SECTION 11 - FLOORS

11 1 Making the floors.

11.1.1 The floors are made from 25mm thick solid African Mahogany. Other suitable timber may be used but avoid Iroko, Oak and Teak or very resiny softwoods like Pitchpine. A softwood like Larch or Douglas Fir would be suitable but, especially with Larch, make sure that it is clean (free of all but very small tight knots) and kiln dried (a lot of home-grown larch is not clean enough and is not kiln dried). The grain in the floors is horizontal. As well as knots, don't use timber with splits or shakes in it (African Mahogany is prone to wind shakes, which occur in the growing tree)

11.1.2 The floors are set out and bevelled from the small Tables of Offsets given on the drawing, in a similar way to the frames.

11.1.3 You can use the grid marked out on the setting-out floor, adding any extra waterlines or buttock lines that are necessary.

11.1.4 Check from the Table of Offsets for each floor which is the larger face. As with the frames, the larger face will be the aft face at the fwd end of the boat and the fwd face at the aft end of the boat with the change-over not necessarily all happening at once.

11.1.5 The drawing shows the aft face of Floor –2000; and the fwd face of the remainder.

11.1.6 As with the frames, mark out the larger dimensions and then bevel back to the smaller.

11.1.7 The simplest way to mark out the floors is usually to get out the timber for each floor as a parallel sided piece at the maximum depth of the floor.

11.1.8 Lay the timber on the setting-out floor, aligning the top of the floor with its appropriate wl. Then transfer the appropriate grid lines (including the centreline) to the floor and then mark heights and offsets as appropriate. Join the marks with a batten as usual.

11.1.9 Using this method is simple but can be wasteful of timber. To overcome this each floor can be marked out on thin ply (don't use hardboard as it is difficult cut accurately). Do this in exactly the same way as you would for marking the floors direct: lay the ply on the setting-out floor; transfer the grid lines; and then mark out the shape.

11.1.10 Cut the shape out of the ply very accurately, cleaning up the edges so that the floor shape lines remain *just* visible. Lay your accurate ply patterns on the timber and arrange them in the most economical way (this is called "nesting"). Then draw round each pattern.

11.1.11 The method in ¶11.1.10 does require accuracy if errors are not to be repeated and made worse. If you are worried about this, then mark the shape on the ply as before but only cut roughly to shape, leaving say 5mm all round. Then nest the patterns as before and tack them in place. Transfer the grid lines for each floor back to the solid timber (checking that no inaccuracies have crept in).

Remove the patterns and mark out the shapes of the floors using the heights and offsets from the Tables of Offsets in the normal way.

11.1.12 Whichever method you use, once the floors are marked out, cut them out to shape and clean the edges up fair and square.

11.1.13 Mark and plane the bevels as you did for the frames.

11.1.14 Cut the hog notch and bevel the base.

11.1.15 Sand the floors and WEST them three coats (but only one coat on the edges).

11.1.16 For the floors in way of the centrecase you can cut the 46mm wide slots out and then strap the floors together again temporarily.

11.1.17 Or, probably better, you can leave these floors whole and cut the slots later on. The slot will be cut in the hog after it is laminated up (with the frames and floors set up in the jig), and before the keel inner laminate is put on. It is not too difficult to cut the slots in the floors either when the hog slot is cut or even afterwards when the hull is turned over.

SECTION 12 - JIG & SETTING UP

12.1 Making the jig & setting up

12.1.1 Refer to the jig schematic drawing .

12.1.2 The purpose of the jig is to provide a means of setting the frames up in their correct positions, accurately vertical, accurately square across the vessel and with their centrelines straight and dwl level. The jig also provides the means to mount the transom and laminate up the stem and backbone of the vessel.

12.1.3 The jig drawing shows certain sizes of timber - you do not need to stick to these particularly, as long as the primary objective is achieved to build a firm and accurate means of setting up the frames etc.. You can usefully use secondhand timber for making the jig. As well as the principal timbers shown on the drawing, you will need a fair bit of other timber for braces and struts.

12.1.4 Make the base of the jig. The jig base rails are set 1200mm outside face to outside face. Make jig base cross rails (same size as base longitudinal rails) at each end, positioned so that the stem and transom posts will just notch into them. So the fwd cross rail will have its fwd face at about 120mm ahead of Position 000; the aft cross rail will have its aft face about 520 aft of Position –4580. A cross rail placed with its aft face at Position –300 will support the post for Frame –300 and another with its fwd face at Position –965 will support the two posts for Frame –990. A further cross rail at about Position –2700 should also be fitted. Brace the jig base firmly square with some ply gussets (say 400mm arms) across the corners in way of the fwd and aft cross rails. These can be nailed top of the jig base rails. Set the jig base up level both across and lengthways, on some blocks on the workshop floor.

12.1.5 Mark the centreline of the boat on the jig base cross rails. A thin wire can be stretched taut to give the centreline of the boat for the full length of the jig. Alternatively a length of timber (say 150 x 25 planed up) can be fixed the length of the jig base and the centreline marked on it. Mark the frame positions on the jig base, accurately square across the base.

12.1.6 Once the base is set up, the post for Frame –300 is set up. This is a single post on the centreline. The fwd face of the post should be accurately at Position –300 and the post accurately on the centreline. If the top of the post is also accurately at 115mm above the dwl, then the cleat on the frame will sit on it an the frame correctly. Note that even with the boat upside down, we still use "above" and "below" the dwl in the sense they would have if the boat was the right way up - so above the dwl means nearer the sheer; below the dwl means nearer the keel. Fit temporary braces to hold the post firm and upright in both directions.

12.1.7 Hang Frame –300 on the fwd face of the post and cramp lightly in position. Check that its dwl is 1400 from the top of the jig base and its centreline plumb over the jig centreline. The frames can be held in place by cramps but these do tend to get in the way and sometimes vibrate loose. A better way is often to screw trigs to the jig to clamp the frame in place. For example a trig (say 100 long by 30 wide by 15 thick) can be screwed to the block on Frame –300 post. If the trig has a slip (about 1mm thick) under it in way of the frame, then it will pull up tight on the frame, clamping the frame to the post. A similar trig, maybe a bit thicker and rebated out 8mm, will pull the 9mm ply floor web tight on to the post

12.1.8 Fit the support post on the fwd face of the frame, bolted through the frame post and blocked out to sandwich the frame to the frame post. This support post acts as a support for the forefoot block - so the top end of it needs to be at the correct height to suit the underside of the block. If the support post is the same width as the forefoot block and stem formers (110mm), then this will make supporting the fwd part of the jig easier.

12.1.9 Get out the forefoot block and the two lengths of post for the stem former. These should be 110mm wide. The apron laminations will be 150mm wide, but from Position –300 fwd, the width will taper down - refer to plan No. 119/003/03 which gives details of this - so blocks etc. any wider than this will interfere with the bevelling of the apron etc.. Join the three pieces up and then mark and cut the outside face to the shape given by the offsets in the table on the jig drawing.

12.1.10 The lower end of the stem former should fit into an angled notch cut in the fwd face of the jig base cross rail - so that the fwd face of the stem former at the jig base is 155 ahead of Position 000, as shown on the jig drawing. Set the block and former assembly up, so that the aft end of the forefoot block rests against the fwd face of Frame –300. Fit ply gussets each side of the block and support post to hold the assembly in place. Brace the assembly firmly. There is considerable pressure on the assembly when the apron etc.

is laminated, so it does need to be secure. Mark the centreline down the outside face of the assembly.

12.1.11 Now set up the post assemblies for Frame –990. The aft faces of the posts will be at Position –965, and they are bolted to the jig base cross rail so that they are 780 apart outside-to-outside. Fix a 45 x 45 mm cross rail across the posts on the fwd faces, with the top of the rail accurately on the dwl. Fit a frame support rail (25 x 45) across the aft faces of the posts accurately at height 994. Sit the frame on the posts so that the foredeck beam rests on the frame support rail. Hold the frame firmly in position.

