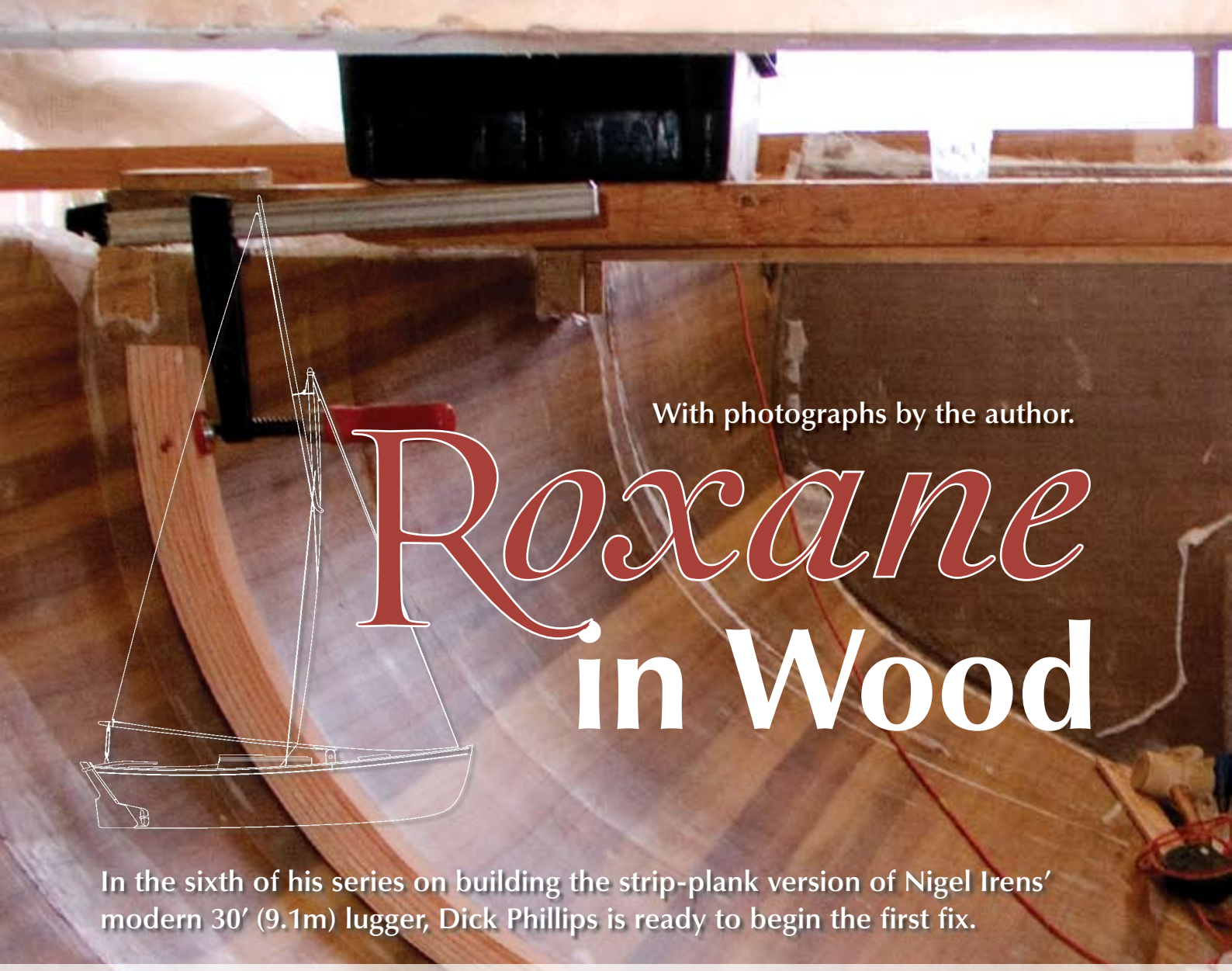


With photographs by the author.

Roxane in Wood

In the sixth of his series on building the strip-plank version of Nigel Irens' modern 30' (9.1m) lugger, Dick Phillips is ready to begin the first fix.

