18. APRON AND STEM

18.1. Apron

18.1.1. Note that the current Jig drawing (Issue 01) does not show the final centreline structure configuration. Refer to the Profile drawing (Issue 03). The jig itself is correct.

18.1.2. The apron is basically 50mm moulded depth (thickness) and 132mm sided (width). It is laminated from 10 off 5mm laminates. It is as well to try a 5mm laminate around the curve of the stem former to make sure it will bend OK. Remember though, that when wetted out and with more than one laminate, they will bend more easily and to a tighter radius. If you are in any doubt however, you can thin your laminates down and use more of them to achieve the 50mm moulded depth.

18.1.3.

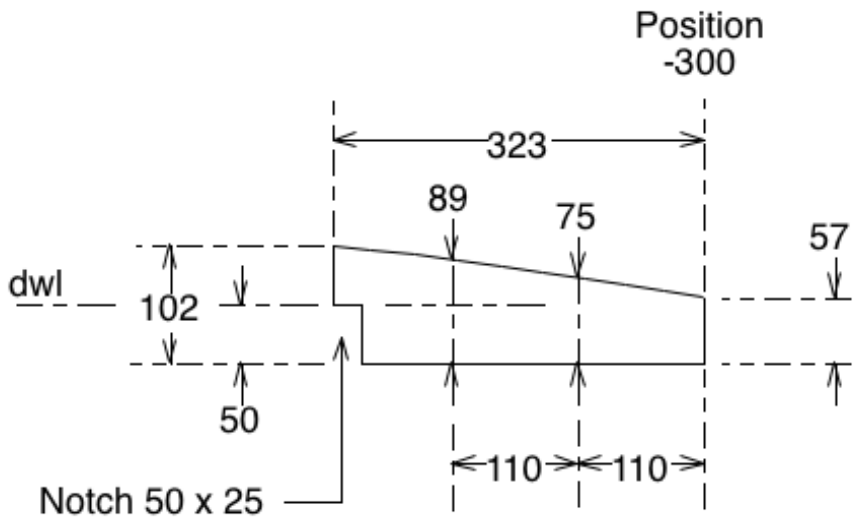
18.1.4. The apron joins to the hog with two staggered butt joins. As the two layers of the hog are 25mm thick, it makes sense to laminate up the apron in two goes, each 25mm (5 off 5mm laminates). If you are using thinner laminates, get as close to 25mm as you can with your laminate thickness.

18.1.5. The inner join comes in a slightly awkward place – in between Frame -300 and Floor -650. You can simply run the first lamination (the first 5 laminates) on to Floor -650 and then cut them back after the lamination has cured. Or you can in fact make the join to the hog midway on Floor -650, rather than as shown.

18.1.6. An alternative is to add in an extra former chock between the aft face of Frame -300 and the fwd face of Floor -650 – as the sketch below. At the aft end, add a 50 x 25 rail across the tops of the Floor -650 support brackets and notch the chock out to suit. At the aft end fix a rail across the support brackets with its to edge at 50mm above (nearer the jig base) the dwl.

18.1.7. If you are using 3mm laminates, then adding in the chock will help them run true.

18.1.8. You need to get your laminates out a little wider than the finished siding of the apron, to allow for cleaning up the finished lamination to the correct siding. By now you have probably made all your frames, so you have a handle on how much extra width you need to achieve the correct siding. If you haven't we would suggest 136mm as a laminate reasonable width. If you do make them wider than 132mm, you will need to trim them to width locally in way of the notches in Frame -300 and Floor -650, if you are running that far aft.



Chock 100 thick

18.1.9. Measure around the former to find the laminate length. The theoretical exact length of the inner laminate is 1516mm; and the fifth laminate is 1552mm. But lengths around you jig former may vary a bit from this and in any case your laminates need to be a bit longer than the finished lamination to allow for trimming and fitting. Probably about 1750 would be a good length if you have added the extra chock. Longer if you are going all the way to Floor -650. This allows sufficient length at the top so that the apron lamination extends beyond the stem lamination – so it can be temporarily screwed to the former while the stem is laminated.

18.1.10. If you don't have laminates of sufficient length, you can simply butt join them in the lamination - stagger the butts by at least 200mm.

18.1.11. The stem former is 100mm wide, so the laminates will overhang it each side by 18mm (if you have made your laminates 136mm wide). This allows you to screw blocks each side for the feet of your clamps as shown in the image to the right. The image shows the shelf in place, but we usually fit this later, after the stem and apron are complete and finished

18.1.12. You may also want to screw some guide pieces each side to retain the laminates correctly in line with each other as they have a tendency to slip when clamping.

18.1.13. Make sure to prevent your laminates getting bonded to the former, chocks and guide pieces – use wax polish, polythene, or shiny brown parcel tape as appropriate.

18.1.14. In the first instance we are going to bond the first 5 laminates in place (or a near-25mm thickness if you are using thinner laminates).

18.1.15. You will need clamping bars across the lamination with a clamp each side. Something like 175 x 50 x 25 (7" x 2" x 1").

18.1.16. If you don't have sufficient clamps, you can use two lengths of wood, say 225 x 50 x 40 (9" x 2" x 1½") pulled together with 8mm ($^5/_{16}$") or similar threaded rod, as a clamp. Or you can use a spanish windlass (see tools and devices) each end, but that can get a bit tedious and crowded.

18.1.17. Have a dry run to make sure the laminates will bend around the former and that your clamping and positioning techniques are satisfactory.

18.1.18. You can screw a block to the chock between Frame -300 and Floor -650 to locate the aft end of the lamination – you will probably get a little slippage, so it's best to locate the block about 10mm aft of the actual position. If you are running aft to Floor -650, clamp a block to the aft face of the floor to push the laminates up against.

18.1.19. Start by clamping the aft end of the laminates hard up against the aft end block. Then gradually ease them down, clamping as you go, until they are fully clamped to the former. make any adjustments to your clamping techniques as needed.

18.1.20. Once all is well, release the laminates and lay them in a pile on the bench. The area of a single laminate surface is about 0.22m^2. (about 2.4ft^2). ONE pump of the WEST™ resin mini-pump and ONE pump of the hardener mini-pump gives the correct 5:1mixing ratio. A single pump mix is about 24 ml (0.8 fl ozs), which will apply a single coat to about 0.188m^2 (about 2ft^2). For five laminates you are going to have to apply resin to 8 surfaces – say 1.8m^2 = about 10 pumps of resin and ten of hardener.

18.1.21. You may want to use slow hardener so you can work more slowly before the resin starts to go off.

18.1.22. Mix the resin and immediately divide it into two batches. Mix one batch with #403 microfibres, mixing them in well until you have a mayonnaise consistency.

18.1.23. Coat the upper surface of the first laminate with the plain resin/hardener (this is called "wetting out") and lay it to one side. Coat the upper face of the next laminate with the resin/#403 mix and lay it WESTed face downwards on to the first laminate. Coat the other face of this laminate with the plain resin/hardener. Coat the upper face of the third laminate with resin/#403 mix, lay it WESTed face down on the second laminate; wet out the upper face. Continue like this until all the laminates are done and piled one on top of the other.

18.1.24. Pick up the pile of laminates and set them on the former; push them up to the aft end block and clamp in position. Easy the laminates around the former, clamping as you go, until the whole lamination is nicely clamped in position.

18.1.25. Clean off excess WEST™ as much as possible. Allow the lamination to go off and cure – at least 24 hours at a minimum of 10ºC (50ºF).

18.1.26. Once the WEST™ has cured, remove the clamps; there should be little or no springback.

18.1.27. Trim the aft end to the correct position – either that shown on the stem drawing, or half-way on to Floor -650. Clean any excess WEST™ off the sides. Replace the lamination.

18.1.28. Clamp the aft end to the chock (or to the floor). Or you can drive a couple of temporary screws. Clamp (or temporary screw) the top end in place.

18.1.29. Get out the laminates for the second half of the lamination. These can be shorter because the laminations starts further forward. At the top end, make them finish just short of the clamp or temporary screws in the first lamination.

18.1.30. At the aft end, screw a chock across the first lamination so as to be able to locate the aft end of the second lamination. On the first lamination, we set this 10mm aft of its true position to allow for trimming. If you got a pretty good result on the first lamination, and didn't really need to trim the end, then you can set this chock exactly; otherwise, again, set it about 10mm further aft than the actual end.

18.1.31. Prepare the second half in just the same way as for the first half, including wetting out the outer face of the first lamination and laminate up the second half, bonded on top of the first half.

18.1.32. Clean of as much excess WEST™ as you can and leave to go off and cure.

18.1.33. Once the whole lamination has cured, remove it from the jig and clean it up to the correct 132mm siding. Trim the aft end of the second half. Leave the top long so the whole lamination can be secured to the former clear of the top of the stem.

18.1.34. Replace the lamination on the former, ensuring it is correctly located. Clamp or temporarily screw in position.

18.1.35. Carefully mark a centreline down the outer face of the lamination. Measure and mark a line 30mm each side of it to represent the 60mm full width of the stem.

18.1.36. It is best to laminate the stem on top of the apron now – before cleaning off the apron faying surfaces. See §18.2.

18.1.37. Once the stem lamination is complete, we can return to finishing the apron:

18.1.38. Refer to the stem drawing. You will see that the shape of the apron is given at waterlines and stations. We need to mark these out on the sides of the lamination, exactly as shown on the drawing. Label the waterlines and stations so you know which is which.

18.1.39. Remove the lamination from the former and mark a centreline around the inside face.

18.1.40. Now we are going to mark and plane the sides of the apron to give the correct faying surface (the surface to receive the planking).