12.1.12 Make the 150mm wide block to fit between Frames –300 and –990. Fit the block into place and support with posts & gussets off the jig posts.. Mark the centreline down the outside face of the block.

12.1.13 Fit the pair of posts for Frame –1614. The fwd face of these posts will be at Position –1614. The posts are bolted on the inside of the jig base rails. The top of the posts can finish on the dwl. Fit the cross rail at 1240 above the dwl. You can also fit blocks on the posts at 115 above the dwl - these will provide additional support for the frame at the correct height. Mount the frame on the posts and set it accurately over the centreline. Check that its dwl is on the jig dwl (i.e 1400 above the jig base). Fix the frame with cramps.

12.1.14 On the aft face of the –1615 posts screw a 45 x 45 cross rail with its top face accurately level and on the dwl This will have a block sat on it (and fixed to it by ply straps or similar) to take the fore-&-aft rails, which support the floors.

12.1.15 Mount the posts for Frame –2380 with cross rails as shown on the drawing. The posts are set on the inside of the jig base rails. Mount the frame, check the centreline and dwl and secure as usual.

12.1.16 Mount the posts for Frame –3150 with cross rails as shown on the drawing. The posts are set on the inside of the jig base rails. Mount the frame, check the centreline and dwl and secure as usual.

12.1.17 Fit the 45 x 45 fore-&-aft rails to take the floors, with their top faces accurately level and set at 150 below the dwl. The rails are 600 apart outside-to-outside. Sit the two floors, –2000 & –2765 on the rails, adjust them accurately to position, accurately square across the vessel and with their centreline accurately plumb over the jig centreline. Secure the floors in place with short lengths of timber screwed to the jig rails and cramped to the floors.

12.1.18 Mount the posts for Frame –4100. The posts are set on the outside of the jig base rails. Make the top of the posts at the dwl. Fix the cross rail at 361 above the dwl. An auxiliary cross rail (say 20 x 45) housed into the posts at about 600 above the dwl would provide extra stiffness to the frame. Mount the frame, check the centreline and dwl and secure as usual.

12.1.19 Mount the posts for Frame –4440. The posts are set on the inside of the jig base

rails. Fit the cross rail at 777 above the dwl. Mount the frame, check the centreline and dwl and secure as usual.

12.1.20 Fit the fore-&-aft rails for Floor –3625. These are fixed to the inside of the Frame posts and set with their top faces on the dwl.

12.1.21 Fit a similar pair of fore-&-aft rails running aft from the –4100 posts, screwed to the inside faces of the posts and set with their top faces at 115 above the dwl. Brace these rails back down to the posts as indicated on the drawing.

12.1.22 Fit the floors –3635 and –4580, set accurately in position, accurately level and with their centrelines plumb over the jig centreline. Secure in place.

12.1.23 The transom post is a single post on the centreline. It will house in an angled notch in the jig base cross rail so that its aft face at the jig base is 544 aft of Position –4580. The post is set at an angle so that its aft face at the top of the post (100 above the dwl) is 441 aft of Position –4580. Brace the transom post down to the jig rails so that it is held firmly in position. Fit a block on the post at Height 863 as noted on the drawing. Mount the transom on the post; check the dwl and centreline as usual; secure with a couple of screws through the post into the sternpost, Brace the transom square across the boat.

12.1.24 Have a good check round the boat that the frames are set square across, accurately on the centreline and accurately on the dwl. Then tack light braces from frame to frame and frame to floor to help keep them sitting square. Use one set of braces right round the boat just below the shelf notches. Use a second set at the bottom of the boat just outside the hog notches; and a third set around the bilge.

SECTION 13 - APRON

13.1 Laminating the apron

13.1.1 The apron is laminated up on the blocks and formers set in the jig. It is laminated from 8 off 5mm thick laminations 150mm wide. However, check that 5mm thick material of the sort you intend to use will bend round the jig former because timber does vary in its bendability and kiln drying also tends to make it more brittle. Warming the laminates with an hot air gun will increase its flexibility. If you can't easily obtain 5mm laminates, or you find that 5mm is too thick to bend successfully, then use 3mm Khaya sliced veneers which are readily available. 13 off 3mm veneers should be sufficient. Sometimes these veneers are slightly less than 3mm thick - often 2·8mm - in which case you will need more of them. You should be able to obtain the veneers sufficiently long (minimum 2300mm) for the lamination. If this is not possible, the veneers can be butt joined as you make the lamination provided the butts are staggered by at least 100mm.

13.1.2 After laminating the apron, it is easier if it can be removed from the jig to clean up and bevel. So cover the face of the jig

formers and the edges of the two frames with shiny brown parcel tape. This will prevent the laminations sticking to the jig and frames. Also tape up the faces of the frames in way of the lamination to prevent any runs of WEST sticking to them.

13.1.3 You will need some side pieces screwed to the jig former where it is only 110 wide, to bring it out to 152mm wide. The outside face of these will require shaping to the same shape as the jig former. These supplementary blocks need not be full length of the jig former but say roughly 100mm long with 100mm gap between. Also screw some pieces of ply to the sides of the supplementary blocks and the 150mm wide part of the former. These are to hold the apron laminations in place sideways so they need to stick up from the former at least 40mm. Fit four pairs of such side pieces one pair at each end of the lamination and two pairs about equally in between. On the 150mm wide block, pack out between the side pieces and the jig former with a few pieces of tape or thin slips of wood or card, so that the gap between the side pieces is a little greater than the width of the laminations (say 152mm for 150mm laminates). This allows the laminates to be pulled down to the former properly without jamming on the side pieces.

13.1.4 The inner 25mm of the lamination can start at the top at Position –965 (i.e on the fwd face of Frame –990) The final 15mm of the lamination can start further fwd if you wish - say about Position –550, to trim back eventually to Position –500.

13.1.5 Get out the laminations required for the apron. The first batch (the first 25mm thickness) should be 100mm longer at the stem head than the second batch; and the apron lamination should be longer than the stem lamination. So make the first batch finish 100mm above the jig base and the second batch about 200 above the jig base. Try one gently round the former. It should go round quite easily but as mentioned previously timber varies considerably in its toughness and ability to bend. If the lamination feels as if it won't go round, then play a hot-air gun on it in the area of tightest bend and this will help ease it round. If you have to do this, pick out the first batch of laminates (for the first 25mm thickness say) and pre-bend all these using the hot air gun. Don't aim the gun just at one spot, but play it over the whole area of tight bend.

13.1.6 Now cramp the first batch of laminates fully in place round the jig. Cramp at the aft end first, gradually moving along to the stemhead Don't tighten any of the cramps (except the first one) fully at first, thus allowing the laminates to move over one another to take up the shape. You will need a pair of cramps at each cramping position - and the cramping positions will need to be about 100mm apart in the tight area around the forefoot, with increasing spacings on the straighter sections. You will require a cramping bar under each pair of cramps. This is a length of timber about 150mm long x 30 wide x 25 thick (dimensions not particularly important). If you don't have enough cramps, then make up pairs of cramping bars about 220 long x 40 wide x 25 thick, with a pair of black iron coach bolts (M8 or M10 would be suitable sizes) or similar passing through them

each side of the lamination. These will work just as well as cramps. Instead of bolts you can use a spanish windlass. A spanish windlass consists of a loop of rope (say Ø6mm) tied around the two parts to be pulled together (in this case the ends of the cramping bars). A bar (say a length of Ø8 steel rod, or a screwdriver) is passed through the loop and twisted round and round to tighten the loop up and pull the parts together. The length of the loop is adjusted so that pressure is exerted after just a few turns. Once the windlass has achieved the necessary pressure, the turning bar is prevented from untwisting, usually by tying one end of it to something - or slipping one end of it over a nail driven in one of the cramping bars. This may all sound rather cumbersome and indeed too many spanish windlasses in a small space can get a bit confused; however they are effective and cheap, easily adjusted to suit a variety of cramping situations and can be quickly knocked up when you run out of cramps for example.

