In just two issues of Water Craft, Dick Phillips has set up the moulds and strip-planked the hull of Nigel Iren's modern lugger. But now he has reached the really sticky part.

Roxane in Wood

With photographs by the author.

With Roxane's 28'6" (8.7m) hull fully planked – see W69 – and if I say so myself, looking particularly attractive in her Western Red Cedar skin, we will cover it all up with glass cloth and epoxy resin. As I explained in the first of this series – see W68 – this variant of strip-plank construction uses relatively thin planks which will need generous layers of epoxy/glass to be applied to both the outside and inside of the planking to complete the balanced structure of the hull. Should anyone want to continue to see the beauty of the wood in a bright-finished hull with an epoxy and varnish finish, we would use a thicker layer of strip planking made from a tougher timber like Douglas fir, as specified by Roxane's designer Nigel Irens.

In keeping with modern boatbuilding practice, we have built Roxane upside-down and the hull will remain so until most of the coatings have been applied, leaving just the final gloss on the topsides to be rolled on. The order of operations will be to fair, fill and prime the wooden hull and then apply the glass epoxy layers to the appropriate weight/thickness. Then we will fit the outer backbone – stem, keel and skeg – followed by the bilge keels. Yes, bilge keels; Charles and Gillian Taylor, the owners of Roxane, would like to have the option of grounding her up the quiet creeks of the west-country rivers where bilge keels will be a boon.

Preparing the bare hull

Before we can start applying coatings, we have some fairing to do. This will be no more than smoothing out the slight angles created when the flat strips have been edge joined. With a finely set, sharp block plane or smoothing plane, we plane along the joints just removing a thin shaving off the edges of the adjacent both planks. This job reminds me of fairing the carvel hulls of passenger boats when I was an apprentice but with much less timber to remove and the boat the right way up. As we plane the edges, we can feel the smoothness of the surface by running an open hand over the hull; this will give a better appreciation of how fair the hull is than any visual check.

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Next we plane the hull diagonally, going across to the strips to fair out any slight corners left from the previous task. Here it is essential to keep the plane sharp and set as finely as possible, so that the edge of the blade does not create any cross-grain grooves. The process is one of methodically working along the hull refining the surface. Most of the hull's surface is convex and can easily be planed but there are areas close to the keel that are concave in shape and will need to be faired with the spokeshave. The curves are relatively gentle and we found that a flat spokeshave was able to remove just enough of the centres of the strips to fair them out.

Once the cutting tools have removed most of the timber to provide a fair hull shape, the surface is sanded to further refine the finish. This is where we call upon the long boards which are made from strips of flexible plywood with handles attached at either end and covered with a strip of 80grit aluminium oxide sandpaper. We can use this fairly coarse grade because the priority is to arrive at a fair surface which is to be sheathed rather than one which will be bright finished. The technique used is the reverse of the previous one: we sand diagonally first to finish the fairing and then sand with the direction of the planks to smooth the surface. Finally when all of the fairing is completed, the hull is cleaned with a vacuum cleaner and wiped over with a clean acetone rag to remove the last of the dust and ensure that there are no other contaminants on the surface.

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Priming and filling

Within a short time of wiping down the surface – say, a half an hour or so – the first coat of resin may be applied. In fact, once we had wiped off one side, my fellow boatbuilder, Luc, broke off to mix the first batch of epoxy resin; by the time I had finished wiping the second side, the acetone on the first side had evaporated away allowing us to start priming. We are using Sicomin SR5550 multi purpose epoxy resin for the build and have added the SD5502 slow hardener to make our primer coat which ensures that it will give a long curing time to help the subsequent layers bond to the wood.

Epoxy resin is a thermo-set resin which requires heat to assist in the setting and curing process. As the chemistry is heat sensitive, the ambient temperature plays quite an important role in the setting times, as does the thickness of coatings, so it's quite important to try to maintain a constant temperature while using epoxies. We have created a tent of polythene sheet around the hull and installed two 3Kw fan heaters to help create a suitable environment. A further variant is the viscosity of the resin at different temperatures. Below 10˚C, the resin becomes too viscous for laminating, so it is important to keep it at a reasonable temperature. To maintain the temperature of the resin and hardener at between 15-20˚C, we store it in a cupboard heated with a soil heating cable controlled by a thermostat.

As soon as Luc had mixed our first batch of resin we applied it to the hull with resin tolerant foam rollers. We use West System roller covers but Harris gloss roller covers are also suitable and may be easier to find in your area. For smaller jobs we use the cheapest foam radiator rollers. There is a calculation to be done when considering which rollers or brushes to use – that is whether it is cheaper to throw away the roller cover/brush or wash it out. The calculation has to include the unit cost of roller/brush, the cost of the brush wash – in this case acetone; nothing else will do, forget about vinegar! – and the labour cost of the washing. Suffice to say, we throw our covers away each day.

