SECTION 20 - LAPSTRAKE PLANKING

Lapstrake planking is an alternative to the standard Cold Moulded Wood-Epoxy Skin (see §21).

The good thing about planking is that once you have mastered the first plank, you know that you can complete the remainder - because neither the principle nor the procedure varies much.

20.1 Marking out

20.1.1 There are thirteen planks each side of the boat and they are all going to show equal width at any one position. The first plank (abutting the keel) is known as the "garboard" and the final plank is known as the "sheer strake" - strake is another word for plank. The actual widths of the planks will be the width they show plus the lap - apart from the sheer strake, which will be the actual width (because there is no further plank to lap on top of it).

20.1.2 The first thing to do is to establish the distance around the perimeter of each frame from the keel to the sheer. This is known as the "half-girth". The plank width at each frame will then be 1/13th of the half girth + the lap; the sheer strake will just be the plain 1/13th girth. In theory half-girths are as follows:

Frame 000	1315
Frame –850	1732
Frame –1700	2012
Frame –2300	2178
Frame –2850	2305
Frame –3700	2425
Frame –4450	2424
Frame –5400	2266
Frame –6225	1990
Frame –7050	1621

Note that these figures are all given on the aft faces of the frames.

20.1.3 This would give apparent plank widths at 1/13th of the above figures:

Frame 000	101
Frame –850	133
Frame –1700	155
Frame –2300	168
Frame –2850	177
Frame –3700	187
Frame –4450	186
Frame –5400	174
Frame –6225	153
Frame –7050	125

To these apparent widths, for all the planks apart from the sheer strake, we must add the lap to arrive at the actual plank widths. The lap is usually 3 times the plank thickness - so (rounding up) we shall use a lap of 40mm.

20.1.4 In practice you may find it easier to measure around the mid-line of the frame edges, rather than exactly on the aft face. And the actual girths of your frames may be a little different from the figures given. So decide on exactly where you are going to measure (aft face, middle, or fwd face) and then measure with a tape around each frame from the centreline to the sheer and write out your own table of half-girths, apparent plank widths and actual plank widths (actual width = apparent width + 40mm) for each frame position. Do this on both sides of the boat in case there is any difference from side to side. If there is a difference (of more than the odd millimetre)

get rid of this in the first few planks, so by the time you reach the waterline the planks are the same on both sides. Measure around the transom and obtain actual and apparent widths in the same way

20.1.5 Now mark the top edges (the edges nearest the sheer) of all the planks on the edge of each frame and the transom. The top edge of the garboard will be the actual plank width away from the centreline - the top edges of all the rest will be the apparent plank width from each other, because they will lap back down on to the previous plank to give the actual width.

20.1.6 You will now need a batten to fair the planks in to the stem. The batten should be long enough to stretch over at least three or four frames - something about 3000mm would be fine. Clean softwood is the best, though a bit of clean hardwood will do. The cross section should be about 20 x 12 (size not critical).

20.1.7 The batten is tacked on to the frames so that one edge is on the lines for the top edge of a plank, in such a way that the batten reaches the stem faying surface and extends at least to the stem face. Hold the batten so that it lays on the stem faying surface and is taking up a fair line with the top-of-plank marks on the frames. Mark this line on the stem faying surface.

20.1.8 The top edge of the garboard is already on the stem at Frame 000, so will only need extending fair to the stem face. Next mark the top-of-plank line for plank No. 12 (the one before the sheer strake) on the stem faying surface fair through to the stem face. Measure up the angle of the stem (either on the fwd or aft faces) the distance between the top of garboard and the top of No. 12 and divide the answer by eleven - mark off these distances, which should be roughly the top edges of plank Nos. 2 - 11.

20.1.9 Check each plank top edge (tacking the batten on to the frame edge lines through to the stem faying surface lines) to see if the marks on the faying surface of the stem do in fact run fair with the top edges of the planks previously marked on the frames. You may need to make a few minor adjustments to obtain a nice fair run.

20.1.10 The actual position of the plank tops is not in itself vital - we are aiming for planks that run fair to the eye and are of fairly equal apparent width.

20.1.11 You will now have the top edges of all the planks marked out on all the frames, the stem and the transom. From time to time during the planking, you may find that the planks themselves depart a little from the marks - because of faulty taking-off of the plank shape, or just the general cussedness of timber. This does not matter too much - but when (if) it occurs, then you will need to re-establish the plank widths for the remaining planks (by measuring the remaining half-girths etc. etc.).

20.1.12 If you have difficulty bending the planks round the boat in the sections that follow, remember to try a hot air gun on the plank to improve its plasticity.

20.2 Garboard

20.2.1 The next task is to establish the shape of the garboard to be cut out of the flat

ply sheet, so that when it is laid around the boat it is the correct shape and fits to the centreline on one edge and the top-of-plank marks on the other. The garboards are in fact the most difficult planks as they have to fit to each other along the centreline - all the remaining planks just have to lap over each other and look fair.

20.2.2 The method we will adopt for this (one of many variants) is to use a pattern batten which is flexible enough to bend around the hull, but wide enough not to bend on edge. Four lengths of 12mm ply, about 200mm wide, scarphed or butted together would do this job nicely (support the butts with a butt strap about 400 long).

20.2.3 The pattern batten does not have to be a straight edge - the important thing is that it does not bend on edge. There is sometimes an advantage in having the pattern batten in a slight banana shape as this. reduces the distance to measure from the edge of the batten to the plank line and thus reduces the inaccuracies. It's worth just cramping the sections together first and trying them up on the boat to see whether curved (it is not really curved but rather four straight sections set slightly out of straight with each other) or straight best follows the top-of-garboard lines on the frames, transom & stem. You can always alter the batten later on to give a more favourable shape for later planks.

20.2.4 Lay the pattern batten on the boat, up near the centreline - so that its edge is as near the centreline as it will go without bending the batten on edge. This is most important - don't try to spring it on edge, just let it lay naturally around the hull - we are relying on the batten being essentially the same shape when laid flat as it is when curved around the hull. Tack the batten in place so that it lays nicely on each frame.

20.2.5 Tick off the accurate position of each frame (choose one edge) on to the batten. Now at regular intervals along the batten (say every 200mm) make a mark and measure from the edge of the batten to the centreline - note the measurement down on the batten by the mark - try to measure square off. Towards the stem (for the garboard particularly) you may need to make the measuring points a bit closer together. You can't mark off the end lengths (transom & stem) accurately because the batten is not in the same place as the plank will be. So take sufficient measurements at the ends to establish where the ends will actually be and enable you to cut the plank out (a bit long for now - the plank end will be cut off flush with the stem & transom faces once it is bonded in place). Also mark the stem face and transom angles on to the pattern. Remove the batten from the boat.

20.2.6 The garboard is made from four lengths scarphed together - three full sheet lengths and a shorter length on the end. On the garboard, start the full lengths from fwd, so the short length is at the end aft. The planking scarphs should be arranged so that they don't all come above one another. So, on plank No. 2 start the full lengths from aft so that the short length is fwd. Later planks will need four full lengths (and may need four full lengths plus a fifth shorter length) , so on alternate planks of four full length planks break down one of the full lengths into half-lengths to give a short plank length both fwd and aft. On planks that need a fifth short length, alternate the short length fwd and aft.

20.2.7 There is no need to arrange the scarphs to come over frames, or at any point in particular as a properly made and bonded scarph is as strong as the rest of the ply. In fact, a properly supported butt is also structurally perfectly satisfactory, but rather discounted nowadays as being unacceptable. If you butt the plank joins, then the butt strap should be at least 175mm long with the ends bevelled off so as to produce a gradual change of section. The butt strap will be the apparent plank width as you can't fit a butt where the planks are lapped - the previous plank supports the butt very adequately. The following instructions are written assuming that you will scarph the planks, but are generally equally applicable for butted plank joins.

20.2.8 The instructions that follow are written assuming that you are going to scarph the plank lengths up on the boat. An alternative to scarphing the planks up on the job like this is to scarph up 5 sheets of ply to start with and mark and cut each plank out full length in one go. This is considerably more wasteful of material, but the scarphs are easier to fit and glue up as this can all be done on the floor. If it is too much to scarph complete sheets, then you can halve them lengthways and scarph up the half sheets (this can be even more wasteful of material). Although either of these methods makes the scarphing easier, handling and fitting the planks is considerably more difficult however, unless you have help. The only problem with fitting scarphs on the job is if the scarph comes in an area of considerable twist. This happens particularly on the first few planks at the fwd end where the upright stem causes the transition from a relatively horizontal plank to a relatively vertical plank to happen in a short distance. Adjusting the scarph position can usually help to relieve the problem.

20.2.9 Turning back to the garboard now, lay four sheets of ply on the floor and lay the pattern batten on top. The scarphs will be 120mm long, so they will reduce the lengths of the sheets by this amount (plus a bit for fitting etc.) We will start by making the fwd section of garboard. So be sure that the is sufficient ply at the fwd end and a bit to spare. Also be sure there is enough ply to allow for the plank to "grow" because of the centreline edge bevel (see ¶20.2.11 to ¶20.2.14) Transfer the frame positions from the pattern to the ply. Also transfer the measuring ticks (at 200mm or less spacings, whatever you chose) and measure up from the edge of the batten on to the ply the measurements noted by each position tick. At the fwd end, using the measurements you took establish where the approximate fwd end of the plank will be and mark the stem face angle on to the ply.

20.2.10 Remove the pattern from the ply. Join all the measurement ticks with a fairing batten - they should run fair but some may be a bit out - so run the line fair, on as good an average as you can. This line should be the centreline, when the plank is bent around the hull.

