, the loading (in N) transmitted by a single rafter to the purlin is:

$$1.25s \left\{(F_i \cos\alpha + F_d)\left(\frac{s_s}{1000}\right) + F_s\right\} \cos\alpha \qquad (5)$$

where

the factor 1.25 is to account for the reaction at the centre of a continuous two-span rafter,

s is the purlin spacing (in mm) measured on slope;

s_s is the rafter spacing (in mm);

F_d is the dead load (in kN/m^2) measured on slope;

F_s is the self weight of the rafter (in kN/m).

This load is applied on a length, s_s, of the purlin, and treating it as uniformly distributed, the uniform load per millimetre length applied along the purlin will be expression (5) divided by s_s, i.e.

$$1.25\,\frac{s}{s_s}\left\{(F_i\cos\alpha + F_d)\left(\frac{s_s}{1000}\right) + F_s\right\}\cos\alpha \text{ N/mm or kN/m} \quad (6)$$

For the point imposed and long term load conditions, the load applied to the purlin by the uniformly distributed rafter load will be given by the corresponding expression with $F_i = 0$.

The purlin loading conditions will therefore be:

Uniform imposed load condition

$$F = 1.25\,\frac{s}{s_s}\left\{(F_i\cos\alpha + F_d)\left(\frac{s_s}{1000}\right) + F_s\right\}\cos\alpha + F_j\cos\alpha \text{ kN/m} \quad (7)$$

Point imposed load condition

$F_p \cos\alpha = 0.9 \cos\alpha$ kN

acting together with uniform dead load and self weight

$$F = 1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\}\cos\alpha + F_j\cos\alpha \text{ kN/m} \quad (8)$$

Long term load condition, i.e. dead load and self weight alone

$$F = 1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\}\cos\alpha + F_j\cos\alpha \text{ kN/m} \quad (9)$$

where

F_j is the self weight of the purlin (in kN/m).

The value of F_j may be found from the equation

$$F_j = 9.80665 \times 10^{-9}\,\rho b h \quad (10)$$

where

ρ is the timber density (in kg/m^3);

b is the purlin breadth (in mm);

h is the purlin depth (in mm).

5 Permissible spans

5.1 General

The permissible effective span of a timber purlin subjected to the applied loads given in **4.3** should be the shortest effective span resulting from calculations for bending strength, shear strength and deflection, as set out in **5.3**, **5.4** and **5.5**.

The permissible clear span should be calculated as the permissible effective span less the notional bearing length calculated in accordance with **5.6**.

5.2 Basis of formulae

5.2.1 *General.* The formulae given are derived from the common domestic construction incorporating a single purlin on each side of the ridge. The purlin reaction is perpendicular to the rafter slope (see Figure 1).

5.2.2 *Single span purlins.* The calculations for a single span assume that the purlin is supported at both ends over a wall or purlin strut, in a manner that does not allow bending moment to be transmitted to any adjacent spans. In the calculations, the purlin is treated as a simply-supported beam.

5.2.3 *Two-span continuous purlins.* In this case the two-span purlin is taken as simply supported at its two ends and supported at its centre by a purlin strut or a wall.

5.2.4 *Multiple purlins.* When purlin spacing is given in computed tables, this may be taken as either the distance between the centres of adjacent purlins or the distance between the eaves or ridge and the adjacent purlin.

5.3 Limitation of bending stress

If lateral restraint is provided in accordance with **14.8** of BS 5268-2:1988 then from BS 5268-2 the permissible bending stress $\sigma_{m,\,adm}$ (in N/mm^2) is given by the equation

$$\sigma_{m,\,adm} = \sigma_{m,\,g} K_3 K_7 \qquad (11)$$

where

- $\sigma_{m,\,g}$ is the grade bending stress (in N/mm^2) (see BS 5268-2);
- K_3 is the load duration modification factor, 1.0 for long term, 1.25 for medium term or 1.5 for short term (see Table 17 of BS 5268-2:1988);
- K_7 is the section depth modification factor (see **14.6** of BS 5268-2:1988).

Expanding the equation

$$\sigma_{m,\,adm} = \frac{M}{Z} \qquad (12)$$

leads to the following equations.

Single span purlins

Uniform imposed load condition

$$\sigma_{m,g} \times 1.25 \times K_7 = \frac{6L^2\cos\alpha}{8bh^2}\left[1.25\,\frac{s}{s_s}\left\{(F_i\cos\alpha + F_d)\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] \qquad (13)$$

Point imposed load condition.

$$\sigma_{m,g} \times 1.5 \times K_7 = \frac{6L^2\cos\alpha}{8bh^2}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] + \frac{6L}{4bh^2} \times 900\cos\alpha \qquad (14)$$

Long term load condition, i.e. dead load and self weight alone

$$\sigma_{m,g} \times 1.0 \times K_7 = \frac{6L^2\cos\alpha}{8bh^2}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] \qquad (15)$$

Two-span continuous purlins

At central support

Uniform imposed load condition

$$\sigma_{m,g} \times 1.25 \times K_7 = \frac{6L^2\cos\alpha}{8bh^2}\left[1.25\,\frac{s}{s_s}\left\{(F_i\cos\alpha + F_d)\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] \qquad (16)$$