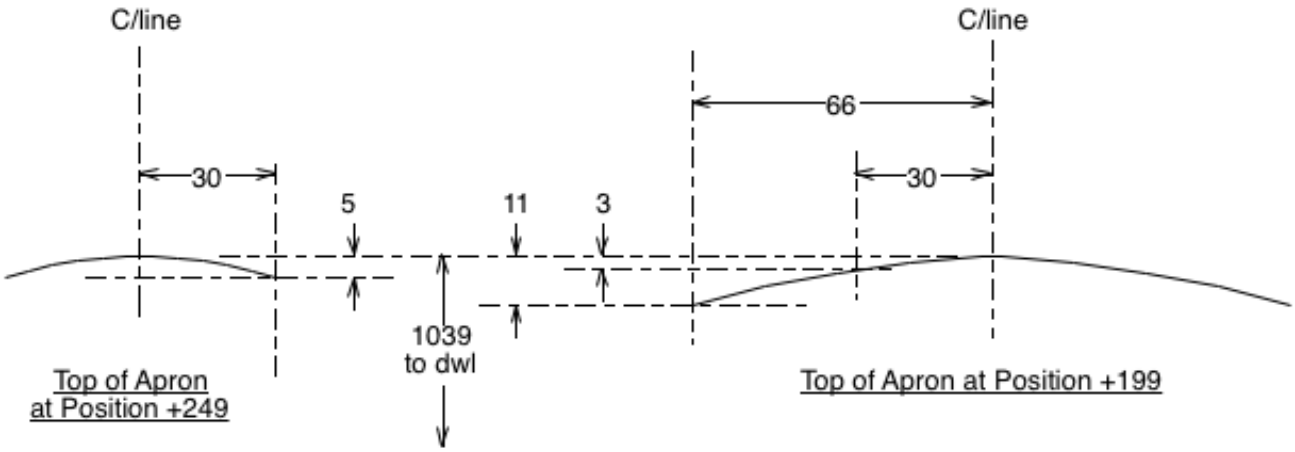
18.1.41. The outer face of the apron will be brought down to 60mm full width in all cases, to suit the full width of the stem. The inner face will remain at 132 full width. The angle of the faying surface will vary to suit the angle of the planking. Dimension L3 on the Stem drawing gives the distance from the inner face of the apron where the faying surface runs out to the full 132mm siding.

18.1.42. Start at the top (the sheer). L3 is 5mm. On the sides of the apron, measure 5mm from the inner face along the line of the sheer and make a mark. On waterline 900, L3 is 6mm – measure and mark 6mm from the inner face. On waterline 800, L3 is 5mm and so on down to the dwl. From the dwl the L3 dimensions are measured as heights on the station lines, from the inner face of the apron.

18.1.43. Using a thin batten, join the marks in a fair line. Do this on both sides of the apron. The line may wander a little (i.e. reverse) but should be largely fair. In practice it is better to remove slightly too much (by too much we are only thinking of about 1mm), than too little.

18.1.44. Now plane the sides of the apron off to the faying surface bevels, making sure you *just* retain the outer and inner lines, particularly the outer lines (for the stem width).

18.1.45. The top of the apron is cleaned of to the correct height, which is 1039 above the dwl on the centreline. The top also has camber to suit the camber of the foredeck, as shown in the sketch below:



18.1.46. The centreline height is level at 1039. At the fwd face it drops 5mm in the 30mm half breadth. On the aft face it drops 3mm at 30mm half-breadth and 11mm at the full 66mm half-breadth. It is better to cut the apron off level at 1039 now and leave the cambering until the shelfs are fitted and in practice there may be rather less camber than shown as cambers tend to get a bit extreme when the offset is very small.

18.1.47. Replace the apron on the former and locate it accurately. It can be permanently bonded to Frame -300 and the ends clamped or fastened temporarily. Make sure you only bond it to Frame-300, not the former and chock.

18.2. Stem

18.2.1. The stem will be laminated up in situ on top of the apron. The stem is not actually bonded to the apron until after it has been cleaned up to its correct siding (60mm), and the apron faying surfaces have been planed off.

18.2.2. The final stem siding is 60mm. You may want to cut your laminates to 64mm width to allow for cleaning up.

18.2.3. Cover the outer face of the apron lamination with clear parcel tape or similar

18.2.4. To retain the stem laminates in place sideways you can drive some nails into the apron at intervals, just outside the stem width lines (sufficient for the width of your laminates).

18.2.5. The stem is laminated in three tranches. The first tranche is 4 off 5mm laminates to make 20mm, to butt join to the keel inner laminate. The second tranche is also 4 off 5mm laminates to butt join to the keel outer laminate. The third tranche consists of three tapered laminates plus two full laminates. This deepens the aft part of the stem so that it runs fair into the forward deadwood.

18.2.6. So, get out your laminates, generally as you did for the apron. Fit a temporary block for the aft ends of the laminates to push against.

18.2.7. Laminate up the first tranche and allow it to cure.

18.2.8. Laminate up the second tranche in the same way and allow it to cure.

18.2.9. Now add the three laminates, which will be tapered, at the aft end. See the stem drawing. It is easier to make them all the same length (the length of the longest one, or a little longer). Once they have gone off, plane them to a smooth taper.

18.2.10. Laminate on the final two full length laminates.

18.2.11. Once the stem lamination has fully cured, remove it from the apron on the former and clean it up to the correct siding (60mm). If necessary, trim the butt joins to the keel laminates and fwd deadwood.

18.2.12. It's better to leave the top of the stem long at this stage and trim it off once the foredeck is laid and the stemhead fitting is fabricated, or being checked for fabrication.

18.2.13. Bond the stem lamination to the apron, clean off excess WEST™ and allow to cure.

18.2.14. Later, after the hull is planked, the leading edge of the stem is faired off to about 25mm siding, running in from about Position -300 and continuing up to about 650 above the dwl, where it fairs back out to a full width front..

19. HOG & WOOD KEEL

19.1. Laminating the Hog

19.1.1. Note that the current Jig drawing (Issue 01) does not show the final centreline structure configuration. Refer to the Profile drawing (Issue 03). The jig itself is correct.

19.1.2. The hog is two 25mm thick laminations. It is laminated up in situ over the frames and floors, and bonded to them as it is laminated. It is bevelled in place, with the bevels being derived from the frames and floors.

19.1.3. The hog can be any suitable, reasonably clean (i.e. free of large or loose knots and bad grain), timber. Most hardwoods are fine (not Oak though). Among the softwoods, Douglas Fir and Larch are both eminently suitable. Western Red Cedar is not ideal, nor is a timber like Paulownia – you are better off with denser, harder timbers.

19.1.4. The fwd and aft ends of the hog are 132 full width, but the central part swells out to 156 full width in way of the centrecase and ballast keel.

19.1.5. If possible start out with 156 wide material and cut it down to 132 at the ends – but if you have to, you can have all 132 wide material and WEST™ bond on the extra width (12mm each side) to make it up to 156mm wide.

19.1.6. Unlike the stem and apron laminations, with the hog we start out with the laminates at the correct width.

19.1.7. The hog broadens out to 156 width at about 50mm ahead of the fwd face of Frame -1900 and reverts to 132 width about 50mm aft of Floor -4150. The actual positions are not particularly important. Taper the change at about 45º.

19.1.8. Measure the length of the two hog laminates and fix the change in width points. Get out your timber to suit.

19.1.9. You may want to get the timber out a little over-length at the aft end (say 20mm).

19.1.10. If you don't have timber of sufficient length, you can scarph two lengths together – scarph length about 8 times the timber thickness (so 200mm scarph length). With WEST™ bonding, there is no real structural need to stagger the scarphs from one laminate to the next, but it is usual to do so.

19.1.11. It's best to scarph the timber up before you laminate it up in place of the jig, as this makes it easier to fit the scarph and clamp it together.

19.1.12. Builders tend to worry about the difficulty of making scarph joints and there is usually a lot of discussion about the best methods, jigs etc. on various boatbuilding forums. In practice it is nothing to be frightened of and it is not very difficult.

19.1.13. It is a good idea to practice on a bit of scrap timber first to get a grip of how to do it.

19.1.14. Basically, with a simple straight scarph like this, square the end of the two pieces of timber. Measure back 200mm and draw a square line across. On the edges of the timber, draw a line from one face to the other, starting from the 200mm line and running diagonally to the end.

19.1.15. You will use a smoothing plane or a jack plane to plane the scarph faces off. Make sure the blade is really sharp and set fine. Plane at about 45º-60º across the scarph until the diagonal lines on the edges of the timber are just showing, maybe not quite off to a feather edge at the ends, but very nearly. Do this on both pieces of timber. Try them together. They should fit reasonably well. Adjust if necessary – but probably you won't need to.

19.1.16. Lay the two lengths on a flat surface, with some polythene or similar under them. Get out a third length of timber (near enough the same width) to use as a clamping piece. Have a dry run to make sure everything is OK.

19.1.17. As you clamp a scarph (with the WEST™ on) there is a tendency to slip, so its best to clamp both lengths a little away from the scarph first to preven this.

19.1.18. Wet out the faces of the scarphs very thoroughly – doing this twice is not a bad idea at all. There is a tendency with scarphs to get a dry joint and we don't want that.

19.1.19. Apply WEST™/#403 fairly generously and clamp the scarph together. Don't apply excessive pressure so as to squeeze all the WEST™ out as, again, there is the possibility of getting a dry joint. So, enough pressure to secure the pieces together very firmly, but don't go crazy!

19.1.20. Allow the scarph to cure fully before stressing it. Sand or plane the faces of the scarphed-up area so that the timber is flat and the same thickness throughout.

19.1.21. Once you have the two lengths of timber ready, try the first inner lamination in place, so that it is a good fit at the fwd end. It should lay nicely in all the notches in the frames and floors – ease any where it is too tight.

