Timber, Tools and Devices

1. Timber.

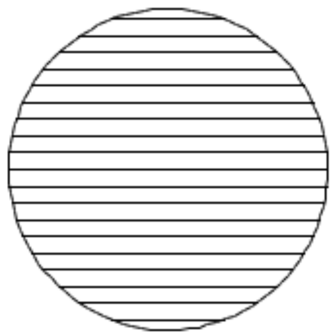
1.1. Solid Timber.

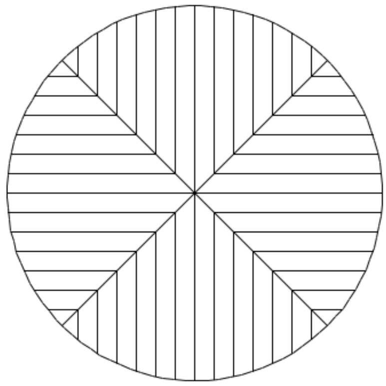
1.1.1. Timber is available prepared from the log in several ways

1.1.2. Planed all Round (PAR) is thicknessed and edge planed, usually to specific sizes, and is basically ready to use as bought. Also called Planed Square Edge (PSE). Typical finished thicknesses are 19mm, 22mm, 5mm, 32mm and 50mm (¾", ⅞", 1", 5/4" and 2"), with widths from 50mm up to about 305mm (2" to 12"). Note that softwoods in particular are usually described by the size they were sawn to before they were thicknessed and edge planed. So for example boards sold as 25 x 100, will actually be 19 x 90 finished, or thereabouts. When buying PAR hardwoods you need to enquire as to the finished size of the boards you are ordering. PAR is the most expensive way to purchase timber and only really worthwhile for smaller projects.

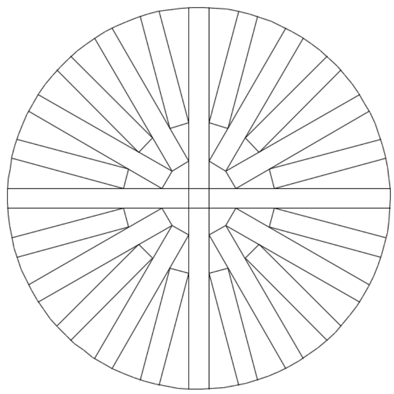
1.1.3. Canadian Lumber Size (CLS) is thicknessed and edged softwood with an arris (a small radius) on all four corners. It is also known as American Lumber Size (ALS) In Europe 'Regularized' timber is similarly prepared. But note that CLS/ALS finished sizes are different from European Regularized finished sizes. CLS/ALS and Regularized timber is softwood mainly used for building construction and generally comes in sizes useful for that purpose – 76 x 50, 100 x 50, 150 x 50, 200 x 50 etc. (3" x 2", 4" x 2", 6" x 2", 8" x 2" etc.). Again the terminology is the sawn size of the timber, not the finished size. So 100 x 50 Regularized actually comes at about 95 x 45 (3¾" x 1¾") whereas the equivalent CLS/ALS 4" x 2" comes in at 3½" x 1½". While the quality of this timber is not particularly useful for structural boatbuilding, it is useful for jig building, shores, and many other general purposes like sole bearers, cleating etc.

1.1.4. Sawn Through and Through. Also call Plain Sawn or Flat Sawn. These are boards sawn directly through the log, without special selection for grain direction. It is the most economical way to saw timber as there is least waste. The boards will usually be 'waney' edge – that is not squared off and the widths will vary according to where in the log they come from. Boards each side of the heart will have fairly vertical end grain but as the boards get nearer the edge of the log, the end grain becomes more horizontal and the outer two 'slabs' are of little use. For boatbuilding purposes, a vertical end grain direction is needed for areas like teak decking as this tends to be the most stable and the grain on the surface doesn't 'shell' out. And reasonably vertical grain is better for items such as the Shelf (Clamp) and for strip-planking. Boards with a more horizontal grain can be used for many general purposes, particularly larger items, such as laminating the hog, laminating the stem, making the keel, sternpost, floors, etc.





1.1.5. Quarter Sawn is more expensive than Through and Through, but you get all reasonably vertical end grain and very stable timber. The log is first quartered and the the boards in each quarter are sawn through and through. Boards are normally square-edged. For general boatbuilding you don't need to buy quarter sawn timber, unless maybe for cabinetry and furniture making, though this can usually be achieved quite satisfactorily from plain sawn boards with a little careful selection. You can 'saw and saw again' to get the grain direction you want – so if you want basically 50 x 15 (2" x ⅝") timber you get this two ways from a 50mm board by cutting it into 50 x 50 (2" x 2") pieces and then sawing those to 15mm (⅝") in whichever direction gives you the better grain.



1.1.6. Rift Sawn is the most expensive and most wasteful cut. The log is quartered and then individual boards are cut radially. This gives vertical end grain on all boards and very stable timber. Boards are normally square edged. For general boatbuilding you don't need to buy rift sawn timber.

1.1.7. Faces as Sawn (FAS). These are sawn boards with square edges. It is not normally specified how they are sawn (plain sawn or quarter sawn) but they are usually plain sawn. They have a specified thickness and width. Typically you would order something like 25 x 200 (1" x 8") x length required, FAS. The boards would probably come in a little thicker than the nominal sawn thickness; the width may vary a little and the sawn edges may not be entirely straight. The ends of the boards may have defects, which reduces the useable length, so the boards you get may be a bit longer than the length ordered. From a 25mm (1") board you should usually be able to achieve a planed finished thickness of between 19mm and 22mm (¾" to ⅞") depending on how the board has been sawn. You can ask your merchant how the boards 'stand up' to their specified thickness and they will tell you what you could expect to obtain as a finished thickness. Unless you are buying a lot of timber for a large boatbuilding project, FAS boards are usually the most economical way to purchase timber.

1.2. Veneer Timber.

1.2.1. Veneers are usually between 0.6mm ($^{1}/_{32}$") and 3mm (⅛") thick. They can be sliced or peeled.

1.2.2. Peeled or Rotary Sliced veneers are made by rotating the log and a blade literally peels off the veneer at the required thickness. This is typically the type of veneers that are used in plywood manufacture. Other than in plywood it is not of use for general boatbuilding.

1.2.3. Sliced veneers are cut through the log. They can be Plain Sliced, Quarter Sliced or Rift Sliced, much as for sawn timber.

1.2.4. In structural boatbuilding we use veneers to laminate items like the frames and beams and as the outer skins on a cold-moulded hull, where they are laid diagonally opposed at ±45°. The usual thickness required is from 2.5mm ($^3/_{32}$") to 3mm (⅛").

1.2.5. The usual width for laminating and cold-moulding is somewhere between 100mm and 200mm (4" to 8"). Plain sliced is fine because we are not looking for grain effects, but sometimes only quarter sliced is available. Lengths are often available up to about 3000mm (10').

1.2.6. Thinner veneers (typically 0.6mm) are used for laminating smaller items of interior furniture – like curved fiddles on bunk fronts and galley tops etc.

1.3. <u>Timber Species</u>.

1.3.1. The timber intended to be used for the various parts of the structure is shown in the brief specification accompanying each design.

1.3.2. But different builders in various parts of the world will have better access to many different timbers. Most timbers are suitable for bonding with WEST™ and durability is no longer of such importance because of the WEST™ encapsulation. This frees us up to use many excellent timbers that were not previously used much in boatbuilding because they were not able to withstand the ravages of wet conditions and poor ventilation.

1.3.3. Some timbers, while perfectly suitable for bonding with WEST, and plenty strong enough are not always the best choice however for some structures. An example would be a furniture timber like Brazilian Mahogany, which is an excellent timber with an attractive grain. It is not a particularly good timber for bending however and so not very suitable for carlings, shelves etc. African Mahogany (Khaya) with its less figured grain, or a softwood like Douglas Fir, European Larch and similar, are much easier to use for these jobs (and also usually considerably cheaper).

1.3.4. Some traditional boatbuilding timbers are not very easy or satisfactory to bond with WEST, so should not be used for primary structural purposes. The most common of these unsatisfactory timbers are Teak (too much oil), Oak (too much tannin) and Pitchpine (too much resin). Iroko is satisfactory, but for most purposes African Mahogany with its more open grain structure, is a preferable substitute.

1.3.5. Thus, while WEST has opened out many new timbers for boatbuilding, some of the old ones are no longer so suitable and there are still timbers which are more suitable for some purposes than others. So if you are moving away from the timbers noted in the specification, and have any doubts, please contact us first to make sure that they will be OK.

1.3.6. Whatever timber you use needs to be kiln dried to 12% moisture content or lower. Store it under cover, with sticks or lathes between the boards so that air can circulate freely through between the boards. Place the sticks at regular intervals so the boards don't bend or warp.

1.3.7. Generally timber for boatbuilding needs to be clear and clean – no large or loose knots and a nice straight grain. With timber for highly stressed items, such as mast and spars, you need to be very careful in selection and it's best to have no knots at all and a very good grain. With larger items and laminated items (like the hog and backbone) some knots are acceptable and a wilder grain is acceptable as minor defects can be staggered from layer to layer. And in really large items such as a deadwood, quite a big tight knot or area of wild grain is acceptable.

1.3.8. Some common timbers (sawn and veneer) that we can use structurally are:

Ash (rather heavy)
Cedar (Western Red, Port Orford etc.)
Elm (rather heavy and nowadays limited supply)
Douglas Fir (and other firs). Note that botanically Douglas Fir is not a fir at all.
Khaya (African Mahogany)
Larch
Occumé
Pine (many different types, some excellent, some not so suitable)
Sapele
Spruce (usually Silver Spruce)

And many others ...

1.4. <u>Plywood</u>.

1.4.1. There are so many different types of plywood out in the marketplace that it can get confusing. And there is also a considerable amount of bogus “marine grade” plywood around to be beware of.