Point imposed load condition

$$\sigma_{m,g} \times 1.5 \times K_7 = \frac{6L^2 \cos\alpha}{8bh^2} \left[1.25 \frac{s}{s_s} \left\{F_d \left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] + \frac{6L}{bh^2} \frac{3}{32} \times 900\cos\alpha \quad (17)$$

Long term load condition, i.e. dead load and self-weight alone

$$\sigma_{m,g} \times 1.0 \times K_7 = \frac{6L^2 \cos\alpha}{8bh^2} \left[1.25 \frac{s}{s_s} \left\{F_d \left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] \quad (18)$$

In mid span

Point imposed load condition

$$\sigma_{m,g} \times 1.5 \times K_7 = \frac{6L^2 \cos\alpha}{bh^2} \frac{9}{128} \left[1.25 \frac{s}{s_s} \left\{F_d \left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] + \frac{6L}{bh^2} \frac{13}{64} \times 900\cos\alpha \quad (19)$$

NOTE These equations lead to the following polynomials in L.

Single span purlins

Uniform imposed load condition

$$\frac{3\cos\alpha}{4bh^2} \left[1.25 \frac{s}{s_s} \left\{(F_i \cos\alpha + F_d) \left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] L^2 - \sigma_{m,g} \times 1.25 \times K_7 = 0 \quad (20)$$

Point imposed load condition

$$\frac{3\cos\alpha}{4bh^2} \left[1.25 \frac{s}{s_s} \left\{F_d \left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] L^2 + \frac{1350\cos\alpha}{bh^2} L - \sigma_{m,g} \times 1.5 \times K_7 = 0 \quad (21)$$

Long term load condition, i.e. dead load and self weight alone

$$\frac{3\cos\alpha}{4bh^2} \left[1.25 \frac{s}{s_s} \left\{F_d \left(\frac{s}{1000}\right) + F_s\right\} + F_j\right] L^2 - \sigma_{m,g} \times 1.0 \times K_7 = 0 \quad (22)$$

Two-span continuous purlins

At central support

Uniform imposed load condition

$$\frac{3\cos\alpha}{4bh^2} \left[1.25 \frac{s}{s_s} \left\{(F_i \cos\alpha + F_d) \left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] L^2 - \sigma_{m,g} \times 1.25 \times K_7 = 0 \quad (23)$$

Point imposed load condition

$$\frac{3\cos\alpha}{4bh^2} \left[1.25 \frac{s}{s_s} \left\{F_d \left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] L^2 + \frac{2025\cos\alpha}{4bh^2} L - \sigma_{m,g} \times 1.5 \times K_7 = 0 \quad (24)$$

Long term load condition, i.e. dead load and self weight alone

$$\frac{3\cos\alpha}{4bh^2} \left[1.25 \frac{s}{s_s} \left\{F_d \left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] L^2 - \sigma_{m,g} \times 1.0 \times K_7 = 0 \quad (25)$$

In mid span

Point imposed Load condition

$$\frac{27\cos\alpha}{64bh^2} \left[1.25 \frac{s}{s_s} \left\{F_d \left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] L^2 + \frac{8775\cos\alpha}{8bh^2} L - \sigma_{m,g} \times 1.5 \times K_7 = 0 \quad (26)$$

5.4 Limitation of shear stress

From BS 5268-2, the permissible shear stress, τ_{adm} (in N/mm^2), is given by the equation

$$\tau_{adm} = \tau_g K_3 \quad (27)$$

where

τ_g is the grade shear stress (in N/mm²) (see BS 5268-2);

K_3 is the lead duration modification factor, 1.0 for long term, 1.25 for medium term, or 1.5 for short term (see Table 17 of BS 5268-2:1988).

Expanding the equation

$$\tau_{adm} = \frac{3}{2} \times \frac{\text{maximum shear force}}{bh} \tag{28}$$

leads to the following equations.

Single span purlins

Uniform imposed lead condition

$$\tau_g \times 1.25 = \frac{3}{2}\left[1.25\,\frac{s}{s_s}\left\{(F_i \cos\alpha + F_d)\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right]\frac{L}{2bh}\cos\alpha \tag{29}$$

Point imposed lead condition

$$\tau_g \times 1.5 = \frac{3}{2}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right]\frac{L}{2bh}\cos\alpha + \frac{3}{2} \times \frac{900}{bh}\cos\alpha \tag{30}$$

Long term lead condition, i.e. dead lead and self weight alone

$$\tau_g \times 1.0 = \frac{3}{2}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right]\frac{L}{2bh}\cos\alpha \tag{31}$$

Two-span continuous purlins

Uniform imposed lead condition

$$\tau_g \times 1.25 = \frac{3}{2}\left[1.25\,\frac{s}{s_s}\left\{(F_i \cos\alpha + F_d)\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right]\frac{5}{8}\,\frac{L\cos\alpha}{bh} \tag{32}$$

Point imposed load condition

Point load adjacent to central support

$$\tau_g \times 1.5 = \frac{3}{2}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right]\frac{5}{8}\,\frac{L\cos\alpha}{bh} + \frac{3}{2} \times \frac{900}{bh}\cos\alpha \tag{33}$$

Long term load condition, i.e. dead load and self weight alone

$$\tau_g \times 1.0 = \frac{3}{2}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right]\frac{5}{8}\,\frac{L\cos\alpha}{bh} \tag{34}$$

NOTE These equations lead to the following polynomials in L.

