

**BRITISH STANDARD**

# **Visual strength grading of softwood – Specification**

ICS 79.040

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# Foreword

## **Publishing information**

This British Standard was published by BSI and came into effect on 31 May 2007. It was prepared by Technical Committee B/518, *Structural timber*. A list of organizations represented on this committee can be obtained on request to its secretary.

## **Supersession**

This British Standard supersedes BS 4978:1996, which is withdrawn.

## **Information about this document**

This edition of this British Standard has been revised to comply with the requirements of BS EN 14081-1:2005, Annex A.

This British Standard specifies the means of assessing the quality of softwood for which design values are given in BS 5268-2 and characteristic values as given in BS EN 338. The assignments to those strength classes of grades defined in this standard are given in BS EN 1912.

It takes account of and includes certain of the provisions contained in the Economic Commission for Europe (ECE) *Recommended standard for stress grading and finger-jointing of structural coniferous sawn timber* [1].

Annex A specifies the method to be used for the determination of knot area ratio in cases of dispute, and Annex B specifies the minimum requirements for the control of strength grading operations.

## **Presentational conventions**

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

## **Contractual and legal considerations**

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard cannot confer immunity from legal obligations.**

# 1 Scope

This British Standard specifies a method of strength grading softwood visually for structural use.

The permissible limits of characteristics for two visual strength grades of softwood, General Structural Grade (GS) and Special Structural Grade (SS) are specified.

This British Standard applies to softwoods, graded for use in the United Kingdom, for both within the United Kingdom and abroad.

# 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 5268-2, *Structural use of timber – Part 2: Code of practice for permissible stress design, materials and workmanship*

BS 6100-4 (all parts), *Glossary of building and civil engineering terms*

BS EN 336, *Structural timber – Sizes, permitted deviations*

BS EN 338, *Structural timber – Strength classes*

BS EN 1310:1997, *Round and sawn timber – Method of measurement of features*

BS EN 1912, *Structural timber – Strength classes – Assignment of visual grades and species*

BS EN 13183-2, *Moisture content of a piece of sawn timber – Part 2: Estimation by electrical resistance method*

BS EN 13556, *Round and sawn timber – Nomenclature of timbers used in Europe*

BS EN 14081-1:2005, *Timber structures – Strength graded structural timber with rectangular cross section – Part 1: General requirements*

# 3 Terms and definitions

For the purposes of this British Standard, the nomenclature given in BS EN 13556 and the terms and definitions given in BS 5268-2, BS EN 14081-1, BS EN 336 and BS 6100-4 and the following apply.

## 3.1 dry graded timber

timber that is part of a batch that has been assessed for fissures and distortion at an average moisture content of 20% or less, with no reading exceeding 24% moisture content

## 3.2 fissure

longitudinal separation of fibres, appearing on a face, edge or end of a piece of softwood, and including checks, shakes and splits

- 3.3 knot area ratio**  
ratio of the sum of projected cross-sectional areas of the knots to the cross-sectional area of the piece
- 3.4 margin**  
area adjoining an edge of the cross-section, occupying one-quarter of the total cross-sectional area of the piece (see Figure 1)
- 3.5 margin knot area ratio (MKAR)**  
ratio of the sum of the projected cross-sectional areas of all knots or portions of knots in a margin intersected at any cross-section, to the cross-sectional area of margin
- 3.6 parcel**  
quantity of sawn timber of the same target size, quality and description
- 3.7 sample**  
number of specimens of one cross-sectional size and from one parcel
- 3.8 strength class**  
classification of timber based on particular values of mechanical properties and density
- 3.9 total knot area ratio (TKAR)**  
ratio of the sum of the total projected cross-sectional areas of all knots intersected by any cross-section to the total cross-sectional area of the piece (see Figure 2)
- 3.10 wet graded timber**  
timber that is part of a batch that has been assessed for fissures and distortion at an average moisture content in excess of 20%