1.4.2. With the use of WEST™ (and other marine epoxy systems) the durability of the timber used to make the plywood is no longer of such importance. But there are two things that remain of vital importance:

1. The glue bond of the veneers making up the plywood must be WBP (Water and Boil Proof) or else, even with WEST™ coating, your ply may delaminate. Marine Grade and Exterior Grade plywoods will be WBP.

2. The structure must be sound. There should be no voids in the core veneers (though limited small splits are generally allowed). And the internal veneers must be flat, not wrinkled. There must be no end joins in the veneers. Face veneers should be a minimum of 1.3mm and no thicker than 3.8mm. Core veneers should be no thicker than 4.8mm.

1.4.3. British Standard BS1088 Marine Plywood is an accepted standard worldwide, but unfortunately it is only enforceable in the UK – there is nothing to stop a plywood manufacturer elsewhere applying a BS1088 stamp to possibly non-marine and quite inferior plywood.

1.4.4. In the USA there is good quality Douglas Fir WBP plywood that is suitable for marine use, though not so suitable for a clear finish.

1.4.5. A lot of true marine grade plywood is made from Occumé, which is a lightweight mahogany-like timber. This is generally very good plywood with an excellent multi-core structure of similar thickness veneers. It is lightweight and sufficiently flexible for normal bending. Occumé takes WEST™ very well.

1.4.6. Many 'Far Eastern' marine grade plywoods are WBP and structurally sound, but made from heavier timbers, such as Meranti, which adds unnecessary weight to the boat. They also tend to be harder, more brittle, less easy to bend and accept a WEST™ coating less well. Other, lower priced, plywoods from this market can be very doubtful. And any ply that has just a few, thick core veneers is also unsatisfactory.

1.4.7. Another consideration with plywood is the quality of the face veneers. A visually poor face veneer can be perfectly satisfactory structurally, but will cause a lot of hassle to get a good finish on it. Face veneers that 'fluff-up' when coated can be really difficult and time-consuming to sand back to a satisfactory finish.

1.4.8. Plywood is expensive but so are the materials (and the CNC cutting) that you are going to use with it. And your building time is valuable. If possible, find a supplier that you can trust to be truthful about the quality of the plywood – and make a few investigations on boatbuilding forums and the like, if you are at all unsure. It truly isn't worth basing the whole boat and all your time on an unsound base material.

2. Machine Tools

2.1. <u>Do I need them?</u>

2.1.1. For a small boatbuilding project – say an open boat up to about 3.5m (12') – probably not. If you already have them, of course you will use them. But it may not be economical to buy machines for a single small project, using instead PAR timber and hand tools and hand power tools.

2.1.2. For a larger project, or if you feel that you will build further boats in the future, then is is more economical to buy FAS timber or Plain Sawn boards, and machine it yourself – the cost of the machines will soon be paid for by the savings in timber cost.

2.1.3. And of course, as projects get larger, the more necessary a reasonable set of machine tools becomes.

2.1.4. The machines discussed below are listen in my personal order of importance.

2.2. Safety.

2.2.1. As with all machines, machine tools are dangerous if improperly used. This is especially the case with power saws. Whilst writing a safety manual is beyond the scope or intent of this document, here are a few sensible do's and don'ts:

Do read the instructions and familiarize yourself thoroughly with the machine.
Do set the machine up properly and firmly.
Do keep the work area around the machine clear of sawdust and offcuts.
Do know how the guards and safety components work.
Do use a push-stick on small stock, or cuts near the blade.
Do have a helper, or properly set-up off-take roller, for long cuts.
Don't use the machines when other people are around (except a helper of course).
Don't get distracted.
Don't get over-confident – that is perhaps the worst danger.
Don't take risks – no piece of wood is worth it.

2.2.2. Guards and the riving knife (the knife behind the saw blade on a table saw) can be a bit flimsy on cheaper machines, so take care not to bend or damage them.

2.3. Table saw.

2.3.1. The most common table saw swings a 250mm (10") blade and will cut to a depth of about 80mm (3¼"). These will operate of a normal domestic supply and are semi-portable. Most nowadays have a rise-&-fall blade, which can be set at any angle between 0º and 45º. They often come with T-slots in the table which take a sliding fence to make angled cross-cuts.

2.3.2. Used carefully, quite cheap table saws perform pretty well – don't force them, keep the blade sharp and make sure that the fence is firm, parallel to the saw and at 90º to the table. My current saw is about 10 years old and has done a lot of cutting.

2.3.3. Second-hand table saws are often available and some of the older ones can be very good; often more solid that cheaper modern ones. Look for a decent powerful motor, and a good solid fence; don't worry too much about a bit of rust or a few dings.

2.3.4. In use, always try to set the blade so that the gullets (the bottoms of the teeth) are just clear of the timber – setting it any higher just loads the saw more because there is more blade area in the cut.

2.3.5. Always use the correct type of blade. A table saw is basically a rip-sawing machine (cutting with the grain) and for that you need a blade, with the correct number of teeth and the correct tooth angle for rip-sawing.

2.3.6. For a 250mm (10") saw, a blade with 36-40 teeth is usually sold as 'General Purpose'. This should rip-saw quite well and give a decent finish; it will also cross-cut if necessary. A true 250mm (10") rip-saw blade will probably have only about 24 teeth and you won't be able to cross-cut with this. A 'Fine Cut' blade will have about 60 teeth and is no use for rip-sawing. For our purposes a general purpose 40 tooth blade is fine, both for general boatbuilding work and cabinetry.

2.3.7. Carbide tipped blades are almost universal nowadays. They can be sharpened, provided you can find a saw doctor or sharpener (not always easy – try your local family hardware store rather than a big-box store).

2.3.8. The only other blade that I ever use is a dado saw – sometimes called a wobble saw. The mandrels of this type of saw can be revolved so that the blade wobbles when it revolves, so it cuts a groove or rebate.

2.3.9. Personally, if I had the space and could afford it, I would go for a bigger saw – one that would swing a 305mm (12") blade with either a rise-&-fall blade or rise-&-fall table, so that I could rip wider timber. Being able to set the blade at an angle is useful. I have never found the 90º sliding fence accurate enough to be very useful – there always seems to be too much play in the T-slots; better results from a sliding mitre saw..

2.4. Thicknesser. After you have sawn the timber you need to plane it smooth and accurately to thickness. The timber lays on a table with free rollers front and back and passes under the cutter block, driven though by power rollers before and after the cutter block.

2.4.1. Commonly nowadays these machines come in a bench-top variety and will handle up to 305mm (12") wide and 150mm (6") thick timber. The maximum cut is usually 3mm (⅛") but that is pushing it with timber much wider than about 100mm (4"). Better to take two 1.5mm ($^{1}/_{16}$") cuts, or even less on very wide or very tough timber.

2.4.2. A three-bladed cutter block generally gives a better finish than a two-bladed one, although mine is only two-bladed and does everything I want.

2.4.3. On the bench-top machines the lower table is static and the cutter block, together with the power rollers, is raised and lowered to adjust the planing thickness.. On bigger machines and combination machines (thicknesser and surfacer in one machine) it is the cutter block that is fixed and the lower table is raised and lowered.

2.4.4. In Europe, combination thicknesser and surfacer machines seem to be more popular and can be reasonably inexpensive. These have one cutter block, with a movable rear table over the top of the cutter block (for the surfacer) and a raise-and-lower table under the cutter block (for the thicknesser). The advantages are less cost (over buying two separate machines) and a saving of space. The disadvantages are that the maximum thicknessing width is often 250mm (10"), rather than 305mm (12") and it can be a bit tedious to swap from one function to the other

2.4.5. Blades can be high-speed steel or carbide tipped. Usually the machines are sold with high-speed steel blades. Keep the blades sharp (they can be re-sharpened). Be wary when using second-hand timber; wire brush grit and dirt off it as this will dull high speed steel blades very quickly; and be very vigilant for nails etc. buried in the timber, which will make a nasty notch in the blades at best, and maybe even break a chunk out of them.

2.5. Mitre Saw (Chop Saw).

2.5.1. On these machines, the saw and motor are mounted on a hinged body above a fixed table. Typically they are used to cross-cut timber which is positioned on the table and the saw brought down to cut it.

2.5.2. If at all possible, go for a 250mm (10") blade sliding, compound machine. In a compound machine, the saw blade can be angled from 0º to 45º and the table can be turned from 0º to 45º (or more), so you can cut compound angles. And on the sliding variety, the whole saw body can be slid back and forth, which much increases the width that can be cut.

2.5.3. A typical 250mm (10") sliding compound mitre saw will handle timber up to 90mm x 305mm (3½" x 12") at 90º and about 50mm x 200mm (2" x 8") at 45º.

2.6. Planer (Jointer).

2.6.1. This machine is basically for planing the edges of timber straight, or planing the edges of timber after rip-sawing. It will typically have a 150mm (6") cutter block. The table before the cutter block is raised and lowered to adjust the depth of cut. The table ahead of the cutter block is usually either static, or, once adjusted, not moved in general use.

2.6.2. Look for a machine with as long a table length as possible. The length of timber that you can effectively plane straight is about 3 times the total table length.

2.6.3. The fence is usually adjustable from 0º to 45º to allow the planing of bevel edges and can be slid across the table to allow the whole width of the blades to be used.

2.6.4. Some machines will allow you to cut a rebate by dropping the rear table to the depth of the rebate and setting the fence to the width – and this is very useful.

2.6.5. Cheap short bench-top machines are not really worthwhile – better look for an older, second-hand, longer, more solid machine.

2.7. Bandsaw.

2.7.1. Personally I don't reckon small bandsaws (say 305mm - 12" wheels, or smaller) are worth the cost and space they take up. The frames are often not rigid enough, nor the guides good enough, nor the blades wide enough, to cut to a line or stay cutting square. For our purposes you can do just as good a job with a decent jig saw (see Power Hand Tools).

2.7.2. If you already have a decent bandsaw, then you will of course find it useful, but I wouldn't go out an buy one.

3. Power hand tools.

3.1. Do I need them?

3.1.1. In an absolute sense, no; but realistically a good set of power tools makes life a lot easier, gets the job done quicker and helps in achieving a quality result.