Single span purlins

Uniform imposed lead condition

$$\frac{3\cos\alpha}{4bh}\left[1.25\,\frac{s}{s_s}\left\{(F_i \cos\alpha + F_d)\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right]L - \tau_g \times 1.25 = 0 \tag{35}$$

Point imposed lead condition

$$\frac{3\cos\alpha}{4bh}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right]L + \frac{1350\cos\alpha}{bh} - \tau_g \times 1.5 = 0 \tag{36}$$

Long term lead condition, i.e. dead lead and self weight alone

$$\frac{3\cos\alpha}{4bh}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L-\tau_g\times 1.0=0 \tag{37}$$

Two-span continuous purlins
Uniform imposed lead condition

$$\frac{15\cos\alpha}{16bh}\left[1.25\,\frac{s}{s_s}\left\{(F_i\cos\alpha+F_d)\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L-\tau_g\times 1.25=0 \tag{38}$$

Point imposed load condition

$$\frac{15\cos\alpha}{16bh}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L+\frac{1350\cos\alpha}{bh}-\tau_g\times 1.5=0 \tag{39}$$

Long term load condition, i.e. dead load and self weight alone

$$\frac{15\cos\alpha}{16bh}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L-\tau_g\times 1.0=0 \tag{40}$$

5.5 Limitation of deflection

From **14.7** of BS 5268-2:1988, the recommended deflection limitation, w_{max} (in mm), is given by the equation

$$w_{max}=0.003\,L \tag{41}$$

Single span purlins

The design equation limiting deflection[1)] is

Uniform imposed load condition

$$w_{max}=\frac{5}{384}\,\frac{FL^4}{EI}+\frac{3FL^2}{20Gbh} \tag{42}$$

Point imposed load condition

$$w_{max}=\frac{5}{384}\,\frac{FL^4}{EI}+\frac{3FL^2}{20Gbh}+\frac{1}{48}\,\frac{F_pL^3}{EI}+\frac{3}{10}\,\frac{F_pL}{Gbh} \tag{43}$$

where

E is the minimum modulus of elasticity.

Taking G as $\frac{E}{16}$ (see clause **11** of BS 5268-2:1988):

Uniform imposed load condition

$$w_{max}=\frac{5}{384}\,\frac{FL^4}{EI}+\frac{12}{5}\,\frac{FL^2}{Ebh} \tag{44}$$

Point imposed load condition

$$w_{max}=\frac{5}{384}\,\frac{FL^4}{EI}+\frac{12}{5}\,\frac{FL^2}{Ebh}+\frac{F_pL^3}{48EI}+\frac{24}{5}\,\frac{F_pL}{Ebh} \tag{45}$$

With a deflection limitation of 0.003 L

[1)] In addition to the deflection due to bending the shear deflection may be significant and has been taken into account.

Uniform imposed load condition

$$0.003L = \cos\alpha \left[1.25 \frac{s}{s_s} \left\{ (F_i \cos\alpha + F_d) \left(\frac{s_s}{1000}\right) + F_s \right\} + F_j \right] \left(\frac{5}{384} \frac{L^4}{E} \frac{12}{bh^3} + \frac{12L^2}{5Ebh} \right) \quad (46)$$

Point imposed load condition

$$0.003L = \cos\alpha \left[1.25 \frac{s}{s_s} \left\{ F_d \left(\frac{s_s}{1000}\right) + F_s \right\} + F_j \right] \left(\frac{5}{384} \frac{L^4}{E} \frac{12}{bh^3} + \frac{12L^2}{5Ebh} \right) + \\ + \left(\frac{L^3}{48EI} + \frac{24}{5} \frac{L}{Ebh} \right) F_p \cos\alpha \quad (47)$$

Two-span continuous purlins

The design equation limiting deflection is

Uniform imposed load condition

$$w_{max} = \frac{FL^4}{185EI} + \frac{3FL^2}{20Gbh} \quad (48)$$

Point imposed load condition

$$w_{max} = \frac{FL^4}{185EI} + \frac{3FL^2}{20Gbh} + 0.015 \frac{F_p L^3}{EI} + \frac{3}{10} \frac{F_p L}{Gbh} \quad (49)$$

where E is the minimum modulus of elasticity.

Taking G as $\frac{E}{16}$ (see clause **11** of as BS 5268-2:1988:

Uniform imposed load condition

$$w_{max} = \frac{FL^4}{185EI} + \frac{12}{5} \frac{FL^2}{Ebh} \quad (50)$$

Point imposed load condition

$$w_{max} = \frac{FL^4}{185EI} + \frac{12}{5} \frac{FL^2}{Ebh} + 0.015 \frac{F_p L^3}{EI} + \frac{24}{5} \frac{F_p L}{Ebh} \quad (51)$$

With a deflection limitation of 0.003 L

Uniform imposed load condition

$$0.003L = \cos\alpha \left[1.25 \frac{s}{s_s} \left\{ (F_i \cos\alpha + F_d) \left(\frac{s_s}{1000}\right) + F_s \right\} + F_j \right] \left(\frac{L^4}{185E} \frac{12}{bh^3} + \frac{12L^2}{5Ebh} \right) \quad (52)$$

Point imposed load condition

$$0.003L = \cos\alpha \left[1.25 \frac{s}{s_s} \left\{ F_d \left(\frac{s_s}{1000}\right) + F_s \right\} + F_j \right] \left(\frac{L^4}{185E} \frac{12}{bh^3} + \frac{12L^2}{5Ebh} \right) + \\ + \left(0.015 \frac{L^3}{E} \frac{12}{bh^3} + \frac{24L}{5Ebh} \right) F_p \cos\alpha \quad (53)$$

NOTE These equations load to the following polynomials in L.