13.1.7 Whatever system or mixture of systems you are using, have a dry run (no glue) to check that it all works OK and that you have sufficient material and equipment to hand. Cover the cramping bars and the feet of the cramps with parcel tape or masking tape so that they don't get stuck to the lamination.

13.1.8 Mix up the WEST resin and hardener. Divide it into two portions. Add #403 microfibres to one portion (to a stiff mayonnaise consistency).

13.1.9 Lay the first laminate down on the bench and wet out the top surface with plain WEST resin/hardener. Lay the second laminate down and also wet out the top surface with plain WEST resin/hardener. Apply the WEST/#403 to the wetted out surface of the first laminate. Lay the second laminate on top of the first, wetted-out face downwards. Wet out the top surface of the second laminate. Now wet out one face of the third laminate; apply WEST/#403 to the wetted out top surface of the second laminate; lay the third laminate on top of the second, wetted-out face downwards. Proceed in this way until all the laminates are piled up on top of each other.

13.1.10 Pick up the bundle of laminates and lay it over the jig. Make sure that the laminates are pushed fully home against the fwd face of Frame –1000. Get the first cramp on and tighten up. Now cramp the lamination into place working gradually towards the stem head. As with the dry run, don't tighten any of the cramps (except the first one) fully at once but gradually tighten them all up, working from the aft end to the stem head each time so that the laminates can slide over each other as they take up the shape.

13.1.11 Clean of as much excess WEST as possible and allow the lamination to cure for at least 24 hours at a minimum of 10ºC, preferably 15ºC.

13.1.12 Once the WEST has gone off most of the cramping systems can be removed. Leave the aft end and stem head cramps in place to hold the lamination still firmly on the jig. Ease the rest of the cramps off gradually rather than just taking them off willy-nilly. The lamination is not fully cured yet so

requires care.

13.1.13 Now the final batch of laminates (15mm thickness) can be bonded on. These start at about Position –550 and finish about 200 above the jig base.

13.1.14 Prepare the laminations, wet out and apply WEST/#403, and bond into place in the same way as for the first bunch. Clean off excess WEST as usual. Leave to cure rather longer than the minimum, because the lamination is going to be removed from the jig for cleaning up and bevelling.

13.2 Finishing the apron

13.2.1 Once the apron lamination is cured hard, remove the cramping systems, apart from the first and last on the first batch - so that lamination still remains in its correct position on the jig. Scrape any excess WEST off the sides and outside face of the lamination. Mark the centreline up the outside face of the lamination. Mark in the sheer line at dwl + 1038. Mark in the cut-off lines for the hog laminations at –500 and –900, across the face of the lamination. Mark in the dwl and wl 100, wl 200, wl 400, wl 600 & wl 800 across the outside face and along the sides. Mark in Positions 000, –150, –300 and –500 on the face and sides. Remove the lamination from the jig.

13.2.2 Refer to the faying surface drawing, Plan No. 119/003/04. A faying surface is the bevelled off surface that the planking sits on. You will see that the shape of the apron is given for the wl's and positions marked out.

13.2.3 On the outside face, mark a line parallel to the centreline each side of it and 30mm out from it - to give the stem width of 60mm, which is also the width of the outside face of the apron.

13.2.4 Transfer the centreline to the inside face of the apron. At each waterline and at the sheer, mark in the offset "O_2" each side of the centreline. At Position –150 mark in the offset shown on the drawing (56mm) each side of the centreline. The inside face of the apron runs out to full width (150mm = offset 75mm) at Position –290. Join the marks with a batten to give a fair line. The shape may look slightly strange but it is a function of the hull shape and the stem curve and angle.

13.2.5 At Position –500, you will see from the drawing that the bevel starts 20mm from the inside face down the sides of the apron. So, on the sides mark in a line running from 20mm down at –500, off to nothing at –290.

13.2.6 Cut off the top of the stem at Height 1038. This is the apron height on the centreline; at the sheer the height is 1034, reflecting the camber of the deck. Leave the head of the apron square across at the moment at Height 1038. Save the bit you have cut off because this will be fixed back on to the jig to provide a blocking to cramp the top part of the stem lamination to.

13.2.7 Plane off the faying surfaces to the lines marked out. Plane off so that the lines are only *just* showing; if the apron is left too big, the planking won't fair in nicely. After Position –500 the bevel will be planed off once

the hog is laminated into place, so just let the bevel fade out quickly for the moment.

13.2.8 Cut the steps at the aft end at –900 and –500 for the hog laminates to fit into.

13.2.9 Clean up the square sides of the apron.

13.2.10 Fit the bit cut off the stem head back on the jig, and screw it in place. Remove the parcel tape from Frames –300 and –990. Try the apron in place - it should pull cleanly down on to the jig. Drill for a screw through from the jig stem former into the apron, near the head of the apron (about 100mm down)

13.2.11 Now bond the apron in place - it bonds in the notch in Frame –300 and the ends of the inner 10mm bond to the fwd face of Frame –990. The hog will be laminated next, in situ on the jig. The apron can be cramped to the jig for the time being to retain it in place and the temporary screw driven at the head.

SECTION 14 - HOG

14.1 Laminating the hog.

14.1.1 The hog consists of two 15mm thick laminations 150mm wide. Fwd they fit into the stepped lamination of the apron. Aft they fit on to the end of the sternpost, which has already been cut to the correct bevel when the transom was made.

14.1.2 Get out the two lengths of timber for the hog, leaving some extra length (about 100mm) for the moment.

14.1.3 Fit the inner lamination into the notches in the aftermost two frames and three floors, with the end of the lamination pushed up against the transom. If necessary ease the sides of the notches so that the hog lamination pulls down easily. Mark the transom angle on to the lamination. Lift the lamination out and cut the aft end off to the correct angle.

14.1.4 Refit the inner lamination full length now, with the aft end pushed up hard against the transom. Mark the fwd end to length to fit into the step in the apron. Cut the fwd end. Make sure that the action of pulling the hog lamination into place does not displace the frames. Add additional bracing from frame to frame if needed.

14.1.5 The inner lamination can now be bonded into place. You can drive permanent fastenings into the frames, floors and the transom to hold the lamination in place while the WEST is curing. Drill off for these fastenings - not too near the outer edges fwd or else the screw heads will be a nuisance when planing the bevels on. Use $1^{1}/_{2}$" x 8g into the frames and $^{1}/_{2}$" x 6g into the transom.

14.1.6 Remove the lamination. Wet out the inner face in way of each frame, the transom and the apron step. Wet out the frame notches, the apron step and the sternpost end. Wet out the ends of the lamination thoroughly. Apply WEST/#403 and bond the lamination in place. Cramp the fwd end to the apron. Clean off excess WEST and allow to cure as usual.

14.1.7 Fit the outer lamination in the same way. Prepare sufficient cramps to cramp it to the inner lamination. You can use screws, but these should be temporary or else they will get in the way when cleaning off the bevels.

14.1.8 Wet out the surfaces of both laminates, the step in the apron and the ends of the outer lamination. Bond the outer lamination in place. Clean off excess WEST and allow to cure. Remove the cramps and scrape off any WEST on the hog sides.

14.2 Bevelling the hog.

14.2.1 You will need a batten, rather more than half the length of the hog.

14.2.2 At each frame and floor position and at the transom, mark on the side of the hog where the edge of each frame (and the transom) intersects with the side of the hog - or where it would intersect if there were not a limber hole.