If we were building a house, we would now be approaching the 'first fix' stage of the project. I use the term because surely every TV viewer in the UK must now be thoroughly familiar with it after the glut of programmes on house building and restoration and will know that first fix refers to the stage at which the shell of the building has been completed and the heavy carpentry can commence.

Similarly, having completed Roxane's hull and turned it over, we can now instal the inner bulkheads, framing and internal stiffening. Before we can start to fit these structural parts, the moulds which have remained in the hull to support it through all the trauma of the turn-over need to be removed. This is where we find out if the parcel tape we stuck around the edges of the moulds to prevent the cedar strip planks sticking to them has fulfilled its purpose or whether we have to break some glue joints – or worse, some moulds. We also have to sheathe the interior of the hull with the same thickness of epoxy/glass as we did on the outside.

Readers of W68 may recall we built the hull over MDF moulds which were set up using I-section TGI beams, which, as TV viewers will know, are lightweight beams made of man-made board used in house building. When Jordan Boats CNC-cut the moulds, we asked them to incorporate I-section cut-outs which allowed us to align the frames precisely along three fore-and-aft TGI beams. This worked well, saving much of the time spent on the precise measuring and adjustment usually required at the vital setting up stage.

However, we now had the problem of how to remove the moulds without cutting the I-beams but short of rigging some kind of tackle to lift the whole assembly out in one piece, the problem defeated us. The three long beams had cost £130 and when cut, would still be serviceable as six shorter ones. We cut a 3" (75mm) section of the beams out between Stations 6 and 7 which allowed us to move each mould to the gap before lifting them clear. This must be carried out in a controlled manner, supporting the beams as you go, otherwise they could easily collapse towards amidships. As we removed moulds we fitted stretchers athwartships at the sheerline to maintain the hull's shape before the internal stiffening was installed.

These stretchers were made from 3" x 3" (75 x 75mm) softwood with shuttering ply brackets fixed at either end to hook over the hull. The beam at each station was checked as each one was fitted to ensure that she had not spread outwards. We also fitted our heavy cargo straps at regular intervals to support the hull around the bilge. Since we had made the fit out cradle when she was still inverted, this was a useful guide as to how well she had maintained her shape. She showed no sign of sagging bilges.

Background picture: *First frame in place.* **Above:** *Removing the moulds, glueing the laminates, laminating a half-frame on the jig.*

With the interior of the hull now exposed, we could see the results of our handiwork. All of the efforts made to clean up the planking as we went had certainly paid off, leaving a small amount of epoxy ooze at the body moulds but little else. Indeed, the hull had all the appearance of having been primed ready for varnishing because the acetone wash-down leaves a thin film of resin behind.

Unlike its exterior, the interior of the cedar strip hull does not need fairing; only small areas of it will be visible after fit out is complete. It is, however, necessary to fill any areas where air may be trapped in the timber, such as screw holes and some joints where the planking takes a convex curve in the bottom of the boat. Once the excess glue has been removed, with a hot air gun and the hull has been cleaned out, we can identify the areas to be filled.

We used the same filler mix we used on the hull's exterior, pressing it into the seams and injecting it into the screw holes with syringes from our local agricultural merchant. Using fast hardener with the Sicomin epoxy resin ensured that in 24 hours, the interior was ready for a final rub down and clean out with the vacuum cleaner before applying the epoxy/glass layers. These we laid diagonally from sheer to keel because the glass is easier to handle this way and the overlaps will only show along the bulwark where they will be easily faired out.

Before applying the epoxy glass layer, we warm up the area well, so that the cellular structure of the timber is cooling down rather than warming up. This ensures that the air within the cells is shrinking rather than expanding which could create air bubbles and poor adhesion. We applied the same layup as on the outside of the hull overlapping onto the keel for 2" (50mm) and laying a wide keel strip to cover the edge. This, we found, allowed us to stand on the keel while applying the layup. When building boats using modern techniques such as this, it is vitally important that the inside of the hull is kept clean because all of the inner strengthening must adhere to it perfectly. For this reason, we again applied peel ply as a final layer to enable us to peel off areas to be bonded as required.

