

Boat 073 - Build Instructions Book 2

SECTION 6 - BACKBONE

6.1 Apron

6.1.1 The apron is 70mm sided (i.e. 70mm wide) and 40mm moulded thickness. It is made from 8 off 5mm laminates.

6.1.2 First of all get out a piece of 5mm material about the correct width and check that it will bend around the stem former without breaking. If it seems reluctant, you can heat it with an hot air gun, which will make it more flexible. If you have to do this, hold the laminate down in place until it cools, when it will retain much of its shape and next time it should bend round cold. If the laminate won't bend round the stem former, then it will be necessary to reduce the laminate thickness (and use more of them to make up the apron thickness). So 10 of 4mm or 13 off 3mm will do much the same job. Timber varies a lot in its 'bendability' from one species to the next; and kiln dried timber is generally stiffer and more brittle than air dried.

6.1.3 Having established the thickness of laminate required, get the correct number of laminates out at 70mm wide - they will need to be about 1200mm long, but check this by measuring around the jig stem post. Allow the for the top end of the lamination to come down roughly level with the jig base rails and the aft end to be about 50mm aft of Position -400.

6.1.4 Screw three sets of blocks on the each side of the jig stem former, one set at the start of the lamination (about Position -400), one set near the point of maximum curvature and the other set near the top end. The purpose of these blocks is to prevent the

laminates slipping sideways as they are bonded together. So that the laminates will slip easily between the blocks fit a piece of thin card between the blocks and the jig sides, so that the gap between the blocks is slightly in excess of the 70mm apron width.

6.1.5 Cover the surface of the jig former and the insides of the retaining blocks with shiny parcel tape, so as to prevent the apron lamination being bonded to the jig. We shall remove the apron from the jig after it has cured to clean it up and bevel off the faying surface (the faying surface is the surface that the planks will sit on).

6.1.6 Now have a dry run (no glue) and cramp all the laminates in place. Start at the aft end and work along the lamination pulling it down gradually. You will require cramping pieces (say 50 x 50 x 4 ply or similar) under the cramp feet so as not to make cramp marks on the face of the laminate (though these will be covered up by the stem laminations it is well to get into good habits early on). You may also need a few cramps sideways across the lamination to prevent the laminates sliding sideways between the retaining blocks. Under these cramps use a cramping piece say 30 x 30 x 60 long each side (parcel tape on the face laying on the lamination). Don't pull these sideways cramps up too tight too soon as you will prevent the laminates sliding over each other and pulling down to the correct shape. If this is happening just ease the side cramps off a little. If you run out of cramps you can use two lengths of square timber with a nut and bolt each end to pull them together.

6.1.7 Once you are happy that all works well and that you have enough equipment, the apron can be bonded together. Mix up the WEST and divide it into two; mix

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WEST/#403 microfibres with one half. Wet out the outer face of the first laminate and lay it down on the bench. Wet out one face of the second laminate and then apply WEST/#403 to the wetted out face of the first laminate; lay the second laminate WEST face down on the first laminate. Wet out the second face of the second laminate. Wet out one face of the third laminate; apply WEST/#403 to the upper face of the second laminate and then lay the third laminate WEST face down on to the second. Proceed in this manner until all the laminates are done.

6.1.8 Pick up the pile of laminates and lay them on the jig. Get the aft end in position, allowing the 50mm extra length and cramp the laminates down to the jig. Pull the laminates round and keep on cramping them down, working from one end progressively so that they pull round sliding one over the other. As you proceed you may need to fit the fit the side cramps and cramping pieces (cramp these fairly lightly until the laminates are pulled down fully). Go over all the cramps and pull them home - but remember that excessive pressure is counterproductive as it just squeezes all the WEST out of the joints. The fact of pulling the laminates down to the curve of the stem will by itself provide much of the necessary pressure. Clean off all excess WEST and leave to cure. Cure should be at least 24 hours at a minimum 10°C - preferably 15°C. It is helpful in cold conditions to arrange a cover over the lamination and put a small heater beneath - the fully enclosed tubular heaters are ideal for this purpose.

6.1.9 Once the laminate has cured off, remove it from the jig and clean it up. Refit it to the jig and mark a centreline down the outside face. Mark in the waterlines and

station lines shown on drawing No. 073/003/01. Remove from the jig again.

6.1.10 Around the outer face of the laminate mark a line each side of the centreline parallel to it and 20mm offset from it - these lines represent the width of the stem lamination

6.1.11 On the sides of the apron mark in the Φ positions/heights from the tables on drawing No. 073/003/01. Mark these from the sheer down to the dwl and also at s -65.

6.1.12 From the aft end through to s -200 mark a line on each side of the apron parallel to the outside face but 20mm up. Join the ends of these lines to a point 2mm below the dwl on s -65. This is the line of the top of the hog and the part of the apron lamination below this will be cut off flat across for the hog to sit on. Cut this off and plane flat and fair

6.1.13 Plane off the faying surface from the 20mm offset lines on the face of the apron to the Φ lines on the sides. The faying surface on the apron will run from the sheer to the dwl, where it will start to move on to the hog. The area just around the dwl and s -65 is probably best left until the hog is bonded in place so that the faying surfaces can be faired in.