Single span purlins

Uniform imposed load condition

$$\frac{5\cos\alpha}{32Ebh^3}\left[1.25\,\frac{s}{s_s}\left\{(F_i\cos\alpha+F_d)\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L^3+$$
$$+\frac{12\cos\alpha}{5Ebh}\left[1.25\,\frac{s}{s_s}\left\{(F_i\cos\alpha+F_d)\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L-0.003=0 \qquad (54)$$

Point imposed load condition

$$\frac{5\cos\alpha}{32Ebh^3}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L^3+\frac{225\cos\alpha}{Ebh^3}L^2+$$
$$+\frac{12\cos\alpha}{5Ebh}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L+\frac{4320\cos\alpha}{Ebh}-0.003=0 \qquad (55)$$

Two-span continuous purlins

Uniform imposed load condition

$$\frac{12\cos\alpha}{185Ebh^3}\left[1.25\,\frac{s}{s_s}\left\{(F_i\cos\alpha+F_d)\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L^3+$$
$$+\frac{12\cos\alpha}{5Ebh}\left[1.25\,\frac{s}{s_s}\left\{(F_i\cos\alpha+F_d)\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L-0.003=0 \qquad (56)$$

Point imposed load condition

$$\frac{12\cos\alpha}{185Ebh^3}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L^3+\frac{162\cos\alpha}{Ebh^3}L^2+$$
$$+\frac{12\cos\alpha}{5Ebh}\left[1.25\,\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right)+F_s\right\}+F_j\right]L+\frac{4320\cos\alpha}{Ebh}-0.003=0 \qquad (57)$$

5.6 Permissible clear spans

The calculation of clear span requires the deduction of a notional bearing length from an effective span.

The calculation of the notional bearing length to be deducted from the permissible effective span to produce the clear span is made after finding L_{adm}, the smallest of the effective spans for a given cross section, as limited by:

a) bending stress under uniform imposed load;

b) bending stress under point imposed load;

c) bending stress under long term load alone;

d) shear stress under uniform imposed load;

e) shear stress under point imposed load;

f) shear stress under long term load alone;

g) deflection under uniform imposed load;

h) deflection under point imposed load.

In the following equations, the notional bearing length is calculated as though the purlin were supported in the manner shown in Figure 2. In practical constructions, the clear span of the purlin will be the clear distance between supporting walls or struts.

When purlin spacing is given in computed tables, this may be taken as either the distance between the centres of adjacent purlins or the distance between the eaves or ridge and the adjacent purlin.

From BS 5268-2, the permissible compression perpendicular to grain stress, $\sigma_{c,\perp,\,adm}$ (in N/mm^2), is given by the equation

$$\sigma_{c,\perp,\,adm}=\sigma_{c,\perp,\,g}K_3 \qquad (58)$$

where

$\sigma_{c,\perp,g}$ is the grade compression perpendicular to grain stress (in N/mm^2) (see BS 5268-2)[a];

K_3 is the load duration modification factor, 1.0 for long term, 1.25 for medium term or 1.5 for short term (see Table 17 of BS 5268-2:1988).

[a] BS 5268-2 provides two values for the grade compression perpendicular to grain stress. When the specification specifically prohibits wane at bearing areas, the higher value may be used; otherwise the lower value applies (see footnotes to Tables 9, 10, 11 and 12 of BS 5268-2:1988). The span table should indicate whether wane is permitted.

The notional bearing length, a (in mm), required at each end should be found from the following equations.

Single span purlins

Uniform imposed load condition

$$\sigma_{c,\perp,g} \times 1.25 \times ba = \frac{L_{adm}\cos\alpha}{2}\left[1.25\frac{s}{s_s}\left\{(F_i\cos\alpha + F_d)\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] \quad (59)$$

Point imposed load condition with bending stress or deflection governing

$$\sigma_{c,\perp,g} \times 1.5 \times ba = \frac{L_{adm}\cos\alpha}{2}\left[1.25\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] + 450\cos\alpha \quad (60)$$

Point imposed load condition with shear stress governing

$$\sigma_{c,\perp,g} \times 1.5 \times ba = \frac{L_{adm}\cos\alpha}{2}\left[1.25\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] + 900\cos\alpha \quad (61)$$

Long term load condition, i.e. dead load and self weight alone

$$\sigma_{c,\perp,g} \times 1.0 \times ba = \frac{L_{adm}\cos\alpha}{2}\left[1.25\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] \quad (62)$$

Two-span continuous purlins

Uniform imposed load condition

$$\sigma_{c,\perp,g} \times 1.25 \times ba = \frac{L_{adm}\cos\alpha}{2}\left[1.25\frac{s}{s_s}\left\{(F_i\cos\alpha + F_d)\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] \quad (63)$$

Point imposed load condition with bending stress or deflection governing

$$\sigma_{c,\perp,g} \times 1.5 \times ba = \frac{L_{adm}\cos\alpha}{2}\left[1.25\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] + 337.5\cos\alpha \quad (64)$$

Point imposed load condition with shear stress governing

$$\sigma_{c,\perp,g} \times 1.5 \times ba = \frac{L_{adm}\cos\alpha}{2}\left[1.25\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] + 900\cos\alpha \quad (65)$$

Long term load condition, i.e. dead load and self weight alone

$$\sigma_{c,\perp,g} \times 1.0 \times ba = \frac{L_{adm}\cos\alpha}{2}\left[1.25\frac{s}{s_s}\left\{F_d\left(\frac{s_s}{1000}\right) + F_s\right\} + F_j\right] \quad (66)$$

In equations (59) to (66)

a is the notional bearing length (in mm);

b is the breadth of the purlin (in mm);

L_{adm} is the permissible effective span (in mm).

