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Timber:

It would be rare not to find some timber installed somewhere on any vessel be it fibreglass, steel, ferro cement and obviously wooden vessels. Large or small, some timber is almost essential in either the structural integrity, the cosmetic appearance or, as likely, in many yachts both.
The major uncertainty that any owner has who is not familiar with the way vessels are constructed and the purpose of timber within the vessel is deciding on what timber should be used for new installations, whether it is cosmetic or structural.
There are instances where if the wrong species of timber is used, this can have a dramatic effect upon the longevity and strength of the vessel, this is particularly so with timber constructed vessels as, with regard to the hull structure, the type of timber employed in the construction has been specifically chosen for its characteristics. This can also apply to fibreglass vessels to a degree, particularly where timber may have been used for reinforcements and subsequently over laminated and forever hidden.
This short article attempts to illustrate the uses and drawbacks of certain timbers within the construction of any vessel.

Firstly, let it be said that, with regard to merely cosmetic improvements virtually any timber can be used, the majority of timber used for cosmetic enhancement will be chosen for its varnished or oiled appearance. Provided the timber is kept dry and well protected then the type of species is probably irrelevant however, bear in mind that if a particularly non durable timber is used for cosmetic enhancement, it must be in a position where it would not be affected by fresh water deck leaks or vulnerable to lack of maintenance where it could decay unseen.

Any unseen decay he can spread to more structurally important members of the vessel. However, it is unlikely that this would be the case as, the timber chosen for its beauty rather than its durability would be obviously on display.

Hardwoods/softwoods

Without going into the botanic qualities of various timbers, they are firstly broken up into two specific groups, hardwoods and soft woods, this has nothing to do with the specific hardness or softness of any timber, for instance balsa wood which is possibly one of the softest surface timbers known is technically a hardwood. This differentiation is a basic technical difference in the way that the timber is formed as the tree grows.

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Looking at the end grain of Oak, (ring porus) the pale narrower rings are series of much larger pores compared to the wider darker areas where the pores are much less dense & smaller.

Magnified section showing large pores in consecutive rings

Hardwoods are again broken up into two specific groups, again the differential is on how the wood is laid down on the tree as it grows. Technically, these two groups are known as ring porous or diffuse porous and it is all to do with the minuscule channels that run up the tree from root to tip. On diffuse porus these channels are all of the same diameter give or take throughout the length and diameter of the tree, on ring porus there is a considerable variation between the spring growth rings channels and to the winter growth rings channels and, looking at the end grain of ring porus timber it can easily be seen that these small holes gradually increase in diameter, suddenly stop and return to small diameter gradually increasing to large diameter next year thus creating constant regular variability in the structure of the timber throughout.

This gives the timber specific properties, these properties are increased resistance to shock loading. Amongst these timbers commonly used on boats for their properties are ash, chestnut, elm, hickory, oak and most famously teak.

All of these Timbers have exceptional strength and are particularly resistant to sudden shock loads. The uses of these include ash for tillers on any type of vessel, oak will often be used as a more durable replacement for ash, framing on timber boats will often be oak or a form of rock elm, spreaders for rigging will often be ash because of its relatively light weight,
Hickory doesn't find many uses in the marine environment although it is used for hammer shafts and pick axe handles etc.

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Teak can be universally used for any of these including a considerable amount of joinery and other structure however, considering its exceptionally high price, it will only be used where it's absolute durability or cosmetic appearance is paramount.

Ash is particularly attractive and is used on many vessels including fibreglass for adding lightness to interiors, as earlier said it is often used for spreaders and tillers due to its high strength/weight ratio. However, if not maintained it is not particularly durable.

Chestnut can occasionally used for attractive joinery although it is not as reliable in its durability as oak however, possibly more durable than ash. It is similar to ash although somewhat more tea colour. Again, it has high strength characteristics when sound.

Oak is possibly well-known to the majority and can be very attractive if varnished and, in some cases, depending how the timber has been sawn, it can mimic teak almost exactly with a pale brown stain. It is long lived, very strong and can have both cosmetic and structural use in all types of vessels. One slight drawback with oak is that it reacts with ferrous fastenings causing black staining at the position of the fastening due to the tannin within the oak.

Elm is very seldom used now, once used for the wooden Keelson for timber construction it was known to be exceptionally durable below the waterline however, not totally reliable above the waterline however, it can be particularly attractive if used for joinery.

Mahogany has been used for many decades however, it is unfortunate that many suppliers call almost any red timber mahogany and, this is incorrect. African mahogany (khaya) has been used for many decades for hull planking, interior and exterior joinery on all types of vessels and there is a particularly attractive timber. The more common Brazilian mahogany is somewhat harder and heavier but still has a similar uses. Honduras mahogany is particularly expensive and somewhat longer lived than the previous two. Other so called mahogany as such as luan and Philippine mahogany are not true mahoganies and will be very variable in their durability and reliability, they are also nowhere near as attractive cosmetically.