3.1.2. I think that this is an area where it pays to buy decent quality tools, rather than the cheapest. In today's boatbuilding, hand power tools get proportionally harder use than machine tools and so quality pays; the better tools also tend to be more powerful, work better, cut squarer and so on.

3.1.3. Here is my personal selection of the power tools that I use most for boatbuilding. As you can see from the accompanying photos, my tools are not at all new. I'm not endorsing the makes shown – they are just what I happen to have.

3.1.4.

3.1.5. Remarks about what features are desirable and what are a waste of time are very much my personal views!

3.2. Impact Driver

3.2.1. This is actually the newest of my power tools and the one that I absolutely wouldn't be without. The later models are often smaller than this. It is shown here with a 50mm (2") extension and a No. 2 Phillips head bit, which is my most common set-up.

3.2.2. An impact driver can drive and remove almost any screw fastening from very small to very big. As well as rotary action, there is a fast hammer action, which drives screws much more effectively than rotary action alone.

3.2.3. Go for the most powerful, cordless variety (18v is usually the most powerful), with the lightest, smallest lithium battery pack. Then you can get into awkward places more easily – and it is surprising how tiring a heavy machine can be after a while.

3.2.4. Impact drivers aren't much use on traditional slotted-head screws as the driver bit jumps out of the slot and usually goes straight into the surrounding timber, causing nasty damage. Some older (usually corded) models do have a sleeve that comes down over the screw head to keep the slotted–head driver bit in the slot, but I haven't seen this on modern machines

3.3. <u>Drill</u>.

3.3.1. Probably the most common power tool ever! A cordless drill is much more convenient than the corded variety.

3.3.2. Again, go for power (18v) and small size. The newer models of this drill are quite a bit smaller than the one shown.

3.3.3. A keyless chuck is almost universal nowadays and, provided it is a good one, very convenient. The chuck on this drill is very good in that it almost never gets jammed too tight to undo manually. But it won't take very small drill bits below about 2mm (about $^{3}/_{32}$"), which is a disadvantage. If you are buying new, check that the chuck accepts from 0 to 13mm (0 to ½").

3.3.4. Mine has all sorts of adjustments for torque, which I never use. And hammer action, which I don't use in boatbuilding, but do occasionally on other jobs. It also has manually selectable two speeds, which is occasionally useful.

3.4. <u>Circular Saw</u>.

3.4.1. For general use get a machine with a 185mm (7¼") diameter saw blade, which will usually cut up to about 60mm (2⅜") depth.

3.4.2. I prefer the corded variety rather than the cordless because they tend to be more powerful – and anyway I don't think you can get the 185mm size (7¼") in cordless.

3.4.3. Choose a powerful model (say 1500 watts or more) as these tools get a lot of hard use.

3.4.4. Look carefully at the base plate: a good solid, robust metal base is usually better than a plastic base, or one made from thinner metal with turned up edges. The one thing you don't want is a flimsy base plate or else the saw will soon be cutting out of square.

3.4.5. Similarly with the revolving guard – metal usually survives better and retains a smooth action.

3.4.6. These saws are adjustable for depth of cut and angle of cut. They should also come with an adjustable fence for straight-line parallel rip-sawing – a must if you don't have a table saw.

3.4.7. Don't worry if the saw you choose doesn't have sophisticated laser guides or other fancy bits – they are mostly useless in practice. Lasers get out of adjustment very easily, get smothered in sticky sawdust very quickly and stop shining much light, and out in sunlight, you can't see them anyway.

3.5. <u>Jig Saw</u>.

3.5.1. Here especially choose a good quality tool. A poor jig saw is worse than useless because as you cut around a curve, the cut will go out of square. And cutting around curves is one of the main jobs for this tool! This particular saw is well over 20 years old and is still excellent.

3.5.2. Choose a machine with adjustable oscillation motion (backwards-&-forwards motion) of the blade as well as straightforward up-&-down motion, as this will improve cutting with the grain immensely.

3.5.3. An insert for the base to help prevent splintering is very useful – nearly all machines have them.

3.5.4. As for the circular saw, I prefer a jig saw with a simple, robust metal base, rather than anything fancy or plastic.

3.5.5. The base is usually adjustable so that angled cuts can be made – useful … but not that useful!

3.5.6. Do use the right blades for the job in hand – there is a huge variety of blades, many with special purposes and it really is worth selecting the right one for the job you are doing. Don't use blunt blades – you will just overload the tool and get a poor cut.

3.6. <u>Orbital sander</u>.

3.6.1. Flat rectangular base, reciprocating motion. These come in ¼-sheet, ⅓-sheet and ½-sheet sizes. ½-sheet is the most useful for general sanding work. ¼-sheet is good for occasional use in small spaces, but not for general sanding. If you are only having one, then choose the ½-sheet size.

3.6.2. Corded is probably better for this tool, rather than cordless as you tend to use them for an extended time at one go.

3.6.3. The particular sander pictured is probably the worst power tool that I ever bought – it has no dust collection and the clamps each end to secure the paper are very difficult to use. And it was expensive too!

3.6.4. Good orbital sanders come with a perforated base and an accessory that pushes over the base once you have fitted the sandpaper, and pierces holes in the paper to coincide with the holes in the base. Dust is then sucked up through the holes into a collection bag at the back of the machine. Not only does this make using the sander very much nicer, it also improves the quality of the sanding and helps to stop the sandpaper getting clogged. I would not buy one again without dust collection – I can live with awkward clamps.

3.6.5. This is quite a heavy machine which generally is not a necessarily bad thing as most sanding is done with the material being sanded bearing the weight, or some of the weight, of the machine.

3.6.6. Aluminium oxide paper is generally the best for sanding. Modern paper often has a slightly sticky back which helps to keep the paper stuck to the sander base – otherwise if it is not pulled nicely tight with the clamps, the sander can oscillate happily and the paper mostly stay still.

3.6.7. Paper comes in grits from 36 (the coarsest) to 360 or finer. Generally 60 grit to 80 grit is good for an initial sand and 120 to 220 for a final sand. But it does vary with the timber being sanded. Hardwoods are better and more effectively sanded with finer grits that softwoods – so for a dense timber I would probably start with 100 grit and finish with 220 grit.

3.7. <u>Trimmer</u>.

3.7.1. This is basically a small router that can be held in one hand.

3.7.2. It is mostly used with bearing guide cutters, so no fence is required.

3.7.3. The principal purpose is rounding over, chamfering, and trimming (as the name suggests).

3.7.4. Pretty much all these jobs can be done with a hand plane and sandpaper – the trimmer just makes it quicker, more consistent and generally easier.

3.7.5. The base of the trimmer can be adjusted up-&-down to get the correct depth of cut – the bearing guide on the cutter automatically adjusts the sideways depth of cut.

3.7.6. You can also use these little machines with a fence, or a guide, to plough a groove, make a rebate, etc. using a parallel straight cutter. They don't have a plunge facility however, so can't be considered a true router and can't do all the things a true router can do.

3.7.7. They generally take 6mm (¼") shank bits.

3.8. <u>Belt sander</u>.

3.8.1. These come in various widths and belt lengths. 75mm or 100mm (3" or 4") are suitable widths.

3.8.2. Common belt lengths are 450mm or 533mm (18" or 21") for a 75mm sander and 610 (24") for a 100mm sander.

3.8.3. Corded is better for this tool, rather than cordless, as they tend to get extended usage.

3.8.4. The one pictured is a 100mm (4") size and is a powerful, heavy old beast, capable of serious work. I bought it second-hand off eBay and it has done sterling work.

3.8.5. I do have a 75mm (3") belt sander but it is neither particularly powerful, nor useful.

3.8.6. Common problems with belt sanders are belt slip (if you lean too hard on them) and the belt running out of true. There is an adjustment for out-of-true running but often this doesn't work too well, especially as a machine gets older and there is a little wear in the bearings.

3.8.7. You can fix this by adding some masking tape or similar, around the middle of the front roller. Belts will migrate so that their centreline is at the highest point of the roller and the masking tape gives a distinct high point. This also helps to fix belt slip. It probably invalidates the warranty of a new machine, but I've been doing it for years!

3.8.8. I haven't found that dust collection works very well on any belt sander that I have owned.

3.8.9. Don't bother with soft-start or other fancy features – if you can't work out when you are intending to start the machine and hold on to it, then you shouldn't be using it.

3.8.10. Generally, though not uniquely, belt sanders are used with the grain of the timber. They need to be used with caution as they are capable of removing a lot of material – so you can unwittingly and quite easily sand too much and make something that was pretty fair into something very unfair. Also you can't get close to the edge against an upstand, so there is a tendency to get a nasty hollow at that point.

3.8.11. Belts come in grits from 36 (the coarsest) to something like 220 (the finest). 36 is really very coarse and only useful for removing a lot of material. 60 and 80 grit are good for general work. 120 is good for finish work, though that is not generally the use for a belt sander.

3.9. Router.

3.9.1. A router, as opposed to a trimmer, has a plunge facility, so the router cutter can be positioned above the work and 'plunged' down into it to start the cut.

3.9.2. A router is essentially a two-hands machine . I find it better to mount the router under a table and pass the timber by it, rather than holding the timber in a vice and passing the router over it – the slightest hand wobble and you get a bad cut, whereas passing the timber over the router is a much steadier, safer and smoother operation.

3.9.3. My router here is shown mounted on a home-made table, attached to my table saw. It can use it's own fence or the table saw fences as appropriate.

3.9.4. It takes router bits up to 12.5mm (½") shank, with sleeves for 9.5mm (⅜") and 6mm (¼") shank bits.

3.9.5. Arranged like this, a router is essentially a small spindle moulder and can perform many of the shaping functions of a spindle moulder using a huge variety of special cutters.

3.9.6. I tend to use my set-up for simple profiling, rebating and grooving, rather than any complicated shaping.

3.9.7. Another common use for a router is to make dovetails with a dovetailing jig. The dovetail cutter is mounted in the router (which in this instance is demounted from the table and hand held) and a special sleeved base insert is fitted that runs in the jig attachment. It cuts both sets of dovetails (e.g., drawer front and side) in one pass.