14.2.3 Lay the batten along the side of the hog so that it runs fair through the points marked. You may find that a small batten in the limbers (so that you mark on the top of it) is easier. Tack the batten in place and join the marks up fair. Do this full length, both sides. Mark the centreline down the outer face of the hog and then mark a line parallel to it each side and 30mm out - to give a full width of 60mm for the keel..

14.2.4 Plane off the outer face of the hog from the 30mm lines to the lines marked on the side to give the faying surface bevels. Don't stray into the 60mm flat down the centre for the keel. At the fwd end, fair the bevel into the apron bevel.

14.3 Centrecase slot

14.3.1 It is easier if the slot in the hog for the centrecase is cut at this stage. The slot in the hog is 46mm wide. It starts at Position –1910 and finishes at position –3125, on the fwd face of the frame.

14.3.2 Mark out the slot on the outside face of the hog. Bore a Ø10 hole in each corner and then cut the slot out with an electric jig saw, using the correct blade for hardwood of this thickness. Make sure the blade is sharp and cutting square to the base.

14.3.3 Take care that the blade doesn't snap off where it gets into deeper timber at Floors –2000 & –2765; with care it will cut through the floor.

14.3.4 Mark the 46mm width down the Floors –2000 & –2765 and with either a jig saw or a hand saw continue the centrecase slot right through the floors.

14.3.5 Clean up the inside faces of the slot with a sharp wide paring chisel. The slot can be a full 46mm in width as this will help retain WEST in the slot when the centrecase is slid in. In fact, if the slot is 46mm on the outside and about 50mm on the inside, then this will provide for a "wedge" of WEST to bond the case to the sides of the slot. The gap in the frames and floors can remain at a full 46mm - the taper for the wedge of WEST should not continue on in them.

14.3.6 WEST coat the inside of the slot and the cut-outs in the floors.

14.4 Outboard well

14.4.1 The hog in way of the outboard well is cut out later, together with the keel and planking in the area. Otherwise it is difficult to get the planking to run nicely.

SECTION 15 - KEEL

15.1 Laminating the inner keel.

15.1.1 The inner part of the keel consists of the inner full length laminate and the inner aft end laminate. Both are 60mm wide x 20mm thick.

15.1.2 Get out the material for the inner laminate, a little over-length as usual.

15.1.3 The fwd end of the laminate starts at Position –750. Sit the laminate in place on the hog and cramp it to the hog. Check that it fits down to the hog and transom nicely. It is worth driving a few pairs of nails into the hog each side of the keel laminate to make sure it stays on the centreline

15.1.4 In way of the 375mm length for the outboard well, carefully cover the outside surface of the hog with parcel tape, so that the keel does not stick to it. Be absolutely sure that the tape is placed accurately so that the ends of the keel once the outboard well piece is cut out are properly bonded to the hog.

15.1.5 Wet out the bonding surfaces of keel laminate, hog and transom, and cramp and bond the keel laminate into place.

15.1.6 The aft end inner laminate starts at –3100. Get this out and bond it to the inner laminate. Cramp a few side pieces on the inner full length laminate to make sure that the aft end laminate stays accurately on the centreline.

15.1.7 Cut the aft end of the laminates off flush with the aft face of the transom and at the transom angle.

16 1 8 Cut the centreboard slot in the keel. The slot in the keel is shorter and narrower than the slot in the hog. the slot starts at –1940 and finishes at –3100. The slot is 28mm wide. So mark the slot and cut it out with a jig saw. Clean up the inside of the slot and WEST coat it.

15.1.9 Don't cut out the 375mm long section of keel in way of the outboard slot at this stage - it will help stiffen the structures for the time being.

15.2 Aft deadwood.

15.2.1 Refer to drawing 119/005/02. The aft deadwood can be made from a single piece of 60mm finished thickness timber, or it can be built two (or more) pieces bonded together. This will depend on what timber you can obtain and whether or not you can machine it or get it machined to the correct thickness in the one width. If you are making the deadwood from a single piece of timber it might be worth making a ply or hardboard pattern to lay on the timber so as to be able to choose the best way to cut it to avoid splits

and defects. Note that the radiused chock at the back end is made and fitted later.

15.2.2 If you are bonding two or more pieces together, it is probably easier to run them parallel to the underside of the deadwood as this is straight.

15.2.3 So, if you are making it from several pieces, bond these together in the usual way. Use some lengths of timber cramped lightly across the lamination to prevent it buckling up when the parts are cramped together, particularly if you are using spanish windlasses to pull the parts together.

15.2.4 Once you have the timber, either a single piece, or several pieces bonded together, mark the shape out direct on the timber. The radiused chock is fitted later on once the keel base laminates are bonded on to the keel.

15.2.5 Cut the deadwood out - leave a little (say 5mm) on the underside in case the face mating with the keel inner laminates needs fitting. Plane the inner face up and try the deadwood on the keel. To check for high spots rub some chalk over the outer face of the keel inner laminate; place the deadwood carefully in position and just rub it back and forward a few mm. Lift the deadwood off and the high spots should have chalk on them. The fit doesn't have to be perfect because the WEST will fill small gaps. It is important however that the deadwood sits on the keel laminate so that it is vertical

15.2.6 Once you are satisfied with the fit, check the depth dimensions of the deadwood and plane off the underside to the correct depth. If it has got too small during fitting, you can bond a slip of timber on the underside to rectify this.

15.2.7 Cramp the deadwood in place and bore off for the M10 deadwood bolts. These are bored on the centreline through the deadwood, keel inner laminates and hog. Note that these bolts are only suitable in these positions in the outboard version of the boat. Use a piece of straight batten cramped up the side of the deadwood at each bolt position to eye up as a guide for boring square. Counterbore the underside of the deadwood for the heads of the bolts, plus a washer. Push a stick through the holes to check for the correct lengths of the bolts. The bolts can be made from lengths of rod, threaded each end. If this is not available you can use stainless steel studding with a nut & washer each end - though this would not be our preferred option. Stainless steel should be Grade 316 S16 or A4 (A2 is not good enough). As an alternative the bolts can be a good quality bronze (Silicon bronze or Aluminium bronze for preference).

15.2.8 Remove the deadwood and blow away all the drillings. Work as much WEST as you can down the bolt holes - a pipe cleaner glued to a stick is good for this. Wet out the bonding surfaces very thoroughly and coat the inside of the hog in way of the washers. Bond the deadwood in place with WEST/#403; drive the bolts and tighten the nuts up on the inside.

15.2.9 Clean off the excess WEST. Fill over the heads of the bolts (WEST/#403 will do for this). Allow the WEST to cure as usual.

15.3 Keel base laminations.

15.3.1 The inner keel base lamination is 60 x 19. it is bonded to the underside of the deadwood. Its fwd end starts 58mm aft of Position –3140. The aft end will finish at the transom angle continued down. For now we shall make the laminate about 50mm longer than is required.

15.3.2 Get the material out for the laminate and bond it to the deadwood. You can cramp it if you have cramps long enough. Otherwise screw it using $1^{3}/_{4}$" x 10g screws countersunk below the surface. Screw about every 100mm staggered from side to side.

15.3.3 Fit and bond the outer base laminate (which is 30 x 60) in a similar way. Aft of the deadwood, cramp the two laminates together; otherwise screw or cramp as necessary. The fwd end starts at 110 aft of Position –3140. Screws should be $1^{3}/_{4}$" x 10g counterbored for dowels. Bond the dowels with WEST.

15.3.4 As an alternative the keel base can be made from a single piece of 50 x 60 bonded to the deadwood. Cramp or screw this (use 3" x 12g counterbored and dowelled over).

15.3.5 The aft end is trimmed off to the transom angle continued down.

15.3.6 Make the radiused chock between the aft end of the deadwood and the top of the keel base laminates and bond into place.