6.1.14 Cut the aft end of the apron off at the -400 position. Replace the apron on the jig. Hold it in place with a screw right at the top end and cramps on the stem face. If this makes the aft end tip up away from the jig, screw a couple of side pieces on the jig top chock, cramp the aft end of the apron down and then cramp sideways across the side pieces to trap the apron and hold it in place so

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that the cramp at the aft end can be removed.

6.2 Hog

6.2.1 Now get out the timber for the hog 100 wide x 20 thick and about 50mm over length.

6.2.2 Lay the hog in place in the slots in the moulds with the aft end pushed up against the inside face of the transom. Ease the slots in the moulds if necessary.

6.2.3 Mark off the transom angle on the end of the hog. Remove the hog and cut the end off to the transom angle. Replace the hog in the moulds with the aft end again pushed firmly up against the transom. Cramp in place.

6.2.4 Mark the fwd end of the hog at Position -65. Measure 40mm from the inside face of the apron up the sides of the hog, from Position -200 through to Position -65. This line is the line of the outside face of the hog as it fairs into the outside face of the apron, but it is best not planed off until the hog is bonded to the apron.

6.2.5 Mark the centreline down the outer face of the hog and then mark the sides of the keel at 20 offset each side of the centreline.

6.2.6 Mark in the Φ heights on the hog sides at s-65, s-200 and s-400. Fix a batten on the hog side pushed down on to the edge of the moulds and running fair between them. Mark along the underside of the batten on to the hog side. Repeat this on the other side. Join these lines through to the Φ heights fwd and through to the transom edge aft.

6.2.7 The hog is bevelled off to give the faying surface between the 20mm offset lines on the outer face and the Φ /mould/transom lines on the sides. At the fwd end, leave the final bevelling off until the hog is bonded to the apron and can be faired in with the apron bevel.

6.2.8 Remove the hog from the moulds etc. It will be bonded to the apron at the fwd end and to the transom at the aft end. Cover any susceptible bits of the jig with parcel tape so that the hog does not get bonded to them.

6.2.9 Wet out the surfaces to be bonded with WEST in the usual way; particularly wet out the end grain of the hog at the aft end. Sand the WEST on the transom in way of the hog aft end, before wetting out. Apply WEST/#403 and cramp the hog in place, pushed firmly up against the transom (you can drive a temporary screw down through the hog into the jig transom post if required, or invent a variety of cramping systems to hold the aft end nicely in place). Cramp the fwd end to the apron. Clean off excess WEST and leave to cure.

6.2.9 Once the WEST has cured off, clean up the bonded areas of the hog as necessary and then fair in the outer surface and the bevels at the fwd end.

6.2.10 Mark and cut the slot in the hog for the centrecase sides - see drawing 073/004/03. The slot in the hog will be 35mm wide and 350mm long, starting at Position -1230 and running aft to Position -1580. The slot is best cut with an electric jig saw. Bore a small (about 10mm) hole at each corner to give the blade a start. Make sure that the blade is in good condition, suitable for cutting hardwood of this thickness and cuts

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nice and square. Try it out first on a piece of similar thickness scrap. Clean the sides of the slot out with a sharp wide firmer chisel. Make sure the slot is the correct width or slightly greater, certainly not under width or else the centre case slot will get too narrow for the daggerboard. Apply two coats of WEST inside the slot.

6.3 Stem

6.3.1 The stem is laminated in two goes, each being 25mm thick. If you needed thinner than 5mm laminates for the stem you may require them also for the stem, though the curvature is getting more open

6.3.2 The stem can be cleaned up after lamination either in place on the apron or it can be removed to be cleaned up. If you are going to remove it, then cover the outer face of the apron and hog temporarily with parcel tape; otherwise the first set of laminates are bonded directly to the apron and hog.

6.3.3 Get out the laminates for the first 25mm section. These start at s -500 and should run through to the top just a little shorter than the top of the apron so that the temporary screw can still be withdrawn.

6.3.4 Have a dry run to check that all is in order and that you have enough cramping equipment. Drive a few pairs of nails into the face of the apron to retain the stem laminations accurately on the centreline. You will need some side cramping pieces and cramps like you used with the apron.

6.3.5 Wet out the laminations and bond into place in the same way as you did the apron. If you are bonding permanently to the apron at this stage, wet out the outer face of

the apron and the inner face of the first laminate also before applying WEST/#403 and placing the laminate pile into place.

6.3.7 Cramp up and allow to cure. Clean off excess WEST as usual.

6.3.8 The second 25mm of laminates is applied in the same way, bonding permanently to the first set. The aft end of these starts at Position -200. Cramp side pieces up the sides of the first 25mm laminate to retain the second laminate accurately in place on the centreline.

6.3.9 Once the second set has cured off, clean up the stem sides. If you made the stem a removable lamination it can then be bonded permanently to the apron and hog (remove the parcel tape!).

6.3.10 Trim the aft ends off neatly square. The actual position of the aft ends is not vital within a few mm.

6.3.11 The top of the stem will be cut off to length later on when the boat is turned over. The sides of the stem will be profiled off after planking, so for the time being the stem is left square.

6.4 Keel

6.4.1 The inner and outer keel laminates are full length. The depth of the keel aft is built up from shorter laminates. All the laminates are 25mm thick x 40mm wide.

