

Timber strength and spans

Timber used for structural applications must be graded and clearly marked to show it complies with the correct standards and strength requirements laid down by building codes and regulations.

The load a member can carry depends on several factors, including its span, thickness, width and species. Usually the deeper/wider the section, the longer the span.

Different species have different strength properties – a factor that needs to be considered when choosing your timber.

How timber is graded

Strength grading is needed to ensure timber is strong enough for a particular job, eg a floor joist or a roof truss. It also saves money by helping to avoid over-specification. Grading can be carried out visually or by machine:

- **Visual strength grading** uses the grader's experience and knowledge to assess each piece of timber.
- **Machine strength grading** is best suited to high volumes of timber where the species and cross section are not changed very often. When a piece of timber is machined into a small cross section, it may need to be re-graded. Cross cutting is permitted.



Sustainable timber

Timber is the most sustainable building product available. It is naturally renewable - over 97% of softwood timber used in the UK comes from Europe, where the forest area is increasing by the equivalent of 90 football pitches every hour of the day and night.*

For reassurance for softwoods and hardwoods look for certification labels like FSC (Forest Stewardship Council) or PEFC (Programme for the Endorsement of Forest Certification).

Always ask your supplier about their responsible purchasing policies.

*IIED & ECCM, Using Wood to Mitigate Climate Change, 2004 and UNECE-FAO, State of the Europe's Forests, 2011.



This information sheet provides general advice only and is not specific to the requirements of a particular building project. It is the builder's responsibility to check compliance with Building Regulations and standards.

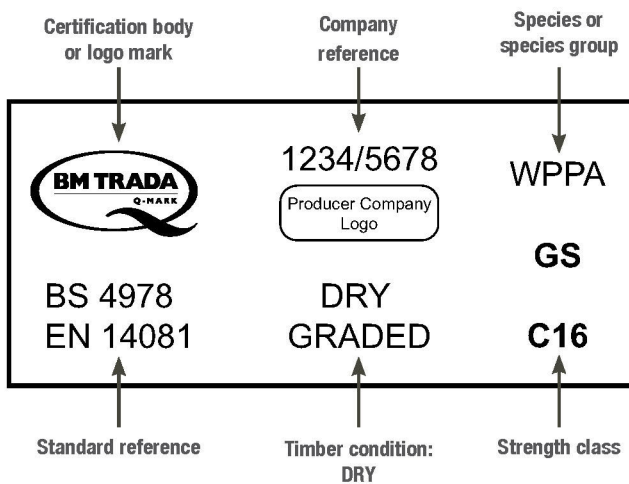
Visual strength grading

Visual strength grading rules define the size, type and number of strength-reducing characteristics allowed in each grade (for example, natural features such as knots, wane and slope of grain, plus splits and shakes which may have developed as a result of drying).

Wane: uneven edge caused by a residue of bark.

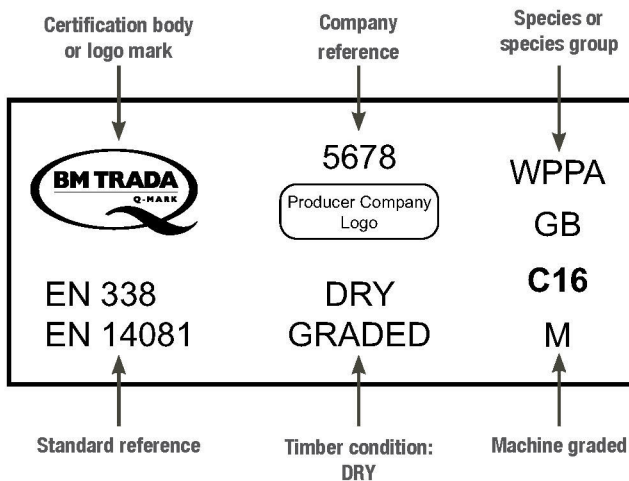
Shakes: fissure caused by the splitting of the wood fibres along the grain.

The grader assesses each piece and stamps it with the appropriate mark.



Machine strength grading

Machine grading is based on the relationship between strength and stiffness. The machine grades each piece and stamps it with the appropriate mark.



An additional visual assessment takes account of strength-reducing characteristics not automatically sensed by the machine.

What do the strength stamps and grades tell me?

Strength grading is a way of assessing the strength of a piece of timber, which depends on its species as well as its grade. A low grade timber from a strong species may be equal in strength to a high grade timber from a weaker species.

To make specifying easier, species and grades are grouped into strength classes of similar strength.

The higher the number, the stronger the timber. Strength classes range from D18 to D70 for hardwoods. The most common available strength classes for softwood are C16 and C24.

The rules governing strength grading and structural uses of timber are laid down in British and European standards.