4. Hand tools.

4.1.1. Buying Your Tools.

4.1.2. You can often pick up old hand tools on eBay, at car boot sales, flea markets, junk shops etc. You don't need collectors items or tools in perfect condition at all – some pitting, rust, a bit of damage to the handle etc. – no problem. As long as you can buff up and sharpen (and adjust where necessary) the blade, the tool will be fine. I have many tools that are very old, certainly part-worn, but still perfectly functional.

4.1.3. The list of tools that follows is roughly what I think you will find useful to build a boat. You can start out with rather fewer than I have shown and build up your tool kit as you go along, if you wish to and as you find that you need to.

4.1.4. I actually have many more tools than shown here and duplicates of many others – but I have been boatbuilding and doing other sorts of structural woodworking and cabinetry for over 50 years, so inevitably I have built up a collection, including tools inherited from my father, which are many years older still.

4.1.5. And modern boatbuilding doesn't require the heavy tools of yesteryear very often either – not a lot of use for tools like the adze or a 65mm (2½") firmer chisel nowadays, or a set of tapered augers for trunnels, etc., all of which are lurking in my workshop!

4.1.6. You do need to take care of your tools but not get obsessive about it. They are a working collection, not a display collection. You will hit a nail or something with a chisel or a plane from time to time and it's a nuisance but not a disaster.

4.2. Sharpening.

4.2.1. You need to sharpen your tools. Blunt tools are dangerous and anyway, won't do the job.

4.2.2. There are many devices on the market for sharpening tools, including various guides and holders, as well as special "cool" stones to go in a bench grinder.

4.2.3. Personally I have always simply sharpened all my tools by hand on an oilstone and I think this is the easiest, quickest and cheapest way. You can also carry it with you to the job, so you can always re-sharpen when ever you need.

4.2.4. You need a coarse and a fine oilstone and a small oil-can or oil-pot. Stones are usually about 200mm long and 50mm wide (8" x 2"). You can also get a composite stone – coarse on one side and fine on the other.

4.2.5. It is worth making a box for the stone to sit in, say 250 x 75 x 20 (10" x 3" x ¾") with the area for the stone recessed out, so that half the depth of the stone sits in the box. Drive two brass or steel pins at the front end underneath, and cut the heads off so they grip the bench and stop the stone sliding about. Make a lid for the box, so the stone doesn't get covered in dust and sawdust.

4.2.6. Use very thin oil, or a 50/50 mixture of about 30 weight oil with paraffin (kerosene) to lubricate the stone whilst sharpening.

4.2.7. You have to learn to sharpen a tool blade. The basic technique is to move the blade (removed from the plane or spokeshave in the case of those tools) steadily back and forth along the oiled stone, holding it at a steady angle to hone the cutting angle to a flat surface. About 25º is a good angle for most tools – too fine an angle and the blade will blunt quickly; too big an angle and it won't cut well.

4.2.8. With a chisel, start off by tucking the handle into your arm (top photo) so the chisel is at the required angle to the stone. The object is to be able to move it back and forth without 'rocking' the chisel – you want a flat surface on the chisel, not a rounded one.

4.2.9. Then place the other hand – or a finger and thumb of it – on the blade as the second photo. Move steadily back and forth, working from the shoulder and elbow – keep the wrist angle constant. A slightly circular motion or a figure-of-eight motion over the stone is OK, and will help wear the stone more evenly.

4.2.10. With shorter blades, like spokeshave and plane, you have to imagine that an extension of the blade is tucked into your arm, so that the wrist stays locked at the correct angle and all the motion is from the shoulder and elbow.

4.2.11. Use the coarse stone first until a slight burr develops right across the blade. Then move to the fine stone and repeat the process. Finally remove any burr with the back of the blade flat on the fine stone. Never try to sharpen both faces – sharpen the angled face and remove the burr with the blade absolutely flat on the stone.

4.2.12. The old test for a sharp blade is to pull a hair out of your head (assuming you still have some after all this!) and hold it between finger and thumb – a really sharp blade will cut the hair across it.

4.2.13. Even the best of us gradually gets the blade sharpened out of square and in a bit of a state, at which point it needs grinding. Use a fine stone in a bench grinder and be very careful not to let the blade get hot – have a pot of water to dip it in regularly. Move the blade steadily across the stone at a constant angle so that the whole width of the blade gets ground to a slight hollow, square across the blade. Then when you come to sharpen it on the oilstone, the hollow will gradually get honed out over several sharpenings.

4.2.14. External gouges (rounded chisels, sharpened on the convex side) can be sharpened on a flat oilstone using a figure-of-eight motion and twisting the wrist, so that the whole bevel on the convex face is sharpened. Finish off with a slipstone (a small thin stone, usually tapered in cross section, with one rounded edge) in the concave side to remove any burr – but do not sharpen any angle on the inside.

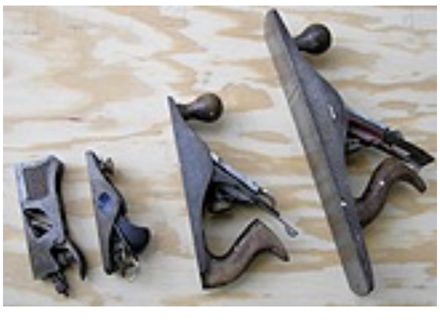
4.2.15. Internal gouges (rounded chisels, sharpened on the concave side) have to be held in a vice and sharpened with a slipstone.

4.2.16. Some large tools, like an adze, are sharpened by holding them in the vice and moving the flat oilstone over the bevel – they are simply too big to do it the usual way.

4.2.17. There is often a lot of discussion in online forums and suchlike about the best way to sharpen tools and the correct angles and so on. And it is true that different blades used for different purposes have optimum sharpening angles and sometimes a double bevel is better than the single bevel I have described. What is important however in practice is that the tool is sharp – concentrate on getting that sorted and the rest will tend to sort itself as you get more practice. Sharpen regularly – don't press on as the blade dulls – take the time out to sharpen – it will save time in the end.

4.2.18. Sharpening and setting handsaws is a subject of its own and beyond the scope of this document, though I do set and sharpen my own handsaws.

4.3. Planes.



4.3.1. Pictured here are the four planes that I use most.

4.3.2. The large one to the right is a jack plane. It is a Marples No. 5½ . About 380 x 73 (15" x 2⅞") and very heavy. The principal use for a jack plane is for planing straight edges on boards, or very long fair curves (say on the edge of a plank). If you have a surface planer, you can pretty much do without a jack plane for straightening the edges of boards. I do however use it quite a lot. I bought it when I was an apprentice boatbuilder in the early 1960’s.

4.3.3. The next plane in, is a smoothing plane, which again I have had since the early ’60’s. Mine is a Stanley No. 4. About 245mm x 60mm with a 50mm blade (9¾" x 2¼" with a 2" blade). This is really the most general purpose plane for both boatbuilding and general woodworking. Kept sharp it will plane and smooth with the grain and across it. With care you can plane the edges of reasonably long boards straight (the jack plane is better for this job however) and you can plane fair curved edges. If you only have a single plane, this is the one you need.

4.3.4. Next to the smoothing plane is a block plane; unlike the previous two planes, this is intended for single hand use. The one shown is a Record 9½. It is 155mm x 50mm with a 40mm blade (6¼" x 2" with a 1½" blade). This particular plane has an adjustable width mouth – the gap in the base where the blade sticks through . Adjustment is by moving the front part of the base backwards and forwards. This is useful as it enables you to set the coarseness or fineness of the cut that the plane will take. Ideal for shaping the edge of diagonal veneers for a cold-moulded hull, and similar jobs. Unlike larger planes, this type of plane cuts on the back of the blade.

4.3.5. Finally there is a shoulder plane. Unlike all the others, the blade is the full width of the base, so you can plane up against a shoulder or plane rebates. A true rebate plane has a fence attached so you can initiate rebates – this is just for cleaning out a rebate after making one over the surfacer, or with a router. This plane is a Record No. 311. With the long front end shown it is about 150mm x 28mm (6" x 1⅛"). The detachable front end, can be replaced with a very short front (about 12mm – ½" long), thus turning it into a bullnose plane – a bullnose plane can cut very close to the end of something. In fact you can use this plane with no front (then called a chisel plane) so you can cut right up to the end of something. It has quite a narrow mouth, so it will only take off fairly fine shavings. It will cut with the grain and across the grain – ideal for cleaning up a tenon for example. As with the block plane, it cuts on the back of the blade.

4.4. <u>Spokeshaves</u>.

4.4.1. A spokeshave has a handle each side and a blade in the middle. The base is very short (about 20mm - ¾") allowing you to plane curves. They are also great for cleaning off solid timber across the grain, or diagonally across the grain. The spokeshave pictured at the top is a Stanley No. 151, 55mm (2⅛") blade, and is very much the most used. As you can just see from the photo, mine has been repaired by brazing – I dropped in in 1963 from high up on stagings and it broke into three bits! Brazed up like that, it has been serving me well ever since – I actually had to buy a new blade for it recently; the original was completely sharpened away.

4.4.2. The middle spokeshave is simply a smaller version of the No. 151. It has a slightly narrower base and a 45mm (1¾") blade. The make is not marked – but it is a No. 64. It does very much the same job as the larger one, but allows planing into a tighter radius, which is really the only time I use it.

4.4.3. The bottom spokeshave is a Record A63, also with a 45mm (1¾") blade. The base of this spokeshave is curved (convex) so that you can plane very tight radii indeed. And for that job, it is incomparable.

4.5. <u>Chisels</u>.

4.5.1. There are basically two sorts of chisel: bevel-edge and firmer. Bevel-edge have, as the name suggests, a blade with bevels running along each edge. Firmer chisels are simply rectangular in profile with square edges. Firmer chisels are intended for heavier work than bevel-edge chisels, but do not make such a fine clean cut. For modern boatbuilding, bevel-edge chisels are the best general purpose type.

