



Wood Processing and Product Development No. 2

The General Principles of Timber Usage

Gordon Knaggs¹

Timber, in all its forms, is one of the oldest materials known to man. Worked timber artefacts, whether in the form of furniture or funeral goods in the Egyptian pyramids from 4,500 years ago, or structural timber in Japanese temples or Norwegian stave churches from 1,000 years ago have clearly stood the test of time and have not deteriorated. But what is “timber” and where does it come from? How should it be specified and used?

This article attempts to give basic information on the nature of wood and to give some guidelines for specification and use.

Softwoods and Hardwoods

With the exception of palms and bamboos, which are of little relevance in Europe, all timber comes from trees that can be botanically classified as either softwoods or hardwoods. At least 30,000 species are known worldwide although a very small number are traded internationally in large quantities.



Figure 1: Traditional Japanese construction with timber from c. 1,000 AD.

COFORD
Agriculture Building,
Belfield, Dublin 4, Ireland.
Telephone: +353 1 716 7700
Email: info@coford.ie
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Softwoods are obtained from conifers, which typically have needles, bear cones, and are generally evergreen. Examples of common softwoods include spruce, pine and fir.

Hardwoods come from broadleaved trees. These, in temperate climates such as Ireland, are typically deciduous. Examples of temperate hardwoods include beech, ash and oak. Tropical hardwoods such as mahogany or iroko tend to be evergreen.

The terms “softwood” and “hardwood” are somewhat misleading as the softness or hardness of the wood does not correspond to these terms. It is true that most commercially important softwoods are relatively soft, but yew, also a softwood, is very hard. The density, and hence the hardness, of hardwoods varies greatly, from very hard species such as greenheart (used for dock and marine work) to the lightest commercial species, balsa, used in model making. Most of the commercially used hardwoods are of medium density and hardness.

Sources of Supply

There are three main natural forest regions which supply our timber. These include the great northern coniferous forests, stretching across Canada and the northern United States; Northern Europe and Northern Asia. In addition to domestic supply, Ireland has traditionally been supplied by Scandinavia, Russia and Canada, but at present supplies come mainly from Scandinavia and the Baltic countries. Spruce (known commercially as “white deal”), pine (known as red deal), Douglas fir and larch are the main species used.

Temperate deciduous and mixed forests occur in both hemispheres, the supply into Ireland being mainly from North America and Europe. Ash, beech, oak and maple account for the majority of such imports.

Tropical rainforests occur mainly in South America, Africa, and South-east Asia. The variety of species here is very large and familiar species include mahogany, teak, and iroko. A point worth bearing in mind is that many

¹The author, Gordon Knaggs, is a consultant timber technologist. He previously worked in the Timber and Furniture Department of Enterprise Ireland where his principal role involved the provision of technical support to industry.

Table 1: Densities of a range of common timbers

Species	Botanical name	Source	Softwood/ Hardwood	Density Kg/m ³
Balsa	<i>Ochroma pyramidale</i>	South America	H	180
Sitka spruce	<i>Picea sitchensis</i>	Ireland	S	410
Scots pine	<i>Pinus sylvestris</i>	Ireland	S	480
Mahogany	<i>Swietenia spp.</i>	South America	H	490
Douglas fir	<i>Pseudotsuga menziesii</i>	Ireland	S	540
Larch	<i>Larix decidua</i>	Ireland	S	610
Teak	<i>Tectona grandis</i>	Southeast Asia	H	620
Iroko	<i>Milicia excelsa</i>	West Africa	H	660
Yew	<i>Taxus baccata</i>	Ireland	S	670
Oak	<i>Quercus robur</i>	Ireland	H	690
Ash	<i>Fraxinus excelsior</i>	Ireland	H	710
Beech	<i>Fagus sylvatica</i>	Ireland	H	720
Greenheart	<i>Ocotea rodiaei</i>	South America	H	990

Note:- The density of individual specimens can vary noticeably from the averages quoted.



Figure 1: Sustainably managed multi-age broadleaved forests (photo courtesy of American Hardwood Export Council).

unfamiliar species can be marketed under the name of a better-known species. A typical example is iroko, a West African species, which is commonly but inaccurately referred to as “teak”. Where there may be doubt, the botanical name should be used in a specification to avoid confusion. For example, the true or Burma teak is *Tectona grandis*, whereas iroko is *Milicia excelsa* (formerly *Chlorophora excelsa*).

Increasingly, the world is becoming more dependent on plantation-grown timber. Here in Ireland, the area under forest has increased from less than 1% in the early 1900’s to 9% today, yielding (in 2000) 3.2 million m³ per annum of round timber. This means that Irish forests produce timber at a rate of 1 m³ every 10 seconds!