The equation corresponding to the loading condition governing the permissible effective span should be solved for a, and half the value of a should be deducted from each end of the span (total deduction a, see Figure 2) to give the permissible clear span, L_{cl} (in mm), which is given by the equation

$$L_{cl} = L_{adm} - a \qquad (67)$$

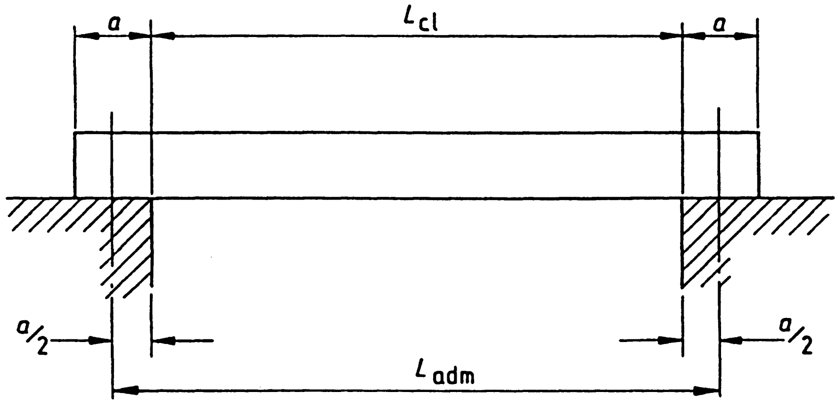


Figure 2 — Bearing length, permissible effective span and permissible clear span

6 Bearing length

Although correct for the calculation of clear span the procedure given in **5.6** for the calculation of notional bearing length may not ensure that the permissible compression perpendicular to the grain stress is not exceeded for all loading cases.

The design of some members may be governed by a loading case that does not represent the greatest total load of all loading cases. For example, the governing design case may include a concentrated load, but another less critical loading case may consist of a greater total load uniformly distributed along the span.

7 Information to be given in span tables

There are many possible formats for span tables. A typical format suitable for purlins at predetermined centres and for quoted loading is given in Appendix B.

This Section of BS 5268 does not recommend formats for different components but whatever format is used the following information should be given in the heading or in the main body or in the footnotes of the span tables, or in an introduction to the tables:

a) the loading;

b) details of the arrangement of the members;

c) the member sizes and their maximum permissible deviations and/or the standards that define these quantities;

d) the species, stress grade or strength class and/or the standards that define these properties;

e) a statement specifying any requirements additional to those given in the stress grading rules, e.g. whether wane is prohibited at bearings;

f) a statement that the spans have been calculated in accordance with the recommendations of BS 5268-2 and BS 5268-7.6;

g) a statement specifying any structural requirements that may be necessary to comply with the qualifying assumptions made in **4.2**, e.g. lateral support requirements, accommodation of lateral thrust at supports;

h) the permissible clear spans.

Appendix A Sample calculations for a purlin supporting rafters

The object is to find the permissible clear span, given the following data as applicable to a particular design case.

Timber	Strength class SC3		(see Tables 3 to 7 of BS 5268-2:1988)
Purlin type	Continuous, roof slope 30°		
Dimensions	Purlin breadth, b	= 63 mm	
	Purlin depth, h	= 200 mm	
	Purlin spacing, s	= 1 800 mm	
Roof loading	Dead load per square metre on slope, F_d	= 0.75 kN/m^2	[see **4.3** b)]
	Imposed snow load on plan	= 0.75 kN/m^2	[see **4.3** a)]
		or = 0.9 kN	
	Weight of rafters, F_s (see Appendix B)	= 50 × 150 × 540 × 9.80665/10^9 = 0.03972 kN/m, rafters at 450 mm spacing	

The following data are given in BS 5268-2:1988.

Grade stresses and density		**BS 5268-2:1988 reference**
Grade bending stress, $\sigma_{m,g}$	= 5.3 N/mm^2	Table 9
Grade shear stress, τ_g	= 0.67 N/mm^2	Table 9
Grade minimum modulus of elasticity, E	= 5 800 N/mm^2	Table 9
Grade compression perpendicular to the grain stress (with wane permitted), $\sigma_{c,\perp,g}$	= 1.7 N/mm^2	Table 9
Density, ρ	= 540 kg/m^3	Table 9
Modification factors		
Uniform load, load duration, K_3	= 1.00	long term, Table 17
Uniform load, load duration, K_3	= 1.25	medium term, Table 17
Point load, load duration, K_3	= 1.5	short term, Table 17
Depth, K_7	= $(300/h)^{0.11}$	**14.6**