Fitting the Frames, Floors and Bulkheads

Although the hull, made of cedar strips edge-glued together and glass-sheathed inside and out with epoxy, has considerable inherent strength, it still requires stiffening and reinforcing with a network of frames, floors, bulkheads and yes, even boat's built-in furniture. Three laminated ring frames are

The keelbolts were positioned to go in pairs through wooden floors like this one, fabricated at the base of each of the plywood bulkheads.

needed, one in the fo'c's'le, one in the saloon amidships and one aft of the engine in way of the cockpit. These frames are made up of a laminated section fitted to the hull at either side, a floor which holds them together at the keel and a deck-beam joined to them and braced with laminated knees. The frames on our Roxane are all made from Douglas fir and are 2 3/8" (60mm) 'sided' x 2" (50mm) 'moulded' – sided means the thickness of the beam, ie the distance between its forward and aft faces and moulded means the depth of the beam, ie the distance between its concave and convex faces.

The floors, which on boats are the main bracing members tying the sides of the boat to one another and the keel, are also made from Douglas fir and are gusseted with 1/2" (12mm) marine plywood across the keel. There are seven of them interspersed with the frames, giving the bottom of the hull considerable added strength. In most cases they are attached to bulkheads or furniture panelling which extends their effect further up the hull and reduces the unsupported panel areas. Five of the floors also provide bracing for the ballast keel having a pair of bolts passing through each one.

To establish the position of these main structural parts accurately and to set out the longitudinal arrangement of all of the furniture, we need to revert to the traditional means of suspending a building board over the hull. The building board is a batten or plank running the full length of the hull which has marked on it all of the positions for the frames and bulkheads. We can then plumb down from the board to fix all of the spacings for the internal structure. With its position fixed at stem and stern and with the station marks set out on it, we can more easily coordinate the setting out.

Using the wonders of modern technology, we could have obtained templates of each bulkhead, frame and floor from Nigel Irens via our friendly CNC router man Alec Jordan or we could have had full-size plots made of them. For various reasons, not least being that Alec was in the throes of changing machines just at the critical time, we opted for spiling the shapes directly from the hull the old fashioned way. So we bought in a few sheets of cheap plywood and cut them into strips to make spiling templates.

To establish the position of each frame, a straight-edge is placed across the sheer from side to side and a plumb bob suspended from the building board at the appropriate mark. The straight edge is brought up to the plumb bob line and 'horned off' from the stem or stern, whichever is nearest. Horning off is the old boatbuilding term for triangulation: squaring an athwartships member by measuring to either side from a point on the centreline. Once the position is established, the plumb bob is then lowered to the hull at regular intervals along the straight-edge and the contact points marked, thus plotting the frame's – or bulkhead's – position along the curve of the hull. We left the peel ply in place on the hull, allowing us to mark it with felt tip pens, make the patterns and offer up the frames or bulkheads without soiling the surface with anything which might prevent adhesion when we came to fit them.

The frames are symmetrical so it is only necessary to make the pattern for one side, doubling them up to make a full frame. Testing different thicknesses of Douglas fir on the hull curves, we found that the main laminations could be 3/8" (10mm) strips. Once the patterns are made, the laminating jig is set up and the laminating process can begin.

We laid up the two side lams for each frame together, one on top of the other, wrapping them separately in polythene to prevent glue oozing on to the jig. The two stacks of strips are laid side by side and turned over together, rolling on a priming coat of epoxy resin to all four surfaces as we go. Once they are all primed, a thickened mix of resin, colloidal silica and cellulose fibre is lightly spread on all faces before wrapping the bundles and placing them on the jig. The brackets are then tightened up to pull them into position and extra ramps applied to ensure a consistent series of glue joints. When all the glue has cured – usually after 24 hours if the temperature has not dropped too low in the night – we release the laminations and clean them up.