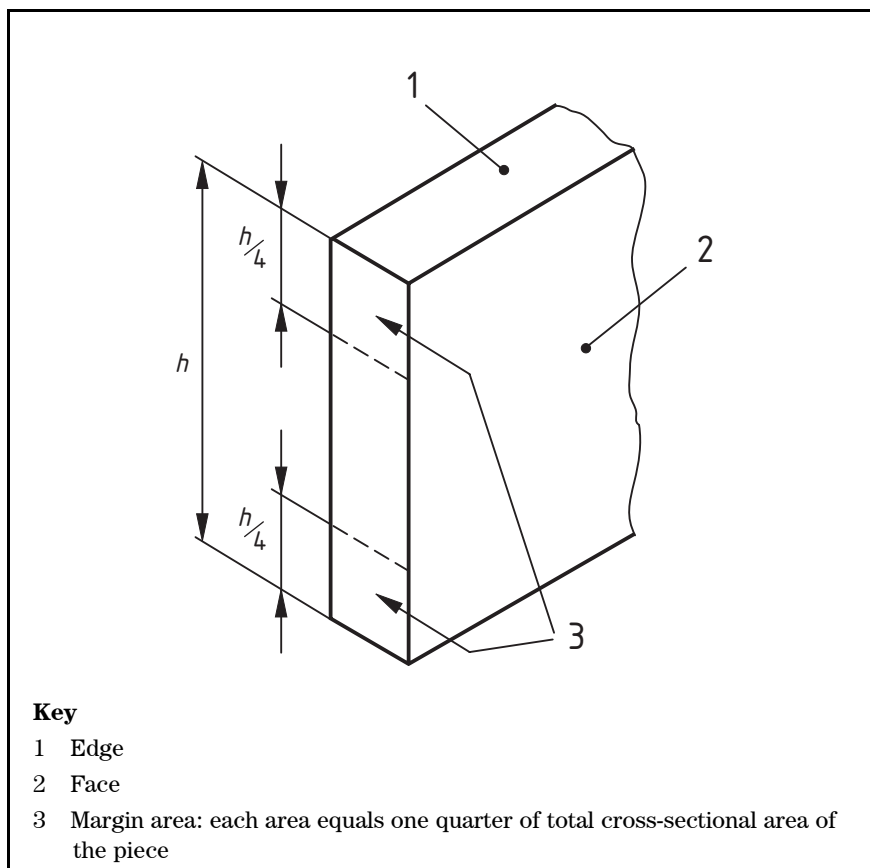
## 4 Strength graded timber

### 4.1 Supervision of strength grading operations

Visual strength grading operations shall be carried out by a grader and/or grading company, in accordance with Annex B and with factory production control requirements in BS EN 14081-1:2005, Clause **6.3** and **ZA2.1**.

*NOTE Softwood which is graded abroad under the supervision of an EU Notified Body and marked in accordance with this British Standard does not have to be regraded in the United Kingdom, provided that it is not resawn into smaller sizes.*

Figure 1 Edge, face and margin areas



## 4.2 Sizes

Unless otherwise specified, softwood graded to BS 4978 shall conform to BS EN 336 with respect to permissible deviations and processing reductions applicable to constructional timber. Timber shall have a minimum cross-sectional area of 2 000 mm<sup>2</sup> and a minimum thickness of 20 mm.

## 4.3 Processed timber

If the grading has been carried out before processing, provided that the processing reduction from the target size is not greater than 5 mm for dimensions less than or equal to 100 mm, or, not greater than 10 mm for dimensions greater than 100 mm, the grade shall not be deemed to have been changed.

*NOTE* The structural performance of each piece reduces depending on the amount of material removed by the processing operation.

## 4.4 Resawing or surfacing

Where graded softwood is resawn or surfaced to an extent beyond the limits of 4.3, the softwood shall be regraded if it is to conform to this British Standard.

#### **4.5 Cross-cutting**

Where pieces are cross-cut, each resulting piece shall conform to the requirements of this British Standard.

#### **4.6 Moisture content**

##### **4.6.1 Determination**

The moisture content shall be determined in accordance with BS EN 13183-2.

##### **4.6.2 Dry graded timber**

The fissures and distortion of a batch of timber being strength graded shall be assessed when the batch has an average moisture content of 20% or less, with no reading exceeding 24% moisture content.

##### **4.6.3 Wet graded timber**

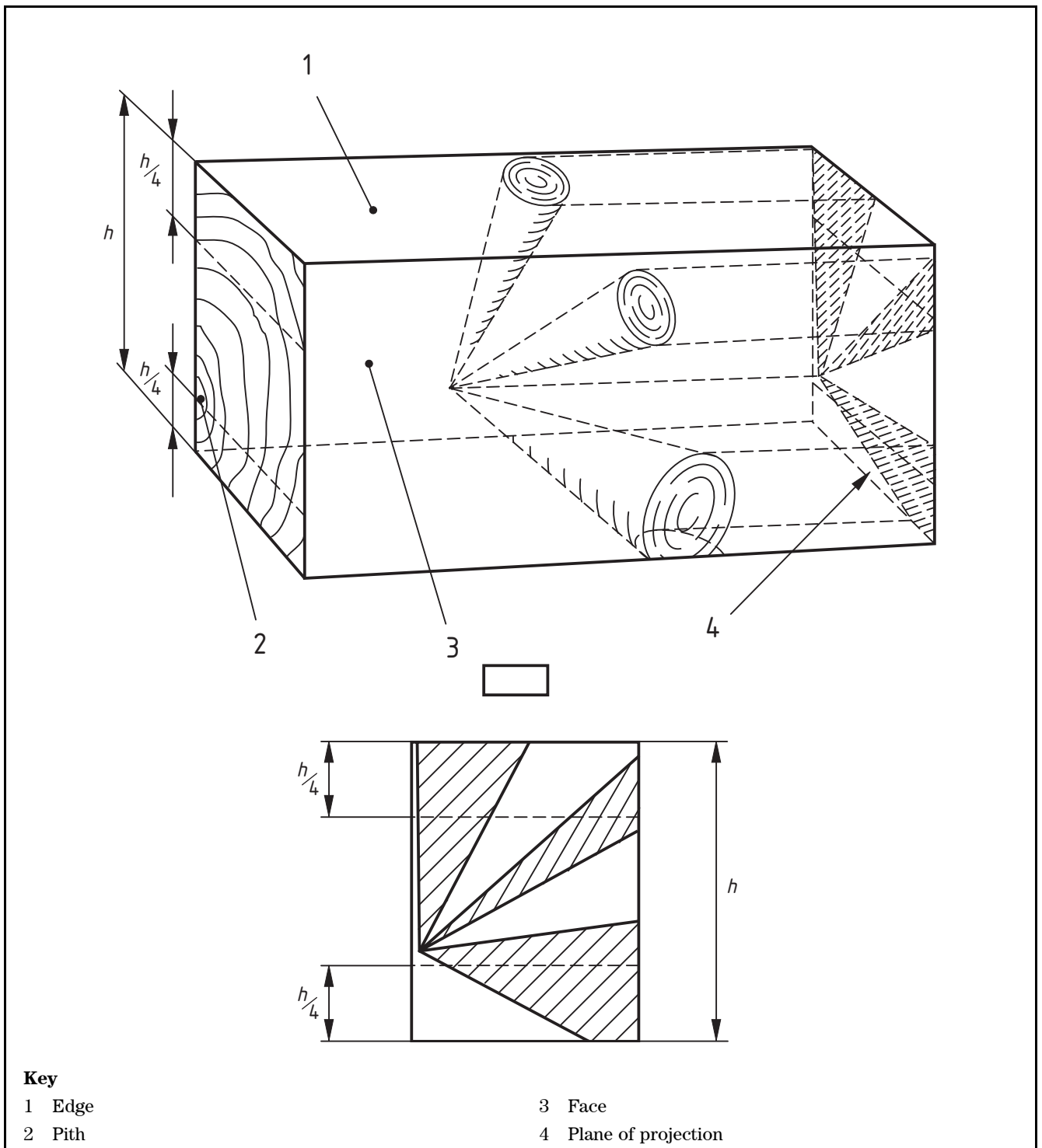
Because thick timber is difficult to dry, **4.6.2** shall not apply to timber that has a target thickness of 100 mm or more. Neither shall **4.6.2** apply to timber that is specified for use in contact with water or in climatic conditions leading to timber moisture content higher than 20% (corresponding to service class 3, as defined in BS 5268-2:2002).