20.2.11 Refer to your table of actual plank widths (apparent + 40mm) at each frame position. Mark off the actual width, measuring down from the line of the centreline drawn in ¶20.2.10. Do the same at the stem, measuring the width along the stem angle. Join these points with a batten - again make it an average fair line. This line should be the top-of-garboard line that is marked on the frame edges.

20.2.11 This is one instance where we are not going to cut accurately to the line everywhere partly because the centreline edges of the garboard have got to "grow" by the amount of edge bevel required to allow the edges to mitre butt together down the centreline. Also, until you have established how accurately your are taking off the plank shapes, it is as well to leave a bit extra for fitting.

20.2.12 The centreline edge bevel can be established very easily. Take two pieces of 12mm ply (say 100 x 50) with nice square edges, and tack these on the backbone so that they touch on the centreline. Take two short length of thin timber (say 20 x 5) and stand these on the ply, crossing each other over the centreline. Mark where they cross on the centreline and mark where the edges of the ply are. The distance from the ply edge mark to the centreline mark is the amount of bevel to go on.

20.2.13 Establish the centreline bevel at regular places (say at each frame and, up fwd particularly, at regular intervals between).

20.2.14 Returning now to the fwd section of garboard marked out, mark the additional amount required along the centreline edge for the bevel and join these marks up in a fair line.

20.2.15 The centreline + bevel edge of the plank can be cut accurately to the line drawn. But allow say 20mm on the line drawn for the other (the top) edge to allow for fitting the plank. You will soon pick up how accurately you are taking off the plank shapes and be able to reduce this allowance as you proceed to the later planks. So cut the plank out.

20.2.16 As this is the first plank, before bevelling the centreline edge, it would be best to try the plank in place to see how good a shape it is. Lay the plank on the boat so that the frame marks on the plank are over the appropriate frame edges and adjust it so that the centreline edge overhangs the backbone centreline by the amounts of the centreline bevel. Not all the bevel amounts may be achievable exactly, but adjust the plank to give the best fit so that all are available as a minimum. Cramp the plank firmly in place.

20.2.17 With the plank in place like this, none of the top-of-garboard marks should be visible (because of the extra 15mm we allowed). Have a final check to see that the plank achieves sufficiency everywhere. Then mark along the backbone centreline accurately along underside of the plank. Mark any other changes (like perhaps the frame positions which may have changed slightly on the plank as you adjusted it for best fit)

20.2.18 Remove the plank from the boat. Add the centreline bevels on to the backbone centreline marked on the underside of the plank and join in a fair line. Plane the centreline edge off to this line and then bevel back to the backbone centreline. In fact, it is not vital that the garboard plank centreline edge bevels are a perfect fit as we can use the gap-filling properties of WEST here to advantage.

20.2.19 Fit the plank up again with the centreline edge accurately over the backbone centreline and frame lines over the appropriate frame edges. Tick off the top edge of the plank on to the frames. Remove the plank. Take a note of the measurement on each frame

between the top-of-garboard lines and the ticked-off lines giving the existing plank edge. Mark these dimensions back on the plank and join to a fair line. Cut the top edge of the plank to this new line and plane fair.

20.2.20 Mark the scarph at the aft end and cut the scarph (scarph length 10 times plank thickness). With the WEST™ scarpher this should be a one cut operation and the face of the scarph should not need cleaning up. Choose the scarph line across the plank to be as near possible at 90° to the plank edges at that point or else your scarphs won't fit very well.

20.2.21 You're now ready to fit the plank permanently. However before doing this, turn it over and mark its mirror image on the ply for the plank the other side - its very irritating indeed to forget to do this and have to go through the whole process again unnecessarily.

20.2.22 The plank is bonded to each frame, the backbone and stem. Fit the plank up (yet again) dry and bore off for the fastenings - also just check that the top edge of your plank is about on the top-of-plank marks on the frames. Use 1" x 6g or 1 1/4" x 6g screws into the backbone and stem driven at about 150mm spacings staggered about 25mm in from the centreline edge and 50mm in from the top edge (no nearer or else the screws will be a nuisance when planing off the lap bevel for the next plank). Drill off for the screws with a Stanley "screwsink". If you are going to dowel over the screws (only necessary really above the waterline if clear finished) then countersink absolute max. 4mm. If you are not going to dowel, then don't bore the countersink very deep - just about 1mm (the screws will pull just below the surface and can be filled over with WEST/#407) If you don't countersink at all, the screws will pull a dent in the surface of the ply which will be very difficult to fill nicely because it will have no very definite boundaries.

20.2.24 Once the WEST has cured, the fwd end can be cleaned off flush with the stem face.

20.2.25 You can now make, fit and bond the forward section of the garboard plank on the other side of the boat in the same way, except that you will have already marked an accurate shape out on the ply, using the first side as a pattern. So only the bevelling and the final fitting will be necessary. If there is any amount of gap (say more than 1mm or so) where the garboards meet along the centreline you will need to use a stiffer WEST mixture that is used for general bonding. In fact WEST/#406 Colloidal Silica would be better than WEST/#403 for this joint, mixed to peanut butter consistency so that it stays in place better. Wet the bonding edges out as usual (two wettings are always a good idea on ply edges). Then butter the first (already fixed) plank edge with the WEST/#406. Then bond and fix the second plank as usual. You can trowel more WEST/#406 into any voids in the centreline join. You can use masking tape to make a "dam" if the WEST/#406 tends to run out the ends.

20.2.26 The fwd mid sections of both garboard planks are fitted in the same way as the forward sections, but with a scarph on both ends. Mark the plank out from the pattern batten, leaving about 150mm on the fwd end for the scarph. Cut the plank out to shape and leave the ends square (i.e. no scarph). Offer

the plank up to the boat, letting the fwd end lap over the plank section already fitted by the 150mm. Adjust the plank to fit as you did for the fwd section but don't mark for the centreline bevel yet. Mark off the aft end of the fwd scarph on the inside of the plank. Remove the plank and mark off the length of the scarph, parallel to the line marked for the aft end. Cut the scarph. Offer the plank up again and check for the fit of the scarph. Adjust as necessary so the scarph fits well. Hopefully this will not alter the fit of the plank generally, but if it does you will have to keep on making adjustments until you are satisfied with the fit of the scarph and the plank generally. Mark the backbone centreline and also mark of the centrecase slot; remove the plank, bevel the centreline edge and cut the centrecase slot. Refit the plank and mark off the top edge on to the frames. Remove the plank; measure, mark & cut the final top edge. Cut the scarph on the aft end. Don't forget to mark out the plank for the other side.

20.2.27 Drill off the plank for fastenings into the backbone. You may also start to get some top edge fastenings into the frames and floors - but don't stray nearer than 50mm to the edge or else the screws will be a nuisance when planing off the lap bevel for the next plank. Remove the plank. Blow off the drillings, WEST down the screw holes and then bond the plank into place, using your usual process of wetting out all bonding surfaces first, then applying the #403 thickened resin as the glue.

20.2.28 When gluing up the scarph, cramp spare pieces of ply (waxed or covered in parcel tape) both sides of the scarph to pull it together. Wet out the surfaces of the scarph twice, to ensure plenty of WEST penetration. If you are going to clear finish the hull, the scarph will need to be better visually than if you are going to paint the hull - the two parts squarer to each other and the feather ends straighter. This is difficult to achieve at first - but at least the bottom is painted, so you will get the opportunity to improve.

20.2.29 Fit and bond the fwd mid section of the garboard on the other side of the boat.

20.2.30 Make and fit the aft mid section and aft section, both sides of the boat in the same way. Just let the aft ends hang over the transom a little and trim off later. Drive three 1 1/4" x 6g or 1 1/2" x 8g hood end fastenings (the hood ends are the ends of the planks lying on the transom or stem faying surfaces) from the into the transom edge - these screws are longer because they don't get such a good hold into the end grain of ply.

20.2 31 In the heyday of timber boatbuilding it used to be a matter of pride (not to say physical effort) to only have to offer up a plank once - a "first time fitter" - and the inside of the planks had to be "soled out" (hollowed out) to suit the hull vertical curvature as well. Well maybe we shan't quite have all first time fitters but you will find that as you progress with the planking you will not need to offer up the plank many times to get it to fit. It is mostly a question of taking an accurate pattern.

20.2.32 If a plank section just doesn't fit, it's not much good forcing it too much because if you try to bend the plank on edge you usually find that one edge will simply lift off the hull and make you lots of problems with the later planks. Best to scrap that section and start again. Nearly all planks not

fitting come down to errors in taking the pattern - mostly allowing or forcing the pattern to bend on edge when around the boat, so transferring a different shape to the ply when laid out flat from that which was marked when the pattern was bent around the boat. So do just let the pattern lay round the boat naturally. If it is getting to be the wrong shape (so that you are having to measure too far to the plank lines), then remake the pattern.