6.4.2 Get out the material for the inner laminate, a bit over length as usual.

6.4.3 Cramp the inner laminate on to the hog, with the fwd end pushed up against the

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aft end of the stem inner laminations. Mark the fwd end to fit the stem end and trim to suit.

6.4.4 When the inner keel laminate is bonded to the hog, you can cramp it or screw it down while the WEST is curing. The screws can be left in permanently. Which method you use will depend on whether you have enough cramps and whether you wish to be able to keep on working on the next keel laminates while the WEST cures. If you do use screws, you will need to bore them off dry at about 150mm spacings and staggered slightly (about 10mm each side of the centreline). Countersink them slightly so that the heads get filled over with WEST on the next lamination. Once bored off, remove the laminate and blow off any drillings. Remember not to drive screws just where you are going to cut the centreboard slot.

6.4.5 Drive a series of pairs of nails into the hog to keep the keel laminate accurately on the centreline.

6.4.6 Once you are all prepared, bond the inner laminate to the hog, stem and transom wetting out and then bonding with WEST as usual. Clean off excess WEST and allow to cure.

6.4.7 Trim the aft end off to the transom angle continued down. Cut the slot for the centreboard - remember that it is narrower and shorter in the keel. WEST the inside of the slot.

6.4.8 The second laminate starts at Position -1710 and runs through to the aft end. So get the material out and bond it to the inner laminate in the usual way. Don't arrange permanent screws in the area from

-1710 to -2265. Cramp side pieces up the sides of the inner laminate to retain the second laminate accurately in place over the inner laminate.

6.4.9 Now mark Position -2265 across the outer face of the second laminate. This is the start of the third laminate. The second laminate will be cleaned off so that it runs from zero thickness at its start at -1710 to full thickness at -2265. Mark these lines on the sides of the laminate and clean the outer face off to within 3mm of the lines, reserving the last bit for a final clean off before the outer laminate is bonded in place. Cut the aft end to the transom angle continued down.

6.4.10 The third laminate starts at -2265 and runs through to the aft end. The fourth laminate will start at -2572, so once the second laminate is bonded on to the second laminate it can be cleaned off from zero thickness at -2265 to full thickness at -2572 (but allowing 3mm on for final cleaning off).

6.4.11 Bond the third laminate in place as usual, retaining it sideways with side pieces cramped to the sides of the keel. Be careful that there are not lumps of WEST etc. on the keel sides and that the keel is cleaned up square and vertical sided otherwise the side pieces can get thrown off upright.

6.4.12 The fourth laminate starts at -2572 and runs through to the aft end. The fifth laminate starts at -2793 and runs through to the stern. Both are bonded in the same way and the fourth laminate is cleaned off from zero thickness at -2572 to full thickness at -2793. The fifth laminate is cleaned off to zero at -2793 to 24mm thickness at the aft end when it is cut off at the transom angle continued down (but again allow 3mm on for

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final cleaning off).

6.4.13 Now clean the final 3mm or so off the faces of the laminates so that they run fair from one to the other and into the inner laminate.

6.4.14 Now bond the outer laminate from the stem through to the transom, fitting the fwd end to the stem lamination. Cut the centreboard slot through the laminate as before. Trim the aft end. Clean off the keel sides. Clean off the aft end of the keel smooth. Fair the fwd end into the stem if necessary.

6.4.15 Leave the keel square for the time being.

6.4.16 At this stage WEST coat the faying surfaces and the first 20mm or so of the keel and stem sides two coats.

SECTION 7 - GUNWHALE

7.1 Fitting the gunwhale

7.1.1 The gunwhale will lay in the cut-outs provided in the moulds. At the aft end it will butt on to the inner face of the transom. At the fwd end it will blade off on to the side of the apron.

7.1.2 Get the material out for the gunwhale and try it round the moulds, with the aft end just over hanging the transom and the fwd end pushed as close as possible to the stem. Adjust the gunwhale so that it is at the correct sheer height in each mould, at the transom and at the stem. The stem and transom sheer heights are shown on the centreline structure drawing (073/003/01) and

the mould sheer heights are given on the temporary mould drawing 073/004/01. The cut-outs in the moulds should adjust the height automatically - but just check these all the same. If you cut some holes in the ply moulds you will be able to hook a cramp foot into them to cramp the gunwhale to the moulds.

7.1.3 Mark the side of apron angles off on to the end of the gunwhale and cut the end off. Trim as necessary so that the gunwhale blades off snugly on to the side of the apron.

7.1.4 Mark the aft end to suit the transom and cut this off to fit.

7.1.5 The gunwhale can either be bonded to the transom and apron now, or this can be left until it is time to fit the final plank. The problem with doing it now is that you will probably need to leave the cramps to the moulds in place and they are a nuisance sticking out. So, after fitting the gunwhales, we shall remove them from the boat and put them aside for bonding together with the final plank.

SECTION 8 - PLANKING

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

8.1 Marking out

8.1.1 There are nine planks each side of the boat and they are all going to show equal width at any one position. The first plank (abutting the keel) is known as the

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“garboard” and the final plank is known as the “sheer strake” - strake is another word for plank. The actual widths of the planks will be the width they show (the apparent width) plus the lap - apart from the sheer strake, which will be the apparent width (because there is no further plank to lap on top of it).