Permissible stresses and recommended deflection limitation		**BS 5268-7.6 reference**
Permissible bending stress, $\sigma_{m,adm}$ (in N/mm^2)	= $\sigma_{m,g} K_3 K_7$ = 6.855 N/mm^2 for uniform load (medium term) or = 8.226 N/mm^2 for point load or = 5.484 N/mm^2 for uniform load (long term)	**5.3**
Permissible shear stress, τ_{adm} (in N/mm^2)	= $\tau_g K_3$ = 0.8375 N/mm^2 for uniform load (medium term) or = 1.005 N/mm^2 for point load or = 0.67 N/mm^2 for uniform load (long term)	**5.4**

		BS 5268-7.6 reference
Recommended deflection limitation, w_{max} (in mm)	= 0.003 L	**5.5**
Permissible compression perpendicular to the grain stress, $\sigma_{c,\perp,adm}$ (in N/mm^2)	$= \sigma_{c,\perp,g} K_3$ = 2.125 N/mm^2 for uniform load (medium term) or = 2.55 N/mm^2 for point load or = 1.7 N/mm^2 for uniform load (long term)	**5.6**

Application of the design equations from **5.3** to **5.5** leads to the following solutions for effective span L:

Limitation of bending stress

at central support

uniform imposed load	L = 3 067 mm (equation 23)
point imposed load	L = 4 270 mm (equation 24)
long term load	L = 3 625 mm (equation 25)

in lower span

point imposed load	L = 5 293 mm (equation 26)

Limitation of shear stress

uniform imposed load	L = 4 179 mm (equation 38)
point imposed load	L = 8 021 mm (equation 39)
long term load	L = 5 837 mm (equation 40)

Limitation of deflection

uniform imposed load	L = 3 779 mm (equation 56)
point imposed load	L = 4 205 mm (equation 57)

The permissible effective span, L_{adm}, is therefore

L_{adm} = 3 067 mm

The appropriate equation is selected from **5.6** to calculate the notional bearing length, a, as 34 mm.

The permissible clear span, $L_{cl,}$ for the joists is then

$L_{cl} = L_{adm} - a$

L_{cl} = 3 033 mm

Appendix B Specimen span tables for purlins supporting rafters

Since the loading of a purlin is a function of the spacing and weight of the rafters it supports, these variables should occur in rigorous design solutions. Provision has been made in the design equations of this Section of BS 5268 for such solutions but the calculations of purlin spans for Appendix B have been based on 50 mm × 150 mm rafters at 450 mm spacing having the same density as the purlin. The assumption of a uniformly distributed load becomes too inaccurate if less than three rafters are supported on the purlin span. For this reason, spans below 1 800 mm have been omitted from the specimen tables.

There are many possible formats for span tables and Table 1, Table 2 and Table 3 are typical examples. Whatever format is used, the information listed in clause **7** should be given.

Table 1 — Permissible clear spans for two-span continuous purlins, roof slope 30°, uniform snow load 0.75 kN/m²: SC3[a], regularized sizes[b]

Size of purlin	Dead load (in kN/m²) supported by roof, excluding the self weight of the rafters end purlin														
	Not more than 0.5 (51 kg/m²)					More than 0.5 but not more than 0.75 (76.5 kg/m²)					More than 0.75 but not more than 1.0 (102 kg/m²)				
	Centre-to-centre spacing of purlins (in m)														
	1.20	1.50	1.80	2.10	2.40	1.20	1.50	1.80	2.10	2.40	1.20	1.50	1.80	2.10	2.40
	Permissible clear span														
mm	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
38 × 122	1.821														
× 147	2.169	1.938				1.977					1.828				
× 170	2.486	2.222	2.025	1.872		2.266	2.024	1.844			2.095	1.869			
× 195	2.826	2.526	2.304	2.130	1.988	2.577	2.302	2.097	1.897		2.382	2.126	1.894		
× 220	3.163	2.828	2.580	2.385	2.227	2.885	2.577	2.349	2.137	1.867	2.667	2.381	2.135	1.826	
44 × 122	1.961														
× 147	2.335	2.087	1.904			2.129	1.902				1.969				
× 170	2.675	2.392	2.182	2.018	1.885	2.440	2.180	1.987	1.837		2.256	2.015	1.835		
× 195	3.040	2.720	2.481	2.295	2.144	2.774	2.479	2.260	2.089	1.922	2.566	2.292	2.088	1.880	
× 220	3.402	3.044	2.778	2.570	2.401	3.104	2.776	2.531	2.340	2.166	2.872	2.566	2.338	2.118	1.850
47 × 97															
× 122	2.026	1.812				1.848									
× 147	2.413	2.158	1.968	1.820		2.201	1.967	1.793			2.035	1.818			
× 170	2.764	2.473	2.256	2.087	1.949	2.522	2.254	2.055	1.900		2.332	2.084	1.899		
× 195	3.141	2.811	2.565	2.373	2.217	2.867	2.563	2.337	2.161	2.018	2.652	2.370	2.160	1.995	
× 220	3.515	3.146	2.872	2.657	2.483	3.208	2.869	2.617	2.420	2.260	2.969	2.653	2.418	2.235	1.978
50 × 97															
× 122	2.090	1.869				1.906									
× 147	2.488	2.226	2.031	1.878		2.270	2.029	1.850			2.100	1.876			
× 170	2.850	2.550	2.327	2.153	2.012	2.601	2.325	2.121	1.961	1.831	2.406	2.150	1.960	1.811	
× 195	3.239	2.899	2.646	2.449	2.288	2.956	2.644	2.412	2.230	2.083	2.736	2.445	2.229	2.060	1.869
× 220	3.624	3.245	2.962	2.741	2.562	3.308	2.960	2.700	2.497	2.333	3.062	2.738	2.496	2.307	2.106
63 × 147	2.790	2.498	2.281	2.111	1.974	2.547	2.279	2.080	1.924		2.358	2.108	1.923		
× 170	3.194	2.861	2.613	2.419	2.262	2.917	2.611	2.383	2.205	2.061	2.701	2.416	2.204	2.038	1.904
× 195	3.629	3.252	2.971	2.751	2.572	3.315	2.968	2.710	2.508	2.344	3.070	2.747	2.506	2.318	2.166
× 220	4.058	3.638	3.324	3.079	2.879	3.709	3.322	3.033	2.807	2.624	3.435	3.074	2.806	2.595	2.425
75 × 195	3.950	3.543	3.239	3.001	2.807	3.612	3.236	2.956	2.737	2.560	3.346	2.996	2.736	2.532	2.366
× 220	4.416	3.962	3.624	3.358	3.142	1.039	3.621	3.308	3.064	2.866	3.743	3.353	3.062	2.834	2.650