The cleaning-up routine we use may seem a little brutal but it works for us. We select the cleanest side and plane off the excess glue with a power plane set moderately fine. The plane has disposable blades which last surprisingly well, cleaning up five or more faces before needing to be replaced. As their replacements cost just over £2 a pair, it saves time and therefore money over the time consuming alternative of warming the glue and scraping it off. Next we clean up the other side by passing the lamination through the circular saw skimming off the glue and a thin off-cut of timber. Finally the two faces are planed up to a finish.

Once the two arms of the frame are fitted in place in the hull, a floor piece is cut out to bridge across the top of the keel, butting up to the frames. A 1/2" (12mm) marine ply gusset is then fitted across the heels of the frame and the floor to strap all of the parts together. The frame is then glued to the hull after removing an 8" (200mm) wide strip of peel ply; it will later be filleted to the hull to increase the glued surface area and to prevent a hard line which could be a potential sheer point. The floors will be similarly attached to the hull but the bulkheads will be filleted and glassed to the hull with a 4" (100mm) wide strip of woven glass cloth

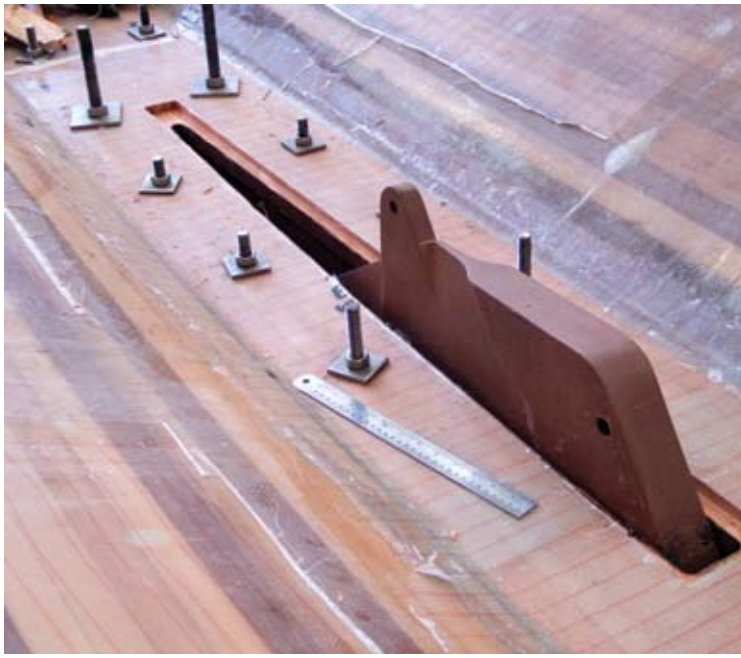
Attaching the bulkheads to the hull requires greater attention than attachment of the frames and floors because they are only 1/2" (12mm) thick and will pose a greater risk of shear to the skin. Therefore we must spread the potential stress point over a greater area of the hull. This is done by first gluing the bulkhead in place using an epoxy glue mix. Then we apply a fillet, which fills the corner formed by the bulkhead and the hull to a neat 1" (25mm) radius. A strip of peel ply may be used to smooth out the radius and ensure a clean bond for the epoxy/glass. Finally a 4" (100mm) strip of 600gm/sq.metre glass tape is laminated into place with epoxy resin. By this method the stresses from the 1/2" (12mm) plywood edge is spread over a width of some 5" (125mm)

Fitting the Ballast Keel

Our ballast keel assembly, which weighs over 1 1/2 tons (1.52 tonnes) and incorporates a 200lb (90kg) cast iron centreplate, was made by the aptly named Irons Bros foundry. To one of the main suppliers of production and custom-built keels for the UK and Europe, Roxane's keel is rather smaller than average but has the added complication of having the cast iron centreplate hinged on a large pin set into the lead. Manufacturing a keel like this presents no difficulties to them with their in-house skills of casting, fabricating and engineering; they also make barrels for cannons!.

A keel of this size may be handled in the boatshop using methods from ancient Egypt or the 21st century. We used a combination of the two; having transported the keel from Cornwall to Dorset on a trailer behind my Land Rover, we unloaded it with the able assistance of Giles Frampton, a friend with more than a passing interest in boatbuilding who has access to an agricultural loader. Once the keel was on the workshop floor, we reverted to ancient Egyptian techniques, namely levers and rollers, with the occasional use of the hydraulic jack thrown in.