19.1.22. Measure and cut the aft end to fit in the notch in the transom fashion pieces – it doesn't have to be prefect lengthwise – a little gap will fill with WEST™.

19.1.23. Once the first laminate fits, you can bond it in place. Mark the locations of the floors and frames on the laminate.

19.1.24. Wet out the lamination in way of the floors and fames, in way of the transom and at the fwd end. Wet out the notches in the floors, frames and the transom; wet out the aft end of the apron. Apply WEST™/#403 to the floor, frame and transom notches and the apron aft end. Bond the hog laminate in place clamping it securely so that it fits down fully in every floor and frame notch.

19.1.25. You can drive permanent or temporary fastenings into the frames and floors if you wish. If they are permanent, use stainless steel or bronze – brass will also be OK in this situation as it won't be subject to corrosion. In theory, steel screws would also be OK, but we really don't recommend them as permanent fastenings even in situations like this where they are protected from corrosion.

19.1.26. Once the WEST™ bonding the first lamination has gone off (say 24 hours at minimum 10ºC – 50ºF), the second laminate can be bonded in place. This is bonded to the inner laminate, the transom notch and the apron – mostly there won't be any floor or frame notch because of the limbers.

19.1.27. Because in most of the floors and frames there is no notch to hold the second laminate sideways, it is best to clamp a few guide pieces to the frames (and/or floors) to keep the laminate in place.

19.1.28. Again, fit the fwd end first and then make a reasonable fit at the aft end. Have a dry run to make sure you have sufficient clamps and clamping equipment. You can drive some screws if you want, but they can really only be temporary – best avoided if possible.

19.1.29. Wet out both bonding surfaces and then apply a fairly generous coat of WEST™/#403 to the inner layer and lay the outer layer down on top of it. Clamp in place.

19.1.30. Clean off as much excess WEST™ as possible. Allow to cure thoroughly. Remove the clamps etc. Clean up the sides as needed.

19.2. Bevelling the hog, cutting the centrecase slot & outboard well aperture.

19.2.1. The centre of the hog is left at 60mm flat width to take the wood keel laminates. each side of this the hog is bevelled off to provide the faying surface for the hull skin.

19.2.2. Measure and mark a centreline all the way along the outer face of the hog. Measure and mark a line 30mm each side of this.

19.2.3. Before we bevel the hog, it is easier to cut the slot for the centrecase, as there is a good base for a saw to sit on.

19.2.4. The slot starts on the aft face of Floor -2350 and runs to the fwd face of the bridgedeck front – the aft face of the front is at -4000, which if the front is a true 9mm ply will give the aft face at Position -3991 and a slot length of 1641mm. If your ply is other than 9mm (say 10mm perhaps - adjust the aft position accordingly.

19.2.5. The slot is nominally 60mm wide, to take a centrecase that is internally 36mm with 12mm ply sides. Again, if you ply is other than 12mm (say ½" ≈ 13mm) then adjust accordingly. Also, it is usual to make the inside top of the slot a little wider than the outside bottom, so that there remains a "wedge" of WEST™ as the case is pushed in and bonded.

19.2.6. Mark the slot out as appropriate – 60 x 1641 as standard.

19.2.7. If your jig saw is a good accurate machine that will cut square through 50mm, then that is a good tool to use. Select the right blade for the job (thick timber) and use a new sharp blade.

19.2.8. Alternatively you can use a circular saw (skil saw), most of which will cut to at least 50mm depth. Don't attempt this unless you know what you are doing – or practice first on some scrap timber until you are absolutely sure that you have it right. It is safe and effective if you are firm and controlled. Otherwise it is dangerous.

19.2.9. Whichever you use, first bore a 10mm (⅜") hole accurately in each corner of the marked out slot.

19.2.10. For the circular saw, tack a guide batten along the face of the hog the distance out from the 30mm line equalling the distance from the blade to the edge of the base of the saw (the "small" side almost certainly). Set the saw to cut a 50mm (or slightly over) depth.

19.2.11. To start the cut with a circular saw, you start in about 150mm from the end of the slot (behind the saw). With the saw NOT running, rest the front of the base very firmly on the face of the hog against the guide batten. Lower the saw until the blade touches the face of the hog to check that you are square across so the blade will cut in the right place. Now lift the back of the saw slightly and turn it on. Lower the saw very slowly, holding it **very firmly**, until it starts to cut. Continue lowering it steadily and firmly until you are fully down and then push forward to start cutting the slot. Do not push backwards to cut behind the saw.

19.2.12. Cut the slot to the end. Repeat on the other side. Reverse the saw in both cuts to cut back to the end of the starting cut.

19.2.13. Cut the ends with a jig saw, starting in the previously cut holes. Try to ensure that the ends are cut vertical, rather than square to the face of the hog – you can tack a shallow wedge to the face of the hog to set the base of the saw horizontal. Also complete the circular saw cuts with a jig saw or a hand saw.

19.2.14. If you are really crafty, with the circular saw cuts, once you have made the initial entry cut, you can set the blade to a slight angle to produce the "wedge" effect. How you set this up will depend on which way your saw angles and how you set the guide batten. The angle wants to be such that the slot is about 2mm wider each side at the top (inside) than it is at the bottom (outside). If you haven't used a circular saw to start a blind cut like this before, it's probably best to stay simple and cut square.

19.2.15. With a jig saw, it's probably best to cut to the line by eye – most jig saws don't cut well against a guide batten – the blade tends to angle off which is a real nuisance. Good jig saws have blade oscillation as well, which will help cutting with the grain like you are. Just go slowly – don't force the blade – and concentrate on staying just on the line.

19.2.16. You can set jigsaws to cut at an angle, just like circular saws, but I have never had a lot of luck doing this, specially in a deep cut like this.

19.2.17. Once the slot is cut, you can clean it out if necessary with a good sharp chisel - an 1¼" bevel edge chisel would be about right for the job.

19.2.18. Unless you have set your circular saw to cut a slightly angled slot, you can pare the sides of the slot with the chisel, so that the top (inside) is about 2mm wider each side than the bottom (outside). Make sure your chisel is really sharp and you will find that you can pare nicely working at a 45º to 60º degree angle, taking off quite fine shavings in a controlled manner.

19.2.19. We are going to put the cut out piece of hog back in so that there is something to bend the wood keel around – the wood keel is 60 wide – the same as the slot in the hog. Cover the surfaces of the cut out piece with shiny brown parcel tape and secure it back in place, with a couple of lengths of scrap timber screwed underneath.

19.2.20. Also, before the hog is bevelled or the wood keel bonded on, make the cuts across the hog for the outboard well aperture. In order to mark and plane the hog bevels, and for the wood keel and planking to run nicely, we will put the cut-out bit back in place.

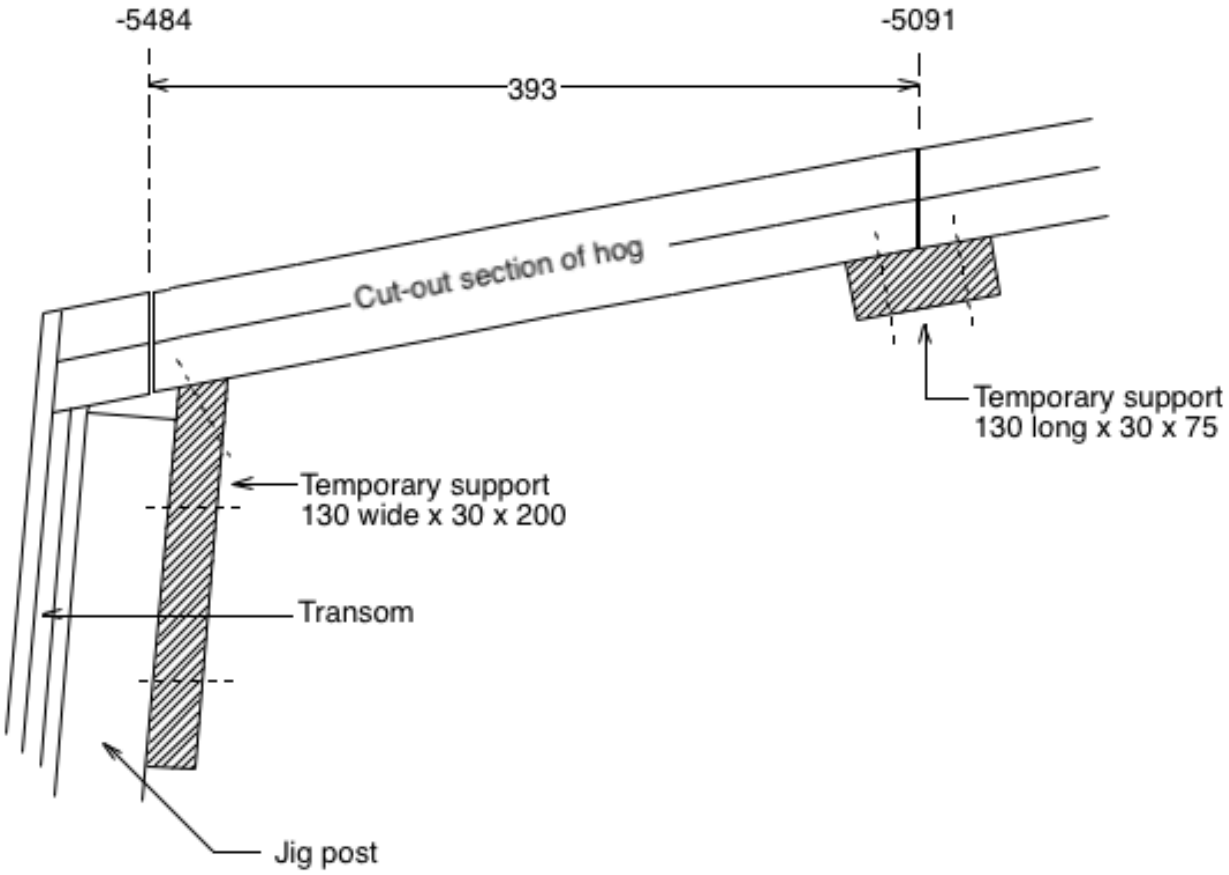
19.2.21. Assuming your ply for the outboard well is 9mm, then the aperture runs from Position -5091 to Position -5484 (the fwd face of the stern knee). The actual outboard well is from -5100 to -5475, inside measurement. If your ply is other than 9mm, then you can make adjustments accordingly – it's not the end of the world if the inside measurement of the well is a little different (but you will have to adjust the other components a little to suit).