NOTE 1 The tables are computed on the basis that the specification does not exclude wane at bearings.

NOTE 2 The spans have been calculated in accordance with the recommendations of BS 5268-2 and BS 5268-7.6. **Lateral support should be provided in accordance with 14.8 of BS 5268-2:1988.**

NOTE 3 The material should be stress graded in accordance with BS 4978.

NOTE 4 The sizes and their maximum permissible deviations should be in accordance with BS 4471.

NOTE 5 For the calculation of this span table it was assumed that the purlins carried 50 mm × 150 mm rafters of the same density as the purlin, at 450 mm spacing.

[a] For species/grade combinations in this strength class, see Table 3 to Table 7 of BS 5268-2:1988.

[b] Regularized sizes are given in BS 4471.

Table 2 — Permissible clear spans for single span purlins, roof slope 30°, uniform snow load 0.75 kN/m²: redwood/whitewood, SS grade, basic sizes[a]

Size of purlin	Dead load (in kN/m²) supported by roof, excluding the self weight of the rafters and purlin														
	Not more than 0.5 (51 kg/m²)					More than 0.5 but not more than 0.75 (76.5 kg/m²)					More than 0.75 but not more than 1.0 (102 kg/m²)				
	Centre-to-centre spacing of purlins (in m)														
	1.20	1.50	1.80	2.10	2.40	1.20	1.50	1.80	2.10	2.40	1.20	1.50	1.80	2.10	2.40
	Permissible clear span														
mm	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
38 × 150	2.123	1.961	1.837			1.989	1.835				1.881				
× 175	2.475	2.286	2.141	2.024	1.926	2.319	2.140	2.002	1.890	1.798	2.193	2.022	1.890		
× 200	2.825	2.611	2.446	2.312	2.201	2.648	2.444	2.287	2.160	2.054	2.505	2.309	2.159	2.037	1.935
× 225	3.176	2.935	2.749	2.599	2.474	2.976	2.748	2.571	2.428	2.309	2.816	2.597	2.427	2.290	2.176
44 × 125	1.865														
× 150	2.235	2.066	1.936	1.832		2.095	1.935	1.812			1.983	1.830			
× 175	2.605	2.109	2.257	2.135	2.034	2.442	2.256	2.112	1.996	1.900	2.311	2.133	1.996	1.884	
× 200	2.973	2.750	2.578	2.439	2.323	2.789	2.576	2.413	2.280	2.170	2.640	2.436	2.279	2.152	2.047
× 225	3.342	3.091	2.898	2.742	2.612	3.134	2.896	2.712	2.564	2.440	2.967	2.739	2.563	2.420	2.302
47 × 125	1.908														
× 150	2.287	2.115	1.983	1.876		2.145	1.982	1.856			2.030	1.874			
× 175	2.665	2.465	2.311	2.187	2.084	2.500	2.310	2.164	2.045	1.947	2.366	2.185	2.045	1.931	1.837
× 200	3.042	2.815	2.639	2.498	2.380	2.854	2.638	2.471	2.336	2.224	2.702	2.495	2.335	2.206	2.099
× 225	3.418	3.164	2.967	2.808	2.676	3.207	2.965	2.778	2.627	2.501	3.037	2.805	2.626	2.481	2.360
50 × 125	1.949	1.803				1.828									
× 150	2.336	2.162	2.027	1.918	1.828	2.192	2.026	1.898			2.075	1.916			
× 175	2.723	2.519	2.363	2.236	2.131	2.554	2.361	2.212	2.092	1.992	2.419	2.234	2.091	1.976	1.880
× 200	3.108	2.877	2.698	2.554	2.434	2.916	2.696	2.527	2.390	2.276	2.762	2.551	2.389	2.257	2.148
× 225	3.492	3.233	3.033	2.871	2.736	3.277	3.031	2.840	2.687	2.559	3.104	2.868	2.686	2.538	2.415
63 × 150	2.529	2.343	2.199	2.083	1.986	2.375	2.198	2.061	1.951	1.859	2.250	2.081	1.950	1.845	
× 175	2.946	2.730	2.563	2.428	2.316	2.767	2.561	2.402	2.274	2.168	2.622	2.425	2.273	2.151	2.049
× 200	3.362	3.116	2.926	2.772	2.644	3.158	2.924	2.743	2.597	2.476	2.994	2.769	2.596	2.456	2.340
× 225	3.777	3.501	3.288	3.116	2.973	3.549	3.286	3.083	2.920	2.783	3.364	3.113	2.918	2.761	2.631
75 × 200	3.565	3.307	3.108	2.946	2.812	3.351	3.106	2.916	2.763	2.635	3.179	2.944	2.762	2.615	2.493
× 225	4.004	3.715	3.492	3.311	3.161	3.765	3.490	3.277	3.105	2.962	3.572	3.308	3.104	2.940	2.802

