



## The challenge of strength grading

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## Timber strength grading - why do it?

- **The aim of timber grading is to make timber usable for structural applications.**
- **Supply engineers and architects with stresses and modulli for design calculations**
- **Give the customer, producer and the market place in general confidence in timber.**

## Machine grading / visual grading

- Machine grading and visual grading are means to the same end – stresses and moduli for engineering use.
- Both require a large amount of data on which to base acceptable grading models.
- Both systems are underpinned by the same statistical principles – strength class / grade stress is determined based on the whole sample statistics.

# Machine grading

- Advantages

- Suitable for mass production – repeated grading of the same dimensions.
- Attributes timber straight to a strength class.
- Fast and reliable
- Increasing range of machine types – bending, X-ray, stress wave
- Potentially greater range of strength classes obtainable particularly the higher ones

- Disadvantages

- Large section sizes can not be graded
- Can not grade hardwoods
- Large amount of data needed to derive settings for a new species

# Visual grading

- Advantages

- Can grade hardwoods and softwoods
- Wider range of species
- Large section sizes can be graded
- Suited for grading a few pieces

- Disadvantages

- Slower than machine grading
- Open to grader error
- Large amount of data need for new species

# MAKING THE BEST OF GRADING

- Strength classes allow timber to be specified without knowing anything about a species – all C16 timber will have the same structural properties regardless of species or origin.
- Variety of strength classes gives best option to meet design – in realty the UK works predominantly on C16 with a little C24.
- Grades stresses may allow better use of the material than strength classes but the designer will need to know something about timber species

## Example – UK grown Douglas fir

- Strength class v grade stress for UK grown Douglas (GS / SS visual grades)

Strength class / grade stress	Bending strength (N/mm <sup>2</sup> )	Mean stiffness (N/mm <sup>2</sup> )	Minimum stiffness (N/mm <sup>2</sup> )
GS visual grade attributed to C14 in BS 5268	4.1	6800	4600
GS visual grade – grade stress	4.4	9500	6000
SS visual graded attributed to C18 in BS 5268	5.8	9100	6000
SS visual grade – grade stress	6.2	11000	7000

## Making best of graded timber - Glulam

- Glulam allows for a better use of graded material where limited by strength class performance.
- Both BS 5268 and BS EN 1194 give information on using strength classes to design glulam.
- It can be expected that a significant improvement can be made to strength performance over the original strength class.
- Good improvements in performance can be gained from very modest re-engineering of the original material.

## European harmonisation of the structural timber codes

- August 2006 the European structural timber codes were harmonised
- What are the implications?
  - The permissible stress code (BS5268) will disappear and be replaced by Eurocode 5, limit state design.
  - Strength grading setting a will be done in country of timber origin – Unlike BS 5268 where all timber was graded to the requirements of the United Timber Grading Committee (UKTGC) under third party certification. So we now must accept graded timber from anywhere in the EU that is graded to the harmonised standards.
  - BS EN 1912 allows nation visual grades to be used in other EU countries.

# Challenges to UK species

- Firstly the challenge to the building industry – compulsory third party certification has been removed and CE marking does not have the same rigor – UK Government has opted out of the need for the UK industry to CE mark.
- The need for countries to derive their own machine settings and grading systems has demonstrated the high quality of the timber they have (C24 plus).
- UK species will struggle to compete with this.
- A review of UK species / grades and strength class has demonstrated that there are anomalies that need to be addressed to allow UK species to meet their full potential.
- BS 4978 and current machine settings for UK species gives relatively conservative results.

## What need to do to address the situation.

- Major revision of BS 4978
  - To address the visual grades and attributed strength classes (GS visual grade Scots pine, Douglas fir C14, SS Douglas fir C18)
  - Rates of growth – and additional features that can act as over-rides to high rates of growth that would otherwise lead to down grading of excellent timber from SS to GS – particularly important for species such as Douglas fir, larch and Scots pine, the stronger UK species.

## What need to do to address the situation - continued

- Higher machine settings for UK species that can accept them – Scots pine, Douglas fir, larch. Scots pine already underway.
- Machine settings for EN338 strength classes for Douglas fir and larch, BS 5268 exist but will eventually be withdrawn.
- More temperate hardwood species for structural applications. Oak and sweet chestnut already done. Ash is under discussion. But with tropical species in difficulties UK grown temperate species could be used.
- Small diameter and coppiced grown material – great potential but needs care, juvenile timber does not have the same properties as mature timber. Need for clear guidance

## If you want to use a species that does not have stresses

- Derivation of stresses is a simple and straight forward matter – EN338 strength classes.
- Stresses for a one off job or for inclusion in BS EN 1912.
- Stresses can be derived from as few as 40 pieces of structural size. However, the  $K_s$  factor for sample size is punitive. It will reduce the characteristic value derived for strength by 25%. Therefore if trying to get stresses into BS EN 1912 at least two sample each containing over a hundred samples would be needed to reduce the  $K_s$  to an acceptable level. However, if a sample of 40 pieces randomly taken from the whole supply of timber needed to complete one job then the  $K_s$  can be ignored as the variability in timber used has been taken into account.

## If you want to use a species that does not have stresses, continued examples

- Derivation of stresses
  - American white oak for the new parliamentary building – Portcullis House – 40 samples taken from whole supply for the job – testing showed that the material exceeded the D40 strength class required by the design.
  - After success of Portcullis House American Hardwood Export Council ask for stresses for 4 American species for inclusion in BS EN 1912, several hundred pieces needed to tested.
  - Vitex for the Chiswick boardwalk, 2000m<sup>2</sup> – 40 pieces taken from the whole supply.
  - Coppiced sweet chestnut – Coppiced material for the Shorne Wood project, Kent.