15.3.7 Trim up the scarph for the ballast keel. Sand the keel sides and the underside etc. and WEST one coat.

SECTION 16 - STEM

16.1 Making the stem.

16.1.1 The stem is made from 9 (tapering off to 8) 10mm laminates, 60mm wide. You can leave the stem 50mm to 100mm long at the stem head.

16.1.2 Check that 10mm will bend around the apron. Use a hot air gun to ease the laminates round if necessary. Otherwise use more, thinner laminates. The laminates are numbered 1 to 9 in the instructions that follow assuming that 10mm will bend round. If you use more, thinner laminates, note that the present laminate No. 8 is not full length - so you will need to emulate this situation with your thinner laminates. Obviously double the quantity of 5mm laminates make this very easy to achieve.

16.1.2 Bond on the inner two laminates first, with their aft ends butting up to the end of the keel full length inner laminate. Bond in the usual way, wetting out the bonding surfaces first; also wet out the face of the apron. Drive nails in the apron 60mm apart, to keep the stem laminations on the centreline.

16.1.3 After the first two laminates have cured, you can cramp some side pieces on them to keep the rest of the laminates from slipping sideways.

16.1.4 Bond on laminate Nos. 3 to 8. The aft end of all these can start at about –1000. The fwd end of No. 8 need not run much

further than shown on the drawing.

16.1.5 Plane off the face of laminate No. 8 as shown on the drawing 119/003/01.

16.1.6 Bond on laminate No. 9, full length.

16.1.7 Clean up the sides of the stem. mark the centreline around the outside face. The stem sides will be shaped up after the planking is completed.

16.1.8 Cut the ballast keel scarph.

SECTION 17 - SHELF

17.1 Fitting the shelf.

17.1.1 If you don't have long enough timber for the shelf, the scarph it up from two lengths - scarph 6 to 8 times the thickness. Make the shelf long enough to allow for a bit of fitting at the fwd end. Make sure that the timber for the shelf is wide enough. The notches are 50mm but have a habit of creeping a bit deeper sometimes when bevelling them. So, before getting the timber out, just check the depth of the notches and make your timber accordingly. In any case it does not matter if the shelf is, say 3mm too deep as this will get planed off when the hull is sheered down - i.e. when the sheer is planed off fair with the boat the right way up. Don't make it more than this however or else you will give yourself a lot of work planing the top edge off.

17.1.2 Where the shelf runs up to the stem, the height of the top edge is a little different from the height of the underside of the deck on the centreline, because of the deck camber. The top inner corner of the shelf is 1034 above the dwl where it meets the aft face of the apron (compared with the centreline height of 1038 on the jig drawing). However, if you have made your shelf a little deeper than finished depth, then don't forget the the top of the shelf will be that much higher at the stem as well.

17.1.3 The fwd end of the shelf butts on to the inner face of the apron, so that its outer face is flush with the faying surface on the apron.

17.1.4 Fit the shelf around the boat in the shelf notches up forward but with the aft end lying over the transom. Push the shelf fwd until the fwd end is hard against the apron. Cramp the fwd part of the shelf into the notches. Be careful when bending the shelf round that the frames are not pulled out of position. If you have trouble getting it round, just let the aft end lay away from the boat for now, supported so that does not break.

17.1.5 Mark the apron face angles back off on to the shelf, using a "dummy" if necessary. Remove the shelf and cut the fwd end. Fit it up again and adjust as necessary until you have a reasonable fit.

7.1.6 There is not much to fasten the fwd end of the shelf to at the moment (a breasthook will be fitted later), so screw a temporary piece of timber to the outside face of the shelf, and screw this temporarily into the apron faying surface.

17.1.7 Now, with the fwd end correctly in position we need to mark the aft end. If the shelf is difficult to pull round, fit the fwd end on the other side of the boat and then use a spanish windlass to pull both aft ends in together.

17.1.8 At the transom the shelf will lay on the edge of the transom until it is cut to length. Make sure that the shelf is at the correct height - on the sheer point of the transom (or slightly higher if you have made the shelf slightly deeper).

17.1.9 You will have to estimate the line to cut the aft end of the shelf as the action of pushing the shelf a further 15mm in will alter the angles etc. a little. As with the fwd ends, there is not much to support the shelf/transom join until the planking and deck is bonded on. Try to make the join as close as possible - though it is not finally of much structural significance.

17.1.10 Once you are happy with the fit of the shelf it can be bonded into place. It is probably best to drive some (permanent) screws from the shelf into the frames to hold the shelf in place while the WEST is curing. Use two 1" x 8g or 1·25" x 8g screws and drill off for these before the WEST is applied. Be careful to drill them parallel to the frame faces so the screws don't break out of the sides. At the aft end, screw a temporary piece of timber to the outside face of the shelf, and screw this temporarily into the transom edge.

17.1.11 Now bond the shelf in place with WEST/#403, wetting out thoroughly as usual. If the shelf was hard to pull round, leave the spanish windlass (or windlasses) in place until the WEST cures.

17.1.12 Fit and bond the other side shelf.

SECTION 18 - PLANKING

18.1 Inner skin.

18.1.1 The inner skin is 6mm Cedar or Douglas Fir strip planks fitted close.

18.1.2 There are usually three possible types of strip planking available (and in the UK, only in Western Red Cedar).

18.1.3 The first simplest style is square edged - simple rectangular profile planks, say 6 x 14. 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. 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.

18.1.4 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 god 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.

18.1.5 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 for 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. If you can't obtain this type - and we do recommend it - then 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 6 x 25, or a bit wider, say 6 x 30. 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.

18.1.6 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 for example, or Yellow Cedar, rather than the rather dark Western Red Cedar.

18.1.7 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 panel pins. The longest you can usually obtain these is 30mm, so the widest you planking can be is about 20mm - you wouldn't want to go much wider at only 6mm thick in any case.

18.1.8 Now one important point. The original design for this boat was for 9mm ply lapstrake and the frames are spaced for this. The spacing is fine for the tongue-&-groove type strip planking but may be rather too far apart for the other types. Offsets are included at the end of this instruction book for

temporary moulds to go in between the frames if needed, cramped to the fwd faces of the intermediate floors. Make any temporary moulds in two pieces (with a vertical join) so that they can be removed easily.

18.1.9 Assuming all is OK, or any extra temporary moulds are now in place, we will proceed with the inner skin.

18.1.10 The first plank will be bonded on with its edge flush with the edge of the sheer. We shall lay the planks groove uppermost, so that we can pour the WEST into the groove and it will mostly stay there. So on this first plank, the tongue will need to be planed off. The planking may not be long enough to go round in one length. There is no need to scarph the length 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 the frames, which are wide enough to take fastenings in the ends of both sections. The planks will be bonded to the frames and floors (and any other bits of structure available). It is also convenient to nail or staple them to the frames and structures. We prefer nails for this job - brass or stainless panel pins, or nylon nails. Take care driving the nails into the frames as it is easy to get the angle wrong and break out of the side faces. If this does happen it is best to deal with it immediately - remove the offending nail and bond the timber back down, with a bit of tape stuck over it to hold it down.

18.1.11 With a boat of this style, with a traditional stem, the plank ends fwd will have to be fitted. With a more modern style boat the stem is all internal and the planks just run over it to be cut off flush afterwards. The same is true to a certain along the backbone where our skin has to be fitted up to the keel. However, even on a more modern style boat, the planks have to be fitted to each other down the centreline, so here at least we don't really have any more work. At the transom, the planks can be left just overlength and trimmed back flush later, after the WEST has gone off.

18.1.12 So, fit the first plank, with its edge flush with the top edge of the shelf. Fit the fwd end first, angled off to suit the stem. Let the aft end overhang the transom a bit (say about 20mm). Bond the plank to the shelf, and the apron and transom faying surfaces fastening it as necessary Wet out the bonding surfaces as usual, including the fwd end of the plank (and any butt ends) and then bond with WEST/#403.