#### **4.7 Acceptance limits for visually graded softwood**

A representative sample of a parcel of graded softwood shall be deemed as conforming to a particular grade, provided that not more than 10% of the pieces exceed the permissible limits of the grade and that not more than 3% of the pieces in the sample exceed the permissible limits by more than one third. Where the parcel contains less than 10 pieces, the permissible limits shall not be exceeded.



Figure 2 Knot projection



## 5 Grade requirements

Timber shall be strength graded to either General Structural (GS) or Special Structural (SS). To qualify for a grade, a piece shall not contain characteristics which exceed the limits given in Table 1 when measured or assessed in accordance with Clause 6.

Sapstain is not a structural defect and shall be acceptable without limitation.

Any piece which contains abnormal defects such as compression wood, insect damage (e.g. worm holes, pin holes), fungal decay (but not sapstain), damage, combinations of knots and/or other characteristics, that could cause a decrease in strength properties to an amount which threatens the serviceability of the piece, shall be excluded from the grades.

Where reduction in strength, caused by the abnormal defect, is obviously less than that caused by the defects admitted by the grade, the piece shall be accepted provided that the abnormal defect is of a type which does not progress after conversion and/or drying (e.g. white pocket rot derived from the standing tree). Where arrises are rounded as part of the manufacturing process, they shall not exceed a radius of 3 mm and shall be ignored when assessing wane.

If, when grading, automatic devices are used to estimate the size or shape of the visual characteristics or to estimate the size or geometrical shape of the individual pieces, such automatic devices shall only be used to assess the grade of each piece against the visual requirements of this British Standard.

## **6 Measurement of characteristics**

### **6.1 Knots**

Knots shall be assessed by their total knot area ratio (TKAR) (see **3.9**) and their margin knot area ratio (MKAR) (see **3.5**). Knots shall be included as part of the same cross-section if any part of the knots or the grain disturbances for which they are responsible overlap along the length of the piece.

*NOTE 1 In making this assessment, knots or knot holes of 5 mm diameter or less can be ignored.*

No distinction shall be made between knot holes, dead knots or live knots. Square section pieces shall be graded in accordance with Table 1, Note 4.

*NOTE 2 Figure 2 illustrates the method of deriving a projection of knots on a cross-sectional plane.*