4.5.2. Mortice chisels are a specialized firmer chisel, thicker and narrower, and stronger, for chopping mortices and levering out the choppings.

4.5.3. Paring chisels are a specialized bevel-edge chisel, with a longer finer blade and are intended, as the name suggests, for fine paring by hand; you generally don't hit them with a mallet at all. They are not robust enough for general boatbuilding work.

4.5.4. The chisels shown are the ones I use all the time. With the exception of the 12mm (½") chisel they are all bevel-edge – I simply have never owned a 12mm (½") bevel-edge chisel for some reason. The sizes shown are 9mm (⅜"), 12mm (½"), 19mm (¾"), 25mm (1") and 32mm (1¼"). You can make do with just a 9mm (⅜") and a 19mm (¾") for pretty much everything, but the range I have shown is useful. You can see by the blade length, that the 19mm (¾") has had the most use.

4.5.5. As you can see, my chisels all have wooden handles and I use a large (old) wooden mallet with them. Modern chisels, specially those sold in sets, usually have composite handles, so you can hit them with a hammer. However I think you get better results using a good heavy mallet – maybe I am just old-fashioned!

4.5.6. It pays to buy a good quality chisel, because the blade will hold its edge much longer. Be a little wary of very cheap chisel sets. You can often find old chisels at car boot sales, flea markets, second-hand shops and so on. As long as there is a reasonable amount of blade left and the handle is not in too bad a state, these older chisels are often very good quality and will clean up well to give years of use.

4.5.7. Gouges are hollow (curved cross section) firmer chisels. Inside gouges have the sharpening bevel on the inside, concave side. Outside gouges have the sharpening bevel on the outside, convex side. Sizes generally range from 3mm (⅛") to 32mm (1¼"). They are occasionally useful in boatbuilding – the outside gouge more so than the inside gouge. So if you find one (say 19mm - ¾") going for a reasonable price, it will probably come in useful.

4.6. Hand Saws.

4.6.1. There are hand saws for every purpose, but they have been somewhat superseded by power saws (circular saw and jig saw). I still find that I use the three pictured quite a bit though.

4.6.2. Panel saw. The one in the middle. Small teeth for cross grain cutting – about 8 to 10 teeth per inch (TPI). It will rip saw (cut with the grain) but is not as efficient as a true rip saw (about 6 TPI), which has much larger teeth. If you have thick material more than about 120mm - 5¼") to cross cut, take a cut each side with the circular saw and then saw the remaining centre portion with the panel saw. And of course you can cut an item in situ, where a power saw would be both difficult and dangerous to use. Many modern panel saws are 'sharp-edge' – that is they have hardened sharp teeth, that cannot be resharpened – but while they are sharp they cut very well.

4.6.3. On the right is a small tenon saw. A dovetail saw is a bit smaller. A mitre saw is larger with a wider blade. A tenon saw may have about 10 TPI, while a dovetail saw will have 14-16 TPI. This type of saw has a brass (or steel) back running along the top which keeps the blade stiff and rigid. Originally for cutting tenons (or dovetails or mitres), these saws are useful for quite a lot of bench and on-the-job applications. On the bench, use in conjunction with a bench saddle – see 'Devices' below. As for a cross-cut saw, you can buy a general purpose hard-back saw with hardened sharp teeth. I haven't had a lot of luck with these – in a way they are 'too sharp' and can be difficult to get a starting cut with. I think that a Japanese hard-back saw would be a better bet – see below.

4.6.4. On the left is a pad saw (sometimes called a keyhole saw). I have a whole set of blades of differing lengths that can be slotted into the handle. The blades have fairly big teeth and don't produce a 'quality' cut necessarily, but they are really very useful where you can't get access for a jig saw, for example. More modern ones sometimes come with a straight round handle and some with a metal pistol grip handle can take metal-cutting blades as well as wood cutting blades.

4.6.5. One type of saw that I don't possess (and I do have a lot of saws!) is a Japanese pull saw. These saws cut on the pull stroke, unlike European saws which cut on the push stroke. Cutting on the pull stroke means the blade can be thinner, so the kerf (the width of the cut) is thinner and thus the work needed to make the cut is less. They come in all the types that European saws come in (crosscut, rip hard-back saw and keyhole saw). Often the rip and cross-cut teeth are on opposite edges of the one saw.

4.7. Squares.

4.7.1. In woodworking, and other trades, 'square' generally means 'at 90º' and a woodworking square is just that – enabling you to draw lines at 90º to the edge of a board, or check that two items are at 90º to each other. It is an indispensable item.

4.7.2. On the left of picture are three traditional carpenter's squares a 300mm (12"), 150mm (6") and 100mm (4").

4.7.3. You can test that a carpenter's square is truly square – draw a line square from a straight-edged piece of timber; then reverse the square and see it it still matches the drawn line. If it doesn't it needs adjusting – often a sharp blow at the tip of the metal part of the square will do it. Try not to drop your squares – this is usually how they get out of square.

4.7.4. Next in, is a combination square – the body slides along the length of the square and can measure either 90º or 45º.

4.7.5. The final two items are bevel gauges (sometimes called bevel squares). These allow you to measure an angle and transfer it to something else (another piece of timber, or to set a saw blade etc). The one on the left is very old and has a short brass blade at one and and a long brass blade at the other. The blades are stiff in the rosewood body, so stay set at the required angle. The one to the right is a modern bevel gauge with a thumb screw to tighten to hold it to the set angle.

4.7.6. At a minimum you should have one carpenter's square (preferably about 300mm – 12" size) and a bevel gauge.

4.7.7. One other square that is very useful is nothing to do with boatbuilding – it is the plasterboard T-square (or drywall T-square). These are usually 610mm - 24" across the top of the 'T' and 1220 – 48" down the length of the 'T' and are usually made of aluminium. They are very useful for setting out square lines on sheet material – plywood in our case.

4.8. Hammers.

4.8.1. The humble hammer rather tends to be taken for granted, but is a vital part of the tool kit. Hammers go by the type and weight of the head.

4.8.2. Pictured here are five useful hammers. The top one is a 110g (4oz) ball pein hammer. Used for clenching copper nails in a small boat and driving brass pins and very small nails generally.

4.8.3. Next down is a 225g (8oz) ball pein, which is a general purpose size for clenching copper nails and driving small nails. It is followed by a 225g (8oz) flat pein hammer, which some boatbuilders prefer over the ball pein for clenching copper nails.

4.8.4. One from the bottom is a 450g (16oz) claw hammer – perhaps the most ubiquitous hammer of all. A claw hammer for boatbuilding and general work is different from a framing hammer in the the claw is much more curved, for pulling nails rather than levering timber. A framing hammer is not really suitable for boatbuilding work.

4.8.5. Finally a 680g (24oz) ball pein hammer. Useful for 'holding on' to cut down on vibration while driving nails; also useful for adjusting items – a gentle tap with a heavy hammer is much more effective than lots of hard hits with a small one.

4.8.6. If I had to choose just three hammers it would be the 225g (8oz) ball pein, the 450g (16oz) claw hammer and the 680g (24oz) ball pein.

4.9. <u>Levels</u>.

4.9.1. A level (or spirit level) will tell you when something is level or vertical. The level is fitted with glass tubes, inscribed with two lines (usually about 12mm - ½" apart). when the bubble in the liquid in the tube is exactly in the middle between the lines, then it is level (or vertical, depending on which bubble you are looking at)

4.9.2. The yellow level at the top of the picture is 610mm (24") long and as well as vertical and horizontal bubbles, it has a 45º bubble – not that I have ever found that very useful!

4.9.3. To test a spirit level for accurate, set a length of timber level, using the spirit level. Then reverse the spirit level. If it still shows level, then the spirit level is accurate; if it doesn't, it isn't and is no use, because they are not usually adjustable in any way. Try not to drop your levels, and don't leave it on timber when you are hitting or nailing the timber as the vibration isn't good for it.

4.9.4. The little acrylic level shown below the yellow level is 90mm (3½") long and has a horizontal and vertical bubble. A small level can be very useful it tight spots where you can't get a bigger level in. Not to be used for general leveling work.

4.9.5. If possible you should add a 1220mm (48") level for setting up the building jig etc. on a larger boat (say over 4.5m - 15').

4.9.6. The final object in the photo is a plumb bob – a relatively heavy steel (or brass) cone-shaped 'bob' terminating in a sharp point. When hung from a thin line, the bob will settle down dead plumb below the point from where it is hung – you will need to restrict it's early gyrations with your hand to start with, else you will be there for a long time! You will find this simple instrument invaluable for setting up the building jig and similar tasks – any task in fact where you want to find out if one point is truly above another.

4.10. <u>An Assortment</u>.

4.10.1. At the top are a few punches (nail sets). If possible some rather longer than these save a few bruised hands. They range from 1.5mm ($^{1}/_{16}$") tip size to about 5mm ($^{3}/_{16}$") tip size. For setting nail heads just below the surface. Also useful for driving nails home in awkward places, to save mis-hitting and damaging the timber.

4.10.2. To the left is a marking gauge. The body slides along the bar and is tightened with a thumb screw. There is a sharp pin set towards the end of the bar, so when the gauge is drawn gently along a board, with the body firmly against the edge, the pin makes a fine parallel scratch mark on the surface of the board. These are used for marking off all sorts of parallel measurements. The one pictured also has a double pin set, the rear one of which can be adjusted by the thumb screw on the end of the bar. This gives a double scratch mark – for marking out tenons, grooves and so on. Older marking gauges are set with a wedge rather than a thumb screw – they are just as effective, if a little more difficult to get set accurately to the measurement you want.

4.10.3. Next in is a hand drill. These have been largely supplanted by electric drills of course for most purposes. But for very small drills that break easily a hand drill is still the better tool.

4.10.4. The brush in the middle is a 'jamb duster' – a 100mm paint brush will do much the same job. Ideal for brushing surfaces, ledges and corners when you don't always want to be dragging a vacuum cleaner hose.