20.2.33 Once the garboard planks are completed and the WEST has gone off hard, the plank top edges have to be bevelled for the next plank to sit on. First of all make sure that the edges in way of the scarph joints are fair - if not just fair them up. Then run a pencil line (not a metal gauge mark) along the outside face of the plank, 40mm in from the top edge. A gauge made from an odd bit of wood with a 40mm (or better say 39mm) rebate in it does this job well - run it along the edge of the plank with the pencil held against the inner edge and this will draw a nice smooth line 40mm parallel to the edge

20.2.34 Now have a short length of stick (as long at least as the widest actual plank width of the next plank). Lay this on the garboard at each frame, so that the end of the stick is on the top-of-plank mark for plank No. 2. The gap between the stick and the 40mm parallel line will be the amount of bevel required. In practice, the stick may lay at a tangent to the edge of the frame before it reaches the top-of-plank mark for plank No. 2. - in which case this will still show the gap that equals the bevel. Make a note of the bevels at each frame - mark them on the edge of the plank and join the lines up. The plank is bevelled from the 40mm line to the bevel line on the edge. The bevel required should not anywhere be the full thickness of the plank - but if it does become so, then just take of to almost full thickness (leaving about 1mm thickness on the top edge). When you are planing off for the bevel be careful not to plane more than 40mm in from the edge or more than the depth line on the edge - in fact just leave both pencil lines visible all the way along.

20.3 The rest of the planking

20.3.1 Now fit the next plank - plank No. 2. The plank sections are made in the same way as the garboard, using the pattern in exactly the same way. The only differences are that you will be measuring to the 40mm parallel line on the previous plank rather than to the backbone centreline and that the plank edge finishes square. Also, as mentioned previously, the scarphs should come in different places to those in the garboard - it is not good practice to have scarph joints immediately above one another in adjacent planks. Try to have at least 1000mm stagger between scarphs in adjacent planks. Because considerable twist may develop in the fwd part of this plank, keep the fwd scarph as far aft consistent with keeping to about 1000mm scarph stagger.

20.3.2 Once you have got the hang of taking measurements from your pattern and are more confident of getting nearly the right shape first time, you can probably reduce the fitting allowance you make on your marked lines. Also, you may find it more convenient when marking the top edge for the second time (after the bottom edge has been fitted) to simply set out the plank apparent widths again - rather than ticking off the top edge on the frames and then measuring the difference

between them and the top-of-plank lines already on the frames.

20.3.3 There is one extra operation to be carried out on this and succeeding planks. At each end it will be necessary to rebate the inside face of the plank so that it fits down closely on to the faying surface of the stem and transom - otherwise there would be a gap between the plank face and the faying surface (because the bevel on the previous plank did not run off to a feather edge).

20.3.3 So when the forward section of the plank is fitted finally, but not fixed, draw along the top of the garboard on to the inside face of plank No. 2, for a distance of about 400mm back from the stem. Take the plank off and turn it over. Cramp a little batten parallel to the line you have drawn but about 5mm nearer the bottom edge of the plank . Use a rebate plane - or any small plane the blade of which comes right to the edge. Plane out a rebate, starting a zero depth about 4000mm back from the end of the plank and arriving at the forward end to the depth remaining on the garboard top edge. The maximum depth of the rebate should not be more than 6mm - if it needs to be more than this, a shallow rebate will have to be taken out of the garboard as well. This applies to all succeeding planks.

20.3.4 Now remove the guide batten and plane the other face of the rebate so that the angle between the two faces is an obtuse one, approximately equalling the angle on the garboard between the edge and bevelled face. The edge of the rebate should now also be on the line you have drawn on the inner face of the plank. Try the plank up and check from inside that the inside faces of the planks are flush with each other as they arrive at the stem.

20.3.5 The WEST will fill any gaps but if the planks do not fit reasonably flush the hood end fastenings will tend to pull the plank down and into the gap cause it to split - this is much more of a problem with traditional clinker than it is with ply lapstrake as ply is much more resistant to splitting.

20.3.6 Carry out the same process at the aft end on to the transom. Again, WEST will fill minor aberrations.

20.3.7 Plank No. 2 and succeeding planks are fastened into the frames, floors (for the first plank or two) and at the hood ends (three into the transom, six staggered into the stem). In way of the frames (and floors where applicable), drive a screw (1 1/2" x 8g or 1 3/4" x 8g) about 20mm in from the bottom edge of the plank. The plank will have to take up some curvature across itself (particularly around the bilge) and we don't particularly want to screw too near the top edge as these screws will be a nuisance when bevelling the plank for the next lap. So the top edges will need to be cramped. In some areas it may not be easy to cramp because of the depth of the frames and then you will have to resort to other methods, like:

1. a spanish windlass around the frame to pull down a stick resting on the frame edge and over the plank edge. Protect the frame corners so the rope of the spanish windlass doesn't bite into them

2. an L-shaped chock cramped to the face of the frame (put a cramping piece on the other face so that you don't get cramp marks on the frame)

with a wedge driven between arm of the "L" and the plank edge

3. a shore from the roof

20.3.8 A hot air gun on the plank will also help it take up shape, though this is a tedious business as you have to wait for the plank to cool before proceeding further. If it is not possible to induce the necessary curvature across the plank, the edge of the frame can be straightened a little in the offending area.

20.3.9 The planks are also bonded to each other along the 40mm wide lap. This is what gives the system much of its structural strength as well as watertightness, so a good bond is essential. The lap joints will need to be held together while the glue goes off. The usual way to do this is to have a series of ply rectangles about 125mm wide by about 70mm longer than the plank width, with a approx. 25mm wide slot cut in them, a little longer than the width of the plank. Together with these is required a fair number of shallow wedges, about 20mm wide - remember the longer the taper on a wedge the more effect it achieves, so make the wedges from zero to about 5mm thick in about 50mm length . Pass the ply over the planks and drive the wedges between the ply "cramp" and the plank (in way of the lap) to hold the plank surfaces together. You will need two or three of these between each frame, maybe more in some places.

20.3.10 When the planking is completed, the lands (the "corner" formed by the edge of one plank and the face of the next) are fillet jointed inside and out with WEST/#405 filleting blend filler, which completes the structural bond and also fills any minor gaps between the face of the plank and the bevel on the preceding plank.

20.3.11 Carry on planking the boat. Plank equally on both sides - do not plank all one side and then the other. Once you are away from the garboard, check that the action of pulling the planks round the frames is not causing them to be displaced from their proper positions. Add extra bracing if necessary.

20.3.12 The sheer strake is fitted just like all the other planks but it is bonded and screwed to the shelf along its top edge. It will not touch the shelf across the whole width of the shelf, so use plenty of fairly thick WEST/#403 when gluing it on, to fill the gap. The screws into the shelf should be at about 200mm intervals and about 15mm down from the top edge. The top of the sheer strake is finished flush with the top of the shelf (the deck goes on top of it), but you should perhaps leave it a few mm high to allow for final sheering down.

20.3.13 The fwd and aft ends of the planks can be trimmed every three or four planks, to end planed off flush with the faces of the stem and transom.

20.3.14 Remember that there may be parts of the jig structure and braces that you want to remove as planking proceeds. After the first three or four planks are on both sides, the boat will start to become very rigid indeed, even without the jig,

SECTION 21 - COLD MOULDED SKIN

This is the Standard Cold Moulded Wood-Epoxy Skin. Lapstrake Planking (see §20) is an alternative.

21.1 Inner skin

21.1.1 The inner skin is strip planked, using 10mm thick by about 40mm wide planking, with the planks edge-to-edge WEST bonded. The skin is also bonded to the sub-structure: frame and transom edges, the stem and backbone, and the shelf.

21.1.2 In addition to bonding, the strips will require fastening to the sub structure to hold them in place while the WEST is curing. It is usual, and more convenient to leave these fastenings in, rather than make them temporary. As we are going to leave them in place, they might as be useful structural fastenings and the usual type of fastening is ring barbed nails either in stainless steel or (preferably) bronze. These are available as "Gripfast" or "Anchorfast" proprietary names from most marine wholesalers and retailers. They can have flat heads or countersunk heads (usually countersunk in the larger sizes, flat in the smaller); either head is suitable. A suitable size for nailing the inner skin to the sub-structure would be 1" x 12g (12g is 0·104" ≈ 2·5mm diameter). You will need somewhere between 1500 and 2000 nails, assuming 50 planks (about 40mm wide) per side with 2 nails per plank per frame, plus extra nails into the other bits of structure - you may find that one nail per plank per frame is OK

21.1.3 The strip planking can be Western Red Cedar (the most usual in the UK - but not everyone likes the black/brown appearance), Yellow Cedar (pretty but more expensive), Douglas Fir (excellent, a bit harder than the cedars and nice looking) or any other clean & clear, reasonably flexible, reasonably lightweight timber (try to keep the weight down below 450g/m3).

21.1.4 There are three styles of strip planking in common use.

21.1.5 The first simplest style is square edged - simple rectangular profile planks, say 10 x 25. This is very easy to plane up yourself from baulk material. The only disadvantage with simple rectangular planks is that they need some form of plank-to-plank edge fastening to ensure that they run in line with each other, hence the use of rather narrower planks. People (usually manufacturers of profiled systems) may tell you that square edge is unsuitable because a gap will open up on the outside as the planks lay round the girth - this is of course true but the gap is so small as to be of no consideration - in any case it fills naturally with WEST as the skinning continues.

21.1.6 The second type has one convex and one concave edge. The theory is that the convex edge sits in the concave one of the previous plank, which thus helps to keep the planks in line with each other. The concave edge also makes a good reservoir for the WEST, so that it doesn't all run away down the plank faces. Finally the concave/convex edge system is supposed to allow the planks to lay round the girth of the boat better. This last claim is not of practical consideration - and in fact because of the feather edges, convex/concave often produces a less good internal finish that plain square edge carefully done. You will also hear that the concave/convex edges are of a special geometry - again we have not found this to be true. We have found equal success (or otherwise) with stuff machined up ourselves

using simple matching convex and concave cutters (which we grind ourselves) in a spindle moulder.