Durability

Other factors affecting the type of timber used for a particular purpose will be the durability of a timber.
Most importantly the sap wood of any timber should never be incorporated into any structure, the sap is the area of timber surrounding the extreme outside of the tree and, this is usually easily distinguishable by the sudden change of colour within the timber. Most people will recognise pine floorboards for instance will have two distinct colours, the darker colour is the hardwood, the paler colour is the sap wood but, because these trees are relatively small diameter the sap wood is always included otherwise, they would be unusable for any decent size of cut timber.

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The sap wood is not durable because this carries the nutrients for the tree whilst it is growing and, at the time of felling, the sap wood is still full of nutrients which attract organic decay and wood damaging insects and borers. In nearly all cases, the sap wood is relatively easily identified by being a significantly paler colour and, in many cases, considerably surface softer.

Again, it is naturally assumed that softwoods will be less durable than hardwoods however, this is not the case although it is true that a higher proportion of softwoods are less durable overall than hardwood.

Pitch pine is particularly durable although extremely difficult to locate nowadays. It was used for planking on many timber vessels from late Victorian Times through to the 1960's when the supply was somewhat diminished. The reason for its durability was partly due to the copious amounts of resin within the timber. However, it is not a particularly attractive timber when varnished and generally, would not be used for cosmetic enhancement.

Many of the cedar species have an incredible lifespan and, many years ago were used for deck construction on some timber vessels because of its lightness and durability however, the timber is particularly soft and easily damaged and has to be protected with a harder outer sheathing. It screw holding ability is also very poor and it is apt to split very easily but does find used in modern epoxy sandwich type construction where it can be sealed and re-lied upon for durability

The other pines and soft woods including Sitka spruce and British Columbian pine (also known as Oregon pine and Douglas fir & Scots fir) and larch, which has been a very good replacement for pitch pine given its potential for longevity have found use in both timber and fibreglass vessels in many instances. Columbian pine holds fastenings very well.

Larch being very durable is often used for timber hull planking as a good alternative to pitch pine, British Columbian pine is used for masts in both timber and some fibreglass vessels, it is also used for engine bearers and other structural components in both timber and fibre-glass (in fibreglass these bearers would be laminated and hidden in some cases) it is also reasonably durable if kept maintained.

Sitka spruce is used in high quality spars in timber vessels because of its relatively light weight however, it is not particularly durable if not maintained. The other pines regularly found in DIY outlets are what would be considered fast grown timbers and although not particularly durable in damp conditions, can be used for hidden structure with regard to joinery attachment etc. such as battenings and so forth.

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When looking at the end grain of any timber, the growth rings can be seen, if one was to compare the same size section of a fast growing timber to a slow grown timber, one will see the slow grown timber has considerably more growth rings. The more growth rings, the heavier the timber but also the stronger.

Two sections of pine, on the left fast grown, fewer rings much lighter in weight, on the right slower grown heavier & stronger, almost twice as many rings for the same section size

With regard to the hardwoods that may be used, teak with all the obvious benefits that the majority of people are aware of almost for any part of any vessel with the obvious exception of mast and spars. The major drawback with teak is its price and unfortunately, the inherent oil within the timber makes gluing sometimes less than reliable.

There are many other non mahoganies that are particularly suitable for joinery and construction in all types, these include sapele which is slightly paler than true mahogany but still quite attractive when varnished, utile which is a very rich red colour with very attractive figuring and grain that can be used as a substitute for mahogany in most cases. There are lesser well-known timbers such as Makore and Agba that can also be used for the majority of structural and cosmetic applications.

Agba was used in the construction of hot Moulded hulls for Fairey Marine and has proved particularly durable and lightweight.

Afromosia is often used in grp vessels for rubbing Strakes and external joinery. It is particularly heavy but quite long lasting and durable. The colouring is very dark brown and, after a few years becomes almost black however, it can be varnished for internal joinery although somewhat dark.