18.1.13 Fit the first plank on the other side. Indeed, we shall always keep the two sides of the boat about evenly planked - DON'T plank up all one side first, else you will tend to pull the frames out of square.

18.1.14 Get out the second plank and fit the fwd end (and any butts). Wet out the two edges with a small brush (cut the hairs off quite short); wet out the surface of the plank and the ends, the shelf, and the transom and apron 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.

18.1.15 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 plank so that you know where to wet it out. 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.

18.1.16 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, don't leave it until later. 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.

18.1.17 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 6mm 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

18.1.18 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.

18.1.19 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.

18.1.20 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.

18.1.21 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.

18.1.22 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.

18.1.23 If you are not going to form a tongue on the stealer (because you maybe don't have the necessary spindle or router), then fix the plank up as described but dummy off 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 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.

18.1.24 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 over 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.

18.1.25 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.

18.1.26 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.

18.1.27 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.

18.1.28 Going back to our original method now, as you near the keel, you will start to need to fit the ends to the keel. This will probably happen first up fwd with a gradual transition from fitting the ends to the stem, to fitting them up to the keel. It will also happen aft eventually, so you will be getting (banana shaped) planks that need fitting at both ends.

18.1.29 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 - the computer says so and, more importantly, previous boats have been so.

18.1.30 There is one area that can get unfair rather easily however and this is around the forefoot. Boats like this with fairly full lines and quite upright stems are changing shape very quickly in this area, so a quite tiny amount of error around the bottom end of Frame –300 can show as an unfairness. The error may not be on the frame itself, indeed it is more likely to be insufficient material cleaned off the apron faying surfaces from about –300 up round to 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 a bit of material off the apron or the frame (whichever you need to cure the problem). Elsewhere, on the boat with the gentler curves, minor errors (indeed often quite big ones) will not show up so much.

18.1.31 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, flush with the transom aft face. 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.

18.1.32 You are now ready for the next skin.

18.2 First diagonal skin.

18.2.1 The first diagonal skin is 3mm Khaya veneers laid at about 45º over the outside of the strip planking. The final skin will be the same, but laid at 45º in the other direction (i.e. at about 90º 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.

18.2.2 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 6mm legs for the inner skin - they can have 8mm or 9mm legs for the outer skin if required. 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 30,000 to 40,000 staples in all; they usually come in boxes of 10,000.

18.2.3 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 cedar. 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.

18.2.4 A second tacking stapler is also useful - this is the same type of machine but driving 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 the thickness of these (say 9mm if using 3mm hardboard). 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.

18.2.5 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 45º. Mark a 45º line at your starting position, using a batten bent round the hull.

18.2.6 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.

18.2.7 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.

18.2.8 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.

18.2.9 So, get the first laminate out at a width that will use your veneers economically - not much narrower than 100mm and not much 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 with the end close up to the keel and mark off the keel 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.

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

18.2.11 Wet out the surface of the veneer and then apply WEST/#403. A good even coat is required; you may find that a notched spreader is 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.

18.2.12 Lay the veneer back on the hull and push the end firmly up to the keel and tack a corner in place. Smooth the veneer down round the hull so that it runs roughly on the 45º line on the hull and tack the top end. Return to the keel 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. If you find that the inner hull is 'bouncing' so that the staples don't drive properly, you will need a helper to hold on inside with a dolly made from timber with a soft pad on the end (to prevent marking the inside of the hull).

18.2.13 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.

18.2.14 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.

18.2.15 Get out the material for the next veneer and lay it alongside the previous one. Mark and fit the keel 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 (an 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.

18.2.16 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.

18.2.17 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.

18.2.18 Continue in this way until all the veneers on one side are fitted. As you go fwd, you will gradually be fitting the veneers to the stem rather than the keel. Aft, they will overhang the transom to be cut off once cured. If the angle of the veneers starts to get extreme, then fit a tapered veneer or two to restore it near to 45º.

18.2.19 Veneer the other side in the same way.

18.2.20 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 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 fill, 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.

18.3 Outer diagonal skin.

18.3.1 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.

18.3.2 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. With this skin take more care fitting the ends of the veneers to the keel and stem as well

18.3.3 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 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 keel 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. If at all possible have a test run to ensure that you've got the right tape.

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

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

18.3.6 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 with the keel and stem are carefully filled. WEST/#406 silica makes a smoother filler than WEST/#403.

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

SECTION 19 - KEEL DEADWOODS, STEM & BILGE RUNNERS

19.1 Keel deadwoods

19.1.1 The keel deadwoods fit each side of the keel inner laminate, on top of the planking. Their purpose is to swell the width of the keel out to 120mm in way of the ballast keel. The bottom face of the deadwoods will be flush with the face of the keel inner laminate and level across.

19.1.2 The fwd ends of the deadwoods can start at Position –825; the aft ends will finish at Position –3250. The final 150mm of the ballast keel each end tapers off in width from 120mm to 60mm and also is angled off to form a scarph with the stem laminations fwd and the aft deadwood aft. Where this occurs, you will need to bond on a triangular shaped fairing piece to the sides of the stem and the sides of the deadwood. These pieces, together with the keel deadwoods can be then be faired off from 120mm full width to 60mm full width, to follow the ballast keel.

19.1.3 Establish the amount of bevel required by tacking a short length of straight timber to the outer face of the keel and measuring down to the skin at 30mm offset (i.e adjacent to the keel side) and 60mm offset (i.e. the outside of the deadwoods). The bevel will be the inner measurement subtracted from the

outer. Take this bevel about every 200mm along the deadwood length. The largest outer measurement will also give you the minimum thickness of the timber for the deadwoods.

19.1.4 Get out the basic material for the keel deadwoods. Each deadwood can be in more than one length if this is more convenient - and the lengths can be butt joined together on the job. The timber will need to be say 5mm thicker than your largest measurement to allow for fitting.

19.1.5 Mark the amount of bevel to be taken off the inside of the deadwood, at the 200mm intervals along the deadwood and join the marks as usual. Plane the bevel off the top face of the deadwood. Plane a small chamfer off the inside top corner, to ensure a tight fit up into the keel/skin "corner".

19.1.6 Bend the deadwood around the boat, close up to the keel sides. Cramp it sideways to the keel - you can hold the deadwood down by temporary strips fixed across the keel. Check for fit to the skin - adjust if necessary.

19.1.7 It is probably much easier to clean the outer faces of the deadwood off flush with the keel laminate on the boat after the deadwoods are bonded on - so we will leave it proud of the keel laminate for now.

19.1.8 Drill off for fastenings down into the skin/hog - $1^{1}/_{2}$" x 8g screws about every 150mm. Alternatively, you can just have one or two screws to position the deadwoods and apply pressure with cramps sideways and pieces of timber fixed across the keel for downwards pressure. Keep screws clear of where you will bore off for keel bolt holes.

19.1.9 Bond the deadwoods to the skin and keel sides.

19.1.10 When the WEST has cured, clean off the outside face of the deadwoods flush with the face of the keel inner laminate and level and flat across.

19.1.11 Fit and bone on the triangular pieces each side each end and, when the WEST has cured, plane to outer faces of these off flush with the outer faces of the scarphs.

19.1.12 Taper the width of the deadwood ends and triangular pieces off from 120 full width to 60mm full width .

19.2 Bilge runners

If you are going to glass cloth the hull (see §20.1) don't fit the bilge runners until after you have done this.

19.2.1 The bilge runners can be any reasonable size - say 30 wide x 25 thick. They are screwed (use $1^{1}/_{2}$" x 10g) about every 125mm) and bonded on to the skin at about 600 out from the centreline, running in to about 500 from the centreline fwd. Their actual extent lengthways is not particularly important, but from Position –1500 to position –3250 will be about right.