First, the keel had to be coated with the requisite layers of Copper Coat antifouling which entailed rolling it from side to side to give access for all over protection to keel and centreplate. Once this had hardened over a few days, we began manoeuvring it into position under the hull on planks and rollers. With the hull sitting on two planks with wooden



The cast iron ballast keel, which was positioned under the hull using the ancient Egyptian methods of levers and rollers, is unusual in that it incorporates a slot for the large cast iron centreplate.

fence posts placed at intervals under them, the keel could easily be nudged into place with wooden levers.

Having positioned the keel, we jacked it up into place against the hull with a combination of hydraulic jacks, blocks and wedges. Once roughly in place we could drop some of the bolts through the keel from inside the hull and use them to finally align and raise the ballast keel into place. This was made easier by the fact that Irons Bros had made the bolts from threaded stud bar which allowed us to take the nuts off and drop them through wood keel and ballast keel from above.

We decided to have a dry run first to ensure that the keel did actually fit the boat before applying the bedding compound and grommets. Having assured ourselves that it did, we lowered it away until we could apply Marineseal 033 bedding compound, a synthetic rubber bedding sealant from marinemastics.com. It comes as a two part, 50/50 mix of pastes which can be obtained in black or white. When mixed together by hand – preferably gloved – it begins a chemical reaction turning the paste to a rubber consistency which begins to thicken in 4 hours and reaches full cure in 4-5 days.

Having spread a 1/4" (6mm) thick layer evenly over the top of the keel, we raised it back into place. We had previously prepared the bolts with their grommeted heads and commenced tightening them up. The grommets were made from several layers of Denso tape, a cloth tape impregnated with oil-based mastic which I do not find pleasant to use – to put it mildly. However, ground workers use Denso tape to seal stubborn underground sewer pipes and drains where it appears to last indefinitely.

The bolts are tightened up methodically from the centre of the keel towards the ends pulling the keel up gradually increasing the torque as the joint closes. The tightening routine must be carried out gradually, giving the bedding compound time to ooze out, repeating the pattern of bolt turning several times. Eventually when the gap has closed to around 3/16" (4mm), we halt the process allowing several days for the compound to set before finally torquing the bolts up. This technique is recommended by Trade Sealants who liken the cured rubbery compound to a gasket which can be compressed after fully curing.

Making the Beam-Shelf

The final stage in the 'first fix' process is to stabilise the sheerline of the hull and establish the line of the deck by fitting the beam-shelf around the top of the hull. On some boats, it may be called the inwale perhaps with a beam-shelf fitted inside it but on Roxane we call it the beam-shelf for the simple reason that the deck beams will be joined into it. These matching pieces of Douglas fir, along each side of the hull, from stem to transom, must be big enough for the 2 3/8" x 2" (60 x50mm) deck beams to be joined into them. It is therefore 3 1/4" (80mm) deep by 1 1/4" (30mm) thick.

Using one of the spare planking strips to gauge the amount of bend required of it, we discovered that for the first 20' (6m) we could bend the section around the curve following the desired line. Aft of this the convex curve of the sheer was too much for the section. As with many problems in modern

boatbuilding, we turned to the properties of epoxy resin again and made the section out of two pieces of Douglas fir laminated one above the other. The hull itself makes the ideal laminating jig. After we taped some polythene along the sheer we cramped the laminates around the outside following the horizontal curve perfectly.

The forward sections of beam-shelf were cut out of a 20' (6m)) length of timber with scarphs cut at the aft ends. Once the glued up after sections had time to cure properly, they were released and cleaned up to the same section as their forward partners and a matching scarph joint cut on them. We decided to glue them together in situ which necessitated a dry run of assembling them in place and fixing them at intervals through the hull with screws. This ensures that when the final assembly takes place you are not struggling with cramps, fastenings and pieces of wood covered in slippery glue.

When all of these pieces have been fitted and fixed to the hull, it is able to hold its shape without the need for any temporary bracing, which allows us to get on with the rest of the fit-out unimpeded.

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