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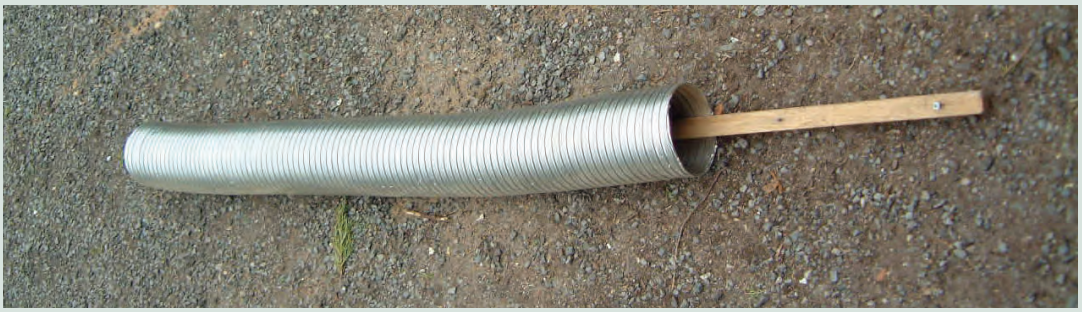
Perhaps the single most popular timber for all round use on both timber and grp vessels for exterior joinery and structural strength is Iroko. This particular timber is African in origin and available in considerable size sections.

It has the advantage of being relatively low in price compared to teak .When first cut this is almost straw like yellow colour but quickly darkens to a rich brown within 2 to 3 weeks and will often be mistaken for teak once it has weathered. It is particularly durable and will often be used for rubbing Strakes, railings, handrails and any other structural addition. It is not a particular pleasant timber to work with as the dust is very irritant. The hardness of the timber varies considerably from piece to piece as, some contains silica which blunts tools particularly quickly. The colour is also quite variable from sample to sample, some quite a pale brown others, extremely dense dark walnut colour. The darker it is, the more difficult it is to work. It can take varnish but it is often left to weather. Splinters can turn septic.

There is a relative newcomer to the marine timber industry called Idigbo, this is a relatively light weight pale straw coloured timber that is easy to machine and work and is relatively durable and, at this time, is one of the lowest price hardwood timbers suitable for marine use available. It will find many uses in boat building.

Bending timber

The other quality often required in boat building whether it be for fibreglass or timber is the ease of bending, there will rarely be a straight line on a vessel other than intricate joinery. Rubbing Strakes and toe rails all have various curves to which any timber must comply. Some timber will bend far easier than others, there are one or two timbers that are particularly difficult to bend cold.
Perhaps the first consideration when considering using a section of timber that will be bent or subject to a curve will be to ensure that the grain is absolutely straight and parallel to the sides as, if not, the chances of breakage are multiplied considerably.



An aluminium flexible ducting pipe which can extend in length & accommodate bent sections fro steaming used with a wallpaper steamer for simple effective steam box.

Sloping grain is the term used when looking at one or the other face of the machined timber it can be seen that the grain runs across the wood at a slight angle.

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Most timber will bend if steamed relatively easily, generally steaming will take 1 hour per inch thickness however, most railings and rubbing Strakes can be cold bent into position if the timber has been carefully chosen before hand. When bending cold always bend the timber very gradually fastening as one goes (or clamping if more appropriate) and do not allow the timber to spring back unexpectedly otherwise this will fracture it.

t is quite surprising how steep a curve a cold bent section of timber can be forced without fracturing if done very carefully and gradually. Some timber will have a propensity to bend easier one-way then it will the other way so, always check for any slight tendency for a curve which can be used to advantage, certainly avoid bending the opposite way to an existing curve.

The most difficult timber to bend is occasionally Iroko and some mahoganies, Afromosia is quite difficult in some sections however, oak ash chestnut elm and teak can take surprisingly steep cold bends with care.

Surprisingly, soft woods, although they are considerably lighter in weight are occasionally more difficult to bend without breakage.

Any timber will bend easier if the growth rings orientation is as near parallel to the face of the section of timber that is following the curve, this is rather like laying several thin sections one on the other to form the curve. When timber is produced and sawn with the growth rings running across the widest section this is commonly known as slash or plain sawn. When timber is sawn with the growth rings all at 90° to the widest face, this is known as quarter sawn or rift sawn. Rift sawn timber is used for laid teak decks and other areas where heavy traffic would wear timber away as, rift sawn timber has less exposed soft timber tissue and therefore does not ridge so much. However, it is rare that under normal circumstances the choice of how the timber is sawn is available.

Steaming

The accepted time for steaming for best efficiency is approximately 1 hour per inch of thickness. Perhaps the most important aspect of this is to remove the timber from the steamer and get to the workplace and bend to shape as quickly as possible as, the timber hardens very quickly once removed from the steam, the smaller the section, the more quickly the timber cools and becomes difficult to bend.
An efficient steam box can be made by using a section of appropriate size alumiium ducting, the advantage of this is that, being convoluted, it can expand and compress to any appropriate size and, it can also accommodate previously bent sections. If one end is sealed and the other receives the wand end of a wallpaper steamer, this does make a very efficient occasional use steam bending assembly that works surprisingly well.