19.2.22. Measure out and mark the cuts.

19.2.23. The cuts across the hog need to be made vertically, not square to the hog. If you use a circular saw to make the cuts, you should be able to set the saw to an angle such that the blade cuts vertically. The angle may be slightly different each end, because of the curvature of the hog. You can measure the angle by setting a level up vertical and setting a bevel gauge to the angle between the hog face and the level.

19.2.24. Make the cuts each end and keep the cut out piece.

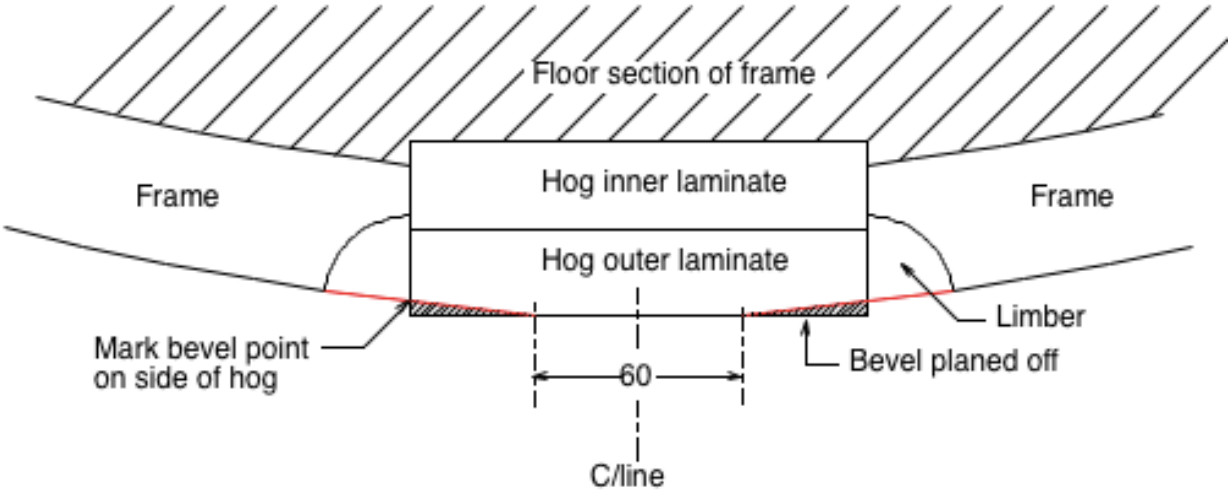
19.2.25. Make a temporary length of scrap timber about 130 wide x 30 x 200 (5" x 1¼" x 8"), with one end bevelled off to match the bevel between the transom jig post and the inner face of the hog. Screw this temporarily to the fwd face of the transom jig post to take the aft end of the hog cut-out piece. Fix another length of scrap timber (say 130 long x 30 x 75 – 5" x 1¼" x 3") under the hog at the fwd end of the outboard aperture cut, half over the cut.



19.2.26. Replace the hog cut-out piece and secure with temporary screws. It is as well to cover the ends of the cut-out piece and the hog with parcel tape so they don't get bonded back together. And similarly the outer surfaces so the wood keel and hull skin don't get bonded on.

19.2.27. Turning now to marking the hog bevels, you will need a batten, rather more than half the length of the hog.

19.2.28. 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. See the red lines on the sketch below.



19.2.29. 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.

19.2.30. 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.

19.3. Wood keel.

19.3.1. The wood keel consists of two full-length laminates 60 sided and 20 thick, bonded on to the hog; and to the stem lamination at the fwd end. At the aft end, the wood keel runs to finish flush with, and at the same angle as, the transom.

19.3.2. Get out the material for the wood keel laminates. As with the hog laminates, these can be scarphed up from two pieces if timber of a sufficient length isn't available. The timber can be sided to 60mm. At the aft end it can run over-length and be trimmed off after lamination.

19.3.3. To keep the keel running nicely central along the 60mm flat on the hog, drive some nails each side at regular intervals along the hog, just outside the flat.

19.3.4. Have a dry run with the first laminate.

19.3.5. Bond the first laminate in place, wetting out both surfaces as usual. You can drive some permanent fastenings if you wish, but keep them clear of the centreboard slot and the aft deadwood bolt locations.

19.3.6. Clean off excess WEST™ as usual. Allow to cure.

19.3.7. Similarly, bond on the second laminate. Use some clamps with protected clamping pieces each side at regular intervals, to ensure the second laminate is truly in line sideways with the first laminate.

19.3.8. Clean off excess WEST™ and allow to cure.

19.3.9. The slot for the centreboard will be cut after the hull is planked or skinned and the ballast keel deadwoods are fitted.

19.3.10. We have now finished with the centreline structure until the hull planking is complete.

20. SHELVES

20.1. Fitting the shelves

20.1.1. The shelf each side is 18 x 50 and sits in the shelf notches in the frames and the transom fashion pieces. The purpose is basically to reinforce the hull-deck join.

20.1.2. After the shelves have been fitted and bonded in place, and once the hull is planked and the boat turned over, the top edge of the shelves, and the hull skin, will be bevelled off to run fair with the deck camber

20.1.3. If you don't have long enough timber for the shelf, the scarph it up from two lengths - scarph 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.

20.1.4. 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 1028 above the dwl where it meets the aft face of the apron (compared with the centreline height of 1039 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.

20.1.5. 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.

20.1.6. 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.

20.1.7. 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.

20.1.8. 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.

20.1.9. 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.

20.1.10. 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).

20.1.11. You will have to estimate the line to cut the aft end of the shelf as the action of pushing the shelf a further 18mm in will alter the angles etc. a little. Try to make the join as close as possible - though it is not finally of much structural significance.

20.1.12. 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 and transom fashion pieces 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..

20.1.13. 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.

20.1.14. Fit and bond the other side shelf.

21. LAPSTRAKE PLANKING

21.1. Marking out

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

21.1.2. There are drawings for each plank, giving all the necessary data to set the plank out to shape and size. However, builders may wish to set out their own planks, maybe to check that the drawn planks are correct, or to have a slightly different run of planks, or even a different number of planks. In the latter instance, we recommend that you stay between 12 and 14 planks – any fewer and you will have difficulty getting the planks to lie nicely on the frames and any more and the planks will be getting too narrow.

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

Frame -300	1138
Frame -1000	1395
Frame -1900	1634
Frame -2800	1735
Frame -3700	1688
Frame -4600	1508

21.1.4. This would give apparent plank widths at one-thirteenth of the above figures:

Frame -300	88
Frame -1000	107
Frame -1900	126
Frame -2800	133
Frame -3700	130
Frame -4600	116

21.1.5. 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

21.1.6. This would give actual plank widths of:

Frame -300	118
Frame -1000	137
Frame -1900	156
Frame -2800	163
Frame -3700	160
Frame -4600	146

21.1.7. In case your frames 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. Measure around the transom and obtain actual and apparent widths in the same way

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

21.1.9. For the planks as drawn, we reduced the actual width (apparent + lap) of the garboard at Frame -300 to 87mm, with the top edge of the garboard running off on to the stem at Position -28 and Height +43.

21.1.10. This has the effect of increasing the actual widths of the remaining planks at Frame -300 to 120mm.

21.1.11. You can start out with this setup and see if you find it makes a pleasing run of plank.

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

21.1.13. Tack the batten so that one edge is on the lines for the top edge of Plank No. 2, in such a way that the batten reaches the apron faying surface. Hold the batten so that it lays on the apron faying surface and is taking up a fair line with the top-of-plank marks on the frames. Mark this line on the apron faying surface. Do the same with the top edge of the plank No. 12 (the one before the sheer strake) and mark this on to the faying surface of the apron. Now measure up the angle of the stem the distance between the top of No.2 and the top of No. 12 and divide the answer by ten - mark off these distances, which should be roughly the top edges of planks 3 - 11.

21.1.14. Check each top edge to see if the marks on the faying surface of the apron do in fact run fair with the top edges of the planks previously marked on the frames. You may need to make a few minor adjustments to allow for the fact that the stem angle is not constant.

21.1.15. You can also look at the plank drawings – the height and position of the top forward "corner" of each plank on the faying surface is noted – and use this as a guide.

21.1.16. 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.

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

21.1.18. 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.

21.2. Garboard

21.2.1. 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.

21.2.2. The method we will adopt for this (one of many variants) is to use a pattern batten which is flexible enough to bend around the hull, but wide enough not to bend on edge. Three lengths of 9mm ply, about 150mm wide, scarphed together would do this job nicely. They can be butted and the butt supported by a butt strap if you prefer but this makes the batten more cumbersome.

21.2.3. The pattern batten does not have to be a straight edge - the important thing is that it does not bend on edge. There is some advantage by having the pattern batten in a slight banana shape as this reduces the distance to measure from the edge of the batten to the plank line and thus reduces the inaccuracies.