4.10.5. Alongside the jamb duster is a bradawl. It has a slightly flattened end (like a tiny screwdriver) and will easily make a starting hole for a screw of nail with a twisting/pushing action. Often easier to start exactly in the right place than a drill, which can tend to spiral sideways until it gets a start.

4.10.6. Next is a pair of nippers (or pincers). About 200mm (8") long. A really useful tool for removing bent nails (and we all bend the odd nail!), staples and so forth. Usually better than a claw hammer.

4.10.7. On the right is a pair of side cutters or snips. Used specially in copper nail clenching to cut off the excess before clenching the nail end over the rove and useful generally for shortening nails and similar odd jobs.

4.10.8. As well as the assortment shown, you will need a decent set of screwdrivers because not all fastenings can be driven with the screw gun (see hand power tools). For the regular length screwdrivers, chose ones with a decent easy-to-grip handle, not a slippery plastic one. You will almost certainly need:

Phillips head Nos. 1, 2 and 3.
Flat blade for 3mm (6g), 4mm (8g) and 5mm (10g) slotted head screws
Phillips No. 2 dumpy (short – about 50mm - 2" long).
Flat blade dumpy for 4mm (8g) slotted head screws.

4.11. Clamps.

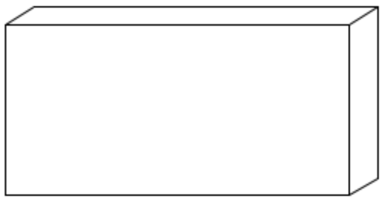
4.11.1. Often also called ‘cramps’. Indispensable for holding things temporarily, or while items are being bonded together. These come in many varieties, the most common being sliding clamps (shown) and G-clamps (shaped like the letter ‘G’). There are many other clamps available – traditional wooden ones with two screw bars; clamps based on a caulking gun motion; spring-clip type and many others.

4.11.2. The sliding types shown are the most useful for boatbuilding – and the more you can have the better!

4.11.3. There is another very versatile sliding clamp based on a length of ¾" (19mm) Nominal pipe (¾" - 19mm pipe is actually about 1" - 25mm outside diameter). With these you buy the two clamp ends and a length of pipe (usually 1200mm - 48") and then slide the clamp ends on it. The advantage of this type of clamp is that the because the ends are free to rotate on the pipe, they don't have to be in alignment so you can clamp more awkward arrangements. Also you can reverse the ends so that you can use the clamp to push as well as pull. Often useful for hauling things upright when setting up, or similar activities.

5. **Devices** – a few simple tools and devices that you can utilize or make yourself.

5.1. Dummy Stick.



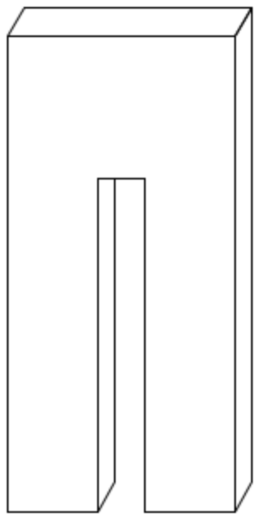
5.1.1. This simple little object is used to transfer shapes from one object to another. Say you are wanting to transfer the curve of the hull to something. Rest a length of spare ply against the hull and then place the ‘dummy’ flat on the ply with one edge on the hull and mark with a pencil on the other edge of the dummy. Continue drawing the dummy down the hull and marking on the ply on the other edge of the dummy. You have effectively transferred the shape of the hull to the ply, albeit the width of the dummy in. Now set the ply on the item you wish to make and ‘dummy out’ again to get the actual shape marked on the item to be made.

5.1.2. A typical dummy would be, say, 50mm x 25mm x 5mm (2" x 1" x nice") and it is worth making a nice one to carry in your pocket – but they can be any size you want for the job in hand.

5.1.3. Suppose you have roughly fitted an item to, say, the hull, and that the widest gap between it and the hull is 15mm (⅝"), then make yourself a 15mm (⅝") dummy and use that to dummy directly on to the item, for a final fit.

5.2. <u>Clamping Pieces</u>.

5.2.1. When building lapstrake, you can use home-made clamps to help clamp the plank laps between fastenings into the frames.



5.2.2. The one illustrated is made from 18mm (¾') ply and it is 250mm x 120mm (10" x 5") with a 25mm (1") x 175mm (7") slot in it. Slide it over the lap and drive a shallow wedge between the outer plank and the slot.

5.2.3. Be careful not to get epoxy on the clamp as it will be stuck to the planking. You can cover the edges of the slot with shiny brown parcel tape to prevent this happening.

5.3. <u>Spanish Windlass</u>.

5.3.1. Another 'clamping' mechanism that is often useful is the Spanish Windlass. This is made from a length of rope or strong tape tied in a loop around the two objects to be pulled together.

5.3.2. A bar of timber, or a length of steel pipe, or a strong screwdriver, is inserted through the loop, roughly in the middle and rotated, twisting the loop and thus pulling the objects together. When it is wound tight enough, the end of the winding bar is secured so that it can't unwind. Provided the rope or tape is strong enough, a spanish windlass can exert substantial force.

5.3.3. You usually need to protect the edges of the objects being pulled together so the rope or tape doesn't bite into them.

5.4. <u>Tie-Down Straps</u>.

5.4.1. Straps of various sorts can be used to secure items together. Ratchet tie-down straps are a favourite. They are wide and relatively soft, so they don't damage things easily and they have a simple ratchet windlass lever action to tighten and secure them.

5.4.2. They can be very useful when strip-planking in cold-moulded construction – both to pull very curved strips down to shape and to secure the strips firmly against the frames while fastening to the frames and while the epoxy is going off.

5.4.3. You can use tie-down straps in a similar way in ply lapstrake construction.

5.4.4. You can also haul things upright with them – say when making a building jig; and even lift fairly light objects into place with them. They can be very useful when working alone in situations where you really need a helper to hold something in place while you position it accurately.

5.5. Weights.

5.5.1. Weights of all sorts can be used to press items together while glue is going off.

5.5.2. And other sorts of 'weight' can be used – for example an hydraulic jack under a heavy item (like an automobile) can be used to push a set of laminations down into a concave jig.

5.6. Wedges and Levers.

5.6.1. Don't neglect the usefulness of both wedges and levers for manoeuvring items into place and holding them there while you fasten them or while glue goes off. We have already discussed one use with the ply clamping piece (see earlier).

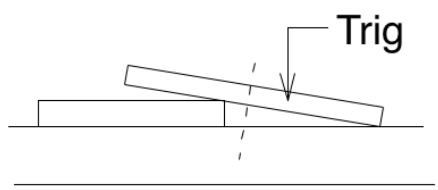
5.6.2. Wedges for this sort of purpose generally need to be quite shallow (5º to 10º).

5.6.3. A pair of wedges driven in opposite directions, one on top of the other is called a 'folding wedge' and this exerts a more even pressure than a single wedge and can be very effective.

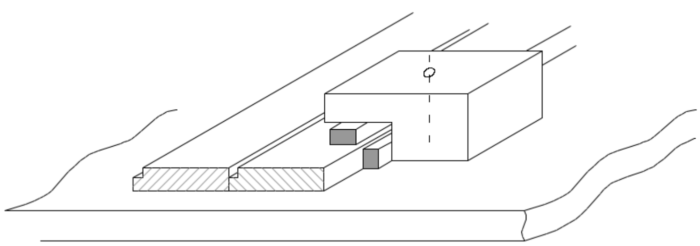
5.7. Trigs.

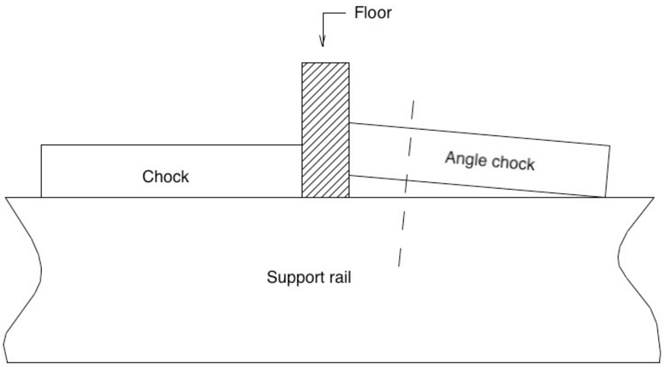
5.7.1. A trig is basically a short length of timber that is used to hold things down.

5.7.2. Quite often it can be just a simple short length of timber with a fastening clear of the item being held down like the sketch opposite. In this example perhaps you would have a series of trigs, staggered on opposite sides of the item being held down.



5.7.3. Or it can be a more complicated L-shaped trig like this one, which in conjunction with wedges is both holding a deck plank down and forcing it sideways against the previous plank





5.7.4. Another example is the angled chock shown opposite, which is pushing the floor up against a chock, so that it is held tight in the correct position. This example is from setting up floors and frames in the building jig on Design 155. You could do much the same job with a flat chock and a pair of folding wedges, but in this case the angled chock is perhaps more secure agains the vibrations of building the boat.

5.8. <u>Bench Saddle</u>.

5.8.1. This simple home-made device is for use when cross-cutting small items with a tenon saw of even a panel saw.

5.8.2. It has another timber cleat on the underside (like the one visible on the top), which hooks over the edge of the bench.

5.8.3. This one is about 250mm (10") long and 150mm (6") wide and is made from 25mm (1") timber with 25mm x 25mm (1" x 1") cleats.

5.8.4. The timber to be cut is held against the top cleat and the cut is made across the timber close to the end of the cleat – you can see all the saw marks in the one in the photo.

5.8.5. More sophisticated versions can be made with a 45º cut through the cleat (in which case it needs to be glued to the base), for making mitre cuts – like a simple version of the mitre-box.