BS EN 14081:2005 covers visual and machine grading of structural timber. It refers to *BS 4978:2007+A1:2011* for softwood visual grading rules and *BS 5756:2007+A1:2011* for hardwood visual grading rules.

BS EN 1995-1-1:2004+A1:2008, or *Eurocode 5: Design of Timber Structures* is the engineer's design code for timber and its structural uses, and has replaced the *BS 5268* family of standards. When published, *PD 6693 Complimentary information for use with Eurocode 5* will incorporate much of the material from the *BS 5268* standards into *Eurocode 5*.



The table below shows how some of the softwood species and grades most commonly used in UK construction are grouped into strength classes.

SOURCE AND SPECIES	GRADING RULES	STRENGTH CLASSES					
		C14	C16	C18	C22	C24	TR26
BRITISH							
British pine	BS 4978 visual	GS			SS		
	BS EN 14081 parts 1-4 machine		•			•	•
British spruce	BS 4978 visual	GS		SS			
	BS EN 14081 parts 1-4 machine		•			•	
Douglas fir	BS 4978 visual	GS		SS			
	BS EN 14081 parts 1-4 machine		•			•	
Larch	BS 4978 visual		GS			SS	

SOURCE AND SPECIES	GRADING RULES	STRENGTH CLASSES					
		C14	C16	C18	C22	C24	TR26
EUROPEAN							
Redwood/whitewood	BS 4978		GS			SS	
	BS EN 14081 parts 1-4 machine		•			•	•

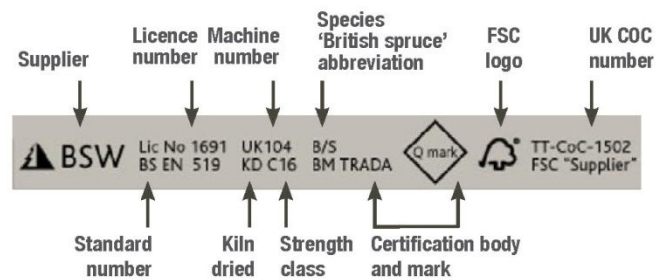
Timber marked as DRY is graded at a maximum moisture content of 20% and should be transported, stored and installed in the building in a manner that does not allow this moisture content to be exceeded.

Note: Although moisture content of 20% or less is permissible for internal use, further shrinkage is likely as the timber dries in service. For example, timber joists used in intermediate floors may dry to around 12% moisture content.

The species is shown on the grading stamp by a code such as WPNN (British corsican/Scots pine), PNSY (European redwood) or WPCA (European whitewood).

GS (General Structural) and SS (Special Structural), are the visual grades of the timber assigned by the grader.

A typical supplier's stamp may look like this:



The chain of custody (COC) number demonstrates that the timber is from a legal and sustainable source. North American graded timber is accepted in Europe under BS EN 14081 and may be marked J&P (joist and plank grade) or NAMSRL (North American machine stress-rated lumber).

How do I use span tables in relation to strength classes?

Use span tables to determine the size of a timber member of a particular strength class required for a given span. They should also tell you what the maximum spacing should be between each section or timber member.

The following examples which apply to solid timber members show how to use span tables for domestic floor joists at 400mm centres.

Size of joist (mm)	C16 clear maximum span (m)	C24 clear maximum span (m)
38 x 97	1.76	2.05
47 x 97	1.95	2.26
38 x 220	4.29	4.78
47 x 220	4.60	5.12

Changing to 600mm centres will change the span distances for the same timber sizes.

Size of joist (mm)	C16 clear maximum span (m)	C24 clear maximum span (m)
38 x 97	1.43	1.68
47 x 97	1.60	1.87
38 x 220	3.74	4.17
47 x 220	4.02	4.48

So if you wanted to span four metres at 600mm centres, you could use 38mm x 220mm C24 instead of 47mm x 220mm C16, a lighter-weight option.



Spans for engineered wood products and I-joists

The introduction of specially engineered timber products, such as glulam beams, I-joists and metal web joists provides solutions across a larger range of depths and spans, and shrinkage after installation is likely to be smaller.

When using these products please refer to the manufacturer's own literature and span tables which are usually available from your timber supplier.

Further information and advice

The structural use of timber is a specialist topic. This leaflet only looks at general situations. Span tables showing timber sizes and strengths can be obtained from www.trada.co.uk or may be available from timber suppliers.

See also: Wood for Good www.woodforgood.com

Choose and Use is a series of information sheets for builders produced by TRADA, The Timber Research and Development Association.

They offer up-to-date advice on how to select the right timber and timber products for different applications.

You can often save time and money by choosing the correct timber material or timber products as well as ensuring you comply with current Building Regulations and Building Codes. For more information about specific products visit www.trada.co.uk or contact your local supplier.

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