8.1.2 The first thing to do is to establish the distance around the perimeter of each mould and the transom from the keel to the sheer. This is known as the “half-girth”. The plank width at each frame will then be one-ninth of the half girth + the lap; the sheer strake will just be the plain one-ninth girth. In theory half-girths are as follows:

-500	746
-1125	918
-1750	960
-2375	870
Transom	707

8.1.3 Apparent plank widths will therefore be as follows:

-500	83
-1125	102
-1750	107
-2375	97
Transom	79

To these apparent widths, for all the planks apart from the sheer strake, we must add the lap to arrive at the actual plank widths. The lap is usually 3 times the plank thickness - so we can reckon on a lap of 30mm.

8.1.4 So, in case your moulds and transom are a little different from theory, measure with a tape around each frame from the rebate (the corner the keel side makes

with the hog) to the sheer and write out your own table of half-girths, apparent plank widths and actual plank widths (apparent + 30mm) for each frame position. Do this on both sides of the boat in case there is any difference from side to side. If there is a difference (of more than the odd millimetre) get rid of this in the first few planks, so by the time you reach the waterline the planks are the same on both sides.

8.1.5 Now mark the top edges of all the planks on the edge of each mould and the transom. The top edge of the garboard will be the actual plank width - all the rest will be the apparent plank width from each other, because they will lap on to the previous plank.

8.1.6 You will now need a batten to fair the planks in to the stem. Clean softwood is the best, though a bit of clean hardwood will do. The cross section should be about 15 x 10 (size not critical) and the batten should be long enough to stretch the length of the boat if possible, or at least the first three moulds.

8.1.7 Tack the batten so that one edge is on the lines for the top edge of the garboard, in such a way that the batten reaches the stem rebate. Hold the batten so that it lays on the stem and is taking up a fair line with the top-of-garboard marks on the moulds. Mark this line on the stem faying surface. Do the same with the top edge of the penultimate plank (the one before the sheer strake) and mark this on to the faying surface of the stem. Now measure up the angle of the stem the distance between these two lines and divide the answer by seven - mark off these distances, which should be roughly the top edges of planks 2 - 7.

8.1.8 Check each top edge to see if the

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marks on the faying surface of the stem do in fact run fair with the top edges of the planks previously marked on the moulds. You may need to make a few minor adjustments to allow for the fact that the stem angle is not constant. If everything seems very wrong, fair in the top edge of plank No. 2 as you did the garboard and then divide the remaining space by six for planks 3 - 7. Once you are into the fairly constant angle part of the stem the plank width (measured along the angle) will start to become also fairly constant.

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

8.1.10 You should also just check that the plank top edges run fair (as marked out on the transom) through to the transom. make any adjustments necessary.

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

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

8.2 Garboard

8.2.1 The next task is to establish the shape of the garboard to be cut out of the flat ply sheet, so that when it is laid around the boat it is the correct shape and fits the keel rebate on one edge and the top-of-plank marks on the other. The garboard is in fact the most difficult plank as it has to fit into the rebate - all the remaining planks just have to lap over each other and look fair.

8.2.2 The method we will adopt for this (one of many variants) is to use a straight edge which is flexible enough to bend around the hull, but wide enough not to bend on edge. Two lengths of 6mm ply, about 150mm wide, scarphed or butted (with a butt strap) together would do this job nicely.

8.2.3 In fact it does not have to be a straight edge - the important thing is that it does not bend on edge. On bigger boats, one used several such battens fastened together following roughly the run of the plank (a "banana" shape). This reduced the distance to measure from the edge of the battens to the plank line and thus reduced the inaccuracies. However, we will start with a straight batten - let us call it the "pattern". We use a "dummy" quite often from now on: a dummy is a small rectangle of thin ply or plastic - say 75 x 50 x 8 - with the sides accurately parallel and the corners square. You lay the dummy with an edge against the item you wish to copy the shape of and draw it along holding a pencil on the opposite edge to transfer the shape to the pattern (or whatever)

8.2.4 Lay the pattern on the boat, up near the keel rebate - so that its edge is as near the rebate as it will go without bending the pattern on edge. This is most important - don't try to spring it on edge, just let it lay

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naturally around the hull - we are relying on the pattern being essentially the same shape when laid flat as it is when curved around the hull. Tack the pattern in place so that it lays nicely on each mould and the transom.

8.2.5 Tick off the accurate position of each mould (choose the same edge, fwd or aft on each mould) on to the pattern. Now at regular intervals along the pattern (say every 200mm) make a mark and measure from the edge of the pattern into the rebate - note the measurement down on the pattern by the mark - try to measure square off. Towards the stem (for the garboard particularly) you may need to make the measuring points a bit closer together. You can dummy off the stem angle on to the pattern but this will only give you the angle not the actual position of the plank end because the pattern is not in the same place as the plank will be. So take sufficient measurements at the front end to enable you to cut the plank out a bit long for now - the plank will be adjusted when it actually fits up into the rebate. Do the same at the transom end. If the pattern sits quite close to the keel, then you will be able to dummy the shape from the keel directly on to the pattern rather than take measurements. Remove the pattern from the boat.