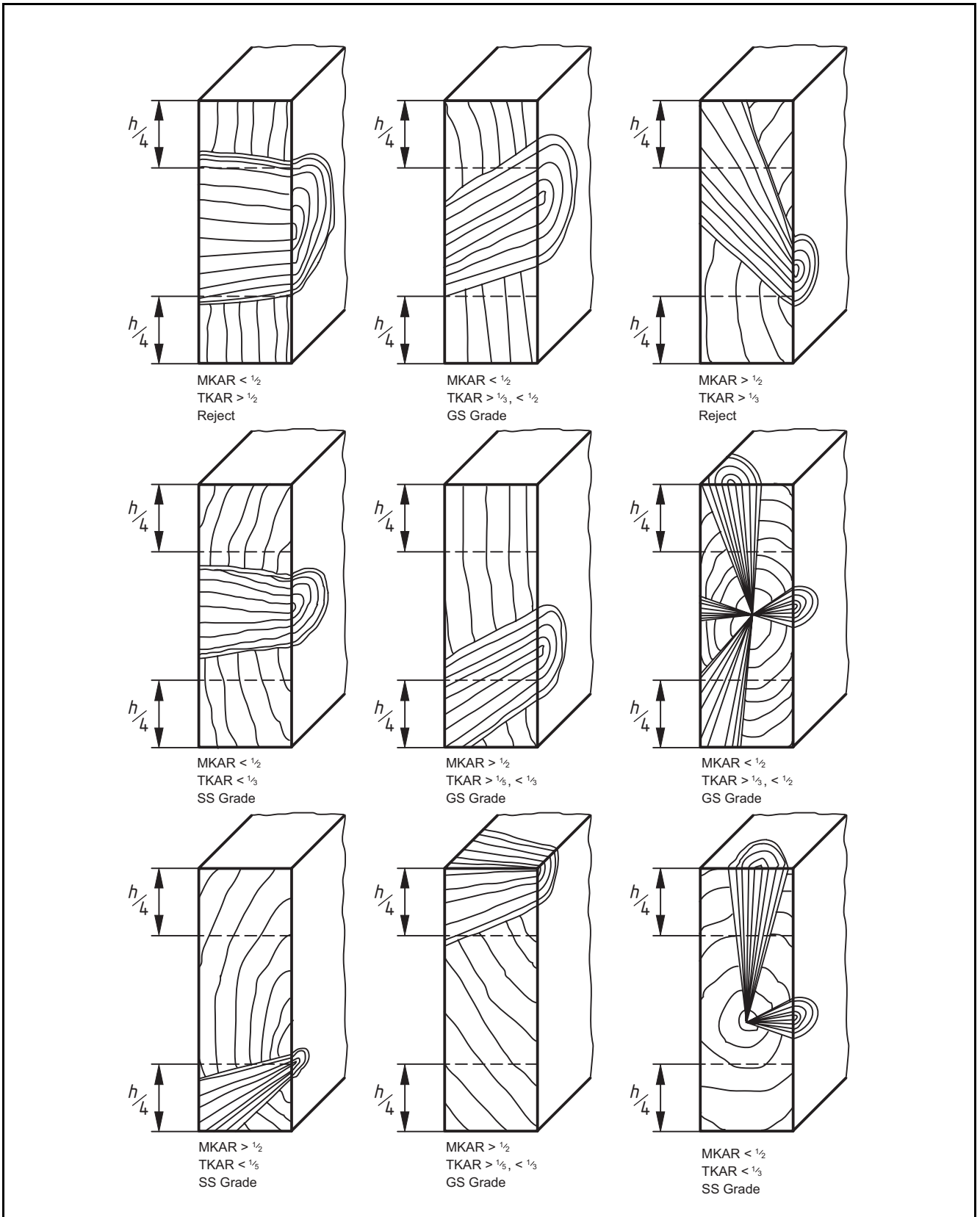
*NOTE 3 Typical knot area ratios are shown in Figure 3.*

In cases of dispute, Annex A shall be used to determine the knot area ratio.

### **6.2 Slope of grain**

Slope of grain shall be assessed as the inclination of the wood fibres (grain) to the longitudinal axis of the piece. The slope shall be expressed as the number of units of length over which unit deviation occurs. It shall be measured over a distance sufficiently great to determine the general slope, disregarding local deviations. The slope of grain shall be measured in accordance with BS EN 1310:1997, **4.4.1**.

Figure 3 Typical knot area ratios and the resulting grades



### 6.3 Rate of growth

To assess the rate of growth, measurement shall be made on one end of the piece and expressed as the average ring width, in millimetres. The measurement shall be taken as follows:

- a) Where possible along a straight line 75 mm long, normal to the growth rings, which:
  - 1) when the pith is absent, passes through the centre of the end of the piece (see Figure 4a); or,
  - 2) when the pith is present, commences 25 mm from the pith (see Figure 4b); or,
- b) If a line 75 mm long is unobtainable, on the longest possible line normal to the growth rings and passing through the centre of the piece.

### 6.4 Wane

Conformity to the limits of wane given in Table 1 shall be determined using the formulae given in items a) and b).

- a) The ratio of full face dimension relative to the target width is given by the formulae:

$$\frac{h - V_1}{h} \text{ or } \frac{h - V_2 - V_3}{h}$$

- b) The ratio of full edge dimension relative to the target thickness is given by the formulae:

$$\frac{b - K_1}{b} \text{ or } \frac{b - K_2 - K_3}{b}$$

where  $h$ ,  $b$ ,  $V_1$  to  $V_3$  and  $K_1$  to  $K_3$  are as given in Figure 5.

### 6.5 Fissures

*NOTE 1 The limits for the length of fissures are given in Table 1.*

Measurement shall be taken at the time of grading. Fissures shall be measured in accordance with BS EN 1310:1997, **4.4.1**.

*NOTE 2 The length of a fissure is influenced by moisture content. Precise limits to cover all conditions and applications cannot therefore be given and guidance only is provided as to what might be considered acceptable limits at 20% moisture content.*

### 6.6 Resin pockets and bark pockets

Resin pockets and bark pockets shall be assessed as fissures or knots according to their shape. If a bark pocket is assessed as a knot, it shall be taken into account when assessing knot area ratio (see **6.1**).

## 6.7 Distortion

*NOTE 1* The methods of assessing distortion are shown in Figure 6.