19.2.2 The last 100mm each end can taper from 25mm thick down to 12mm.

19.2.3 You can fit brass strip (25 x 3 or

similar) to the underside of the bilge runners. Bore off for this at about 100mm intervals - but don't screw the strip down until the hull is finished off and WESTed. When you do screw the strips on, bed them on Sikaflex 220.

19.3 Profiling the stem.

19.3.1 The stem is tapered from rectangular section 60mm wide at Position –750 to 60 at the root (say 10 to 15 out from the surface of the planking) tapering to 25 at the outside face by about Position –200. Thereafter it maintains this profile round the forefoot and up the stem to about height 700 above the dwl, when it flares out again to rectangular profile 60 sided.

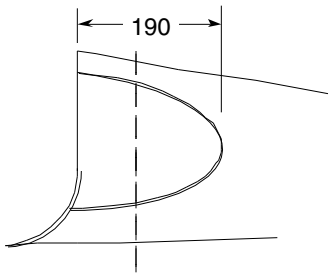
19.3.2 The top of the stem finishes level through at height 1100. Mark this now while you have the jig to measure from - but it will be easier to cut it off when the boat is the right way up.

19.3.3 Run a 3mm radius up the stem outer corners.

19.4 Aft deadwood profiling.

19.4.1 The trailing edge of the deadwood can be reduced in width to give a better water flow into the propeller.

19.4.2 The final width of the trailing edge can be reduced to 30mm (but leave the edge square across, not rounded off). This can be eased out back to the full 60mm width by about Position –4400. The reduced width will be scooped out rather like a half-saucer shaped depression, so that it everywhere fairs out to full width top and bottom:



19.4.3 Sand the deadwoods, keel and stem up smooth and WEST one coat. Allow to cure and sand lightly.

SECTION 20 - FINISHING OFF

20.1 Glass cloth

20.1.1 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.

20.1.2 Use a fairly open weave cloth about 200 g/m^2 to 225 g/m^2 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.

20.1.3 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 prefer wet lay.

20.1.4 On the hull, the cloth lays best like the diagonal veneers, draped in lengths at about 45º, opposite to the final veneer direction.

20.1.5 The keel, deadwood and stem 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.

20.1.6 Start with the deadwoods and aft keel area up to to where the ballast keel fits. You may need to radius off the keel and deadwood edges a little more to help the cloth drape easily. The keel edges must remain sharp however in way of the ballast keel. Depending on the width of your cloth this can be covered in a single horizontal run, covering the bottom face and both sides. If not, do each side separately, with a join on the bottom face.

20.1.7 Mask the hull a parallel 25mm away from the keel. Get out the length of cloth you need. Don't bother with the 50 x 60 bit of keel sticking out beyond the aft face of the deadwood as this can either be left without glass or done separately. When you cut the cloth stick a wide length of masking tape where you want to cut and cut down the middle of this - the cloth will then be prevented from fraying out. Large scissors (about 250mm or so blades) are best for cutting glass cloth.

20.1.8 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.

20.1.9 Apply a good heavy coat of WEST on the area to be glassed. Lay the cloth in place over the keel and press it down along the bottom face. Roll it down gently with the ribbed rollers, forcing the WEST to wet through the cloth. Smooth the cloth down the sides of the keel 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.

20.1.10 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.

20.1.11 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). Once the WEST has fully cured sand the edges on the hull skin to as feather edge.

20.1.12 Now cloth the area in way of the ballast keel in the same way, running 25mm on to the hull skin.

20.1.13 The stem is a little more difficult and is probably best done in short lengths the width of the cloth wrapped round the stem horizontally. You can overlap the joins 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.

20.1.14 Cloth the transom, wetting the cloth out so that it is turned on to the hull by 25mm.

20.1.15 Now we can turn to the hull. Start by getting a length of cloth out somewhere amidships. Cut one end to the keel angle and drape the cloth down over the boat. Cut the other end off roughly to the sheer. Leave the cloth a bit over length each end. Get out several such lengths.

20.1.16 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.

20.1.17 As the WEST is getting sticky, go back and cut the keel ends of the cloth off to fit just up to the keel side but not turn up it. WEST these ends well down.

20.1.18 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.

20.1.19 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.

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

20.1.21 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 and up against the keel and stem. The sheer will be finally cleaned off when the boat is the right way up.

20.1.22 Once the hull, keel, stem etc. are 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 §20.2

20.1.23 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.

20.1.24 Finally sand to a smooth matt finish overall, ready to start the final paint systems. Before the final coating is is a good idea to mark the waterline and boottop - see §20.2

20.1.25 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. A general trowel over the hull surface (as ¶20.1.23) is possibly the easiest way to catch all these. You can with advantage add #420 aluminium powder or to the final coat, to increase the hardness of the coated surface. Or, below 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 §20.2

20.2 Marking the waterlines

20.2.1 The waterline is marked at 75mm 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.

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

20.2.3 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 2000mm - 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.

20.2.4 Fix a long board (say 25 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 75mm above the dwl - You can measure this off the jig rails. The planks need to be about 3000mm long if possible, sticking out about equally each side of the boat.

20.2.5 The basic method of marking the waterline is to stretch a thin strong line (like fishing 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. The 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.

20.2.6 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.

20.2.7 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.

20.2.8 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 60mm.

20.2.10 The waterline can be marked straight across the transom. To look traditional, it can be marked in a half-moon rather than a straight line. Boottops are not usually marked across the transom - and certainly not if the water is marked as a half-moon.

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

SECTION 21 - BALLAST KEEL PATTERN

21.1 Basics.

21.1.1 To cast the keel the foundry will need a pattern. They will make this from the keel drawing, or you can make it yourself. If you make it yourself, the the responsibilities of the foundry (with regard to accuracy of shape and weight etc.) will be rather less - though of course they will be responsible for casting the keel properly from your pattern.

21.1.2 Basically the keel pattern is set in casting sand, which is packed firmly around it. The pattern is then withdrawn from the sand, leaving a mould into which the molten metal can be poured.

21.1.3 Some keels are of such a shape that neither they nor the pattern can be withdrawn from a simple mould like this, so then a split mould is made, so that it can be split in two to get the pattern out.

21.1.4 Your keel will probably be cast on its side so that there is a flat top for the molten metal to level to.

21.1.5 It is worth talking to the foundry

before you make the pattern to find out how they intend to cast the keel and whether they have any preferred methods of making or finishing the pattern. Please ask if you need more copies of the ballast keel drawing to send out for quote.

21.1.6 As the molten metal in the mould cools it will shrink. Thus to get a keel the correct size the pattern has to be made bigger to allow for this shrinkage. The foundry will usually quote you a shrinkage figure. If this information is not available from the foundry, then make the pattern 1·042% bigger. The allowance for shrinkage has to be applied overall. So, if you were positioning bolt holes on the pattern for instance you would make their spacing just over 1% greater than the real spacing - so the bolts spaced at 320mm on your keel would be spaced at 323mm apart, and so on.

21.1.7 To form the centreboard slot a "core" is required. This sits in the mould where the slot is required, so that, in the keel, a slot is formed. The foundry will make this as it is usually made from metal (often aluminium). You can indicate the position of the slot by a "core plug" on the top of the keel. This will be a strip of timber the width and length of the slot, and about 30mm high, bonded to the pattern. This gives the foundry a slot in the mould in which to place the core. You can do the same for keel bolt holes and the centreboard pivot hole if they are to be cast in.

21.1.8 However, for this keel, it is almost certain that the foundry will prefer to position the slot core themselves, so no core plug on the keel will be necessary. The same applies to the bolt holes and pivot hole - they will almost certainly prefer to drill these. So again check with the foundry first.