8.2.6 The garboard (and all the planks) will be made from two lengths of 9mm ply scarphed together. The scarphs will tend to be near one end of the plank and you should alternate this. On the garboard make the scarph near the aft end - there is a lot of twist fwd and fitting a short bit will be difficult. If you are not going for a clear finish, you can use the scarph to set the two parts at a slight angle to save width on the ply. So, decide where the scarph is going to be and mark this on the pattern - we are going to fit the

forward section first, so we need to mark the aft end of the scarph on the pattern. Allow yourself a bit of spare at the forward end for fitting into the stem rebate. It is best to arrange the scarph between moulds, not on them.

8.2.7 Now lay the pattern on the forward sheet of ply so that the scarph mark is at one end and so that there is enough ply beyond the pattern to measure back from the marks on the pattern with the measurements into the keel rebate as noted (§8.2.5). Transfer the mould and transom positions from the pattern to the ply. Also transfer the measuring ticks (at 200mm or less spacings, whatever you chose) and measure up from the edge of the pattern on to the ply the measurements noted by each position tick. If you were able to dummy direct on to the pattern, then dummy back on to the ply.

8.2.8 At the front end, dummy the plank end angle off from the pattern on to the ply. From the measurements you took, establish roughly where the plank end is and transfer the angle to this position.

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

8.2.10 Refer to your table of actual plank widths (apparent + 30mm) at each mould position. Mark off the actual width, measuring down from the line of the rebate edge drawn in §8.2.9. Do the same at the stem, measuring the width along the stem angle (dummied on to the ply). Join these

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points with a batten - again make it an average fair line. This line should be the top-of-garboard line that is marked on the mould edges.

8.2.11 This is one instance where we are not going to cut accurately to the line everywhere. Cut the rebate edge of the plank accurately to the line drawn, but allow 15mm on the line drawn for the other (the top) edge to allow for fitting the plank into the rebate. You will soon pick up how accurately you are taking off the plank shapes and be able to reduce this allowance as you proceed to the later planks. So cut the plank out.

8.2.12 Put the plank up on to the boat, with the mould marks in position over the moulds and as close as the plank will fit into the rebate and cramp it down. If it is a close fit (say within 2mm at the bottom corner - the gap will be wider at the top because the rebate is not 90°), then you can dummy off the stem angle/shape. If the gap at the bottom is more than 2mm, then mark the adjustments necessary using a thin piece of timber as a dummy against the keel side. Remove the plank and make the necessary adjustments.

8.2.13 Fit the plank up again and now dummy the stem end. Also check the gap at the top all the way along and note it at relevant intervals. Remove the plank. Cut the front end, leaving a little (say 5mm) on. Transfer the top gap measurements to the inside of the plank, join these up and plane the necessary bevel on the plank edge (as you did for the moulds). Fit the plank up again and check for a good fit (obviously, we can use the gap filling properties of WEST here if necessary - but it is nice to get the fit to about 1mm). Make a final dummy of the front end angle and bevel. Remove the plank

and make the final adjustments.

8.2.14 Now from the inside rebate edge of the plank, measure the actual plank widths on each mould position to give you a new top edge - join these with a batten and plane or cut (as appropriate) the new top edge - plane it fair. Mark the scarph at the aft end and cut the scarph (scarph length min. 6 and max. 10 times plank thickness). With the WEST™ scarpher this should be a one cut operation and the face of the scarph should not need cleaning up. Choose the scarph line across the plank to be as near possible at 90° to the plank edges at that point or else your scarphs won't fit very well.

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

8.1.16 The plank is bonded to the keel rebate and the stem rebate. Fit the plank up (yet again) dry and bore off for the fastenings - also just have a final check that the top edge of your plank is about on the top-of-plank marks on the moulds. Use 0.75" or 1" by 6g screws at about 150mm spacings into the hog (stagger these a little); four screws in two rows of two staggered, into the stem (these are called the "hood end" fastenings). If you are going to dowel over the screws (only necessary really above the waterline if clear finished), then use a Stanley "screwsink" to bore off for the screws - probably a good idea to use this in any case - and countersink absolute max. 4mm. If you are not going to dowel, then don't bore the countersink very deep - just about 1mm (the screws will pull

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just below the surface and can be filled over with WEST/#407) If you don't countersink at all, the screws will pull a dent in the surface of the ply which will be very difficult to fill nicely because it will have no very definite boundaries. Remove the plank, blow off the drillings and then bond it into place, using your usual process of wetting out first, then applying the #403 thickened resin as the glue.

8.1.17 You can now make, fit and bond the forward section of the garboard plank on the other side of the boat in the same way, except that you will have already marked an accurate shape out on the ply, using the first side as a pattern. So only the bevelling and the final fitting will be necessary.

8.1.18 The aft sections of both garboard planks are fitted in the same way as the forward sections. The aft end can be left long and trimmed after the plank is bonded on. The plank is made a little long at the forward end to start with to allow the scarph to be fitted. When gluing up the scarph, cramp spare pieces of ply (waxed or covered in parcel tape) both sides of the scarph to pull it together. If you are going to clear finish the hull, the scarph will need to be better visually than if you are going to paint the hull - the two parts squarer to each other and the feather ends straighter. Drive three hood end fastenings into the transom.