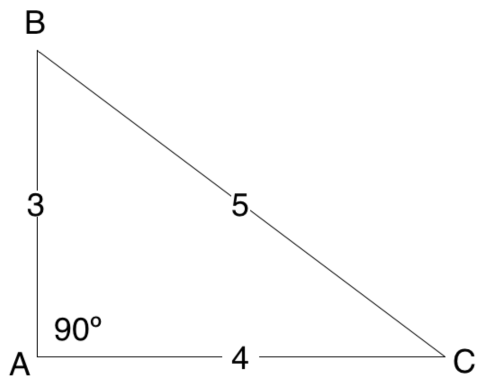
5.8.6. As well as bench work, the saddle is very useful for working on the job. You can hook it over the sheer edge of an open hull, or over the top of a floor and make a cut in a piece of timber without clambering back down to the bench. It just stabilizes the timber to be cut enough to make a decent cut.

5.9. <u>Checking for Square</u>

5.9.1. The squares mentioned above, plus the drywall T-square will check most of the components in yacht construction and their assembly for square (90º).

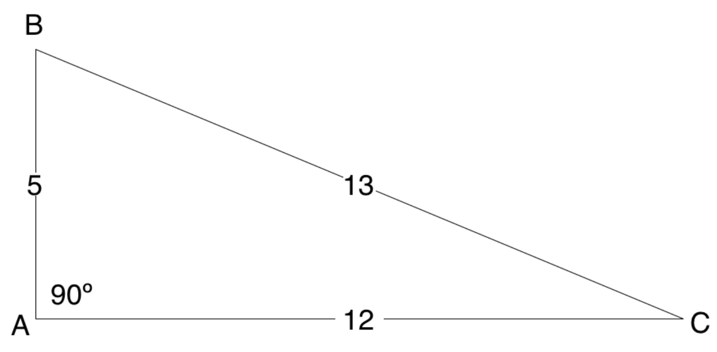
5.9.2. But there is sometimes the need to check that two large or long items are square to each other – like the base of the building jig for example – where these squares are simply not big enough. Under these circumstances we resort to the Right Angled Triangle method of checking for square. The most common of these is the 3:4:5 triangle.

5.9.3. A triangle ABC whose sides are in the ratio 3:4:5 as shown below will contain a right angle between the sides AB and AC, and we can use this fact to check for square.



5.9.4. To check two items are square to one another, measure a multiple of 3 (e.g. 3000mm) along one (AB in our triangle) and mark it off. Measure and mark the same multiple of 4 (so, 4000mm) along the second (AC in our triangle). Then measure from the first mark to the second mark (BC in our triangle). If BC is the same multiple of 5 (5000mm in this example) then the two items are at 90º to each other. If it isn't – then they are not!

5.9.5. There are other common right-angled triangles, but they all have larger numbers – the next ratio up is the 5:12:13 triangle, which can be useful on long thin items (perhaps the building jig), but the maths is a little harder to do in your head.



5.10. <u>Straight Edges & Battens</u>

5.10.1. A level can be used as a straight edge for short lines and distances. But for longer distances we need a straight edge.

5.10.2. A useful length is 2000mm to 2500mm (say, 6' - 8'). Make this from good quality 25 x 150 (1" x 6") softwood, planed and straightened. Try to make it so that it is truly a parallel width – so that you can sit the straight edge on two points and use a level on the other edge.

5.10.3. Check the straight edge from time to time to make sure it has stayed straight

5.10.4. You will also need a variety of battens. make these from clean softwood (preferably pine or fir) with straight grain, no knots and with vertical end grain.

5.10.5. A long one about 5000 x 50 x 15 for marking the waterline and fairing long items

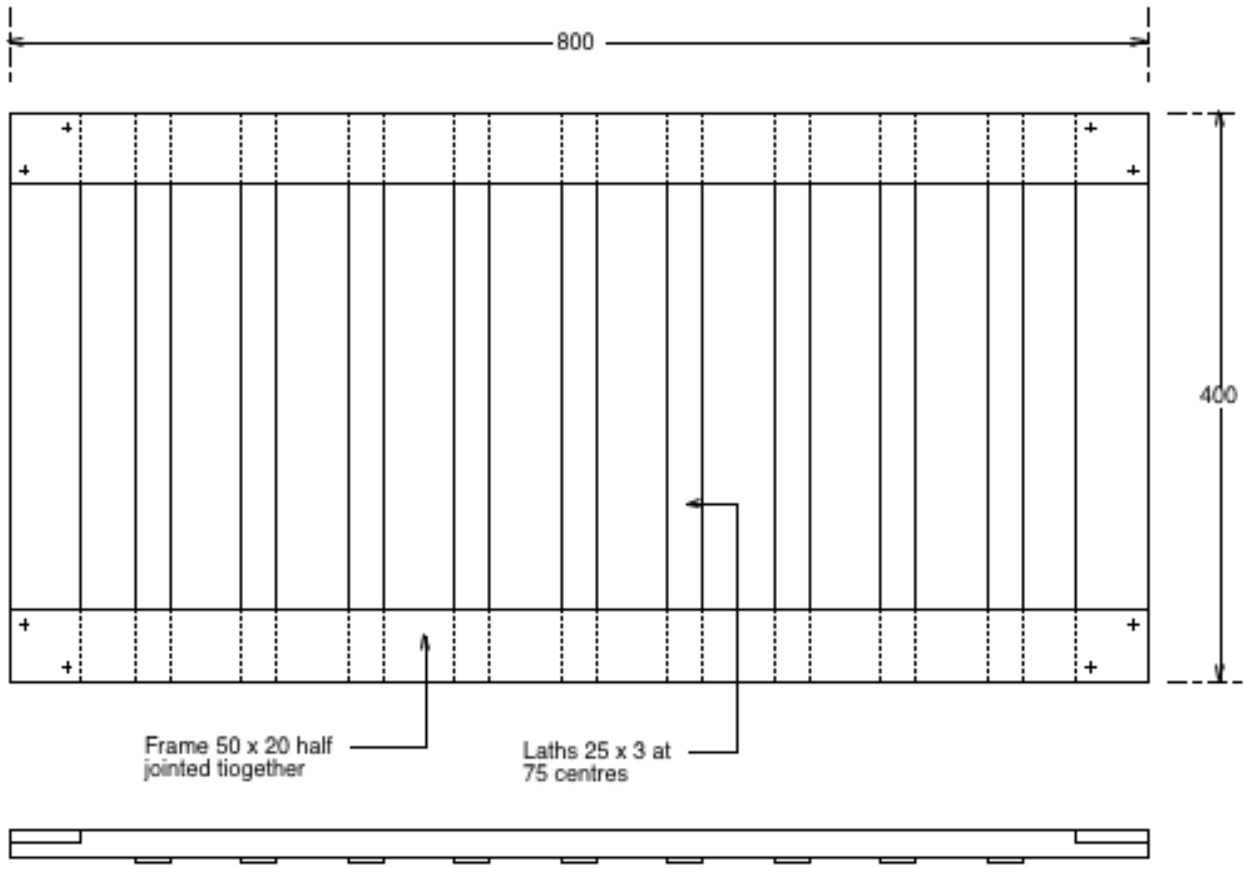
5.10.6. A couple of shorter ones, say, 2000 x 10 x 5 and 2500 x 15 x 8 for fairing frames and similar items

5.10.7. And a very small one, say, 1200 x 8 x 3 for fairing tight curves.

5.10.8. Various other materials are also good for small battens for tight curves. For example, 3mm acrylic (Perspex) makes a good batten, as does 3mm Tufnol. In fact anything springy, that will return to its original shape when let go, should make a decent batten.

5.11. <u>Taking-Off Frame</u>

5.11.1. A traditional device for taking curved lines off the loft floor and transferring them to a piece of timber or plywood.



5.11.2. The sketch above illustrates a typical frame. The size is shown as 800mm x 400mm (say 32" x 16"), which is convenient for small boats. It has an outer frame made from 50mm x 20mm (2" x ¾") softwood half jointed together and glued up so that it stays firm and doesn't rack out of shape. 25mm x 3mm (1" x ⅛") laths are glued and pinned to the underside at about 75mm (3") centres. The whole device is painted white, with water-based paint.

5.11.3. To use, lay the frame on the loft floor or setting-out floor over the line or lines to be transferred. Mark on the laths where the line(s) cross the laths.

5.11.4. Now take the frame and lay it on top of your timber. Move it about to the orientation and position you want (with reference to grain direction, economy of use etc.). Transfer the marks on the laths to the surface of the timber. Join the marks with a batten in the usual way.

5.11.5. The frame (perhaps a longer version than this) was often used when marking out the futtocks of sawn frames, to transfer the hull shape to the timber. Nowadays it is still useful for transferring curved lines and shapes off the setting-out floor for items like intermediate floors, ply panels and so on.

5.12. <u>Scarphing Ply</u>

5.12.1. There's always a lot of discussion about the best way to make a scarph in relatively thin material like ply, where you can't do a lot of cleaning up afterwards.

5.12.2. The WEST™ scarpher which fits on to a standard 185mm (7¼") blade circular saw,cuts accurate scarphs in ply up to 9mm (⅜") in one operation.