Bow, spring and twist shall be assessed over a 2 m length. Longitudinal curvature in square section pieces shall be assessed using the limits for bow. Measurement shall be taken at the time of grading. Bow and spring shall be measured in accordance with BS EN 1310:1997, 4.10.1. Twist shall be measured in accordance with BS EN 1310:1997, 4.10.3.

*NOTE 2* The amount of distortion is influenced by moisture content. Precise limits to cover all conditions and applications cannot therefore be given and guidance only is provided as to what might be considered acceptable limits at 20% moisture content.

Figure 4 Measurement of rate of growth

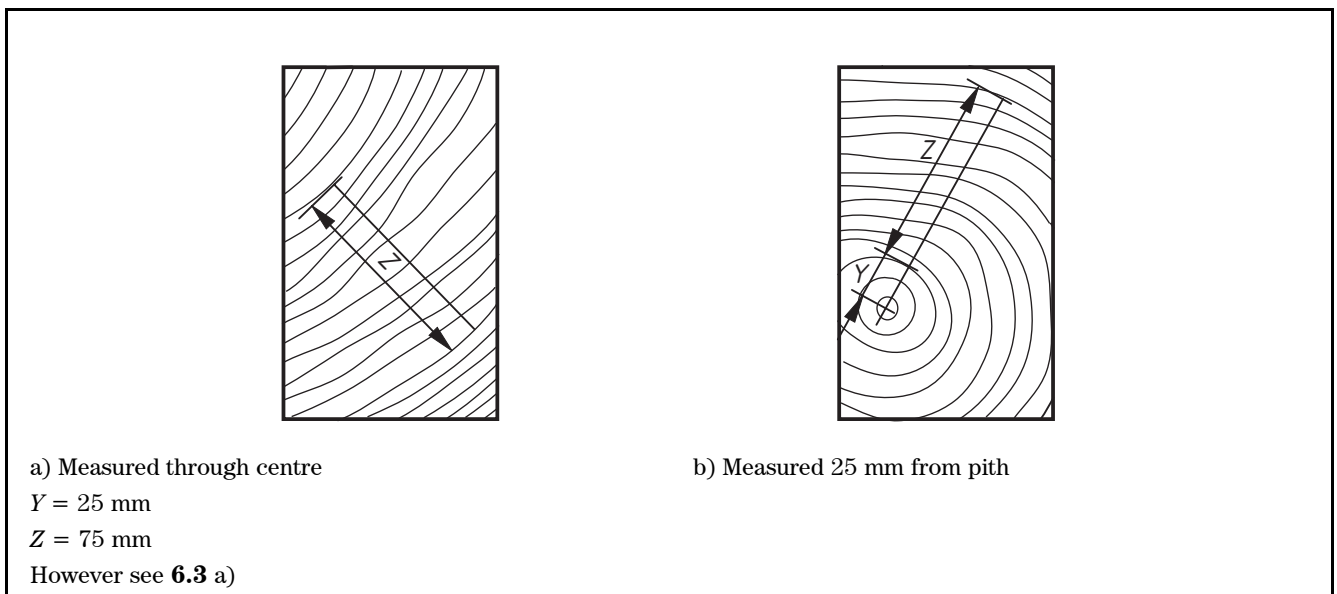


Figure 5 Amounts of wane

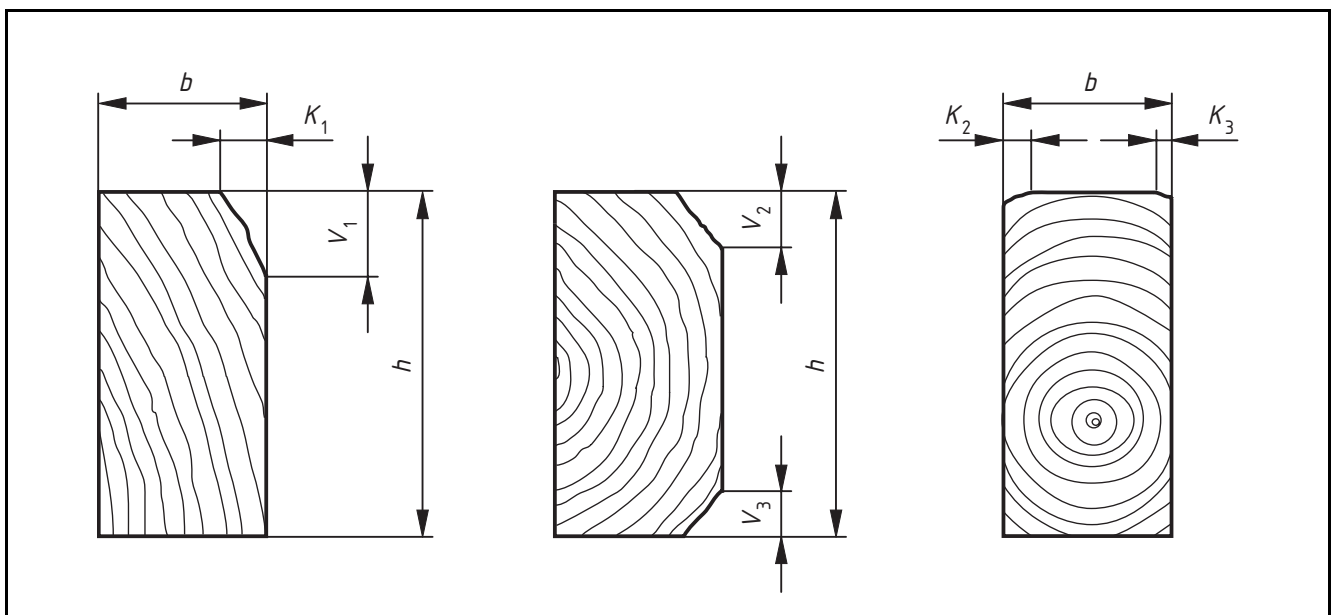


Figure 6 Measurement of bow, spring and twist

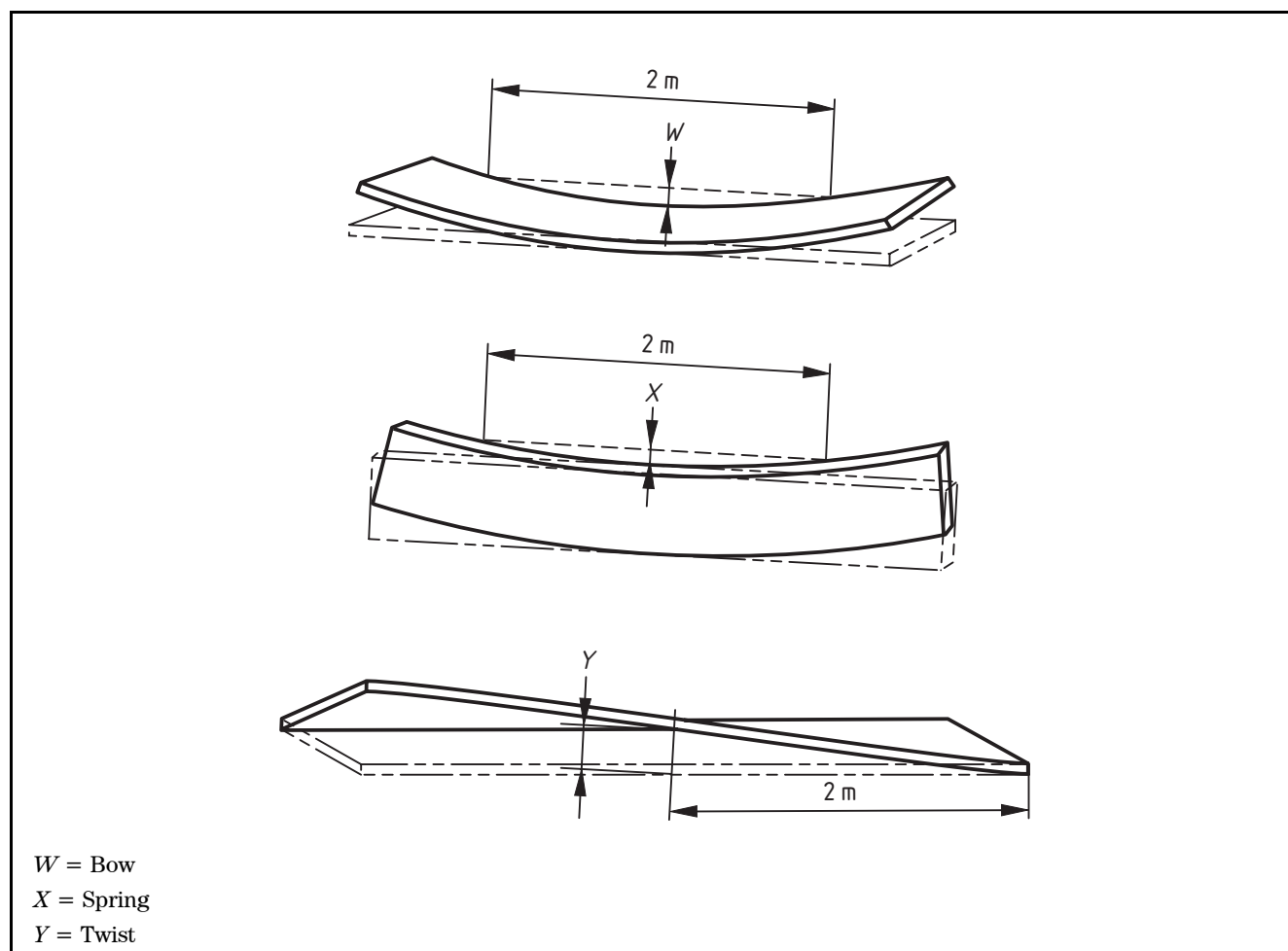


Table 1 Permissible limits for the GS and SS visual strength grades

Characteristic (see Clause 3)	Grade	
	GS (see Note 3)	SS
Knots (see Note 4)	Either: If MKAR is less than or equal to $\frac{1}{2}$ , then TKAR shall be less or equal to $\frac{1}{2}$ . Or: If MKAR is greater than $\frac{1}{2}$ , then TKAR shall be less than or equal to $\frac{1}{3}$ .	Either: If MKAR is less than or equal to $\frac{1}{2}$ , then TKAR shall be less or equal to $\frac{1}{3}$ . Or: If MKAR is greater than $\frac{1}{2}$ , then TKAR shall be less than or equal to $\frac{1}{5}$ .
Slope of grain	Not greater than 1 in 6.	TKAR shall be less than or equal to $\frac{1}{5}$ .
Rate of growth	Average width or annual rings not greater than 10 mm.	Average width or annual rings not greater than 6 mm.
Fissures:		
not through the thickness	Not greater than 1.5 m or $\frac{1}{2}$ the length of the piece, whatever is the lesser; however fissures with depth less than half the thickness can be ignored.	Not greater than 1.0 m or $\frac{1}{4}$ the length of the piece, whichever is the lesser.