8.1.18 In the heyday of timber boatbuilding it used to be a matter of pride (not to say physical effort) to only have to offer up a plank once - called reasonably enough a "first time fitter" - and the inside face of the planks had to be "soled out" (hollowed out) to suit the hull vertical curvature as well. We maybe shan't quite have all first time fitters but you will find that

as you progress with the planking you will not need to offer up the plank many times to get it to fit. It is mostly a question of taking an accurate pattern.

8.1.19 Once the garboard planks are completed and the WEST™ has gone off hard, the plank top edges have to be bevelled. First of all make sure that the edges in way of the scarph is fair - if not just fair it up. Then run a pencil line (not a metal gauge mark) along the outside face of the plank, 30mm in from the top edge. A gauge made from an odd bit of wood with a 30mm (or better say 29mm) rebate in it does this job well - run it along the edge of the plank with the pencil held against the inner edge and this will draw a nice smooth line 30mm parallel to the edge

8.1.20 Now have a short length of stick (as long at least as the widest actual plank width). Lay this on the garboard at a each mould and the transom, so that the end of the stick is on the top-of-plank mark for plank No. 2. The gap between the stick and the 30mm parallel line will be the amount of bevel required. In practice, the stick may lay at a tangent to the edge of the frame before it reaches the top-of-plank mark for plank No. 2. - in which case this will still show the gap that equals the bevel. Make a note of the bevels at each frame - mark them on the edge of the plank and join the lines up. The plank is bevelled from the 30mm line to the bevel line on the edge. The bevel required should not anywhere be the full thickness of the plank - but if it does become so, then just take off to almost full thickness (leaving about 1mm on the top edge). When you are planing off for the bevel be careful not to plane more than 30mm in from the edge or more than the depth line on the edge - in fact just leave both pencil lines visible all the way along.

8.3 The rest of the planking

8.3.1 Now make the next plank - plank No. 2. This will have the scarph nearer the fwd end - but because there is still quite a bit of twist fwd, don't make the fwd bit too short else you will have difficulty in getting it to lay nicely in position. The plank sections are made in the same way as the garboard, using the pattern in exactly the same way. The only difference is that you will be measuring to the 30mm parallel line on the previous plank rather than into the keel rebate and the plank edge finishes square.

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

8.3.3 So when the forward section of the plank is fitted finally, but not fixed, draw with a pencil inside along the top of the garboard on to the inner face of plank No. 2, for a distance of about 350mm back from the stem. Take the plank off and turn it over. Cramp a little batten parallel to the line you have drawn but about 5mm nearer the bottom edge of the plank . Use a rebate plane - or any small plane the blade of which comes right to the edge. Plane out a rebate, starting a no depth about 350mm back from the end of the plank and arriving at the forward end to the depth remaining on the garboard top edge. The maximum depth of the rebate should not be more than 4.5mm - if it appears

to need to be more than this, a shallow rebate will have to be taken out of the garboard as well. This applies to all succeeding planks.

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

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

8.3.6 Carry out the same process at the aft end on to the transom - it is more important on the transom as if the planks are not flush on the inside there will actually be a hole through which water can pass (because there is no rebate). Again, WEST™ will however fill minor aberrations.

8.3.7 Plank No. 2 and succeeding planks are fastened into the hood ends (three into the transom, four staggered into the stem).

8.3.8 The planks are also bonded to each other along the 30mm wide lap. This is what gives the system much of its structural strength as well as watertightness, so a good bond is essential. The lap joints will need to be held together while the glue goes off. The usual way to do this is to have a series of ply

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rectangles about 100mm wide by about 50mm longer than the plank width, with a approx. 25mm wide slot cut in them, a little longer than the width of the plank. Together with these is required a fair number of shallow wedges, about 20mm wide - remember the longer the taper on a wedge the more effect it achieves, so make your wedges from nothing to about 5mm thick in about 50mm length . Pass the ply over the planks and drive the wedges between the ply “cramp” and the plank (in way of the lap) to hold the plank surfaces together. You will probably need two or three of these between each mould, maybe more in some places. In way of the moulds, an L-shaped chock cramped to the face of a mould with a wedge driven between arm of the “L” and the plank edge will also serve Don’t forget that an hot air gun will also help a recalcitrant plank to twist to shape - hold it in place until cool, when it will have taken up some of the shape required.

8.3.9 The sheer strake is fitted just like all the other planks but its top edge will be bonded to the gunwhale as well. The gunwhale was fitted in §7, but not bonded into place. Once the top strake is ready to bond, get the gunwhale and try it in (perhaps the boat has changed shape a little during building). Adjust if necessary. Wet out the gunwhale ends and bond it to the transom and apron side. Now immediately bond the sheer strake into place, bonding it to the transom, stem, previous plank and the gunwhale. Cramp the whole assembly lightly to the moulds (using the holes previously cut in§7) and cramp the strake firmly to the gunwhale.

8.3.10 The aft ends of the planks can be trimmed as you go to end flush with the face

of the transom.

8.3.11 When the planking is completed, the lands (the “corner” formed by the edge of one plank and the face of the next) are fillet jointed inside and out with WEST/filleting blend filler, which completes the structural bond.