21.2 Making the pattern

21.2.1 The pattern can be made in a variety of ways - the principal requirement is that is is correct to shape (allowing for shrinkage), stable & strong, and well finished.

21.2.2 The two principal ways to make keel patterns are "bread-&-butter" or "planked". Bread-&-butter uses horizontal boards of timber glued one to the other to make up the pattern. Planked is built rather like a carvel boat hull - a top, bottom and planked sides on internal bulkheads. The planked method is usually used for large keels and the bread-&-butter method for smaller ones. The individual board of the bread-&-butter method can be hollowed out in the centre to reduce weight, leaving walls about 20mm thick.

21.2.3 For this keel the bread-&-butter method is the simplest and most effective and to keep the weight down and to ease handling, hollow out the bread-&-butter sections, leaving walls 25 thick.

21.2.4 The easiest way is to make the bread-&-butter slices vertical rather than horizontal.

21.2.5 Make a pattern of the keel profile (i.e. with the curved top and bottom edges) on thin ply. Make the keel pattern from dry 150 x 25 joiners quality softwood planed to a full

20mm thick, so that six pieces will make up the width of the keel pattern (121mm, including shrinkage allowance of 1·042%). The boards will need to be 2600mm or so in length. Don't forget to allow shrinkage on the lengths and heights when you mark out and make the pattern.

21.2.6 Also, try the ply pattern against the boat in the keel position, where the ballast keel will fit - it won't fit in the place because it is longer, but by holding it alongside you should be able to get a good idea how near your boat is to the theoretical shape. The curve won't be quite the same because of the shrinkage allowance on the pattern.

21.2.7 If your boat seems very different, then you can alter you ply pattern to suit your boat's shape. The eventual ballast keel will be bonded to the boat using WEST/#406 Silica and this will easily cope with gaps of up to say 7mm (it will cope with bigger gaps but you may feel that this is becoming unsatisfactory). Also the lead ballast keel will bend a bit to suit the boat - if the keel is cast iron, then it won't. Don't worry if your boat is a different shape: the accumulated small errors of making the components, making the jig and setting up and the stresses imposed by planking etc. can all cause such changes.

21.2.8 Lay the finished ply pattern on each of the planed up boards and mark out the keel shape. Dummy in to leave walls 25mm thick on the four boards to be used on the inside; leave the last 300mm each end solid. Cut the boards out to shape (leave a little oversize for cleaning up); cut the inside hollow out of the four inside boards boards.

21.2.7 WEST bond the boards together, making sure to keep the top and bottom of the keel square to the sides - you can nail the boards together to apply pressure while the WEST cures.

21.2.8 Once the WEST has cured, clean the keel pattern up accurately to shape, checking with the ply pattern.

21.2.9 Sand the pattern smooth and WEST at least two coats, so that the grain etc. is properly filled (WEST fill if necessary) and the keel pattern is a smooth, stable finish.

21.2.10 Ask the foundry whether they want any particular finish, marks etc. painted on.

21.2.11 If the foundry are going to bore the bolt holes, you can make an accurate ply pattern on the keel top (without shrinkage allowance) with the hole centres pricked through (1·5mm drill). They can lay this on the keel when cast to mark the holes out - and you can also lay it on the boat to drill the keel bolt holes. An alternative is to let them drill the holes by measurement (using the drawing dimensions) and then offer the keel up to the boat and spot the holes through. The bolt holes do need to be accurately placed because there is not much spare space around the case - make this point clear to the foundry.

21.2.12 Paint your name & address or some other identifying mark/number on the pattern - the foundry make quote you a job number for example.

SECTION 22 - TURN OVER & SET UP

22.1 Turning over

22.1.1 It is best to turn the boat over complete with the jig. This helps you set the boat up level - using the jig members for levelling. You will need some old tyres, old mattresses, or a big canvas cover(s) folded up - in fact anything soft enough to cushion the hull side and edge from the concrete floor and spread the load along the boat a bit. Then you can (with several helpers) pick up one side of the boat and roll her over, holding her at balance point while most of the people transfer to the other side to lower her down.

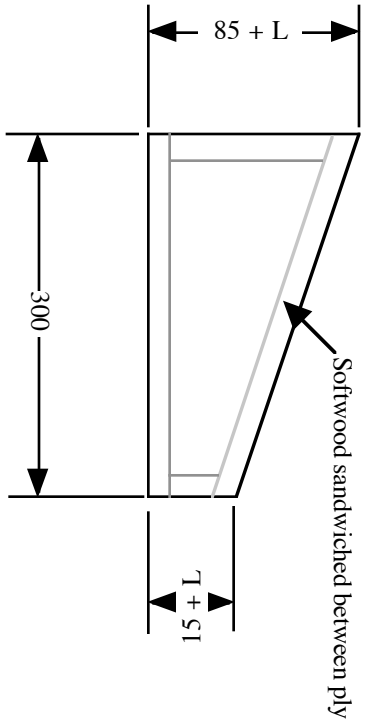
22.1.2 It has become traditional to have a drink of beer after the boat is turned over - and certainly the lure of a barrel of beer seems to produce helpers for turning over

22.2 Setting up

22.2.1 You should sit the keel on some blocks - three in the length of the boat at say, about –3625, –2380 and –990. Set the boat up on the fwd and aft blocks so that she is level fore-&-aft - you can use the jig rails to check for level. Then tuck the third, middle set of blocks in with a pair of folding wedges tapped home lightly. Folding wedges are a pair of very shallow wedges, driven one over the other from opposite directions, so they form a sort of expanding rectangle. Drive a couple of nails through the wedges to the block, so the wedges cannot work loose.

22.2.2 To hold the boat upright you will need some bilge chocks each side of the boat. The principal pair should be at –2380 so they bear on the hull in way of a frame and so that they can be tied in to the middle keel chock by timber braces. This will stop them working out with vibration as the boat is worked on.

22.2.3 Measure the depth from the underside of the keel lamination to the floor from the floor at about –2380 - call this "L". Make up four pieces of ply in a trapezium shape approx as follows:



22.2.4 Get out some softwood about 45 x

45 and sandwich four bits of this between two pieces of the ply to form a chock, shaped as above and nailed together. Nail a bit of ply about 100mm wide on the base and wrap the top face with some thin foam and canvas, or something similar just to cushion the top.

22.2.5 Push these chocks firmly in under the bilge each side and adjust until the boat is level across and cannot rock from side to side - i.e. so that the cushion on the top of the chocks is well compressed. Fix a couple of braces either from chock to chock, or from chock to centre block, to retain the blocks in place.

22.2.6 Make two further pairs of chocks of similar design, one pair on Frame –3625 and the other on Frame –1615. Tie these together with braces also, so they do not work out. Also tie the chocks together with lengthwise braces to further secure them in position

22.2.7 Finally check the boat for level both fore-&-aft and athwartships.

22.2.8 Remove the jig structure.

22.2.9 Lay some planks on the frames inside the bottom of the boat, so that you can walk about inside the boat and work comfortably. Wear soft shoes.

22.2.10 From time to time during the completion of the boat have a check to see that she is keeping level and the the chocks are all still firmly in place.

SECTION 23 - FINISHING INSIDE

23.1 WESTing.

23.1.1 Go over the inside of the planking and sand it smooth. WEST fill any defects, minor crevices between the planks etc. If the planks are not laying flush with each other, you will need to clean them off so they do. It is only worth doing this where they are visible in the finished boat - so sort this out, together with the furniture unit drawings etc. WEST the hull interior one coat and sand smooth.

23.1.2 Apply at two further coats, allowing the WEST to cure and sanding between each.

23.1.3 Then sand throughout, including all the frames and floors if necessary and WEST one further coat.

23.1.4 Allow the final coat to cure hard and sand matt and smooth.

END