



**TIMBER  
DEVELOPMENT  
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# Strength Grading

Due to the significant variability of characteristics across different woods, a strength grading system exists to classify timber that is safe and effective for use in structural applications.



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# Strength Grading

An independently monitored system grades structural timber to uniform standards across the British and European construction industries. This grants timber consumers and users, designers, specifiers, and certifying bodies assurance on the quality of timber used in construction.

## Types of Structural Grading

The strength of timber can be measured using various non-destructive tests, grouped into two categories:

- **Visual Strength Grading (VSG)** relies on an inspector visually inspecting timber and observing certain grain, knot, warping and twisting characteristics that take away strength from the ideal for that species. Different grades of timber allow differing measurements or rates of occurrence of these characteristics.
- **Machine Strength Grading (MSG)** uses non-destructive methods that measure the stiffness of timber, given that stiffness correlates with strength. Machine grading includes a visual inspection for VSG characteristics. Different grades allow for different measurements of stiffness, size and location of knots, and timber density.

A common European wide system of strength classes, described in **BS EN 338**, supports timber design.

This means all strength graded timber is allocated to a strength class allowing simple comparison or substitution of alternative structural timber whichever species, grading system, or grade used.

### Timber Grading Standards

Softwoods are visually graded to **BS 4978 Visual strength grading of softwood. Specification**. They are machine graded to **BS EN 14081 Timber structures. Strength graded structural timber with rectangular cross section. General requirements**. This is to a strength class defined in **BS EN 338 Structural timber. Strength classes**.

Temperate hardwoods are visually graded to **BS 5756 Visual strength grading of temperate hardwood. Specification**

Tropical hardwoods are visually graded to **BS EN 16737 Visual strength grading of temperate hardwood. Specification**

Standards also exist for strength grading of scaffolding boards (**BS 2482**) and the visual assessment of tiling battens (**BS 5534**).

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## Identifying Timber Grades

Strength-graded timber should bear a stamp which describes its strength class and contains other crucial information.

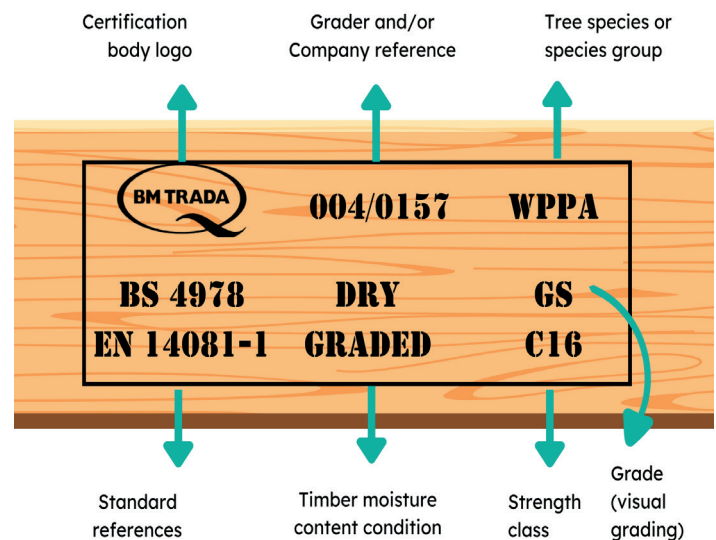
The National Annex to **BS EN 14081-1 (2016) Timber structures – Strength graded structural timber with rectangular cross section** specifies how timber in Britain should be labelled.

Each label must include:

- The strength class
- The manufacturer's name or mark
- Reference to the Declaration of Performance (DoP) made available by the manufacturer
- UKCA, UKNI, or CE Mark symbol as appropriate
- DG if the timber has been dry graded, or other terms such as Dry Graded, KD or Kiln Dried as long as they reflect timber dried to the requirements of **BS EN 14081-1**
- M if the timber was machine graded
- If the timber is visually graded, GS to indicate General Structural softwood or SS to indicate Special Structural softwood
- THA or THB for large cross-section temperate hardwoods ( $\geq 20,000\text{mm}^2$  or  $\geq 100\text{mm}$  thickness)
- TH1 or TH2 for temperate hardwoods with a cross-sectional area of  $2000\text{mm}^2$  to  $20,000\text{mm}^2$ , or a thickness of 20mm to 100mm
- STH for structural tropical hardwoods with cross sections of more than  $2200\text{mm}^2$  or a thickness of 22mm or greater.

The label may also include:

- The identification number of the Approved or Notified Body that certified the timber
- The grade and grading rule or standard for visually graded timber
- The tree species code, as listed in **BS EN 14081-1**, or botanical name of the wood species
- PT to identify preservative treated timber



**IMAGE:** Example of a visual strength graded timber stamp

In the UK and Northern Ireland, each piece of timber must be grade stamped on at least one face or edge, at least 600mm from the end of the piece. The strength class may in addition be stamped on the end of each piece.

Timber not individually labelled is regarded as package marked, so long as it has the correct accompanying documentation.

Although package-marked timber is allowed under the CE Marking rules, the **UK National Annex to Eurocode 5** applies a punitive partial factor to package-marked timber that reduces its strength grading. This partial factor is applied to package-marked timber because it cannot be identified on site once it is removed from its package.

Timber that is package-marked in order to preserve the faces and edges of each piece for aesthetic reasons – such as naturally-finished timber used in structural façades – is exempted from the partial factor rule.

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## Designing for Strength-Graded Timber

Designers can specify minimum strength classes for timber components of certain sizes based on **BS EN 338 Structural timber - strength classes** for use in **Eurocode 5** designs with confidence that at least 95% of the graded pieces exceed that strength class. This probability is known as the fifth percentile.

For stiffness, the mean and the fifth percentile are both used to calculate the resistance to buckling in different situations. The mean is used in most calculations. The fifth percentile is used in high-stress situations such as calculating the deflection of a joist where there can be no risk of failure.

In the UK, the most common softwood strength classes available are C16 for general structural applications and C24 where greater strength is required. Timber Development UK publish span tables allowing the performance of these two strength classes to be compared: these can be downloaded from the TDUK website.

## Moisture Content and Strength Grading

The moisture content of timber can change the size and length of fissures, the amount of distortion, and the cross-sectional size, all of which have an impact on strength and durability.

Visually graded timber is dry-graded when its moisture is 20% or less, with no reading exceeding 24%, and should be used for Service Classes 1 and 2.

Timber sections over 100mm thick are difficult to dry and may be graded and installed wet – with a moisture content of greater than 20%. In this case, design must account for shrinkage as the timber dries; structural calculations must use numbers for wet stresses, and the timber should be used in Service Class 3, and in applications where it is in contact with water.

As there is no requirement to label wet-graded timber, always assume that timber is wet graded unless its label specifies that it was *DG, Dry Graded, KD, or Kiln Dried*.

## Resizing and Strength

For timber machined after grading, it is considered to have maintained its strength grading if:

- For timbers with dimensions  $\leq 100\text{mm}$ , the machining has removed no more than 5mm from that dimension
- For timbers with dimensions  $> 100\text{mm}$ , the machining has removed no more than 10 mm from that dimension.