21.1.7 The third type (sometimes called speed strip in the UK) has a tongue on one edge and a groove in the other. It is in fact a slightly modified version of plain old tongue-&-groove matching. The tongue is only about as deep as the groove is wide and has a rounded off edge. This allows the planks to rotate slightly one on the other so that they can lay nicely round the girth. The function of the tongue-&-groove is (as with the convex/concave) to make the planks run nicely together - which it does very successfully. The groove also acts as a reservoir fot the WEST. This type possesses the best features of the previous two types - the nice clean square inner edge of the square edge type and the guiding function, WEST reservoir function and no requirement for edge-to-edge fastenings of the concave/convex. The only criticism that we have heard of this type is that it is possible to get voids (i.e. lack of WEST) in the grooves - but careful attention to pouring the WEST in the grooves should obviate this. It is not difficult to make yourself (given a spindle moulder). You can grind the cutters yourself from blanks (use the Whitehill type head). You will need to make up a few sample bits first by hand to get the geometry right - but it is not very complicated. The planks should be 10 thick by about 40 wide. The actual width is not too important as long as they are all the same. You could have two widths - wider for the first 600mm or so from the sheer down, and narrower for the rest of the hull.

21.1.8 Machining your own planking may sound a nuisance, but it does give you greater choice of timber - to get a lighter coloured interior by using Douglas Fir or Yellow Cedar, rather than the rather dark Western Red Cedar.

21.1.9 We are assuming that you are using tongue-&-groove type strip. But there is little procedural difference whichever type you use - just with simple square edge (our next preference after tongue-&-groove) you will need to drive edge fastenings. If you are to do this use brass or stainless pins. The longest you can usually obtain these is 40mm, so the widest you planking can be is about 25mm as noted earlier.

21.1.10 The planks are laid groove uppermost, so that the WEST can be poured into the groove and mostly stay there. The planking will not be long enough to go round in one length. There is no need to scarph the lengths of plank together - just simply butt them. The butts will be well supported by the previous and next planks, as well as the two diagonal outer skins. Stagger the butts well - by a minimum say of 200mm (though in practice a greater distance should be easy to achieve). You can also arrange for some butts to come on Frame –2460, which is wide enough to take fastenings in the ends of both sections.

21.1.11 Fwd the planks run over the faying surface of the stem and are cut off flush with the stem face afterwards. Similarly, at the aft end the planks simply run over the transom edge and are cut off flush afterwards. Along the backbone, the plank ends will mitre butt together, the mitres getting longer and longer as they near amidships. At the forefoot there has to be a change from planks being cut off flush with the stem face to being mitre butted

together. This will occur at the point where the stem face becomes zero width, but to maintain a fair stem line around the forefoot, the ends of the planks butted together will need to be planed back and faired in for a certain distance aft.

21.1.12 The first plank will be fitted with its lower edge (after planing the tongues off) flush with, or slightly proud of, the top edge of the shelf. Bond the plank to the shelf, and the stem and transom faying surfaces fastening it as necessary. Mostly you will not need to drill for the nails, though they do bend rather easily and so can need a pilot hole into hard timber (pilot hole half nail diameter). You can make drills for this job from a thin bicycle spoke - hammer the end flat and then file to a diamond shape, with the cutting edges angled back. These are very simple to make and don't break off so easily as a small size HSS morse drill. You will also need to drill for nails near the plan ends to prevent splitting. Wet out the bonding surfaces as usual, including the plank butts and then bond with WEST/#403. Make sure that any pre-WESTed surfaces are well sanded matt before bonding.

21.1.13 Fit the first plank on the other side. Indeed, always keep the two sides of the boat about evenly planked - don't plank up all one side first, else you may tend to pull the frames out of square.

21.1.14 Get out the second plank and try it round dry, fitting any butts. Wet out the two bonding edges with a small brush (cut the hairs off quite short); wet out the surface of the plank and the butt ends, the shelf, and the transom and stem faying surfaces. Then run WEST/#403 into the groove of the previous plank and apply WEST/#403 to the surface of the plank etc. Make the WEST/#403 thinnish mayonnaise consistency so that it will pour satisfactorily. Fit the plank up. pushing it well down into the groove of the first plank; fasten as necessary. Repeat on the other side.

21.1.15 With the third plank we are getting away from the shelf and so the planks from here on will be bonded to each other and to the frames, transom and stem. When the plank is being fitted up, mark the frame positions etc. on the outside of the plank so that you know where to wet it out on the inside. It is usually easier to apply the WEST/#403 to the frame edges and the transom and stem faying surfaces (as well as in the previous plank groove), rather than to the surface of the plank.

21.1.16 It takes a plank or two to establish exactly the best consistency of WEST/#403 and how much to apply so as not to get voids, but on the other hand not to have vast amounts going to waste and running down the planks. Clean off the excess as you go; <u>don't leave it until later</u>. A rag damped with acetone or WEST solvent can also be useful to wipe over the inside off the planking from time to time, but don't be so vigorous with this that you wipe the WEST out of the plank seams. Do be especially meticulous about cleaning off the inside of the boat as you go, before the WEST hardens, otherwise you are setting yourself a <u>really hard</u> task later on to get the inside finish that makes a wood/epoxy boat such a joy.

21.1.17 With square-edge planking you must take care that the planks run flush with each other on the inside, so you will need to hold them while you drive the edge fastenings. If you are working single handed you will almost certainly need to devise clips of some

sort to hold them flush together while you nail them. The simplest is a piece of thin ply with a 10mm wide slot cut out of it, which you just push over the planks. If you have a helper, then one of you can hold the planks flush while the other nails

21.1.18 Tongue-&-groove planks should stay running even with each other by virtue of the tongue-&-groove - however just keep a check as you fix the planks to make sure that this is so. Apply a few clips if necessary.

21.1.19 As you proceed with the planking you will find that you will gradually have to apply edge bend to the planks to get them to fit down tightly on the previous plank. The amount of edge bend will gradually increase until you get to the point where it is too much for the plank, or is starting to produce distortion in the planks. At this point we need to fit some 'stealers' until we are back straight again. We would expect this to occur somewhere about 600mm down from the sheer - but we don't know this. You may find that you can go on further than this - or not so far. The reason for all this is basically that the girth of the boat is greater amidships than it is at the ends.

21.1.20 A stealer is a tapered plank that (usually) does not run full length. In this case the stealers will most likely be widest in the middle and taper down each end - rather like a half-moon shape.

21.1.21 To make the first stealer, get a length of plank out, probably about half or three-fifths full length. Let it lay on the previous plank, so that the tongues at the ends are sitting in the grooves in the previous plank. Edge bend the plank so that the maximum gap between it and the previous plank is at the maximum the apparent plank width (i.e. the width you see, which is the total width less the depth of the the tongue). Measure the gap from the mating edge of the stealer, not the edge of the tongue. Tack the plank in position like this. Now, using a dummy which is the apparent width less the tongue depth, dummy the shape of the edge of the previous plank on to the stealer. This line will be the edge of the tongue on the stealer.

21.1.22 Remove the plank from the boat and cut it out to the marked shape. Then machine the cut edge to form the tongue. The resultant plank should now fit into the previous plank, with the tongue in the groove all along.

21.1.23 If you are not going to form a tongue on the stealer (because you maybe don't have the necessary spindle or router), then fit the plank up as described in ¶21.1.21 but dummy off the using a dummy the apparent plank width. Then remove the plank and cut to the dummied line, which will remove all the existing tongue and reproduce the just the mating edge. Then when fitting the plank you will need to edge fasten it as if it were the square-edge system. You will need to fill the groove on the previous plank, preferably with a spline of timber WESTed in.

21.1.24 Another alternative is to run a groove in the shaped edge of the stealer and insert a double width tongue - this is probably quicker than fitting a spline in the previous plank groove and rather more satisfactory. And you are more likely to have a grooving cutter available than a tonguing cutter. If you are using a router for this purpose it is much easier if you make up a table and mount the

router under it, with the cutter sticking up. Then with a simple fence, you can pass the timber past the router, rather than trying to move the router along the timber. This applies whenever you are routing small, difficult-to-hold, or difficult-to-handle pieces of timber - it is easier to pass them by the router than pass the router over them. If you have a spindle moulder or an overhead or table router, then you don't have a problem.

21.1.25 Continue fitting stealers, each of which will have less edge bend and be longer than the precious one, until you get to full length again with very little, or no, edge bend.

21.1.26 Then start to strip plank again in the usual way. One set of stealers may be sufficient and take enough girth out to get you to the keel. Or you may have to put a second set in.

21.1.27 There are other methods of setting out strip planking. The most usual alternative is to lay a "king plank" around the bilge, with little or no induced edge bend. You can mark the run of this by bending a wide (but thin) straight edge around the bilge; as the straight edge will not easily edge bend you are finding the shape of a straight line around the boat - it will look a bit like a banana shape on the boat. Fix this king plank and then plank above and below it. Because you are starting in the middle like this you may then be able to plank right out without any stealers, or at most one set down towards the keel. This system works very well, but we don't feel that the internal appearance in the upper part of the hull is so good. Instead of running roughly with the sheer, the planks are sweeping up at the ends, with more and more banana shaped looking planks as they near the sheer amidships. We find this a bit disconcerting, giving the impression of excessive sheer.

21.1.28 Going back to our original method now, as you near the backbone, you will start to need to fit the ends of the planks to their opposite number on the other side of the boat with mitre butts. This will probably happen first up fwd and then aft as you come off the transom, so you will be getting (banana shaped) planks that need fitting to their opposite numbers on at both ends.