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

21.2.5. Tick off the accurate position of each frame (choose one edge) on to the batten. Now at regular intervals along the batten (say every 200mm) make a mark and measure from the edge of the batten into the rebate - note the measurement down on the batten by the mark - try to measure square off. Towards the stem (for the garboard particularly) you may need to make the measuring points a bit closer together. You can dummy off the stem angle on to the batten but this will only give you the angle, not the actual position, of the plank end because the batten is not in the same place as the plank will be. So take sufficient measurements at the front end to establish where the front end is and 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. Remove the batten from the boat.

21.2.6. The garboard is made from three lengths scarphed together - two full sheet lengths and a shorter length on the end. On the garboard, start the full lengths from fwd, so the short length is at the end aft. On the alternate planks, start the full lengths from aft so that the short length is fwd so that the scarph joints will not come above one another on adjacent planks. There is no need to arrange the scarphs to come over frames, or at any point in particular as a properly made and bonded scarph is as strong as the rest of the ply. In fact, a properly supported butt is also structurally perfectly satisfactory, but rather discounted nowadays as being unacceptable. If you butt the plank joins, then the butt strap should be at least 150mm long with the ends bevelled off so as to produce a gradual change of section. The butt strap will be the apparent plank width as you can't fit a butt where the planks are lapped - the previous plank supports the butt very adequately. The following instructions are written assuming that you will scarph the planks, but are generally equally applicable for butted plank joins

21.2.7. You can also use the scarph positions shown on the plank drawings.

21.2.8. Lay three sheets of ply on the floor and lay the pattern batten on top. The 8:1 scarphs will theoretically be 72mm long, so they will reduce the lengths of the sheets by this amount (plus a bit for fitting etc. – say 100mm). We will start by making the fwd section of garboard. So be sure that there is sufficient ply at the fwd end to mark the fwd end out from the measurements taken, and a bit to spare for fitting. Transfer the frame positions from the pattern to the ply. Also transfer the measuring ticks (at 200mm or less spacings, whatever you chose) and measure up from the edge of the batten on to the ply the measurements noted by each position tick

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

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

21.2.11. Refer to your table of actual plank widths (apparent + 30mm) at each frame position. Mark off the actual width, measuring from the line of the rebate edge previously drawn. Do the same at the stem, measuring the width along the stem angle (dummied on to the ply). Join these points with a batten - again make it an average fair line. This line should be the top-of-garboard line that is marked on the frame edges.

21.2.12. 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, say, 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.

21.2.13. Put the plank up on to the boat, with the frame marks in position over the frames 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 on the outside of the plank because the rebate is not 90°), then you can dummy off the stem angle. 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.

21.2.14. Fit the plank up again and now dummy the stem end. Also check the gap on the outside of the plank to the keel all the way along and note it at relevant intervals. Remove the plank. Cut the front end, leaving a little (say 5mm) on.

21.2.15. Transfer the outside 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 frames). 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 about right). Make a final dummy of the front end angle and bevel. Remove the plank and make the final adjustments.

21.2.16. Now from the inside rebate edge of the plank, measure the plank widths on each frame 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 – scarph length 8 times plank thickness. Make 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.

21.2.17. There's always a lot of debate about the best way to cut a scarph in thin material like plywood, where you can't do much cleaning up after the two parts are bonded together. Refer to Timber, Tools & Devices on whisstock.com >> Articles (also 165/002/011) for a discussion of this and various ways to make a scarph, including a simple scarphing jig that you can make for a standard 185mm (7¼") blade circular saw.

21.2.18. Whatever system you go for, practice on some scrap ply first to get the hang of it

21.2.19. Once you have cut the scarph, 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.

21.2.20. The plank is bonded to each frame, each floor, the keel rebate and the stem rebate. Fit the plank up (yet again) dry and bore off for the fastenings – also just check that the top edge of your plank is about on the top-of-plank marks on the frames. Use 20 x 3.5 or 25 x 3.5 (¾" x 6g or 1" x 6g) screws at about 150mm spacings into the hog (stagger these a little); six 25 x 3.5 (1" x 6g) screws in two rows of three staggered, into the stem (these are called the hood end fastenings) and one screw into each frame and floor about 15mm in from the top edge of the plank. If you are going to dowel over the screws (only necessary really above the waterline if clear finished), then use a Stanley "screwsink" or similar to bore off for the screws - probably a good idea to use this in any case - and countersink about 3mm. If you are not going to dowel, then don't bore the countersink very deep – just about 1mm (the screws will pull just below the surface and can be filled over with WEST/#407) If you don't countersink at all, the screws will pull a dent in the surface of the ply which will be very difficult to fill nicely because it will have no very definite boundaries. Remove the plank, blow off the drillings, WEST™ down the screw holes and then bond the plank into place, using your usual process of wetting out first, then applying the #403 thickened resin as the glue.

21.2.21. Be extra careful to clean off excess WEST™ as much as possible as it is really hard to do this later on, specially on the inside of the boat.

21.2.22. 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.

21.2.23. The mid sections of both garboard planks are fitted in the same way as the forward sections, but with a scarph on both ends. Mark the plank out from the pattern batten, leaving about 120mm on the fwd end for the scarph. Cut the plank out to shape and leave the ends square (i.e. no scarph). Offer the plank up to the boat, letting the fwd end lap over the plank section already fitted by the 120mm. Adjust the plank to fit as you did for the fwd section. When the plank is fitting properly along the keel, mark off the aft end of the fwd scarph on the inside of the plank.

21.2.24. Remove the plank and mark off the length of the scarph, parallel to the line marked for the aft end. Cut the scarph. Offer the plank up again and check for the fit of the scarph. Adjust as necessary so the scarph fits well. Hopefully this will not alter the fit of the plank generally, but if it does you will have to keep on making adjustments until you are satisfied with the fit of the scarph and the plank generally. Then measure off the actual plank widths again and fair the top edge. Cut the scarph on the aft end. Don’t forget to mark out the plank for the other side.

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

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

21.2.27. Make and fit the aft section, both sides of the boat in the same way. Just let the aft ends hang over the transom a little and trim off later. Drive three 35 x 3.5 (1¼" x 6g) hood end fastenings into the transom edge - these screws are longer because they don’t get such a good hold into the end grain of ply.

21.2.28. In the heyday of timber boatbuilding it used to be a matter of pride (not to say physical effort) to only have to offer up a plank once – a "first time fitter" Well maybe we shan’t quite have all first time fitters but you will find that as you progress with the planking you will not need to offer up the plank many times to get it to fit. It is mostly a question of taking an accurate pattern.

21.2.29. 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 joints are fair - if not just fair them up. Then run a pencil line (not a metal gauge mark) along the outside face of the plank, 30mm in from the top edge. A gauge made from an odd bit of wood with a 30mm 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.

21.2.30. Now have a short length of stick (as long at least as the widest actual plank width). Lay this on the garboard at each frame, so that the end of the stick is on the top-of-plank mark for plank No. 2. The gap between the stick and the 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 and mark them on the edge of the plank.

21.2.31. It's not easy to join the bevel marks in a fair line as you really can't use a batten. The most practical solution is to add in additional marks, averaging out the marks each side. So say you have a 5mm bevel on one frame and 4mm on the next – pencil in 4.5mm half-way in between. With a bit of practice you will find that you can join the marks in a reasonably fair line holding a pencil and using the end of your finger as a guide.

21.2.32. 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 of to almost full thickness (leaving about 2mm 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.

21.3. The rest of the planking

21.3.1. Now fit the next plank - plank No. 2. The plank sections are made in the same way as the garboard, using the pattern in exactly the same way. The only 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. Also, the scarphs should come in different places to those in the garboard – it is not good practice to have scarph joints immediately above one another in adjacent planks. Try to have at least 1000mm stagger between scarphs in adjacent planks. Because considerable twist may develop in the fwd part of this plank, it is probably best to make the fwd scarph about 1300mm back from the stem, then a full length mid-section and a shorter aft section.

21.3.2. You can also use the scarph positions shown on the plank drawings.

21.3.3. Also 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).

21.3.4. So when the forward section of the plank is fitted finally, but not fixed, draw along the top of the garboard on to the inside face of plank No. 2, for a distance of about 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.

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

21.3.6. 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.

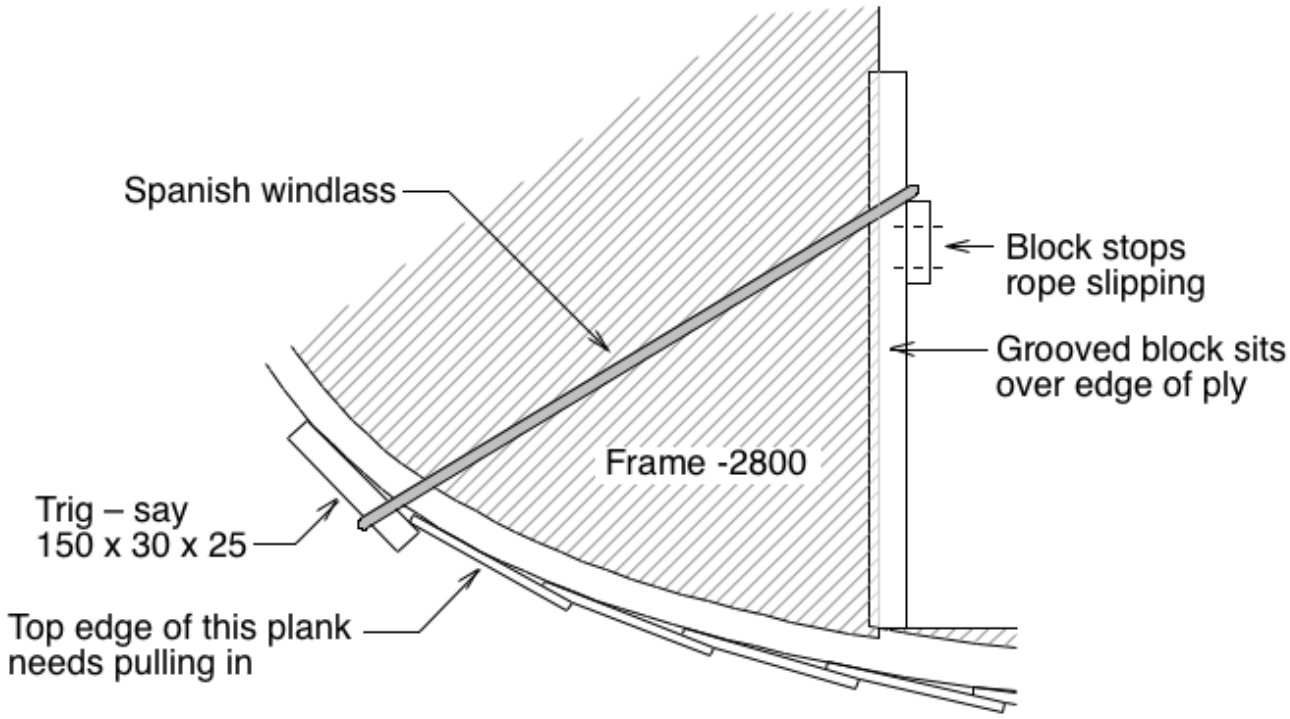
21.3.7. Carry out the same process at the aft end on to the transom. Again, WEST™ will fill minor aberrations.