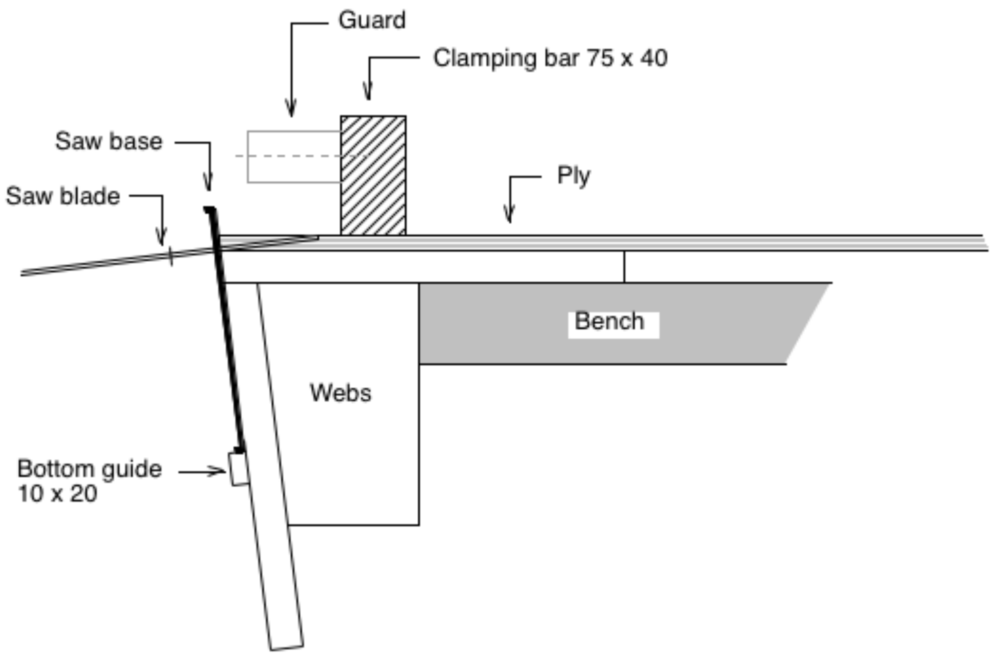
5.12.3. It's surprisingly easy to plane a scarph by hand, specially for items like planking, where the scarph isn't very wide. Mark the scarph out at 8:1 – so on 9mm material the length of the scarph will be 8 * 9 = 72mm. For ease of measuring you can make this 75mm, as long as you do this on both pieces. Use a smoothing plane, with the blade very sharp and set fine. Cut at about 60º across the scarph, leaving the mark at 75mm just showing and the end just off to a feather edge. Test for flat – slightly hollow is OK – slightly rounded (convex) isn't.

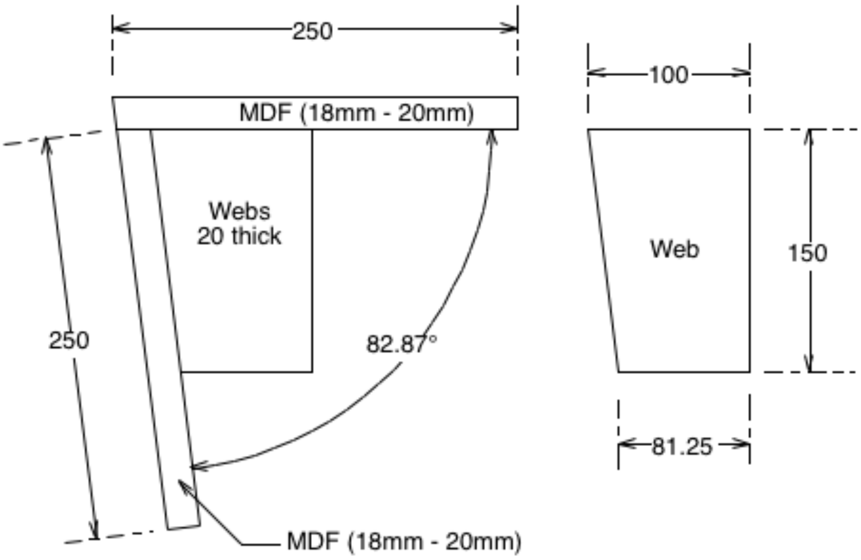
5.12.4. Here's a simple scarphing jig you can make up to use a standard 185mm (7¼") blade circular saw. It will cut scarphs in ply up to 9mm (with a tiny bit of cleaning up left to do at the surface furthest from the saw).

5.12.5. If you make the scarpher about 800mm (32") long you will be able to cut scarphs in ply half a sheet wide (610mm – 24"). The basics are two lengths of 20mm (¾") MDF, 250mm (10") wide. Make up five webs as shown; space these about 150mm apart, starting 50mm in from the ends. Glue and screw the whole thing together. The dimensions given for the webs will be such as to cut an 8:1 scarph (angle = 7.13º)

5.12.6. Rest your circular saw on the jig with the blade on the top piece of MDF and mark the bottom side of the base. Make a guide as shown, glued and screwed to the face of the jig – make sure this is accurate and parallel to the top corner.

5.12.7. In operation, the scarpher jig is fixed firmly to the end of the bench (best screwed). The ply to be scarphed is laid on the bench and clamped in place with a strong straight clamping bar. The edge of the ply should be flush with the edge of the jig (just touching the saw base in fact). The clamping bar is positioned just clear of the blade. If you wish you can fix a guard to the face of the clamping bar





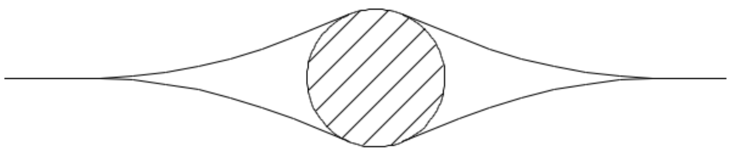
5.12.8. In operation, keep the saw pressed very firmly on the face of the jig with the edge of the base running on the bottom guide. Start clear of the ply and slide the saw slowly and smoothly into the cut. Try to cut in one continuous smooth movement. You may need to help the saw blade guard move back as you start the cut, else it may jam.

5.12.9. The jig, as shown, will give an exact 8:1 scarph. But 81.25mm is pretty hard to measure and mark and be sure of it's accuracy. If you made the bottom of the web 82mm, the scarph would be 8.33:1, which is absolutely fine. If you made it 81, the scarph would be 7.89:1, which is also OK.

5.13. <u>Fastenings – Nails</u>

5.13.1. We don't use nails so much in the building of modern wood-epoxy boats, but in case you do need to do so here are some points to consider.

5.13.2. Nails get a better hold if they have a pilot hole drilled first. The reason for this is that, if they are simply driven into the timber, they split the fibres and so only get a minimal grip on each side as sketch below. We all know about this if a nail is driven too near the end of a piece of timber – it splits it.



5.13.3. If you drill a pilot hole, the nail doesn't split the fibres, rather it compresses them slightly all around it and gets a much superior hold. A suitable pilot hole size is ⅘ths the diameter of the nail.

5.13.4. An old carpenter's trick is to burr over the end of a nail before driving it – this punches a hole in the timber rather than splitting the fibres and achieves much the same effect.

5.13.5. When using a ring-shank nail, the pilot hole can be rather smaller than ⅘ths the diameter of the nail.

5.14. <u>Fastenings – Screws</u>

5.14.1. We use screw fastenings, mainly to hold things together while the WEST™ is going off. These screws can be temporary and removed once the WEST™ has cured; or they can be left in permanently. We mostly leave them in permanently.

5.14.2. When screwing two pieces of timber together we usually want to pull the first piece tightly down on to the second. For this to happen, the screw mustn't get much bite in the first piece, as this will prevent the two pieces of timber pulling really tightly together.

5.14.3. To overcome this we drill a hole in the first piece at just about the shank diameter of the screw, with, if necessary a smaller pilot hole in the second piece. This lets the screw cut a good thread in the second piece while pulling smoothly through the first.

5.14.4. Traditional wood screws have a section of plain shank under the head, which is designed to facilitate this, because the non-threaded part doesn't get a grip. With this type of screw, shank and pilot hole sizes are as follows:

Screw size	Hole for shank	Pilot Hardwood	Pilot Softwood	Counterbore for head
3.0mm (4g)	3.0mm (⅛")	1.5mm (1/16")	1.0mm (3/64")	6mm (¼")
3.5mm (6g)	3.5mm (9/64")	2.0mm (5/64")	1.5mm (1/16")	8mm (5/16")
4.0mm (8g)	4.0mm (11/64")	2.5mm (3/32")	2.0mm (5/64")	9mm (⅜")
5.0mm (10g)	5.0mm (13/64")	2.7mm (7/64")	2.5mm (3/32")	10mm (13/32")
6.0mm (12g)	6.0mm (15/64")	3.0mm (⅛")	2.7mm (7/64")	12mm (15/32")

5.14.5. The counterbore sizes given are to make a countersink so the screw head sits just below the surface. If you are intending to plug the counterbores, then the counterbore sizes may vary slightly from those given above, to suit the plug cutter.

5.14.6. A lot of general purpose screws nowadays and also sheet metal screws have thread all the way up – you may need to experiment to get the correct hole size in the first piece of timber so that the threaded part doesn't get much of a grip.

5.14.7. If the plain shank of a wood screw penetrates through to the second piece of timber, you will need to extend the shank pilot hole into the second pieces of timber or else the screw may tend to break.

5.14.8. When using brass screws into very hard woods, a dab of grease on the thread will help stop the screw breaking. In fact a dab of grease on the thread of any screw driven into hardwood will make driving easier. But you do need to ensure that any grease doesn't get onto the bonding surfaces as this will adversely affect the epoxy bond – so this technique is best left for unbonded or non-critical items (like much of the interior furniture for example).

5.15. <u>Fastenings – Staples</u>

5.15.1. Mostly staples are only uses to pull down the hull skin veneers. These can be temporary or permanent.

5.15.2. Most often, the staples are left in on the inner veneer and removed on the outer veneer.

5.15.3. For staples that are to be removed it is better to staple through a tape that is wider than the crown of the staple – then when it comes to pulling them out, if you are reasonably careful, both legs of the staple can be removed in one go.

5.15.4. Stapling over twine (to remove the staples later) isn't so successful. It tends to leave a little dent in the veneer where the twine passes under the crown of the staple; and most often when you pull the twine only one leg of the staples comes out, leaving you with the tedious task of pulling out the other legs one by one.

5.16. Fastenings – Materials

5.16.1. For temporary nails, screws and staples you can use ordinary steel. Be very sure to remove them, especially the ends of staples, which have a habit of breaking off.

5.16.2. For permanent nails and screws use stainless steel, brass or bronze. For permanent staples use nylon or stainless steel.

5.16.3. Brass is better not used underwater unless it is WEST™ filled over, or plugged. Brass screws also break easily when power driven. Bronze is excellent in every respect, except that it is generally expensive and not usually available in smaller sizes

5.16.4. Stainless steel also has corrosion problems underwater, so is best WEST™ filled over or plugged. Even so, stainless is probably the best choice for permanent fastenings as it is strong, relatively inexpensive, easily obtainable and available with a pozidrive or philips head, so can be power driven.

That's it for the moment!