21.1.29 As you are planking you may find that the shape of the boat looks peculiar. This is because you are looking at curves that you are unused to. We are used to the shapes of diagonals, waterlines and buttocks, but the run of strip planking is none of these, so we do not have any inbuilt expectation of shape or feel for it. These peculiar shapes usually disappear as you complete more and more of the planking and the boat starts to assume its true 3-dimensional surface shape. Only if you think that there is a definite bump or hollow developing do you need to get concerned at all. This shouldn't happen because we know that the boat is fair.

21.1.30 However, there is one area as mentioned in the stem instructions that can get unfair rather easily and this is around the forefoot. This is most usually caused by insufficient material being cleaned off the stem faying surfaces from about –300 up round to 200 above the dwl. If the strip planks seem to be running unfair in this area, then it is worth checking with a batten to try and sort the problem and clean some material off the stem (or more rarely off the fwd frame). Elsewhere, on the boat with the gentler curves, minor errors (indeed quite big ones) will not show

up so much.

21.1.31 Once you have completed the inner skin strip planking and allowed the final WEST to cure off, sand the outside of the hull thoroughly but not heavily. The purpose is to remove any excess WEST, odd bits of timber sticking up, minor angularities etc., not to reshape the boat. More damage (to the hull shape) can be done at this stage with a sander than one would imagine. Once the hull is smooth, run you hands over it - you will be surprised how sensitive your hands are and how small an inconsistency they can pick up. Mark any areas that you think are unfair and run over them preferably hand sanding, not machine sanding. Trim the ends of the planking off round the transom and down the stem face; fair in the forefoot. Dust the hull down and WEST fill any crevices, dents etc. Sand gently over again, dust down and WEST coat the entire hull surface. Allow to cure and sand smooth.

21.1.32 You are now ready for the next skin.

21.2 First diagonal skin.

21.2.1 The first diagonal skin is 3mm Khaya veneers laid at about 45° over the outside of the strip planking. The final skin will be the same, but laid at 45° in the other direction (i.e. at about 90° to the first diagonal skin) over the outside of the first diagonal skin. It is immaterial structurally which diagonal you choose first - most people like to have the top ends of the final skin pointing fwd.

21.2.2 The diagonal skins are usually stapled on. The staples can be left in the first diagonal skin, but are removed from the final one. Use stainless, bronze or nylon staples, preferably in an air operated staple gun. The staple should have about a 10mm crown (the distance across the top) with about 10mm legs for the inner skin - they can have 6mm or 8mm legs for the outer skin to make them easier to withdraw (and anyway they will get a better hold in the Khaya). You will need a surprising amount of staples, especially for the inner skin as they do not get a very good hold (poor in Cedar, much better in Douglas Fir). It is difficult to be precise about this - but you will probably need about 60,000 staples in all; they usually come in boxes of 10,000.

21.2.3 Before starting to lay the diagonals, you will need to experiment with the staples and gun. Take a piece of Khaya veneer and try stapling it to a piece of the inner skin timber. Staple across the grain of the Khaya. Adjust the air pressure until the gun drives the staple just below the surface of the Khaya. You have to press the nose of the gun firmly against the timber to get a proper drive.

21.2.4 A second tacking stapler is also useful - this is the same type of machine but driving rather longer staples. You will need lots of squares (say 30 x 30) of thin ply or hardboard and the staples need to be longer by about the thickness of these. You will use these when you want to tack a veneer in place for fitting etc., so that you can easily remove the tacking staples.

21.2.5 The most usual place to start the diagonals is roughly amidships with (as in this case when there are two layers of veneer) the top end pointing aft. The angle is not too important - just guess at 45°. Mark a 45° line at your starting position, using a batten bent

round the hull.

21.2.6 Now that the hull is a complete surface, you can veneer one side first and then the other. Do all of the first veneer skin however before proceeding to the second.

21.2.7 Just as the strip planks needed edge bending and then edge fitting, so will the veneers. Because they are wider however (typically 100mm to 150mm) and thinner, you will not be able to induce much edge bend before they wrinkle up.

21.2.8 There are several methods of fitting the veneers. Perhaps the simplest is to edge fit each one. A common alternative is to edge bend as many as possible, then leave a gap and start straight again and so forth - finally going back and veneering in all the gaps. Some prefer to dry fit a group of veneers and then have one good WESTing session; others prefer to WEST bond each veneer as it is fitted. The method we prefer for a small boat is to edge fit each veneer and bond it on as you go. This is not so tedious as it sounds, because edge fitting is very easy and you are always up-to-date on your WEST bonding. It is probably a little more wasteful of WEST.

21.2.9 So, get the first laminate out at a width that will use your veneers economically - not much narrower than 100mm and no wider than 150mm. Lay it round the hull with one edge near enough on your starting line marked on the hull. Tack it in place over the centreline and mark off the end angle. If you have a helper, then life is much easier because the veneer can usually be held in place, reducing the amount of tacking you need to do. Also mark the sheer line on the veneer.

21.2.10 Remove the veneer and cut the centreline angle on the end. Cut the sheer end - leaving it perhaps 25mm long.

21.2.11 Wet out the surface of the veneer thoroughly (the more wetting out the more flexible the veneer will become) and then apply WEST/#403. A 50mm cheap brush with the hairs cut short to about 25mm long is good for wetting out and basically applying WEST/#403 - if you keep your brushes in a large screw-top jar with about 50mm of acetone in it, they will last quite a while (pickled egg jars, often obtainable from pubs and chip shops, are ideal for this). A good even coat is required; you may find that a notched spreader is also useful here - you can make these from bits of plastic laminate with about 3mm notches spaced with 3mm in between. The WEST/#403 consistency should be mayonnaise. The hull has already been WEST coated and sanded so it should not require any wetting out or further attention, apart from a wipe over with a solvent dampened cloth from time to time.

21.2.12 Lay the veneer back on the hull and push the end firmly up to the centreline and tack a corner in place. Smooth the veneer down round the hull so that it runs roughly on the 45° line on the hull and tack the sheer end. Return to the centreline end and start to staple the veneer down on to the hull working from the middle line of the veneer out to the edges. You will need staple spaced at about 40mm from each other in both directions. Keep the outer staples just in from the veneer edges. Press the veneer down with you hand as you staple so as not to get bumps of WEST or bubbles of air trapped under the veneer. Once you are about half way to the sheer, remove the tack staple at the sheer, so that the veneer

can slide smoothly over the hull. Make sure that you are not driving the staples so hard that they are piercing through inside.

21.2.13 Clean off the excess WEST. As with the strip planking, you will get to know the right amount of WEST to apply so as to get a good wet bond but not too much excess.

21.2.14 Have a feel and tap over the veneer to find any bumps or bubbles. Often these can be fixed with a tacking staple or two through a square of hardboard (covered in parcel tape or similar). If not you can make a cut in the veneer, perhaps cutting a very thin lens-shaped piece out and then pulling down the edges with staples. If for some reason you miss a defect, it can be dealt with later on when the WEST has cured - especially on this skin which is going to be covered up.

21.2.15 Get out the material for the next veneer and lay it alongside the previous one. Mark and fit the centreline end, and cut the sheer end off about 25mm long. The veneer will now lay against the previous one either touching somewhere in the middle and with gaps top and bottom - or gaps in the middle and touching top and bottom. Use a dummy about as wide as the widest gap (an odd bit of veneer does fine for this) and dummy the shape of the edge of the previous veneer on to the new veneer. Take the veneer off the boat and cut the edge to the marked shape. You can use a Stanley knife for this, but we find these tend to run off with the grain rather than follow the line. If the amount is small (and as we are fitting each veneer, it usually is) the a small thumb plane is often the quickest. Or push the veneer through the circular saw, with a small diameter (say 150mm) fine toothed saw in it. We prefer a thumb plane well sharpened and set fairly coarse, and the veneer laid on the bench.

21.2.16 Once you have fitted the edge just try the veneer back in place to check that you have got a good fit. As you get practised, you won't need to do this, just bond the veneer straight on from the first fitting.

21.2.17 Bond and staple the second veneer on alongside the first one. Clean off the excess WEST etc. as usual. Then proceed to the next veneer. Every now and again, say every seven or eight veneers, you may like to go back and trim the sheer off closer to the shelf.

21.2.18 Continue in this way until all the veneers on one side are fitted. If the angle of the veneers starts to get extreme, then fit a tapered veneer or two to restore it near to 45º.

21.2.19 Veneer the other side in the same way.

21.2.20 Once both sides are veneered and trimmed and the final WEST has cured, sand over the hull to remove excess WEST etc. The edges of the veneers may have curled up a little and these will need sanding or lightly spokeshaving down. Any bumps that are full of WEST (i.e. don't tap hollow) can be sanded flat. Any hollow bumps should be cut out and either WEST filled, or have a piece of veneer let in and bonded in. Make sure all the staples are flush (or below) with the surface of the hull. It doesn't matter if you sand the crowns off any that are proud, just leaving the legs in the hull. WEST fill any small gaps, crevices etc. and sand smooth. Dust down the hull and WEST coat all over; sand lightly when cured.

21.3 Outer diagonal skin.

21.3.1 This is fitted at 90º opposed to the first diagonal skin. And this time the staples are removed. Otherwise there is no real difference in the process.

21.3.2 By now you should have got pretty good at fitting the veneers and bonding them on, which is excellent as we hope to get the best finish possible on this outer skin, so the fewer glitches, bumps etc. the better. Also, the better the edge fit of the final skin veneers, the easier is the final finishing of the hull. If you are intending to clear finish the topsides, a good careful fit and a regular width of veneers is important. If on the first skin you found that the veneer angle became extreme so that tapered veneer stealers had to be fitted, do this more often on this skin if clear finishing, so that they are less obvious.