21.3.8. Plank No. 2 and succeeding planks are fastened into the frames, floors (where applicable), and at the hood ends (three into the transom, six staggered into the stem). In way of the frames, drive a screw about 15mm in from each edge of the plank.

21.3.9.

21.3.10. In some areas planks will have to take up some degree of curvature across themselves (particularly around the bilge). The twist of the planks will induce this mostly, but often the screw in the top edge will not be sufficient to draw the plank down, or even hold it down until the glue has gone off, so they will need to be clamped before screwing, and while the WEST™ is curing.

21.3.11. In some areas it may not be easy to clamp because of the depth of the frames and then you will have to resort to other methods – a spanish windlass around the frame for example:



21.3.12. If it is not possible to induce the necessary curvature across the plank, the edge of the frame can be straightened a little in the offending area.

21.3.13. 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 'slot' clamps – see Timber, Tools & Devices §5.

21.3.14. Together with these is required a fair number of shallow wedges, about 20mm wide - remember the longer the taper on a wedge the more effect it achieves, so make the wedges from nothing to about 5mm thick in about 50mm length . Pass the ply clamps over the planks and drive the wedges between the ply clamp and the plank (in way of the lap) to hold the plank surfaces together. You will need two or three of these between each frame, maybe more in some places.

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

21.3.16. Remember to clean off as much excess WEST™ as possible as you go; this will save a lot of work in the long run.

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

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

21.3.19. The aft ends of the planks can be trimmed every three or four planks, to end planed off flush with the face of the transom.

21.4. Other options

21.4.1. Scarph whole sheets. An alternative to scarphing the planks up on the job like this is to scarph up 3 sheets of. ply to start with and mark and cut each plank out full length in one go. This is considerably more wasteful of material, but the scarphs are easier to fit and glue up as this can all be done on the floor. If it is too much to scarph complete sheets, then you can halve them lengthways and scarph up the half sheets. Although either of these methods makes the scarphing easier, handling and fitting the planks is considerably more difficult however, unless you have help. The only problem with fitting scarphs on the job is if the scarph comes in an area of considerable twist. This happens particularly on the first few planks at the fwd end where the upright stem causes the transition from a relatively horizontal plank to a relatively vertical plank to happen in a short distance. Adjusting the scarph position can usually help to relieve the problem.

21.4.2. Mark the planks out directly from the plank drawings. If you do this, you can if you wish, scarph the three sections up off the boat. Dimensions of the shape of the bottom edge of the whole plank are given off a straight base line. So, once you have cut your plank parts out you can scarph them up on a flat floor, ensuring the the shape of the bottom edge remains correct as measured from the baseline. If you do mark your planks out from the drawings, we recommend that you still measure the half-girths and mark the plank top edge positions on the frames, transom and stem, generally as described above. Then check your first plank part (the fwd end of the garboard) to see how well it fits your marks. This will give you a view on how the drawn planks are going to match up with the boat.

22. FINISHING OFF THE LAPSTRAKE SKIN

22.1. Outside

22.1.1. Read the WEST™ Fact Sheet sections on coating, sanding and precautions.

22.1.2. 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. Vacuum and wipe down with thinners to get rid of dust. WEST™ the hull exterior one coat, working plenty of WEST™ into all fastening holes. Try to have the temperature at least 15ºC (60ºF) for 12 hours before applying the WEST™ coating, so the timber is warm through; and keep the temperature up for 12 hours after coating. This will help avoid amine 'sweat'.

22.1.3. Once the first coat has cured, fill (or dowel if the exterior is to be clear finished) over all fastening holes. If filling, use WEST™/#407.

22.1.4. Sand the hull smooth again all over the outside. Do not sand partially cured WEST™.

22.1.5. 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 for this purpose.

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

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

22.1.8. 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 spread about all over the planking.

22.1.9. 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 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. You can add a small amount of #406 colloidal silica to the mix to improve the smoothness – too much #406 will make the fillet tough to sand however. Try about 10% (of the total additive)

22.1.10. Using a trowel knife (about 50mm - 2" wide), trowel swiftly along the land, depositing a small but regular amount of WEST™/#405. 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 you 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

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

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

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

22.1.14. Sand the whole hull exterior smooth and apply one coat WEST™. It's probably not worth applying the full WEST system to the ballast keel deadwood sides as they will more than likely have to be cleaned off flush with the ballast keel after it is fitted.

22.1.15. It is not so usual to glass cloth a lapstrake hull as a cold-moulded one. And laying the glass cloth is more difficult to do really well because of all the plank edges. However if you do wish to glass cloth the hull, you can follow the instructions for the cold-moulded hull. You will need to take particular care wetting out the cloth and making sure it goes down well into the plank lands.

22.1.16. Follow the final coating scheme as for the cold-moulded hull skin.

22.2. Inside.

22.2.1. This is done after the hull is turned over and all the jig components removed.

22.2.2. Sand the hull interior, vacuum and clean out the dust, and WEST™ throughout one coat. You have already WESTed some of the frames, so you don't need to do any more to them at the moment.

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

22.2.4. Structurally, you don't have to fillet the hull skin to the frames, but you may find that you wish to do so if the planks don't lay entirely on the faces of the frames everywhere. This will get rid of any voids etc. which can trap water and cause problems later in the boat's life. Use a fillet joint with about 15mm arms – you will have to vary this a bit up forward where the bevel on the frames is greater so that there is quite a difference in angle between skin and frame on the fwd and aft sides. Use masking tape as before to keep the fillets to size and prevent mess.

22.2.5. Sand and WEST™ coat the interior of the hull 2 further coats and catch up any WESTing on the frames etc., so that the whole structure, including the frames, hog, floors etc. has had three coats. Do not coat the gunwhale (i.e. the top of the sheer strake and the shelf) yet.

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

23. COLD-MOULDED HULL PLANKING

23.1. Inner skin.

23.1.1. The inner skin is 6mm Cedar, Douglas Fir or similar timber, strip planks fitted close.

23.1.2. 18.1.2 There are usually three possible types of strip planking available (often only in Western Red Cedar).

23.1.3. The first, simplest style is square edged - simple rectangular profile planks, say 6 x 14. This is very easy to saw and plane up yourself. 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.

23.1.4. Square-edge strips work best on larger boats where the thickness is greater, which makes for easier edge-to-edge nailing.

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

23.1.6. The third type (sometimes called "speed strip" or similar) 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 is a slightly loose fit. 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. 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.

23.1.7. If you can't obtain this type - and we do recommend it - then it is not difficult to make yourself (given a spindle moulder or a decent table-mounted router). For a spindle moulder, you can grind the spindle 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 about 6 x 30 (¼" x 1⅛") , or maybe a bit wider, say 6 x 40 (¼" x 1½"). 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 turn of bilge.

23.1.8. Machining your own planking may sound a nuisance, but it does give you greater choice of timber - to get a lighter coloured interior by using Douglas Fir for example, or Yellow Cedar, rather than the rather dark Western Red Cedar. You also get to use local timbers rather than having to pay a lot for imported timbers. But choose a relatively lightweight timber– less than 500 kg/m^3 if at all possible.

23.1.9. We are assuming that you are using tongue-&-groove type strip. But there is little procedural difference whichever type you use - just with simple square edge (our next preference after tongue-&-groove) you will need to drive edge fastenings. If you are to do this use brass or stainless 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.

23.1.10. Now one important point. The frame spacing is fine for the tongue-&-groove type strip planking but may be rather too far apart for the other types to run fair. We can supply offsets for temporary intermediate moulds if wished. Or you could increase the thickness of the strips to, say, 8mm. This will add to the overall weight of the boat (by about 17 kg) but she will float on the same waterline because the weight of the extra timber is less than the weight of water it displaces.

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

23.1.12. 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). 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.

23.1.13. 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 over-length and trimmed back flush later, after the WEST™ has gone off.

23.1.14. 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.

23.1.15. 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.

23.1.16. 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.

23.1.17. 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.

23.1.18. 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.

23.1.19. 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

23.1.20. 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 ply clips if necessary.

23.1.21. 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.

23.1.22. 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.

23.1.23. 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.

23.1.24. 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.

23.1.25. 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.

23.1.26. An 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.

23.1.27. 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.

23.1.28. 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.

23.1.29. 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.

23.1.30. 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.