through the thickness	Not longer than 1.0 m or $\frac{1}{4}$ the length of the piece whichever is the lesser. If at the ends, length not greater than twice the width of the piece.	Only permitted at the ends with a length not greater than the width of the piece.
Wane (see 6.4 and Figure 5)	Wane shall not reduce the full edge and face dimensions to less than $\frac{2}{3}$ of the dimensions of the piece. Length of wane is unlimited.	
Distortion (see Figure 6):		
Bow	Not greater than 20 mm over a length of 2 m.	Not greater than 10 mm over a length of 2 m.
Spring	Not greater than 12 mm over a length of 2 m.	Not greater than 8 mm over a length of 2 m.
Twist	Not greater than 2 mm per 25 mm width over a length of 2 m.	Not greater than 1 mm per 25 mm width over a length of 2 m.
Cup	Unlimited.	Unlimited.
Resin pockets and bark pockets:		
not through the thickness	Unlimited, if shorter than the width of the piece; otherwise, the same limits as for length of fissures.	
through the thickness	Unlimited, if shorter than half the width of the piece; otherwise the same limits as for length of fissures.	
Insect damage:	Permitted provided it conforms to the requirements of Clause 5. No active infestation is permitted. Wood wasp holes are not permitted.	
When grading square sections, they shall be considered in their unfavourable orientation, i.e. for determining MKAR, those surfaces shall be considered to be edges that result in the worse grade.		
<i>NOTE 1 Typical knot area ratios are shown in Figure 3.</i>		
<i>NOTE 2 The length of fissures and the amount of distortion are linked with moisture content, therefore the limits given can only be applicable at the time of grading.</i>		