8.4 Finishing off & filleting outside

8.4.1 Sand the hull exterior up smooth; make sure the plank ends at the transom are truly flush with the face of the transom and sanded off really smooth. WEST the hull exterior one coat, working plenty of WEST into all fastening holes. Don’t WEST the keel sides, keel bottom or the sides and face of the stem at the moment.

8.4.2 Fill (or dowel if the exterior is to be clear finished) over all fastening holes. If filling, use WEST/#407.

8.4.3 Sand the hull smooth again all over the outside.

8.4.4 Now the plank lands (the “corners” made by the lap of one plank over the other) have to be filleted. A fillet is a cove shaped application of thickened epoxy bridging an inside corner. Use WEST/#405 + #406 (in the proportions roughly 60% #405 and 40% #406) for this purpose.

8.4.5 For forming and smoothing the fillet you will need a narrow spatula with a rounded off end - the rounded off end will form the concave radius of the fillet. For a fillet this size something like a lolly stick is probably about right, but you will need to experiment. The arms of the fillet will be

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quite small - just the depth of the plank lands up the plank edges and about 10mm across the planks.

8.4.6 Filleting can be messy and a bit of practice on odd bits of timber nailed together to emulate the plank lands will be worthwhile.

8.4.7 Make a little dummy stick 10mm wide and use this with a pencil to draw a line on the surface of each plank 10mm away from each plank land. Stick masking tape along the surface of each plank with the edge on the 10mm parallel line. Also stick masking tape on the top edge of each plank immediately above the lands. The masking tape will make it much easier to finish the fillets accurately and not get WEST/#405/#406 spread about all over the planking.

8.4.8 You will need a piece of 10mm or 12mm ply about 250mm square, with a handle fixed centrally on one side of it (a 150mm length of broom stick does fine) - like a plasterer's hawk. Mix the WEST/#405/#406 to a non-sagging peanut butter like consistency and put it on the hawk - it will last longer spread out like this and excess material can be scraped back on to the hawk easily.

8.4.9 Using a trowel knife (about 50mm wide), trowel swiftly along the land, depositing a small but regular amount of WEST/#405/#406. Draw the spatula along pressing down quite hard so that the fillet runs off to a feather edge on the plank land edge and along the 10mm parallel line (marked with masking tape). Try to just have the one run rather than keep poking about with it. There will be a point in the cure of the WEST when it is ideal for smoothing -

but it is difficult to arrange for this to happen throughout. If the fillets sag away down the hull, then your mix is too thin. If the fillet material drags up very rough then your mix is too thick, or the WEST has started to cure beyond use. Remove the excess material (which should have deposited itself on the masking tape just clear of the fillet joint) using a narrow trowel, chisel or similar. Take care not to tear the masking tape. Make sure that the fillet joint is not running over the masking tape or else you will have difficulty removing it later

8.4.10 When the fillet joint has gone off, but not cured fully hard, pull off the masking tape carefully, bringing with it the remaining excess material.

8.4.11 When the fillet has cured fully, sand it up (using about 80 grit paper).

8.4.12 The joint between the garboard and the keel sides is not filleted. Any gap should be filled out flush with the surface of the planking, preferably with WEST/#406 colloidal silica.

8.4.13 Sand the whole hull exterior smooth and apply one coat WEST (but not the keel sides, keel bottom or the sides and face of the stem at the moment).

SECTION 9 - CENTRECASE & BILGE RUNNERS

9.1 Centrecase runners

9.1.1 The centrecase runners stiffen the keel sides in way of the centreboard slot. Their profile dimensions is shown on drawing No. 073/004/03. The runners are made

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550mm long so that they extend 120mm fwd and aft of the slot ends.

9.1.2 Get out the material for the runners and cut to length. Try the runners up in position against the keel side - they will need bevelling off on the underside to suit the keel/plank angle - the amount of bevel can be measured from the outside corner to the surface of the plank.

9.1.3 Bevel the runners and try them up again; adjust the fit as necessary. Run a small chamfer along the inside corner of the runners (so they can pull fully home). Drill off for 1½" x 8g screw fastenings at about 75mm centres driven square to the outside face of the runners (so they angle slightly into the garboard and hog) and countersunk 5mm maximum.

9.1.4 Remove the runners and clean off the drillings. Round the ends off in plan view and round them down in profile view.

9.1.6 WEST bond the runners to the keel sides and WEST bond and fasten them to the garboard.

9.1.7 Dowel over the screw heads (WEST bond the dowels).

9.2 Bilge runners

9.2.1 The bilge runners can be any reasonable size . It is useful to make them wide enough to be able to screw a brass strip on (say 20mm x 3mm flat). They are screwed (use 1" x 8g about every 125mm) and bonded to the lap of the third and fourth planks . Their actual extent lengthways is not particularly important, but from Position -1600 to Position -1800 will be about right.

Fastenings are not necessary, but probably the easiest way to hold the runners down.

SECTION 10 - FINISHING OFF OUTSIDE

10.1 Finishing off the keel & stem

10.1.1 The keel bottom is tapered in from 40mm full width at Position -2375 to 30mm full width at the back end. Mark this taper off on the underside of the keel and then plane off the keel sides to match. The taper fairs out about 15mm above the surface of the planking.

10.1.2 The stem leading edge tapers from 40mm full width at Position -1000 to 15mm full width at Position -200. It then remains at 15mm full width on the leading edge up to 350mm above the dwl. The stem then flares back out again to 40mm full width, square section all the way to the top.

