Does home-grown make the grade?

Some of the factors that affect timber properties are familiar to anyone who has worked with wood. They include density, knots, and character of grain. It is easy to imagine that density equates to the amount of strength-giving material. Similarly, it is easy to imagine that wide growth rings equate to fast growth and, as a result, low density. However, like many things in life, the truth is a bit more complicated than what is immediately obvious. Most notably, density does not tell the whole picture, as it depends how the strength-giving material is arranged and composed.

It is often said that UK plantations grow too quickly, compared to the colder forests of Scandinavia, and that the result is low density timber. Years of work at Edinburgh Napier University on the UK's main commercial species, Sitka spruce (*Picea sitchensis*), has categorically shown that density is, in fact, the least limiting property. It is true that Sitka reaches saw log size rather quickly, which is an advantage in a country prone to damaging storms. The downside is that a high proportion of a short rotation conifer log is made up of juvenile wood, which is generally less stiff. Some of what we associate as rate of growth is actually just the annual rings getting narrower with increasing diameter. Timbers with apparent slower rate of growth may just be from the stiffer mature wood, further from the pith, when the tree was actually growing, in total volume terms, faster.

The properties of structural timber can be conveniently compared using the system of C classes in the European Standard EN338. Strength classes are defined by three main properties: bending strength, bending stiffness and density, and are named according to the strength requirement. The class that timber can be assigned to in grading is governed by whichever of the three properties is limiting. We have seen that UK-grown Sitka spruce fits to C16 by its stiffness, having the strength required of C18 and density of C20. These are grades for near 100% yield (for simplicity, I shall refer to this here as the 'basic grade') and there are higher grades within the resource as a whole. Indeed it is possible, with existing grading technology, to grade small yields of C27, and there are some stands that could, with compatible technology and standards, be graded entirely to C24. Regional variation of properties means the situation for individual mills varies. This is because stiffness is evaluated by mean value, and small variations in mean stiffness from site-to-site require relatively larger shifts in the grading threshold than would grade-limiting shifts in strength and density, which are evaluated by lower 5th percentile.

We recently also carried out work to establish machine grading settings for UK grown larch (*Larix decidua/x eurolepsis/kaempferi*). As with Sitka, the main limiting factor is the stiffness, although strength is also close to limiting. The basic grade is C22, but it achieves the density required for C35. Small yields of C35 could indeed be graded but it is probably better to go for C27 with a yield of around 30-40% and the majority of what remains grading to C16. While this is not quite in the same league as European larch from the Alps, or Siberian larch from Russia (both basic grade C24) it is a pretty good showing for UK timber.

The reason we undertook the work on larch was, of course, *Phytophthora ramorum*, and this also raises the question as to what we can do to diversify UK forestry to protect against the threats of pests, diseases and climate change.

Tom Drewett recently completed his PhD thesis on UK grown Douglas-fir (*Pseudotsuga menziesii*). Our data is less extensive, and grading indications more tentative, but it looks as though this is also

stiffness limited with, perhaps, a basic grade of C18 or C20. As with larch, strength is close to limiting and density is not critical (meeting the C27 requirement).

PhD student David Gil-Moreno is close to finishing his study of noble fir (*Abies procera*), western hemlock (*Tsuga heterophylla*), Norway spruce (*Picea abies*) and western red cedar (*Thuja plicata*). With these minor species, a big challenge has been getting stands that are comparable to commercial Sitka stands, and the data that follows has been adjusted in an attempt to predict likely properties for a 45 year rotation. The number of samples is relatively small, and results must therefore be treated with caution.

Norway spruce is already processed and sold alongside Sitka spruce as 'British spruce'. It has long been known that the properties are similar, but suspected that Norway is slightly better. This appears to be the case (basic grade C18, stiffness and strength limiting with density meeting C22). western hemlock and noble fir also appear similar to Sitka, although noble fir appears to be strength limited. Western red cedar is stiffness limited to a greater extent, but is probably still capable of producing high yields of C16.

Work is currently underway on other candidate species, and we now have Serbian spruce (*Picea omorika*) and Pacific silver fir (*Abies amabilis*) in our laboratory awaiting testing, Japanese incense cedar (*Cryptomeria Japonica*) awaiting kiln drying, and logs of grand fir (*Abies grandis*) and European silver fir (*Abies alba*) awaiting sawing. The other species in our sights are sycamore (*Acer pseudoplatanus*) and birch (*Betula pendula/pubescens*).

We gratefully acknowledge the assistance of funders and collaborators too numerous to list here, but particular thanks are extended to Forest Research, without whose help we would have very little.

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In "Forestry & Timber News" (Confor) April 2016