21.3.3 To remove the staples we need to staple them through something. You can use polypropylene binder twine but this tends to leave a dent in the veneer under each staple and often only pulls one leg of the staple out. The best material we have found is very heavy duty parcel binding tape. This is usually about 15mm wide, with a nylon crisscross reinforcing laminated in it. It is used in mechanical parcel binders. You do need a heavy duty grade - the lighter grades just split lengthwise when you staple through, or break off when you come to pull the staples out. The tapes are stapled at the centreline end and run down the length of the veneer in rows about 40mm apart, with the staples driven through them. With luck and care, when it comes to remove the staples, you can pull on the end of the tape and lift all the staples in that row right out. Have a test run to ensure that you've got the right tape.

21.3.4 So, proceed with this skin generally as before, making the best job you can of it.

21.3.5 Once the WEST cures, remove the staples - don't wait until the whole skin is finished but remove the previous day's batch as you go.

21.3.6 Once this skin is finished, go over it carefully to remove any rogue staples and then sand the whole surface as before. WEST fill any crevices etc. - hopefully not too many on this skin - and re-sand. Ensure that any gaps in the hull skin join along the centreline are carefully filled. WEST/#406 silica makes a smoother filler than WEST/#403.

21.3.7 Have a final trim round, sand and dust down - and then WEST the hull one coat. When this is cured, sand lightly.

SECTION 22 - FINISHING OFF

22.1 Glass cloth (Cold-moulded skin)

22.1.1 Now we have a choice about whether to incorporate a glass cloth membrane in the final WEST coating system. This is not necessary structurally at all but it does provide abrasion resistance and it also helps the WEST coatings to wick over the staple holes (which although very small can be a nuisance with the WEST forming "fish-eyes" round them). So we recommend incorporating a thin woven glass cloth with the second WEST coat.

22.1.2 Use a fairly open weave cloth about 200 g/m2 to 300 g/m2 in weight. Your WEST supplier should be able to recommend the most appropriate weave - it mustn't be to tight a weave or else you will have difficulty wetting it out. If you are going for a clear finish, you will need rather a lighter more closely woven cloth than for a painted finish - make sure that your supplier knows that a clear finish is intended. Provided the cloth is properly wetted out, it will become transparent, so is quite suitable for a clear finish.

22.1.3 You can dry lay or wet lay the cloth. With dry lay you lay the cloth on the dry hull and apply the resin over it and work it down through the cloth. With wet lay, you coat the hull and lay the cloth on the wet resin and work it up through the cloth We strongly recommend wet lay.

22.1.4 On the hull, the cloth lays best like the diagonal veneers, draped in lengths at about 45°.

22.1.5 The transom and stem face should be glass clothed before the hull and the cloth allowed to run about 25mm on to the hull skin, to a nice neat finish. Lay the cloth horizontal on the transom and vertical down the stem face.

22.1.6 Start with the stem face. Mask the hull a parallel 25mm away from the edges of the stem face. Drape the cloth over the stem and masking tape it back to the hull. Run masking tape (use wider than normal tape - say 35mm wide) over the cloth just clear of the 25mm parallel tape on the hull. Remove the cloth and cut it up the centreline of the 35mm tape - this will prevent fraying of the edges. Large scissors (about 250mm or so blades) are best for cutting glass cloth.

22.1.7 You may find that slow hardener #206 is better for this job as it gives you more working time. You will also need some ribbed rollers (#811) or washer rollers (#812) for wetting the resin through the glass. Wear gloves as you have to handle the glass cloth with WEST on it.

22.1.8 Apply a good heavy coat of WEST on the area to be glassed. Lay the cloth in place and press it down. Roll it down gently with the ribbed rollers, forcing the WEST to wet through the cloth. Smooth the cloth on to the hull and work it into the WEST coating with the ribbed rollers until the cloth is very thoroughly wetted out. As the cloth wets out you will find that it can take up more shape - so go back to any areas that wouldn't lay properly the first time around. With slow hardener you have plenty of working time so don't panic - just keep working on different areas and it will gradually fall into shape.

22.1.9 If there is not enough WEST to come through fully, you can apply some extra on top and work this well in with the ribbed rollers. Don't use the rollers too fiercely or else you will start to fluff the cloth up.

22.1.10 Allow the WEST to cure 'green' before you do any trimming off. It is very easy then to trim excess cloth off with a sharp Stanley knife (and a straight edge for long cuts). Remove the masking tape from the hull. Once the WEST has fully cured sand the edges on the hull skin to as feather edge.

22.1.11 Now cloth the transom using horizontal strips, running them 25mm on to the hull skin in the same way. You can

overlap the joins between the strips and sand them smooth after they are cured. Or you can wait until the WEST has started to go off but is still just flexible and then cut through both layers of the overlap with a sharp knife and straight edge. Remove the excess from the top layer and then peel back the top layer enough to remove the excess from the bottom layer. Press the top layer down again and it should be a perfect butt join. You will need to apply a little more WEST to the join and lightly roll over it with the ribbed roller. This latter system only works when you have the time to get at the join at just the right moment in the cure process - if you can't manage this, just leave the overlap join and sand it off later.

22.1.12 Now we can turn to the hull. Start by getting a length of cloth out somewhere amidships. The strips can run right over both sides of the hull or they can join on the centreline. You may find that joining on the centreline is easier to handle. So get the cloth out cut roughly to length, with the ends roughly at the correct angles. As before, stick masking tape on the cloth where you want to cut it and cut along the centreline of the tape. Leave the cloth a bit over length each end. Get out several such lengths.

22.1.13 WEST the area of hull that you have cut the cloth for. Drape the first piece of cloth and work the WEST through with the ribbed roller. Do the same for the other lengths. Have plenty of WEST at the overlaps.

22.1.14 As the WEST is getting sticky, go back and cut the centreline ends; WEST these well down again.

22.1.15 Now go over the whole area with the roller, smoothing out any air pockets or any puckered areas. As the cloth wets out it will become more flexible and drape to shape easier.

22.1.16 If you have time, deal with the overlaps now - if not leave until the WEST has fully cured. Do make sure the cloth is thoroughly wetted out - apply extra WEST if needed.

22.1.17 Continue until the whole hull is glass clothed both sides.

22.1.18 Once the WEST has fully cured, go over the whole hull and deal with any defects, sanding off overlaps etc. Tidy up all the edges especially around the transom, stem and centreline. The sheer will be finally cleaned off when the boat is the right way up.

22.1.19 Once the hull, transom etc. is smooth and any defects WEST filled and sanded off, apply two further coats of WEST, sanding between coats. This should entirely fill the weave of the cloth and leave a smooth surface. Before the final coating is is a good idea to mark the waterline and boottop - see §22.2

22.1.20 If your cloth was a very open weave this may not be the case. So, after the first of these final coats, skim over the entire hull with WEST filler. WEST/#410 microlight is the easiest to trowel and sand - but it is not recommended if you are going to overcoat with a dark colour. In this case use WEST/#407, perhaps with a small amount of #406 silica mixed in to improve smoothness. Don't apply vast amounts of filler but trowel over the whole surface with a wide bladed trowel knife, just filling the cloth weave and

scraping off as much excess filler as possible. When the filler is well cured, sand over the whole hull and apply one or two more WEST coats.

22.1.20 If you are clear finishing, you will have used a finer cloth, but you may still require an extra WEST coat to entirely fill the weave.

22.1.21 Finally sand to a smooth matt finish overall, ready to start the final coating systems. Before the final coating is is a good idea to mark the waterline and boottop - see §22.2

22.1.23 If you are not going to lay glass cloth, then we recommend four WEST coatings, sanding between each. You will need to go carefully over the hull after the first (and probably again after the second) coat to spot fill the staple holes. If you are not clear finishing then a general trowel over the hull surface (as ¶22.1.20) is possibly the easiest way to catch all these. You can with advantage add #420 aluminium powder to the final coat, to increase the hardness of the coated surface. Or, below the lwl (100mm above the dwl), you can add #425 copper compound which performs the same function and also increases water resistance and acts as a foundation for the antifouling. Before the final coating is is a good idea to mark the waterline and boottop - see §22.2

22.1.24 You can glass cloth a lapstrake hull but it is a little more difficult. Follow the in structions for a clod-moulded skin, but paying particular attention to wetting out the cloth along the plank lands. You will fillet the lands in the normal way before glass clothing.

22.2 Marking the waterlines (Lapstrake & Cold-moulded)

22.2.1 The waterline is marked at 100mm above (nearer the sheer) the dwl. This will be the antifouling line. The boottop (if required) is painted parallel vertically to the waterline. This will mean that the actual width on the planking will vary according to the hull angles, but that viewed level, the boottop will appear parallel.

22.2.2 The waterline and boottop line are marked in pencil before the final WEST coating, so that they are permanent.

22.2.3 Rig up two posts just aft of the transom and two posts just fwd of the stem. The posts should be a reasonable distance apart - say 2500mm - and fixed firmly and braced fore-&-aft. The posts do not need to be dead upright, but it is just as easy to make them so. Nor do they need to be exactly square to the centreline.

22.2.4 Fix a long board (say 35 x 150) across the posts each end. The planks must have a straight top edge and must be set on the posts so that they are level across. They should be positioned vertically so that their top edges are 100mm above (i.e. nearer the sheer) the dwl - You can measure this off the jig rails. The planks need to be about 3500mm long if possible, sticking out about equally each side of the boat.