23.1.31. 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.

23.1.32. 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.

23.1.33. 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.

23.1.34. 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.

23.1.35. You are now ready for the next skin.

23.2. First diagonal skin.

23.2.1. The first diagonal skin is 3mm Khaya (or other suitable timber) 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.

23.2.2. 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 40,000 to 50,000 staples in all; they usually come in boxes of 10,000.

23.2.3. 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.

23.2.4. 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 – 1¼" x 1¼") 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.

23.2.5. The most usual place to start the diagonals is roughly amidships with the top end pointing aft. The angle is not too important – just get reasonably close to 45º. Mark the (approximate) 45º line at your starting position, using a batten bent round the hull.

23.2.6. 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.

23.2.7. 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.

23.2.8. 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™.

23.2.9. 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.

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

23.2.11. 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.

23.2.12. 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).

23.2.13. 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.

23.2.14. 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.

23.2.15. 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 Utility knife for this, but we find these tend to run off with the grain rather than follow the line. If the amount is small (and as we are fitting each veneer, it usually is) the a small thumb plane is often the quickest. Or push the veneer through the circular saw, with a small diameter (say 150mm) fine toothed saw in it. We prefer a thumb plane well sharpened and set fairly coarse, and the veneer laid on the bench.

23.2.16. 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.

23.2.17. 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.

23.2.18. 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.

23.2.19. Veneer the other side in the same way.

23.2.20. 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™ filled, or have a piece of veneer let in and bonded in. Make sure all the staples are flush (or below) with the surface of the hull. It doesn't matter if you sand the crowns off any that are proud, just leaving the legs in the hull. WEST™ fill any small gaps, crevices etc. and sand smooth. Dust down the hull and WEST™ coat all over; sand lightly when cured.

23.3. Outer diagonal skin.

23.3.1. 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.

23.3.2. 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

23.3.3. 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.

23.3.4. 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.

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

23.3.6. 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.

23.3.7. 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.

23.3.8. Have a final trim round, sand and dust down - and then WEST™ the hull one coat. When this is cured, sand lightly. We will fit the various deadwoods and the outer keel laminates before finishing off the coating system etc.

24. DEADWOODS

24.1. Fwd deadwood.

24.1.1. The fwd deadwood transitions from the stem to the ballast keel. The dimensions are given on the Fwd Deadwood drawing.

24.1.2. It is basically 60mm sided, flaring out to 130mm to fair in with the ballast keel.

24.1.3. The additional siding can be achieved by WEST™ bonding a 35mm block each side at the aft end of the deadwood and then fairing this in. It's a simple straight-line increase form 60mm to 130mm.

24.1.4. Cut the scarph on the aft end as indicated.

24.1.5. Bond the fwd deadwood in place. You can drive some fairly hefty permanent fastenings if you wish (say 75 x 6 – 3" x 12g). Pre-drill for these and counter-bore for the heads – fill or dowel over.

24.1.6. Clean off excess WEST™ as usual.

24.2. Ballast keel deadwoods.

24.2.1. These are important deadwoods in the they provide part of the base for the ballast keel. They sit each side of the wood keel, swelling the total width out to 132mm, and on top of the planking. They are WEST™ bonded to the wood keel and the planking.

24.2.2. The data for making the deadwoods is given on the Ballast Keel Deadwoods drawing. The data assumes a 9mm ply skin. For the 12mm cold moulded skin you will need to deduct 3mm from the dimensions given.

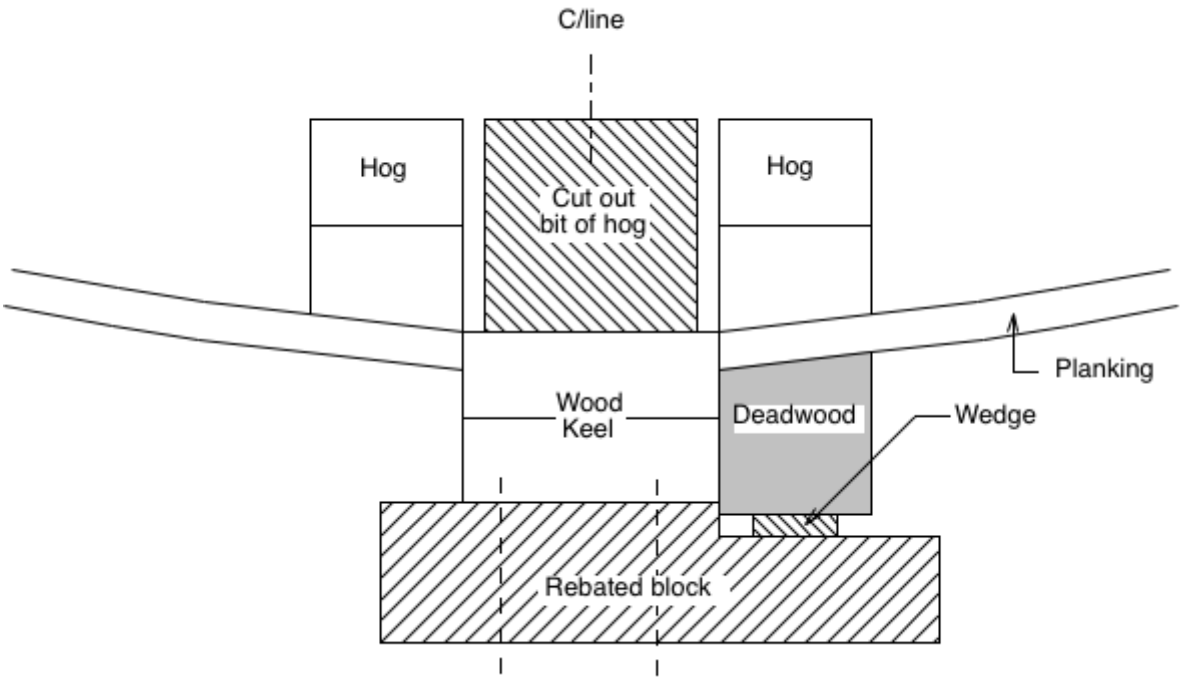
24.2.3. Although we give shape data for the deadwoods, you will also find that they can be bent to shape from a parallel length of timber; You do need to get the bevel pretty much right, so that when you bend the deadwood around the skin, it stays reasonably alongside the wood keel. You can induce some double curvature by clamping the deadwoods to the wood keel.

24.2.4. Before making the deadwoods, check from the boat that the depth dimensions on the drawing are correct for your boat. And check that the bevels are correct too.

24.2.5. Its best to make the deadwoods square ended and then cut the taper from 132 to 60 afterwards.

24.2.6. If you are going to bend the deadwoods to shape, get the timber out at 36mm wide and a about 3mm thicker than the actual final depth. Plane the bevel along the inner face.

24.2.7. Screw a length of scrap timber across the wood keel, with a couple of good temporary screws. You will need to rebate out the protruding part so that the deadwood timber can just tuck under it and be wedged down.



24.2.8. Pull the deadwood down on to the planking and fit a similar rebated block to hold it down at the other end.

24.2.9. Clamp the deadwood sideways to the wood keel.

24.2.10. Make any adjustments necessary.

24.2.11. Once you are happy that the deadwood is a good fit, you can bond it on. Wet out the bonding surfaces as necessary and apply a good thick coat of WEST™/#403. Wedge and clamp in place.

24.2.12. Once the WEST™ has cured, bond the other side deadwood on in the same way.

24.2.13. Plane the outer face of the deadwoods off flush with the wood keel. Try to keep the outer face flat and level across.

24.2.14. Taper the ends of the deadwoods off to fair into the wood keel. You can cut some of this with a circular saw, finishing off with a good sharp paring chisel.

24.2.15. Once the ballast keel deadwoods are complete, the slot for the centreboard can be cut.

24.2.16. The slot is 36mm wide and 1310mm long, starting from Position -2390 (40mm further aft than the slot in the hog).

24.2.17. The slot can be cut and finished in much the same way as described for the centrecase slot in the hog – except that the sides are kept parallel.

24.3. Inner deadwood.

24.3.1. This is a quite small deadwood at the aft end of the ballast keel, between it and the ballast keel deadwoods – transitioning the rocker of the hull to the flat surface of the top of the ballast keel in this area.

24.3.2. Make the deadwood to the shape shown on the Aft Deadwoods drawing and bond in place.

24.3.3. Note that the aft deadwood is shown as 130mm wide (the width of the ballast keel). The ballast keel deadwoods are sized so as to make the total width (deadwood + wood keel + deadwood) 132mm wide – allowing just a little to clean off once the ballast keel is in place. You can make the inner deadwood 132mm wide also for the same reason.

24.4. Aft deadwood.

24.4.1. You might want to cut the outboard well aperture (§25) before fitting the aft deadwood.

24.4.2. This is quite a large item and is bolted as well as bonded in place. It can be made from one lump of timber or it can be made sandwich-style from several thicknesses (say something like 50mm).

24.4.3. The swell from 60 sided to 130 sided can be made with extra pieces bonded on each side.

24.4.4. If you are going to make it sandwich-style, get out your timber and WEST™ bond the layers together to make sufficient width to cut the deadwood out – say 300mm.

24.4.5. Another option is to bond two 30mm+ layers together to make up the 60mm width. You can often obtain quite decent Douglas Fir in a CLS (ALS) size like 2" x 12" (actually 38mm x 290mm - 1½" x 11½") from your local "big-box" store. If you have a thicknesser (planer) that will handle 305mm (12") wide, then this is a good option.

24.4.6. Whichever way you achieve it, you are going to end up with a lump of timber about 1400mm long x 300mm wide x 60mm thick.

24.4.7. Mark out and cut the top face shape and the scarph to the keel. Offer it up to the wood keel and adjust until you get a decent fit.