<i>NOTE 3 For the following species, and species combinations, the fissure and distortion limits in the GS column apply, irrespective of the strength grade:</i> <i>Douglas Fir (British);</i> <i>British spruce</i> <i>Sitka spruce (Canadian);</i> <i>western red cedar;</i> <i>western white woods.</i>		
<i>NOTE 4 Where British Standards covering specific end use requirements specify permissible limits for grades covered by this standard, varying from those given in Table 1, the requirements of those standards replace or are additional to the requirements of Table 1.</i>		
<i>NOTE 5 Additional requirements for trussed rafter material are given in BS 5268-3.</i>		

## **7 Marking<sup>1)</sup>**

### **7.1 General**

Each piece of graded timber shall be clearly and indelibly marked to provide the information given in **7.2**. The information given in **7.3** shall also be marked on each piece of timber or given in accompanying documentation. If the end use of the timber requires marking to be omitted for aesthetic reasons, each batch of timber shall be accompanied by a commercial document bearing all the information given in **7.2** and **7.3**.

If timber is to be CE marked then additional marks are required according to BS EN 14081-1:2005, Annex ZA.

### **7.2 Information to be marked on the product**

The following information shall be marked on the product (except if omitted for aesthetic reasons):

- Name or identifying mark of grader and/or producer.
- The strength class as assigned in BS EN 1912, or, if not included in BS EN 1912, the strength grade and the number of this grading standard.
- The words “DRY GRADED” if appropriate (see **3.8**).
- The certification body.
- Either, the information required in **7.3** or a reference number that identifies the documentation containing the information required in **7.3**.

### **7.3 Information to be marked on the product or in accompanying documentation**

The following information shall be marked on the product or in accompanying documentation:

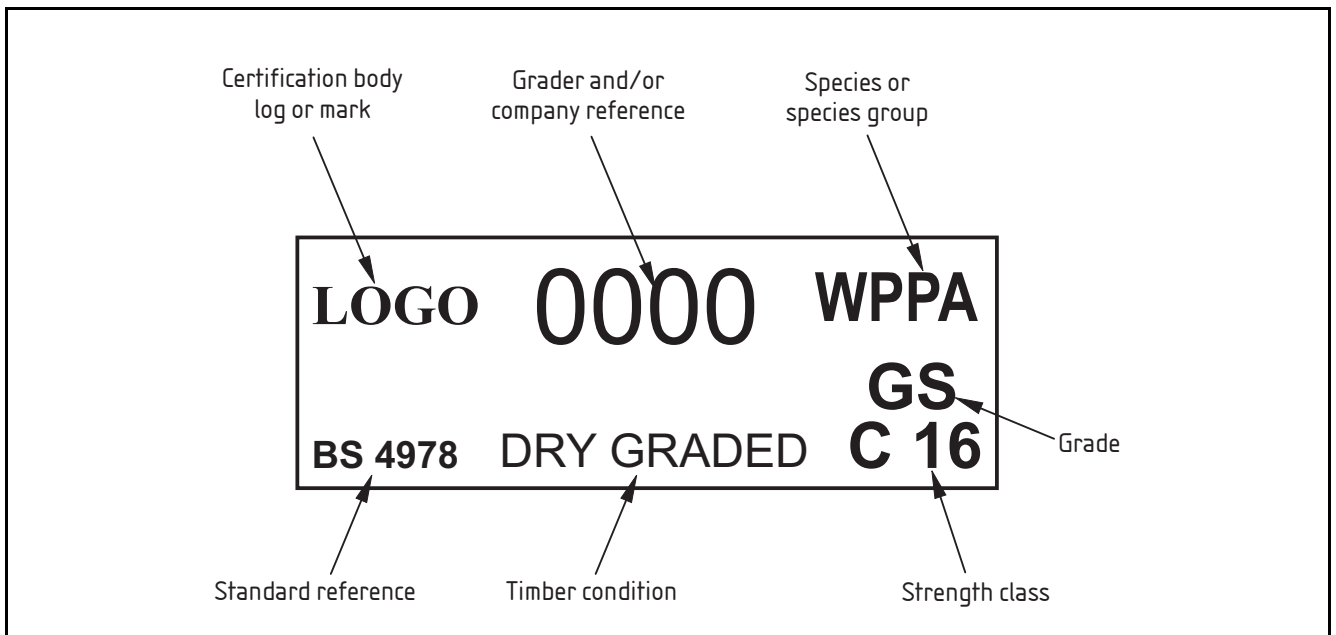
- If single species, the species code in accordance with BS EN 13556:2003, Table 2.
- If species combination, the species code specified in EN 14081-1:2005, Table 4.
- If marked with strength class (see **7.2**), the grade and grading standard.

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<sup>1)</sup> Marking BS 4978:2007 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.



Figure 7 Example of a mark on visually strength graded softwood



## **Annex A (normative) Determination of the knot area ratio in cases of dispute**

In cases of dispute, the worst knot area ratio in any piece of softwood shall be determined using the following procedure:

- a) Choose that section in the piece which intersects the knot or group of knots of which the knot area ratio produces the lowest grade. (See **6.1** to determine which knots to include in any one section.)
- b) Consider all knots with diameters greater than 5 mm intersected by the chosen section in calculating the knot area ratio of both margin areas and of the whole piece.

Make full-scale drawings of the chosen section and mark the margin areas by dotted lines. Mark points on the appropriate side of the rectangle representing any knot on that surface. The points marked need to represent the widest projection of the knot on that face or edge.

- c) Estimate the position of the pith within or without the cross-section by examining the end nearest to the chosen section. Assume that the annual rings are concentric with the pith.
- d) Depending on the position of the pith, calculate the knot area ratio using one of the methods given, as follows.
  - 1) If the pith is within the cross-section, join the points representing the limits of the knots on the drawing by straight lines to a point representing the estimated position of the pith. Measure the area within these lines which corresponds to knots for the whole cross-section and for that area which lies within either margin.
  - 2) Where the pith is outside the cross-section, join up the points on the perimeter of the drawing in a manner appropriate to the assumption that each knot is approximately a cone with its apex at the pith. Measure the area thus enclosed, corresponding to the estimated position of knots, for the whole cross-section and for both margin areas.
- e) In both the cases referred to in d)1) and d)2) express:
  - 1) the total area of knots within each margin area as a proportion of the whole of that margin area for the purpose of deciding whether a margin condition exists or not;
  - 2) the total area of knots within the cross-sectional area of the piece as a proportion of the cross-sectional area of the piece for the purpose of determining the knot area ratio at that section.

## Annex B (normative) **The control and supervision of visual strength grading operations**

The control and supervision of visual strength grading shall be carried out as follows:

- a) All grading shall be in accordance with the National Annex of BS EN 14081-1:2005.
- b) The company carrying out the grading shall nominate a representative responsible for the operation of the graders and review the grading records on a weekly basis.
- c) The company carrying out the grading shall be responsible for seeing that steps are taken to ensure that rejected timber is not regraded and is stored separately from timber conforming to this British Standard.
- d) Graded timber shall be protected in storage and transport to the extent necessary to minimize downgrading of the timber.
- e) Where a company is strength grading for a specific order, records shall be kept for each parcel of graded timber as follows:
  - 1) the job or order number;
  - 2) the customer's name, if known, or identifying reference;
  - 3) the timber species or species combination and its source;

*NOTE For source, it is sufficient to record the shipper's end mark where this exists.*

- 4) timber size and surface finish (planed or sawn);
- 5) the number of pieces in each grade and the number of rejects;
- 6) the date of grading;
- 7) the grader's name or identification number;
- 8) the average moisture content;
- 9) the highest moisture content reading.

*NOTE Where the company or sawmill is strength grading for stock or in a continuous process the requirements to keep records as in items 1), 2) and 5) can be modified in consultation with the certification body.*

# Bibliography

## Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 5268-3, *Structural use of timber – Part 3: Code of practice for trussed rafter roofs*

## Other references

[1] EUROPEAN ECONOMIC COMMISSION (ECE). *Recommended standard for stress grading and finger-jointing of structural coniferous sawn timber*. Geneva: United Nations<sup>2)</sup>.

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<sup>2)</sup> Available from the Department of the Environment, Building Research Establishment, Garston, Watford, Herts, WD2 7JR.



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