NOTE 1 The tables are computed on the basis that the specification does not exclude wane at bearings.
NOTE 2 The spans have been calculated in accordance with the recommendations of BS 5268-2 and BS 5268-7.6. Lateral support should be provided in accordance with **14.8** of BS 5268-2:1988.
NOTE 3 The material should be stress graded in accordance with BS 4978.
NOTE 4 The sizes and their maximum permissible deviations should be in accordance with BS 4471.
NOTE 5 For the calculation of this span table it was assumed that the purlins carried 50 mm × 150 mm rafters of the same density as the purlin, at 450 mm spacing.

[a] Basic sizes are given in BS 4471.

Table 3 — Permissible clear spans for two-span continuous purlins, roof slope 30°, uniform snow load 0.75 kN/m²: spruce-pine-fir, joist and plank no. 2 grade, CLS sizes[a]

Size of purlin	Dead load (in kN/m^2) supported by roof, excluding the self weight of the rafters and purlin														
	Not more than 0.5 (51 kg/m^2)					More than 0.5 but not more than 0.75 (76.5 kg/m^2)					More than 0.75 but not more than 1.0 (102 kg/m^2)				
	Centre-to-centre spacing of purlins (in m)														
	1.20	1.50	1.80	2.10	2.40	1.20	1.50	1.80	2.10	2.40	1.20	1.50	1.80	2.10	2.40
	Permissible clear span														
mm	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
38 × 140	2.144	1.915				1.952					1.802				
× 184	2.771	2.476	2.257	2.085	1.937	2.523	2.252	2.051	1.836		2.330	2.079	1.832		
× 235	3.483	3.114	2.839	2.624	2.450	3.173	2.834	2.582	2.340	2.044	2.931	2.616	2.334	1.996	
× 285	4.170	3.730	3.402	3.145	2.936	3.800	3.395	3.094	2.832	2.474	3.511	3.135	2.824	2.416	2.109

NOTE 1 The tables are computed on the basis that the specification does not exclude wane at bearings.

NOTE 2 The spans have been calculated in accordance with the recommendations of BS 5268-2 and BS 5268-7.6. Lateral support should be provided in accordance with **14.8** of BS 5268-2:1988.

NOTE 3 The material should be stress graded in accordance with NLGA rules. (The similar ALS (American Lumber Standards) sizes are graded in the USA to NGRDL rules.)

NOTE 4 The sizes and their maximum permissible deviations should be in accordance with BS 4471.

NOTE 5 For the calculation of this span table it was assumed that the purlins carried 50 mm × 150 mm rafters of the same density as the purlin, at 450 mm spacing.

[a] CLS sizes are given in Appendix A of BS 4471:1987.

blank

Publications referred to

BS 648, *Schedule of weights of building materials.*
BS 4471, *Specification for sizes of sawn and processed softwood.*
BS 4978, *Specification for softwood grades for structural use.*
BS 5268, *Structural use of timber.*
BS 5268-2, *Code of practice for permissible stress design, materials and workmanship.*
BS 5268-3, *Code of practice for trussed rafter roofs.*
BS 5268-7, *Recommendations for the calculation basis for span tables.*
BS 5268-7.1, *Domestic floor joists*[2].
BS 5268-7.2, *Joists for flat roofs*[2].
BS 5268-7.3, *Ceiling joists*[2].
BS 5268-7.4, *Ceiling binders*[2].
BS 5268-7.5, *Rafters*[2].
BS 5268-7.7, *Purlins supporting sheeting or decking*[2].
BS 6100, *Glossary of building and civil engineering terms.*
BS 6100-2, *Civil engineering.*
BS 6100-2.1, *Structural design and elements.*
BS 6100-4, *Forest products.*
BS 6100-4.1, *Characteristics and properties of timber and wood based panel products.*
BS 6100-4.2, *Sizes and quantities of solid timber.*
BS 6100-4.3, *Wood based panel products.*
BS 6100-4.4, *Carpentry and joinery.*
BS 6399, *Loading for buildings.*
BS 6399-1, *Code of practice for dead and imposed loads.*
BS 6399-3, *Code of practice for imposed roof loads.*
ISO 3898, *Basis for design of structures — Notations — General symbols.*
International Council for Building Research Studies and Documentation
CIB-W18-1, *Symbols for use in structural timber design.*
National Lumber Grades Authority (Canada)
NLGA 1979, *The National Grading Rules for Dimension Lumber.*
National Grading Rules for Dimension Lumber (USA)
NGRDL 1975, *The National Grading Rules for Softwood Dimension Lumber.*

[2] Referred to in the foreword only.

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL