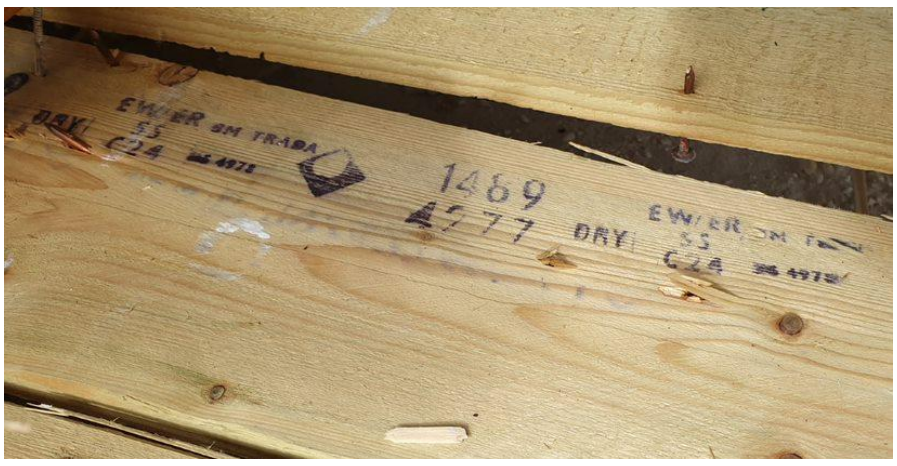
ForestValue

InFutUReWood Madrid Virtual Meeting
15 April 2021

Grading Recovered Timber

A quick overview

Dan Ridley-Ellis
Edinburgh Napier University, UK
d.ridleyellis@napier.ac.uk



A relatively recent grade stamp. We can tell that the wood is Scots pine, Norway spruce or silver fir (EW/ER), visually graded (SS to BS4978), and grown somewhere in central, northern or eastern Europe (from EN1912).

What are the main issues?

- *We need safe design values to be able to reuse wood in structures*
- *We cannot totally rely on grade stamps, or records of the original grade*
- *We cannot simply apply grading rules for new timber*
- *Grading recovered wood to EN338 strength classes might not be ideal*

The first questions to ask

Often people start from the grade – by asking if the timber can be graded to a familiar strength class, such as C24. But, if the intended use is known, it is better to start by thinking about the properties:

Which of the properties are needed for the calculations?

And for those, what is the lowest value that works?

There is no point putting effort into grading for things that do not matter and rejecting timber unnecessarily.

The point of strength grading

The objective of strength grading is to quantify performance, so that design calculations can be done, and the safety of the building confirmed.

Structural design to the Eurocodes needs characteristic values – lower fifth percentiles for strength and density, and mean for the stiffness. Perfect knowledge is impossible, so there is a balance to be made between certainty of these values, and cost of obtaining that certainty.

This balance can be adjusted to suit the situation, so long as the design is in line with EN1990 principles.

For recovered wood, the most difficult property to grade for is strength. But low certainty of strength can be compensated for with conservative strength design values, and a building design, that does not require high strength wood – instead, relying on more certain properties like density and stiffness. Despite the name, strength grading does not have to prioritise strength.

Original grade information

The original grade information is not, alone, sufficient to say what the design values are. Things may have happened to the timber that changed the properties. For example:

- *Due to the loads in service, environmental conditions, biological actions etc.*
- *Due to informal grading during the deconstruction, where material may have been segregated on purpose (e.g., for quality) or incidentally (e.g., because of how the timber was selected during construction, and how the deconstruction proceeds)*
- *Due to the action of deconstruction itself, especially if this involves breaking the wood*
- *Reprocessing of the wood, since changing the cross-section also invalidates grading*

It can also be the case that the original grading is not in line with current standards.

Original grade information can, however, give useful information about species, origin, age, and a good idea of the approximate properties to expect. It might also give a clue about the likely effect of prior grading.

Application of grading rules for new wood

The rules for grading of new timber, whether visually or by machine, rely on knowing species and growth area. This is because they are based on populations rather than properties of individual pieces of timber. For recovered timber, species and growth area are likely unknown, but even when they are known, there is also the problem of prior grading. This means that grading rules for new timber can only safely be applied in very specific circumstances.

Be aware, also, that visual strength grading is not as straightforward as it seems. A lot of people think it is directly checking against things that directly determine strength, but that is not how it works unfortunately.

For more see: "Re-grading of timber" [webpage]; "Strength grading of sawn timber in Europe: an explanation for engineers and researchers" [paper]

The problem with EN338 strength classes

The EN338 strength classes are a convenient way of specifying design values, but, for recovered wood, that convenience might not be useful. In fact, it might actually cause unnecessary problems. The issues include:

- *How well they fit (or don't) to the actual ratios of properties of the wood*
- *The relative importance of the different properties for the intended use*
- *The balance of certainty and cost (particularly for strength in the case of recovered wood)*

Instead of trying to fit to EN388 strength classes, more suitable alternative strength classes can be created, or the design values can be declared directly without reference to a strength class.

For more see: "Why grading isn't about the grade" [webpage]; "Does grading help or hinder the circular economy?" [video]; "Thinking beyond the usual strength grades" [paper].

What can we do?

Density and stiffness can both be non-destructively assessed for individual pieces of wood relatively easily, without needing to know much about the species and growth area, or any prior grading. Density and strength estimates of all the pieces of a batch of timber can therefore be used, quite reliably, to calculate a lower fifth percentile of the density of the batch of timber, and also a mean stiffness for the batch of timber.

Strength is more difficult, since it must be estimated indirectly. The relationship between strength and things that can be measured (e.g. stiffness, density, knots, slope of grain) is still dependent on species, growth area and prior grading. However, conservative estimates can be arrived at for the batch of timber, and confirmed by destructive testing or proof loading of a part of that batch.

This short guide applies to grading of individual pieces of wood. For building elements, such as wall panels, glulam beams, CLT etc. the situation is different. In those cases, the original grading is more useful. However, it will still be necessary to consider any changes in the wood properties that might have occurred as a result of service conditions, building reconstruction, and any reprocessing of the element.

Project InFutUReWood is supported under the umbrella of ERA-NET Cofund ForestValue by Vinnova – Sweden´s Innovation Agency, Formas – Swedish Research Council for Sustainable Development, Swedish Energy Agency, the Forestry Commissioners for the UK, the Department of Agriculture, Food and the Marine for Ireland, the Ministry of the Environment for Finland, the Federal Ministry of Food and Agriculture through the Agency for Renewable Resources for Germany, the Ministry of Science, Innovation and Universities for Spain, the Ministry of Education, Science and Sport for Slovenia. ForestValue has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773324.

InFutURe Wood