22.2.5 The basic method of marking the waterline is to stretch a thin strong line from the top of the aft plank to the top of the fwd plank. Adjust the line sideways so that it just touches the hull about amidships. Tick off this point on the hull. Then move one end of

the line in and the other out, so that the line just touches the hull about 100mm to 150mm away from the first place. Mark this point. Continue in this way, moving the line so that it lies tangential to the hull at about 100mm to 150mm intervals, marking each point off on the hull.

22.2.6 Unless your planks are very long, they will not be wide enough to mark the ends. You will need to set up a third post each side. These will have a length of level plank fixed to them, the inner end of which can rest on a waterline mark already made on the hull. You will need to set these up first as near the stern as possible and mark the waterline round the hull to the transom. Then move the third set of posts etc. forward and repeat the procedure round on to the stem.

22.2.7 To mark the waterline in fully, you will need a batten and several people to hold it in place. Hold the batten around the hull so that it lays fair over the waterline marks. Mark the waterline in.

22.2.8 To mark a vertically parallel boottop, you follow exactly the same procedure with the planks set the boottop width higher - or easier, with a boottop thickness block held on top of each of the planks. If you use blocks under the line, then you can mark the boottop at the same time as the waterline, which saves setting up the planks etc. twice. A good width for a boottop would be about 75mm.

22.2.10 The waterline (and boottop) can be marked straight across the transom.

22.2.11 Then have a final sand over the hull and the final full WEST coat.

SECTION 23 - BILGE KEEL BASES

Note: This section is only required if you have the shallow keel AND want to fit bilge keels as well

23.1 Basic principles

23.1.1 The bilge keels are made from steel plate with a top flange welded on (they also have a bottom flange). The top flanges are through-bolted to the hull.

23.1.2 It is important that the bilge keels run dead fore-&-aft and this can be a little difficult to organize at this stage because the top flange is curved to suit the hull shape and thus its intersection with the hull is not a constant offset out from the centreline (because the ends are curving up at the 22º angle).

23.1.3 When the bilge keels are actually fitted it should not be difficult to get them truly parallel to the centreline because the bottom edges are straight and level. However the bilge keel bases need to be right in order the the top flange shape fits the hull, with the bilge keels parallel and level.

23.1.4 The outer face of the bases is cleaned off so that it is square to the 22º diagonal.

23.1.5 The dimensions given on the drawing are based upon lapstrake planking. They also assume it is fitted generally as indicated on the Lapstrake Planking drawings. In practice, with lapstrake planking there will probably be some amount of variation from

this. For the cold-moulded skin, follow the cold-moulded dimensions given on the drawing, again checking back from the boat as you proceed.

23.1.6 The bases run from the fwd face of Frame –2850 to the aft face of Floor –4125, plus a little extra length each end to allow for fairing in.

23.2 Setting out the bases.

23.2.1 Sand the area where the bases sit on the hull thoroughly, to give a smooth matt surface for WEST bonding.

23.2.2 Working from the jig, the sheer and the centreboard slot, mark the appropriate frame and floor positions on plank No. 4. The offsets for the base centreline are all given on the aft faces of the frames and floors (i.e. on the nominal positions).

23.2.3 Using the offsets given, mark out the centreline of the base on Plank No. 4 (joining the marks with a batten as usual). Mark a parallel line each side of the base centreline, 60mm out, to give the base width of 120mm. Check that the base runs generally as shown on the drawing. If the planking is sufficiently different to make the base cross a plank land in order to achieve its width, then the whole keel base can be moved bodily inboard or outboard. In this case come back to us for new measurements.

23.2.4 The base will be laminated up wider than the 120mm to allow the sides to be bevelled off. An inner face width of about 145mm would be about right. Towards the fwd end, the wider base should start to run into the edge of plank No. 5 and in way of this the laminates will need to be reduced in width on the outboard edges to suit.

23.2.5 The base will also start to run into the plank fillet towards the fwd end - again reduce the laminate width on one edge to suit.

23.2.6 At the fwd and aft ends, make the lamination about 50mm over length so that the ends can be faired into the hull planking.

23.2.7 Get out the laminates to width and length as required.

23.2.8 The bases can either be laminated up in place on the boat or you can make a jig to laminate them up on.

23.2.9 Making a jig to produce the accurate shape required is not so very easy, so we are going to describe the process to laminate up in place on the boat.

23.3 Laminating the bases.

23.3.1 Cover the base area on the hull with polythene, tightly taped on so that there are no crinkles. We shall remove the laminated bases to clean them up, bevel off the sides and ends and plane the outer faces square to the 22º diagonal.

23.3.2 Prepare a piece of 12mm ply the length and width of the lamination and cover this with polythene or (better) shiny brown parcel tape. We shall place this on top of the laminations and screw through the laminations into the hull, in order to pull the laminates down to shape.

23.3.3 Lay the ply on the hull in the correct position for the base and transfer the

frame and floor positions.

23.3.4 Remove the ply and bore off for screws into the frames and floors (remember to mark on the frame/floor half thickness so that the screws drive centrally into the frames and floors. Use 2 screws per frame/floor. Drill a clearance hole (about 4·5 to 5mm) for 8g (4mm) screws. You can use the BZP twinthread pozidrive type screw for this job and these are available in a great variety of length at 8g. Make sure the screw heads are inside the 120mm final width.

23.3.5 Lay the ply on the laminates and align them accurately in a heap; bore the holes in the ply through the laminates. Drill slowly taking care not to split the laminates. Use clearance holes: about 4·5 - 5mm.

23.3.6 Now position the laminates and the ply on the boat and adjust to the correct position. Prick the holes through on to the boat hull. Remove the laminates and ply and pilot bore for the screws (twinthread screws only require a very small pilot - smaller than an 8g Stanley Screwsink))

23.3.7 Try the whole assembly up dry - drive the screws gently by hand (not a screw gun) as they have to be removed and driven again and we don't want them to lose their hold. Use large washers under the screw heads so that they don't pull into the ply.

23.3.8 Check that the ply is pulling the laminates down firmly and fair. If additional pressure is required, try to arrange for shores from the roof. You can also run a post up the centreboard slot (fix the bottom end to the jig) and bring a cross bar out from this over the lamination, so that you can wedge between the cross bar and the ply. The outer end of the cross bar will need to be tied down to the jig base. Instead of wedges you can work a spanish windlass on the outer end of the cross bar, hinging the bar on a single bolt through the post up through the centreboard slot.

23.3.9 Some ingenuity may be required for these additional clamping pressure arrangements so take time and trouble to be sure that they will work OK.

23.3.10 Once you are satisfied that you can pull the lamination down fair, remove the screws etc. and set the laminates out for WEST bonding. Wax the screws so that they can be removed after the WEST has cured (use fresh screws as pozidrive heads are difficult to remove if damaged at all)

23.3.11 Wet out the laminates and then coat with WEST/#403 as usual for laminating. Place the laminates on the hull accurately in place and screw the ply down over them; fit the additional clamping arrangements (if any). Clean off the excess WEST and allow to cure. Before the WEST has gone off quite hard it is as well just to give the clamping screws a quarter turn back and forth to ensure that any WEST bond is broken.

23.4 Finishing the bases

23.4.1 Once the WEST has cured (allow plenty of time) the lamination can be removed from the vessel. Before removing it, mark the frame and floor positions. The lamination should be strong without any spring back.

23.4.2 Clean up the sides of the lamination.

23.4.3 Mark the thicknesses of the lamination on the sides at each frame/floor position. Remember that it is the outer face that is to be planed off - the inner face is left alone. The lamination is actually 145mm wide at the moment, not 120mm as shown and the thickness measurements are given on a 120mm width. However the difference will be very small - and the differences can be extrapolated in any case.

23.4.4 On Frame –2850 the thickness variation is 10mm. 10÷120 = .083; .083 x 145 = 12. So the thickness difference over 145 mm will be 12mm instead of 10mm over 120mm - i.e. 1mm each side. So on the inner side mark a thickness of 19mm (instead of 20mm) measuring up from the inner face. On the other side we can't go to 31mm because the lamination is only 30mm thick so we just run the outer face off to a line 60mm parallel to the centreline.

23.4.5 On –3275 & –3700 the difference for 145 instead of 120 is not significant enough to worry about. On –4125 it amounts to 0·5mm each side, which can be allowed for in the same way as –2850.

23.4.6 Join the lines on the sides of the lamination with a batten as usual. Where the 145 width lamination runs out of thickness (outer side on –2850 & inner side on –4125) run the batten 1mm and 0·5mm respectively above the outer surface to get the true fair line. Note the the angle on the outer face of the lamination is twisted, being high on the outside fwd and high on the inside aft.

23.4.7 Plane the outer surface off so that the lines on the edges remain just visible.

23.4.8 Mark the centreline down the outer fact and mark a line each side 60mm parallel out. Plane the bevel on the sides so that the 60mm parallel lines are just showing. Bevel the end off. The fwd and aft corners and bevels can be radiused off (say R30 or thereabouts).

23.5 Fitting the bases.

23.5.1 The bases can now be bonded to the hull. Remove the polythene from the hull an make sure that there is a clean matt bonding surface.

23.5.2 Try the bases in place and fit as necessary where the fwd ends come against plank No. 5.

23.5.3 Try the bases down screwed in place (still using 8g screws)

23.5.4 Open the screw holes in the lamination out to take 10g (5mm) countersunk stainless steel screws.

23.5.5 Bond the bases in place using WEST/#403, with 10g screws driven into the frames and floors. Dowel or fill over the screws.