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Gluing and fastening

The other aspect which has obvious importance is the reliability of gluing or fastening the timber. Many Timbers will accept glue and epoxy without any difficulty, the exceptions being teak as earlier noted with its relatively high oil content and pitch pine occasionally due to the excess resin however, even teak can be successfully glued provided the surface is solvent cleaned immediately before gluing. With regard to epoxy, any timber glued must be absolutely dry with a low moisture content for long life reliability. At the other extreme, many of the waterproof polyurethane glues can utilise relatively high moisture content in the timber to make an exceptionally strong joint.
Screw holding does have to be seriously considered when utilising timber for structural use. Generally, the less heavy the timber, the less powerful will be the screw holding ability with Timbers such as cedar and fast grown pine having a relatively low screw holding and Iroko, teak and oak having very acceptable attributes regarding screw fastenings. In the case of dubious screw holding Timbers then it is always wise to supplement with an appropriate glue.

Plywood

The use of plywood is practically universal on any boat of any construction and has been for many decades. The proliferation of plywood suppliers from Europe, Asia and beyond has flooded the market with no end of variability with respect to quality and type of construction. Firstly, the minimum grade plywood used anywhere on a vessel should be WBP this is water and boil proof and is generally known as exterior ply. There are lesser grades available including moisture resistant and non waterproof plywood however, these should not be used on vessels under any circumstances. The main plywood used for boats and yachts will be marine plywood BS1088, this standard ensures a certain quality however, there are many plywood manufacturers of this standard and, the quality varies considerably between the even these highly esteemed standards.

Various sheets of plywood, note the differing veneer construction, the more veneers the stronger, particularly if all veneers are the same thickness

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Exterior WBP plywood and marine plywood should use the identical glues in most cases and therefore, in that respect there is no difference between the two other than a considerable price difference.

The main difference encountered will be the standard of internal core construction which, on BS1088 is constructed to have a minimum number of voids within the plywood, these voids are where internal veneers generally don't butt close together and there would be a gap within the plywood which obviously weakens the plywood somewhat. The core materials are also subject to a minimum durability type.

Exterior plywood is not subject to such close manufacturing standards although, this does not necessarily mean that all exterior plywood is going to be of a lower grade than the low grade marine plywood. It merely depends upon the manufacturer at that time. One would also expect marine plywood to be constructed with mainly durable core laminates however, some exterior plywood can also be manufactured of higher quality internal cores than other manufacturers.

Perhaps one of the more significant areas where the strength of plywood of a given thickness can vary considerably is in the number of veneers used to construct a sheet. Some marine plywood will have fewer laminates than some high quality exterior plywood, obviously, the more separate laminates that are available, the stronger the plywood will be. Some six millimetre plywood will have three cores, some may well have five, and this is irrespective of whether it is marine grade or WBP grade. Note the photograph and for the variants of different plywood manufacturing methods.

Perhaps when selecting plywood for a plywood hull skin one might definitely choose BS 1088 with as many separate veneers as possible over and above any WBP grade, although, if replacing plywood dividers below decks, many builders will use a good quality WBP plywood.

Plywood is available with an almost unlimited array of different surface veneers and core construction, the most expensive plywood being the cabin sole teak decking design with the Black Rubber seam followed very closely by the teak and Holly cabin sole which, in some cases, can run into hundreds of pounds for a single sheet. A reasonable quality WBP plywood 12 mm thick will start off at around £26.00 at this time with an equivalent marine grade BS 1088 starting at perhaps £45.00 upwards.

Teak faced plywood is available however, it is very expensive and, unfortunately, there is a considerable variance in the thickness of the surface veneer, in some, the veneer is a few thousands of an inch thick which, although it may be perfect when new, leaves no room for subsequent sanding or finishing.

Scarfing

This is referring to the technique of joining short sections of timber or similar size to create a longer single section. This type of joint is often undertaken for mast making where it will be impossible to locate a section of timber longer than approximately 20 feet.

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For a reliable glued scarf joint without any mechanical fastenings it is obvious that the bigger the surface area of glue the stronger the joint would be and, the minimum recommended scarf joint is usually no less than a slope of 11 to 1, that is a 1 inch thick piece of timber connecting to a similar 1 inch thick piece of timber would have a scarf joint of approximately 11 inches long.

This can usually be reduced if supplemented with mechanical fastenings to a slope of 7 to 1 however, the glued scarf is totally dependent upon the absolute accuracy of face to face contact and accuracy of machining or creating the scarf. Modern glues are significantly stronger than the older glues that these original figures were based upon and it is likely that the joints can be slightly shortened if accurately undertaken with a good quality adhesive however, one might consider that there is no harm in having a joint which is more reliable and less likely to keep us awake at night worrying about whether the mast is going to fall to pieces because the scarf is too short!.

I hope this short article gives some insight to the understanding and use of timber.

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