

A Guide to Criteria Used for Visual Stress Grading* of Timber in the UK

Introduction

White Wood Management has been asked by a number of its customers to provide background information and guidelines for milling timber for structural purposes. We hope the following is of some help. Please do get in touch (contact details at the foot of the page) if you need further information or support in preparing your timber for visual stress grading and don't forget we can grade single large pieces for individual client jobs or multiple pieces for stock or higher volume projects. We offer reduced hourly rates for locally grown and home grown timber.

Background Facts

- All timber needs to be graded for structural use and is checked by building control to see that the timber has been passed as fit for structural use.
- Visual strength grading (VSG) of timber provides a consistent method* to assess the strength of a timber for structural use depending upon the species and grade required. Strength grading can also be carried out by machine but requires greater initial investment, ongoing maintenance and higher throughput of timber to meet economies of scale.
- In either case, VSG or machine, the timber is stamped with appropriate codes and assessors' identity number to demonstrate that the piece has been passed as fit for structural purposes appropriate to the strength class given. An accompanying commercial document ('ACD') can be issued confirming the strength grade of individual pieces of timber if they need to remain 'clean'/free of the stress grade stamp and CE mark. Either way, liability is with the grader if the piece fails or is found to be sub-grade.
- All licensed visual stress graders are independent third party trained and monitored and can provide evidence as such, demonstrating that they are equipped with current knowledge and practice to meet the British Standards for stress grading.
- VSG can assess two grades for softwood, General Structural (GS) and Special Structural (SS) and five grades for hardwood, General Structural Temperate Hardwood (TH1 & TH2), Heavy Structural Temperate Hardwood (THA & THB) and Structural Tropical Hardwood (HS) each of these grades cover a range of strength classes according to the species of timber being graded.
- A strength class is simply a group of species/strength grade combinations which have similar properties.
- There are twelve strength classes for softwoods ranging from C14 to C50. The majority of timber specified for construction is specified in two strength classes C16 or C24, most common grade for carcassing is C16. There are six strength classes for hardwoods ranging from D30 to D70 (in Oak... TH1=D30 and THA=D40). The numbers represent bending stress for each class, the higher the number the stiffer and stronger the timber in relation to its cross-sectional area.
- An architect or structural engineer will specify what strength class of timber is needed to span a particular distance or to fulfil some other structural requirement. They may also specify use of a particular species for consistency and /or aesthetic reasons.
- Since 1st July 2013, it has been a requirement that structural graded timber products covered by the harmonised European Standard (hEN) for timber grading, EN 14081 (and supported by Standards such as BS 4978 and BS 5756), and placed on the market will need to be CE Marked.

Minimum Dimensions

The minimum thickness for timber to pass through the VSG process is 20mm ($\frac{3}{4}$ "") with a minimum sectional area of 2,000mm² (3.1"²) (eg external dimensions of 100mm x 20mm - 4" x $\frac{3}{4}$ "")

** fulfilling BS4978:2007 for softwoods and BS 5756: 1997 for hardwoods*

Key Criteria

The criteria for visual stress grading remain much the same for softwoods and hardwoods although tolerances (and thus confidence limits) vary according to the grade at which the timber is assessed.

The criteria are: Moisture Content, Rate of Growth, Fissures, Slope of Grain, Wane, Knots, Resin and Bark Pockets, Distortion, Compression/Tension Wood, Insect Damage and Rot. All are assessed during the VSG process for each piece of timber inspected.

Selection of Softwoods and Hardwoods for Milling structural timber in the UK

Key VSG Criteria	Notes and Tips for milling to structural requirements
Moisture Content (MC) +	<ul style="list-style-type: none"> • Check with client, prior to cutting, if the timber required is for interior or exterior use. • Dry Grading - For timbers intended for interior structural use, average less than or equal (\leq) to 20% MC with no single piece being $> 24\%$ MC. (Use long air dried or kiln dried timber) • Wet Grading - For timbers where the average $> 20\%$MC and the timber is intended for exterior use / high humidity conditions or thickness of timber is $\geq 100\text{mm}$ (4"). • Check MC of the timber (not at the ends) with a meter, preferably with deep probes, prior to cutting. • Air-dry the timber AMAP before cutting and kiln dry down to below 20% MC as necessary for interior use
Rate of Growth	<ul style="list-style-type: none"> • Critical for softwoods - choose timber with tight annual growth rings (ie averaging less than ($<$) 10mm and ideally less $< 6\text{mm}$ gaps between rings.) Not measured in hardwoods.
Fissures	<ul style="list-style-type: none"> • Fissures are classified as being "through the thickness" or "not through the thickness" • Fissures are inclined to appear as cut timber dries. • Avoid using anything with visible cracks or fissures of length greater than twice the width of the piece being cut especially if through the thickness. • Select well seasoned/dried timber if intended for interior structural use. • Measure depth of fissures with a thin probe (eg metal spike or point)
Slope of Grain	<ul style="list-style-type: none"> • Set the log to be cut so that the saw runs, as much as possible, parallel with the grain.
Wane	<ul style="list-style-type: none"> • Wane reduces the sectional area, and thus the strength of the piece. Plan the cut of your timber carefully to minimise risk of wane appearing in the final pieces intended for stress grading.
Knots	<ul style="list-style-type: none"> • Avoid using knotty specimens for structural timber. • Make sure knots are small in quantity and do not take up a large proportion of the sectional area of the timber to be cut. • Use timber with large or numerous knots for the larger dimension pieces where they will form a smaller proportion of the overall section. • In softwoods cut the timber so that knots are kept in the middle of the width of the piece and (as much as is possible) not at the outer faces or edges.
Resin & Bark Pockets	<ul style="list-style-type: none"> • Resin/bark pockets are classified as being "through the thickness" or "not through the thickness" • It is unusual for resin/bark pockets to occur to such an extent that they will preclude use of the timber for structural purposes but keep an eye out for it. • Avoid using timber with resin/bark pockets greater in length than the width of the piece being cut, especially if through the thickness.
Distortion	<ul style="list-style-type: none"> • Distortions include: Bow, Cup, Spring and Twist • Although tolerances exist for structural timber, the customer will not want to purchase / work with twisted, cupped or bent pieces so they are best avoided as much as possible.
Compression / Tension Wood	<ul style="list-style-type: none"> • The VSG rules leave it to the discretion of the grader to decide if it '<i>significantly reduces the strength of the piece</i>'. Compression wood in softwoods is more critical in this respect. • Avoid compression wood being $> \frac{1}{3}$ of the width of the piece being cut, if softwood.
Insect Damage	<ul style="list-style-type: none"> • As with distortion, the customer is King here. Even if VSG rules allow for old wood-worm holes in a piece of timber, the customer will not want to buy it. Best avoid all worm / insect damaged timbers.
Rot/Fungal Decay	<ul style="list-style-type: none"> • Blue stain or sap stain is not a strength-reducing feature and is acceptable without limit but may indicate timber over 20%MC. Brown stain in oak affects the structural performance of the timber and therefore cannot be permitted • Consider client's sensibilities on this issue ... would you buy it if you were the customer?

**SPECIES / STRENGTH GRADE COMBINATIONS AS ASSIGNED TO BS EN 338
STRUCTURAL TIMBER - STRENGTH CLASSES**

Hardwoods

SPECIES (there are over 2,600 commercial hardwoods used in the world. Just two UK temperate and two tropical species are listed here)	GRADING RULES	STRENGTH CLASSES						
		D24	D30	D35	D40	D50	D60	D70
Oak *	BS 5756	TH2	TH1, THB		THA			
Sweet Chestnut*	BS 5756	TH1						
Greenheart	BS 5756							HS
Iroko	BS 5756				HS			

* Note that the TH1 grade of sweet chestnut and the TH2 grade of oak do not meet the requirements for the D30 strength class. Designs for these species/grade are better based on the grade stresses given in BS 5268-2 (Eurocode 5 by 2011) for the individual species and grade and have recently been given a D24 (hardwood equivalent to C24) strength class.

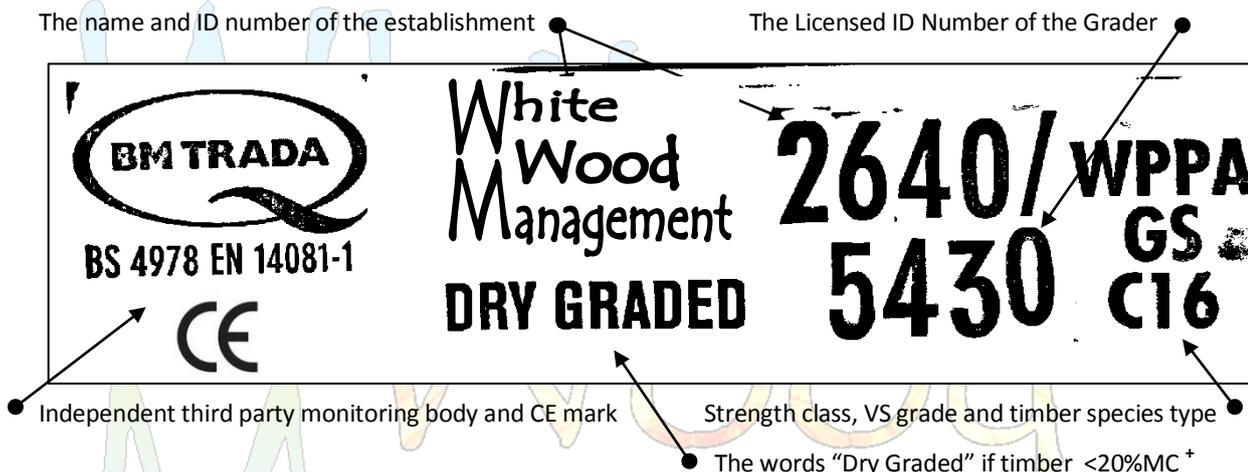
Softwoods

SOURCE & SPECIES	GRADING RULES	STRENGTH CLASSES						
		C14	C16	C18	C22	C24	C27	C30
BRITISH								
British pine (Scots)	BS 4978	GS			SS			
British spruce (Sitka, Norway)	BS 4978	GS		SS				
Douglas fir	BS 4978	GS		SS		*		
Larch	BS 4978		GS			SS		
EUROPEAN								
Redwood	BS 4978		GS			SS		
Whitewood	BS 4978		GS			SS		
CANADIAN / USA								
Douglas fir-larch	BS 4978		GS			SS		
Hem-fir	BS 4978		GS			SS		
Spruce pine fir (SPF)	BS 4978		GS			SS		
Canadian Sitka spruce	BS 4978	GS		SS				
Western Whitewood	BS 4978	GS		SS				
Southern pine	BS 4978			GS		SS		
OTHER								
Parana pine	BS 4978		GS			SS		
Caribbean pitch pine	BS 4978			GS			SS	

* Note: British Douglas fir with a cross sectional size of 20,000mm² or more can be assigned as C24 if it meets the requirements of the SS grade.

Marking Visually Strength Graded Softwood

Each piece of visually strength graded softwood must be stamped clearly and indelibly on one face with the following ⁺⁺:



⁺ The British Standard requires that the moisture content condition of the timber, if graded dry, is shown on the grade stamp as 'Dry Graded' and if graded wet the no reference is made to the moisture content on the stamp.

⁺⁺ An 'ACD' (Accompanying Commercial Document) can be issued confirming the strength grade of individual pieces of timber if they need to remain 'clean'/free of a stress grade stamp mark.

Tolerances for sawn, machined and planed timber

The following relates to the size desired (at 20% moisture content) after a particular production process, to which permissible deviations should be related.

Tolerances for sawn timber (Class 1)

For thickness and widths less than or equal to 100mm	+3 - 1mm
For thickness and widths over 100mm	+4 - 2mm

Tolerances for structural timbers that have been machined or planed (Class 2)

For thickness and widths less than or equal to 100mm	+ 1 - 1mm
For thickness and widths over 100mm	+1.5 - 1.5mm

If processing (planing or regularising) takes place after grading has been carried out, the following reductions are allowed:

- Not greater than 5mm on sizes up to and including 100mm
- Not greater than 10mm on larger dimensions.

If timber is re-sawn or surfaced beyond these limits, the timber must be re-graded.

Cross cutting is permitted provided that each resulting piece conforms to the grading rules.