10.1.3 Mark the taper and parallel lines on the faces of the keel and stem and plane the taper off, letting it run down the sides of the keel and stem as close to the surface of the planking as you can achieve conveniently - but not closer than 5mm.

10.1.4 WEST coat the keel and stem, two coats.

10.2 Chafe pieces

10.2.1 It is usual to fit chafing strips to the underside of the keel and bilge runners.

10.2.2 The chafing strips on the bilge runners can be 20 x 3 brass strip, screwed at 100mm intervals with 0.5" x 6g countersunk

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brass screws. Drill off for the screws and then work some WEST down the screw holes before driving the screws home. Bed the strips on to the runners with Sikaflex 221.

10.2.3 A 15 x 3 brass strip can be fitted to the face of the stem from dwl +350 round to the start of the centreboard slot. Then a similar brass strip each side of the centreboard slot, starting 100mm ahead of the slot and finishing 100mm astern of the slot. Then a centreline strip again, running from the aft end of the slot to the aft end of the keel. If you radius off the end of the keel (about 25mm radius) then the strip can be dressed round the radius and run about 100mm up the aft face of the keel. Screw these strips at 100mm intervals using 0.75" x 6g countersunk screws - WESTing down the holes before driving the screws home. Bed the strips on to the keel and stem with a smear of Sikaflex 221.

10.3 Finishing off

10.3.1 Have a good check around the hull to see if there are any holes, dents etc. that require filling. Pay particular attention to the plank ends fwd and aft to make sure there are no little holes through which water can enter. fill as necessary using WEST/#407.

10.3.2 Bring all areas of the hull outside to a full two coats of WEST.

10.4 Marking the waterlines

10.4.1 The waterline is marked at 50mm above (nearer the sheer) the dwl. This will be the antifouling line.

10.4.2 The waterline is marked in pencil before the final WEST coatings, so that it is

permanently visible.

10.4.3 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. 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.

10.4.4 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 50mm above the dwl - You can measure this off the jig rails.

10.4.5 The basic method of marking the waterline is to stretch a thin strong line from the top of the aft plank to the top of the fwd plank. Adjust the line sideways so that it just touches the hull about amidships. Tick off this point on the hull. Then move one end of the line in and the other out, so that the line just touches the hull about 100mm to 150mm away from the first place. Mark this point. Continue in this way, moving the line so that it lies tangential to the hull at about 100mm to 150mm intervals, marking each point off on the hull.

10.4.6 Your planks may not be long enough to mark the ends and then 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.

10.4.7 To mark the waterline in fully, you will need a batten and one or two people to hold it in place. Hold the batten around the hull so that it lays fair over the waterline

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marks. Mark the waterline in taking care to mark it fully into the plank lands.

10.4.8 The waterline can be marked straight across the transom. Or to look traditional, it can be marked in a half-moon rather than a straight line.

10.4.9 Then have a final sand over the hull and apply two further full WEST coats.

SECTION 11 - TURN OVER & SET UP

11.1 Turning over

11.1.1 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.

11.2 Setting up

11.2.1 You should sit the keel on two blocks at say, about -1000 and -2200. Set the boat up on the blocks so that she is level fore-&-aft - you can use the jig rails to check for level.

11.2.2 To hold the boat upright you will need some bilge chocks each side of the boat at about -1500

11.2.3 For each chock, make up two pieces of ply in a trapezium shape to sit on the floor and touch the hull. 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.

11.2.4 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 from chock to chock, to retain the blocks in place.

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

11.2.6 Remove the jig structure. The moulds can be dismantled by unscrewing the centreline butt strap and twisting the mould halves out. The hull should be quite rigid at this stage, but there is no need to remove the moulds permanently until the mid thwart and centrecase structure is completed. Leave them all in until you have faired the sheer (§12.1). Remove them to fillet and WEST coat the interior (§12.2) and then replace them when the WEST has cured.

SECTION 12 - INSIDE JOBS

12.1 Fair in the sheer.

12.1.1 You will need to run a plane along the top of the topstrake and gunwhale to set the sheer fair. The top edge is generally at 90° to the face of the top strake, but towards the bow this angle can flatten off a little.

12.1.2 When planing this use a plane with blade very sharp and set fine. Try to take a few continuous shavings off as full length as possible, rather than a lot of short strokes.

12.1.3 Eye along the sheer to see if it looks fair - put your eye right down close to one end and look along it. You will see any

serious bumps or hollows quite easily. If the gunwhale was set carefully to the sheer heights given, there should be very little fairing to do.

12.2 Filleting.

12.2.1 Remove the moulds. Sand the hull interior and WEST throughout one coat.

12.2.2 Fillet joint the plank lands inside in exactly the same way as the outside lands.

12.2.3 Sand and WEST coat the interior of the hull 2 further coats. The final coat will be applied when all the other structures are complete. Replace the moulds.

END

See Book 3 for:

Fwd thwart assembly
Mid thwart & centrecase assembly
Aft thwart assembly
Knees
Floors and sole boards
Finishing off

See Book 4 for:

Making the rudder & tiller
Making the spars and fittings
Making the rigging
Making the oars
Rigging & setting the sails