Only 40% of these logs are classified as “large sawlog”, suitable for sawn structural timber. The remainder is smaller, supplying the raw material for fencing, pallets and for the manufacture of board materials. At present, most of this is Sitka spruce.

Increasing domestic supplies of hardwoods will become available as recent plantings of these hardwoods mature, although due to the slower growth rate of these species this will be well into the future. In the meantime, however, Irish sawmills supply about 40% of our structural softwood requirements, and much more in the pallet and fencing sectors, with a sawmill output of 888,000 m³ in 2000. The estimated total Irish market, North and South, is 1.48 million m³.

Regular thinning of forests is necessary if optimum growth rates and quality are to be achieved. These



Figure 3: The Weyerhaeuser Europe MDF production facility in Clonmel, Co Tipperary typifies the state-of-the-art forest products industry in Ireland. Weyerhaeuser Europe exports its range of MDF products throughout Europe. All of their raw material comes from sustainably managed forests in Ireland.

thinnings are the raw material for our board mills, which also utilise sawmill residue to produce a wide range of panel products such as Medium Density Fibreboard (MDF), Oriented Strand Board (OSB), chipboard, and fibreboard door skins. Ireland does not, at present, have plywood or paper mills, although such developments can be anticipated to cater for a projected 56% increase in output in the next 15 years.

Grading and Strength Classes

Solid timber, being a natural material, is inherently more variable than man-made or engineered products and as a result grading systems have evolved. These are used to place limits on characteristics such as knots, distortion or fissures.

There are two basic grades:

1. appearance grades which limit characteristics primarily on the basis of their visual appearance, and
2. strength (formerly stress) grades which are used in structural applications where the appearance of timber is secondary to its load-bearing function.

An example of the first is EN (European Standard) 942:1996 “Timber in Joinery – General classification of timber quality”, and of the second is IS (Irish standard) 127:1990 “Specification for the stress grading of softwood timber”. The latter allows graded timber to be assigned to “Strength classes” under EN 338:1995 “Structural timber - Strength classes” and EN 1912:1998 “Structural timber - Strength classes- Assignment of visual grades and species”.

Structural timber graded to strength classes C14, C16, C18, and C24 are widely available. Other strength classes can be very difficult to source and should be avoided when specifying.

Hardwoods are generally imported as FAS (First and second grade), which is the highest grade normally available and is appropriate for use in furniture and high quality joinery. Hardwoods are little used here for structural purposes, but Irish oak is sometimes used for specialist restoration work.

It should also be noted that structural softwood is normally available in standard thicknesses of 35, 44 and 75 mm, widths of 75 to 225 mm in increments of 25 mm, and lengths of 1.8 to 5.7 m in increments of 300 mm, but not all combinations of dimensions are stocked, and economies can be effected by ensuring that the projected sizes are available. A premium is payable for the longer lengths. For joinery and furniture work, red deal is supplied in thicknesses of 50, 63 and 75 mm.

Hardwoods tend still to be supplied in the metric equivalent of 1, 2, 3 and 4 inches.



Figure 4: The new investment at Glennon (Bros.) Timber Ltd's mill in Fermoy, Co Cork epitomises the commitment of the Irish sawmilling industry to continued capital investment in state-of-the-art technology.

Moisture Content

In the living tree, water or moisture plays an essential part in the living process and the wood of the tree naturally has a high moisture content. In this state it is less strong, prone to fungal and insect attack, and cannot be readily worked or glued.

Therefore it must, after felling and conversion into sawn sections, be dried to bring it to the appropriate moisture content for use. This is normally achieved



Figure 5: A load of timber being extracted from a kiln drier. The control of moisture is a vital component of the correct use of timber products.

by kiln drying as air or natural drying cannot bring the moisture content low enough for most purposes. Timber is a hygroscopic material and in practice always contains some moisture. It will gain or lose moisture in response to changes in the humidity of its surroundings, with an accompanying swelling or shrinkage. Therefore the moisture content should be appropriate to the conditions of use to minimise movement in service. The moisture content is specified in most timber-related standards and can range from 20% for structural use down to 7 or 8% for flooring with underfloor heating. It is essential

that the correct moisture content is specified for the intended use and checked on site by means of an electrical moisture meter. On delivery to site, timber or timber products should receive adequate protection to prevent undue uptake of moisture.

Durability

As an organic material, timber can be attacked by a range of organisms that utilise it as a food source. In practice, only fungi and insects are of major concern to most users. By ensuring that the moisture content is brought below 20%, and remains so, timber will be effectively immune from fungal attack (decay or rot) as there is insufficient moisture present for these to survive. A similar situation pertains with most insects, which require high moisture contents. The only insect likely to be encountered in dry timber in Ireland is the common woodworm or furniture beetle.