23.5.6 Once the WEST has cured, sand the bases and adjacent hull smooth and WEST one coat.

23.5.7 WEST fillet any areas where the bases are very close to a plank land. As the movement away from the land is gradual, make a decision when to stop filleting (say when the gap is 10mm) - or you can WEST fill the entire length against plank No. 5 if this

seems better.

23.5.8 Sand the assemblies smooth and WEST coat a further three coats.

SECTION 24 - TURNING OVER & SETTING UP

24.1 Turning over.

24.1.1 Drawing 067/002/12 shows the basic method usually employed to turn the boat over by crane and we have also discussed this by telephone and e-mail.

24.2 Setting up.

24.2.1 Drawing 067/062/13 shows the basic chocks and blocks required to set the boat up level and upright to complete the building and fitting out.

24.1.2 Once the boat is turned over, we are assuming that she will be lifted back into her build slot by crane. An alternative is to slide/roll her back in place. In this case an actual cradle will be required rather than the independent chocks and blocks shown on the drawing. These instructions assume a crane lift back to the building slot.

24.1.3 The drawing shows chocks and gives block heights to set the vessel up with the dwl 600 above the floor; and the heights and dimensions are also given assuming a level and flat floor. This is of course probably not the case, especially with an earth floor. By now you probably know roughly how far out of level etc. your floor is so you can make some allowances for this when you make up your chocks and collect together the various blocks needed.

24.1.3 Minor variations in floor levels etc. should not affect the chocks too much as they can be pushed closer together or moved further apart as required; also further pieces of timber or ply can be added to the top to make up for floor inconsistencies. Also, the chocks can be moved fwd or aft a little, or set in at a slight angle if necessary, to make them fit. So, unless there are major inconsistencies with your floor, we suggest that you make the blocks as shown and then modify them if required during the course of setting up.

24.2.4 As well as the two sets of chocks shown, a third set will be required at Frame –3700. These are not made up beforehand, but you will need sufficient timber to make them up during the setting-up process. They will be made in the same way as the other chocks.

24.2.5 So, make up the –1700 and –5400 chocks. They can be made from 50 x 100 sawn softwood (no need to plane it up) or similar material. Screw the chocks together to the dimensions given (or as modified by you). Then cover the chocks each side with 12mm ply, screwed well to the softwood core.

24.2.6 The top piece of softwood on the chocks is shown a bit longer than is theoretically required - this to make it easier to drive in levelling wedges between the chocks and the hull, or add additional bits to the chocks. The over-length dimensions given are not particularly important however - and the ply only needs extend to the outside face of the main outer support. Fit a strip of carpet to the top face of the chocks, turned down over the sides and nailed in place.

24.2.7 Prepare the –1700 and –5400 blocks. These can be built up from 200 x 50 (or similar) softwood or you can often buy pieces off larger baulks of timber from a local saw mill or fence manufacturer - the species of timber is unimportant (for example willow blocks are often available from a timber merchant growing or selling bat willows). Old railway sleepers also make good blocks but beware grit and fastening embedded in them when you saw them up. If you make the main blocks up from several layers of, say, 50mm material it would probably be best to push this through the planer to get a reasonable surface on the layers. You can nail the layers together and also nail a piece of ply either side to make really solid blocks.

24.2.8 You are going to need various other bits of timber to make the basic blocks the right height for the boat to sit level fore-&-aft. We show the theoretical additional block required at –5400, but in practice you will almost certainly require a variety of pieces of differing thicknesses. You can take some measurements now, before you move the boat out to establish the distance from, say, the jig base to the floor at –1700 and –5400. This will give you a difference that your floor is out of level between these two points. You can then apply this difference to the theoretical difference between the heights of the –1700 and –5400 blocks, so that at least you can prepare a pair of blocks that will initially sit the boat reasonably level.

24.2.9 Have plenty of timber to hand to make the intermediate blocks at –2850, –3700 & –4550.

24.2.10 You will need a variety of wedges, so make these beforehand. Make them about 50mm wide - an average wedge can angle from nil to about 40mm thick in about 250mm length. You will also need 3 pairs of good folding wedges for the intermediate blocks.

24.2.11 Mark the frame positions on the underside of the hull with masking tape, so that you will be able to locate them easily when the boat is turned over.

24.2.12 Place the –1700 and –5400 blocks in position and have the –1700 and –5400 chocks standing ready close to hand.

24.2.13 Have the crane lower the boat gently on to the blocks so that they are nicely located under their frame positions. Get the crane to slack off until it is still holding the boat upright but most of the weight is on the blocks. Then slide the chocks into place with carpet or similar, between the chocks and the hull. Have the crane slack away until all the weight is on the blocks and the chocks are holding the boat steady. Don't allow the slings to go totally slack and fall away until you have checked that the chocks are indeed holding the boat steady and that the blocks are firm and not sinking into the ground. Also check that the blocks are basically taking the weight, not the chocks. While the slings are still basically in place, give the hull a good shake by hand to make sure that your chocks have really got her firmly. The crane can then be dismissed.

24.2.14 Now make up the Frame –3700 chocks and slide them into place (with some carpet between them and the hull). Make sure that the chocks are pushed firmly home. Nail or screw a couple of temporary battens across from one chock to the other so that the chocks

cannot easily slip out of place or move apart.

24.2.15 Check the boat for level both fore-&-aft and athwartships. You should be able to use the jig base for this purpose - but also check from the frame floors - they should read the same as the jig base.

24.2.16 Get the boat near enough level athwartships. To do this you can move the –1700 and –5400 chocks just away from the boat and then strap each of them together athwartships so that they cannot move further. Then release the straps across the –3700 chocks and wedge the boat upright - you will need to move the high-side chock out a little and wedge up on the low side chock. This process is much the best carried out by two people - one driving the wedge on the low side and the other holding a wedge between the chock and the hull on the high side, just keeping the wedge about 10mm away from the hull. Then if the boat rocks over suddenly, it can't rock very far. Keep hands and fingers clear - hold the wedge by the side or use a very long wedge. Once the boat is level athwartships, wedge both sides on the –3700 chocks firmly and re-strap the chocks across.

24.2.17 Now level the boat fore-&-aft. If the boat is high fwd, jack up under the centreline close to the fwd block, just sufficient to allow the fwd block to come loose. Slide the –1700 and –5400 chocks into place temporarily so the boat is held firmly. She is still on the jack but the fwd blocks have not been removed yet. Fit a new set of blocks at –3700 and set these tight with folding wedges.

24.1.18 The fwd block is now removed - but before removing it, lay a thinner block in place alongside it. Make this new block about 40mm thinner and then sit several pieces of 12mm ply (three pieces if the block is 40mm thinner) on top so that the top piece of ply is close to the hull. Make this temporary block and ply pieces as wide as you can and sufficiently long, so that it is stable. The purpose of the temporary block is to prevent the boat falling far should something go wrong. As the bow is lowered the pieces of ply can be successively removed to "follow" the boat down - in much the same way as we used a wedge to follow the boat as she was listed over to upright. We shall always use this principle when jacking or listing the boat.

24.1.19 Slide the –1700 chocks out away from the boat a little. Remove the fwd block. Lower away gently on the jack. In all probability the bow won't come down, so it will be necessary to jack up under the stern. the boat should pivot nicely on the –3700 blocks - check that the hull isn't getting tight in the –3700 chocks. If it does, set the boat down on temporary blocks fwd and aft and push the –1700 and –5400 chocks in while you ease the –3700 chocks out a little. Then resume the process of the stern lifting and the bow lowering. As the bow drops, keep removing pieces of ply so that the temporary fwd block always stays clear of the hull. Do everything carefully and slowly, so that nothing happens with a rush. If you need to take a break, simply block and chock the boat up temporarily. Don't leave the weight on the jack unattended as hydraulic jacks can gradually leak and lower themselves.

24.1.20 Once the boat is level fore-&-aft arrange permanent blocks fwd of the correct height and jack aft until the weight is full on the fwd block (it's best to make the fwd block

just a small amount - say 2mm -thicker than is required to allow for settling as the weight comes on it).

24.1.21 Jack a tiny bit more aft and slide new permanent blocks in - lower away aft until all the weight is on the fwd and aft blocks. Then have a final test for fore-&-aft level. You may find that you need to jack fwd or aft and slip a thin piece of ply or similar in just to get the boat finally level.

24.1.22 Now push all three sets of chocks home and check the boat for athwartships level. Wedge over as necessary until she is level. Then tap the chocks home so that the boat is held very firmly and cannot rock about - but not so firmly that the chocks start to lift the boat off the blocks.

24.1.23 Have a final check to see that the boat is level fore-&-aft and athwartships. Then strap the chocks across so that they cannot move out.

24.1.24 Fit all three intermediate blocks under the hull centreline and tap home folding wedges to make them tight. Again, don't make them so tight that they start to lift the boat off the fwd and aft blocks. In way of the centrecase, you might find it best to have a piece of ply up under the hull, rather than wedge directly on the hull.

24.1.25 We have described the fore-&-aft levelling process for a bow-high situation. A stern-high situation is just the same but in reverse - lifting the bow and lowering the stern.

24.1.26 It is a good idea to screw some fore-&-aft battens to link the chocks each side as well as linking them athwartships under the boat. This will all help to stop the chocks working loose as work on the boat proceeds.

24.1.27 It is as well to check the boat for athwartships and fore-&-aft level about once a week as boats do have the tendency to work round in the chocks and the blocks may settle, especially on an earth floor.

END