After the resin had been applied, we mixed up a small batch of filler to fill the larger seams and the screw holes left from attaching the planks. Again we used a slow hardener with our resin to ensure that the filled areas were uncured when they were over laminated. ,The resin was thickened with Mixfill 10, a light filler powder. When mixed with the resin it gives an extremely smooth filler which is easy to apply, sands easily and has good mechanical strength with flexibility. Only a minimal amount of seam filling was required as most of them are too close to fill but around the bilge aft and at the bottom of the stem we managed to find some where the planking turns around a tight radius. There were, of course, plenty of screw holes to fill.

Applying the epoxy/glass

The idea of covering surfaces in a combination of coatings impregnated into an absorbent material is nothing new. We have been sheathing boats and coachwork, amongst other things, for many years. Some examples have done little to promote the advantages of the technique, such as the sheathing of many lovely old boats with polyester resin and chopped strand mat in the Sixties. This usually fell off within 5 to 10 years, giving sheathing a bad name. With the advent of epoxy resins, we now have a much improved coating and bonding material and the reinforcement manufacturers have responded by producing high quality glass, carbon and aramid fibre cloths.

The specification for Roxane's inner and outer skins given to us by her designer Nigel Irens was: 1 layer of 600gsm quadraxial 0-90/+-45 and 2 layers of 300gsm twill. These layers are applied over the complete hull, with an extra layer of 300gsm added below the waterline. The quadraxial cloth consists of four layers of glass rovings laid at 45˚ to each other and stitched together, not woven. This gives a material which has strength in four directions and one which will drape over

complex shapes easily. The twill is a fine woven cloth which at 300gsm wets out easily and follows shapes well.

Glass reinforcements are measured by weight, not thickness, hence a 'lay up' of epoxy/glass is specified by weight per unit area. The Imperial equivalent of gsm – grams per square metre – is oz/sq.ft – ounces per square foot– and the accepted conversion is approximately 300:1. This makes 300gsm cloth the equivalent to 1oz/sq.ft, 450gsm equivalent to 1.5oz and 600gm equivalent to 2oz.

On the advice of our resin and cloth supplier, Whiz Deas at MCMC Ltd, we applied the cloth lengthways to give horizontal joints. This gives improved fairness of the hull fore and aft by dispensing with all those vertical joints. To ease handling the 30' (9.3m) lengths of cloth during the laminating process, we rolled them onto 1" (25mm) square pieces of softwood, with their edges rounded off to prevent snagging the cloth. The first layers were applied along the sheer on both sides and then along either side of the centreline. They consisted of one 600gsm quadraxial and one 300gsm twill, followed by a layer of peel ply. The final layers were added after removing the peel ply and gently abrading the surface. This consisted of one layer of 300 gsm on the topsides and two layers of 300gsm on the bottom, all finished with peel ply.

Peel ply is a finely woven nylon cloth which is laid on the last layer of epoxy/glass while it is still wet. As the ply is so fine, it simply absorbs the excess resin from the surface and usually wets out totally after being rolled gently. The first time I used it I thought that it would be impossible to remove as it appears to combine with the lay-up perfectly. Once the edge has been lifted, it peels away relatively easily, exposing a perfectly smooth surface with a fine cloth pattern which is clean and free from any amine blush exuded from the resin. The use of peel ply may appear pointless to some but in the production process, it saves valuable time in surface preparation and protects it from possible contaminants.

The reason for applying the skin in the way we did was that we estimated the amount of cloth to apply by the time it takes to wet out against the pot life of the resin. In practice it took 5 hours for two of us to apply one full complex of mats, that is 30' (9.3m) of two layers of cloth and one of peel ply. It is recommended that the sheathing should be applied while the timber is cooling rather than warming, so that the air in the timber is not bleeding out beneath the glass. Thus we would warm up the area in the morning while we prepared the day's materials, then cut back the heat just before midday as we started the laminating process.

Applying the epoxy glass layer is a relatively simple process of rolling the resin onto the surface to be sheathed and laying the mat on the surface. Important points to remember are that it is easier draw the resin up through the cloth than to try pushing it down through it, that the perimeter of the area should be marked to prevent under- or over-coating resin and that you should decide on the length of cloth to apply for each resin mix. We reckon to apply the resin at a ratio of approximately 1 : 1 resin to cloth ratio. Therefore if we are to wet out 2 square metres of cloth we calculate 900gsm of cloth (2 layers) x 2 metres = 1800gms of resin is required. As much of the resin as possible should be applied to the hull surface,

without it running off, before the cloth is applied and the remaining resin is used to wet out any dry areas after pressing the cloth in place with rollers.

Once the cloth has been wetted out it should be rolled with serrated metal rollers to consolidate the laminate. These rollers are either serrated lengthways along the roller, which is called a paddle roller or widthways around the roller, called a washer roller – this latter one gets its name from the original ones which were made from fitting penny washers and standard washers alternately on to a length of rod. We favour the washer roller for consolidating these particular cloths as it appears to apply a firm and constant pressure to the surface.

In the next issue, we should be fitting the outer backbone and bilge-keels, applying the finishes to the hull and turning her over in preparation for the fit-out.

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