The natural durability of timber species varies greatly. Some, such as oak or teak, are naturally durable and, even in moist external conditions, will endure for many years, as exemplified by their use for boat building. Others, such as beech, are non-durable or perishable and will deteriorate rapidly when moist. It is therefore essential to specify the appropriate species. It should be noted that sapwood (the outer, paler portion of the log), is perishable, even where the heartwood is durable, and should be removed or treated if the timber is to be used in conditions conducive to decay.

Another point worth noting is in relation to plywood. It is frequently thought that plywood is extremely prone to woodworm attack. While this may have been true many years ago when plywood was made with casein adhesives, modern resin-bonded plywood is unlikely to be attacked, and the same holds true for other man-made board materials such as OSB, MDF or chipboard.

The natural durability of wood can be greatly enhanced by good detailing. In external applications, good weathering details and appropriate finishes ensure that timber which becomes wetted can dry off rapidly, reducing the risk of decay. In structures, particularly walls and roofs, the provision of appropriate ventilation and of vapour barrier arrangements prevent the build-up of water vapour, condensation, and thus minimise the risk of decay.

Put simply, if timber can be kept dry it will have a long life, as exemplified by ancient structures and artefacts which have survived for centuries.

Preservation

In situations where timber cannot be kept dry, preservation treatment is essential for most species, and always when sapwood is incorporated, although it should not be thought of as a substitute for good detailing. A wide range of preservatives and preservative treatments are available, although restrictions may be placed on some products in coming years.

Board Materials

The size and shape of solid timber sections is limited by the dimensions of the natural tree. By breaking the solid wood into veneer, particles or fibres, and adding an adhesive or binder, the material can be reconstituted into any desired shape or form. The bulk of these are produced in the form of flat sheets, generally 1.2 x 2.4 m, but larger may be obtained to special order.

There are four main categories.

1. Plywood – where sheets of veneer “peeled” from the log are bonded together with alternate layers at right angles, thereby utilising the greater strength of timber along the grain and increasing stability. Plywood is classed according to both the durability of the timber species and the durability of the adhesive. Where a high degree of moisture resistance is required, grade WBP (Weather and Boil Proof) should be specified, with the plywood being manufactured under an independently monitored quality control scheme.

Note: This is broadly equivalent to bond class 3 of EN 314-2. As yet, plywood manufactured to this standard is not commercially available.

2. Particle or chipboard, with particles of wood bonded with a resin adhesive, widely used in the furniture industry when faced with veneer or other materials. It is also available in a moisture resistant grade, appropriate for flooring applications where occasional moisture or condensation may occur. Oriented Strand Board (OSB) is a particular panel product where instead of particles of varying shape and size, wood is reduced to consistently sized flakes or “strands”. When bound together, alternative layers are oriented at right angles to give a board which closely resembles plywood in strength and moisture resistance, if not in appearance.

3. Fibreboard, where the wood is ground down into fibre form and re-formed. There are two categories,



Figure 6: OSB, shown here in a timber frame housing application, is manufactured by Smart Ply Ltd (previously LP Coillte Ltd) in Waterford.

the “wet” process exemplified by “hardboard” with one smooth and one mesh side; and the “dry” process where a resin binder is added, exemplified by MDF – Medium density fibreboard. MDF is available in a wide range of grades, including fire retardant, moisture resistant, exterior (Medex), and high density for flooring applications.

Sustainability

Timber is the one structural material that can be regarded as truly renewable, with new trees planted for every tree harvested in all sustainable managed forests. Most forests in Europe and North America are being managed as a renewable resource, with plantings and new growth exceeding fellings. Many are certified under one of the environmental schemes, an example being the Irish forest estate owned by Coillte, which has been certified as being sustainably managed by the FSC (Forest Stewardship Council).



Figure 7: External stairs made from Irish oak at Athenry Castle, Co Galway.

Fire

While it is true that timber is a combustible material, it burns at a predictable rate and, unlike metals, it does not lose its strength when exposed to high temperatures. Its performance in a fire situation can be accurately calculated and, with the appropriate detailing, can provide the fire resistance required by the Building Regulations. The surface spread of flame characteristics can be upgraded by the use of appropriate fire retardant treatments and finishes.

Conservation

When protected from moisture, timber retains its strength indefinitely, so that historic buildings can continue to be used and enjoyed safely. If upgrading or strengthening is needed to meet modern regulations, the existing timberwork can be strength graded in-situ so that the most cost-effective and least disruptive process can be used, retaining the original materials. Because of the ease of working in wood, repairs can be readily undertaken without disruption, with salvaged materials being readily available to ensure authenticity.

Woodspec, available in hard copy or on CD-ROM format, or on-line at www.coford.ie/woodspec is a comprehensive guide to designing, detailing and specifying timber in Ireland. Free technical advice on designing, detailing and specifying timber in Ireland is also available by completing a form at the WOODSPEC website. Alternatively, queries can be emailed to woodspec@coford.ie.