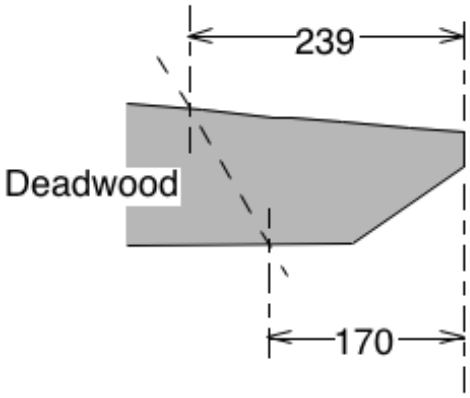
24.4.8. It is important that you keep the mating surface square across so that the deadwood is vertical when bonded and bolted in place.

24.4.9. To help keep everything vertical and nicely in place, you can clamp a couple of lengths of timber to the wood keel, each end of the aft deadwood.

24.4.10. Once the top and the fwd end are a satisfactory fit, mark out and cut the rest of the shape. The radius chock at the aft end can be added later, once the outer keel laminates are on – or you can form it now as part of the deadwood.

24.4.11. Finally, you need to drill off for the four M10 (⅜") bolts through the hog. Drilling a longish hole like this is really a matter of practice, care and confidence. The best drill bit for the job is probably a long twist bit. Spade bits are OK and you can get long-shank versions, but they are harder work in a long hole and tend to wander more than a standard twist drill.

24.4.12. It can pay to set up a length of timber to act as a visual guide – you need a helper to eye up the drill against the guide and tell you if you are going astray.



24.4.13. If you are uncertain, have a few practice runs through some scrap timber.

24.4.14. It's probably better to drill the deadwood first, separately from the boat, as you can set it up in a more comfortable drilling position. Make sure the deadwood is firmly clamped. Drill from the inner mating surface to the outer bottom face.

24.4.15. Clamp a length of timber vertically in way of where you are going to drill. Mark the centre of the hole carefully and make a start with a small drill (say 5mm), to about 6mm depth – this will give a better centre start for the 10mm drill.

24.4.16. Now drill the 10mm hole steadily, preferably with a helper eyeing up you drill to keep it parallel with the guide. Withdraw the drill at regular intervals to clear it.

24.4.17. The fwd hole is at an angle. The sketch below shows the inner face and outer face locations of the hole. You should clamp your guide at the angle, and, as with the other three holes, drill from the inside face to the outside.

24.4.18. Once you have drilled all the holes, locate the deadwood accurately on the wood keel and drill the holes through the wood keel and the hog.

24.4.19. Counterbore the holes on the underside of the deadwood to a sufficient depth for the nut, a good washer, and about 10mm extra depth to WEST™ fill over.

24.4.20. On the inside, just chop a sufficient flat into the hog for the washers to sit square to the bolts. WEST™ coat these flats and the area around the washers, three good coats and allow to cure.

24.4.21. Some builders like to make their bolt holes slightly oversize and WEST™ coat the holes. This works but it can be a bit of a fiddle working WEST™ down a long hole. Because the deadwood is WEST™ bonded to the wood keel and the heads of the bolts are WEST™ stopped over on the outside, and then there are two outer keel laminates, the chance of water penetration into the bolt holes is very small, so this is not really necessary.

24.4.22. You can drive the bolts through the deadwood and just into the wood keel, to make sure they all line up OK. Drive them gently back a little bit into the deadwood before bonding.

24.4.23. Once you are all ready, bond and bolt the deadwood in place. Clamp guides each side of the wood keel, each end of the deadwood to ensure that it sits vertically.

24.4.24. Wet out both surfaces very thoroughly. Also wet out the end of the inner deadwood and the end of the aft deadwood where it butts. Bond the deadwood with WEST™™/#406 colloidal silica. Make the mix fairly stiff – almost peanut butter consistency. Slow hardener will give you a longer working time.

24.4.25. Place the deadwood on the wood keel and adjust it to the correct position, hard up against the inner deadwood. Start all four bolts into their holes in the wood keel. Then drive all four home. Drive the three vertical ones before driving the fwd angled bolt, otherwise this may tend to pull the deadwood aft. Clean any WEST™ off the threads of the bolts inside before you thread on the nuts and washers – apply a smear of grease lubricant. Pull the bolts up tight.

24.4.26. If your wood keel surface is not perfectly level across, there will be a tendency for the deadwood to pull out of vertical as you tighten the bolts. In this case, only tighten them enough to pull the deadwood home; then allow the WEST™/#406 to go off hard before tightening them a little further.

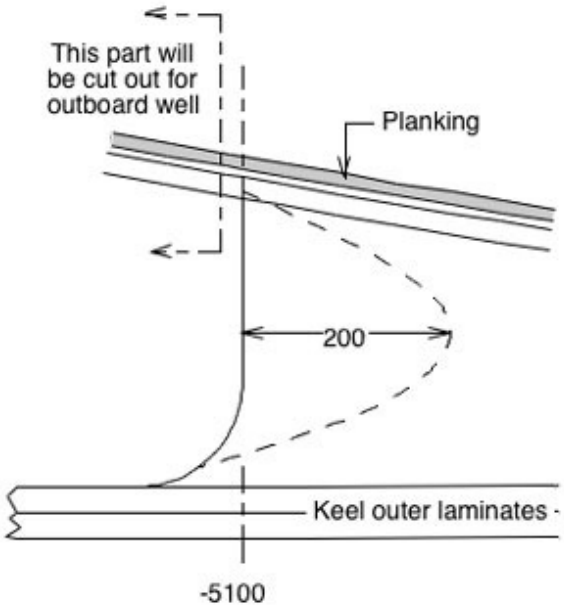
24.4.27. Clean off excess WEST™ and allow to cure.

24.5. Stem and aft deadwood profiling.

24.5.1. The leading edge of the stem is faired off to about 25mm full width, running in from about Position -300 and continuing up to about 650 above the dwl, where it fairs back out to a full width front.

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

24.5.3. The final width of the trailing edge can be reduced to 30mm (but leave the aft edge square across, not rounded off). This can be eased out back to the full 60mm width by 200mm fwd of the trailing edge – see the sketch below. The reduced width will be scooped out rather like a half-ellipse shaped depression, so that it everywhere fairs out to full width top and bottom.



24.5.4. Once you are done, sand the deadwoods, keel and stem smooth and WEST™ one coat. Allow to cure and sand lightly.

25. OUTBOARD WELL APERTURE

25.1. Cutting the aperture.

25.1.1. If you are going to glass cloth the hull, it's best to cut the aperture for the outboard well before you do so. It's also easier to cut the aperture before fitting the aft deadwood.

25.1.2. You do need to know what outboard you are intending to use before cutting the aperture. The sizes shown on the Outboard Well drawing will suit many outboards, but maybe not all.

25.1.3. The size of the actual aperture in the hull skin is a bit smaller all round (say 20mm) that the "box" made by the sides and ends of the well.

25.1.4. At this stage we are only going to cut the aperture in the hull skin, and cut and remove the section of wood keel in way of the aperture. And remove the temporary section of hog that we cut out earlier.

25.1.5. The outboard well structure will be installed later. The well sides in particular replace some of the longitudinal structure that we have lost by cutting out the hog and keel.

25.1.6.

25.1.7. Once you have established the size of the aperture you need to pass the outboard through, mark this out on the hull skin and up the sides of the wood keel. On the drawings generally, it shows the wood keel cut back to be flush with the inside faces of the outboard well ends – that is 9mm each end past the cut out in the hog. However, there is no reason why the wood keel can't end flush with the actual aperture in the hull skin if you wish. Radius the corners of the aperture in the hull skin – say 25mm or so.

25.1.8. From the inside, remove the temporary section of hog.

25.1.9. Make your cuts through the wood keel. Then use a jig saw to cut the aperture in the hull skin – you may need to finish the cuts with a pad saw (keyhole saw). Carefully remove the section of wood keel and hull skin.

25.1.10. Clean up around the aperture in the skin and lightly radius the edges.

26. FINISHING OFF

26.1. **Glass cloth**

26.1.1. 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.

26.1.2. Use a fairly open weave cloth about 200 g/m2 to 225 g/m2 in weight. Your WEST supplier should be able to recommend the most appropriate weave - it mustn’t be to tight a weave or else you will have difficulty wetting it out.

26.1.3. 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.

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

26.1.5. 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.

26.1.6. 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.

26.1.7. 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 –10" or so blades) are best for cutting glass cloth.

26.1.8. 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.

26.1.9. 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.

26.1.10. 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.

26.1.11. 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.

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

26.1.13. Cloth around the outboard well aperture, wetting the cloth out very thoroughly and wrapping it about 25mm inside and outside. This will take a little patience and care.

26.1.14. The stem 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.

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

26.1.16. 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.

26.1.17. 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.

26.1.18. 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.

26.1.19. 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.

26.1.20. 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.

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

26.1.22. 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.

26.1.23. 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.

26.1.24. 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.

26.1.25. 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.

26.1.26. 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 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.

27. MARKING THE WATERLINES

27.1. Waterline

27.1.1. 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.

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

27.1.3. 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 (6') – 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.

27.1.4. Fix a long board (say 25 x 150 – 1" x 6") 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 (10') long if possible, sticking out about equally each side of the boat.

27.1.5. 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 (4' to 6") 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.

27.1.6. 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.

27.1.7. 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.

27.2. Boottop.

27.2.1. 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.

27.2.2. 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 not if the water is marked as a half-moon.

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

27.2.4. This is the "low-tech" method of marking waterlines. If you have access to a builders level (sometimes called a dumpy level), then you can make your waterline marks on the hull using that, quickly and accurately

27.2.5. END OF BOOK FOUR