The birth of a new boat **PART 3**

Finishing the mould and building the first hull

In part three of PBO's series following the building of the new Cornish Crabber 26, David Harding shows how the moulds are prepared and the very first hull is made

When we left the Cornish Crabber 26 last month, the hull mould had just been completed and lifted off the plug.

The plug was then turned over so the team could start to build the parts above the gunwale: the deck and coachroof. In the meantime, the hull mould needed to be prepared for the laying up of the first boat. It was important to get on with this as soon as possible, as the completed hull would need to remain in the mould for some time while the tooling for the interior moulding was built inside it.

Preparing a newly-made mould isn't just a matter of a quick flick around with a duster and a vacuum cleaner: it's a good two weeks' work. The surface has to be perfect because any bumps or hollows will be transferred to the hulls themselves.

Before any work started inside the mould, the ragged edges of dry mat around the gunwale were trimmed off to leave a smooth lip. Then every square inch of the inside was dry-sanded with a fine grade of wet-and-dry sandpaper. Orbital polishers followed and finally, as on the plug, five coats of wax to make sure the moulding wouldn't stick to the mould. It's vital to ensure that recesses such as the keel and bilge runners are given as much attention as the flat surfaces and, of course, the back box (the removable section at the aft end of the keel) was treated as well.

Time for a trim: the rough, dry mat around the lip outboard of the gunwale needs to be tidied up to leave a smooth edge. A blade is used first to cut away the excess...

...followed by an angle grinder. The lip is there to help stiffen both the mould and the hull moulding

The centreplate case mould

Before lamination of the first hull could get under way, one more essential element was needed: the mould for the centreplate case. It's impossible to laminate such a deep, narrow structure using a female mould (where the laminate is built up on the inside surfaces) so a male mould was used instead. Constructed separately in aluminium, it was fitted into the hull mould so the centreplate case could be laid up over it as an integral part of the hull.

The surfaces of a mould must normally incorporate a 'release angle' of at least a couple of degrees from the vertical: if more than one surface is vertical, the moulded structure will be difficult to separate from the mould. As a centreplate case needs to be absolutely upright, it's vital to ensure the easiest possible release, and that's why it was built in aluminium. Resin has a tendency not to stick to metal particularly well at the best of times, but the surface was prepared every bit as thoroughly as the rest of the mould.

Checking the fit of the case mould, to make sure it was both vertical and aligned precisely fore and aft, was a time-consuming but crucial job. The holes for the pivot bolt had to line up, too. The foreman in charge, Mark Hemings, spent a day lifting it in and out and making adjustments with a grinder before finally lowering it in and bolting it into position through the bottom of the hull mould.

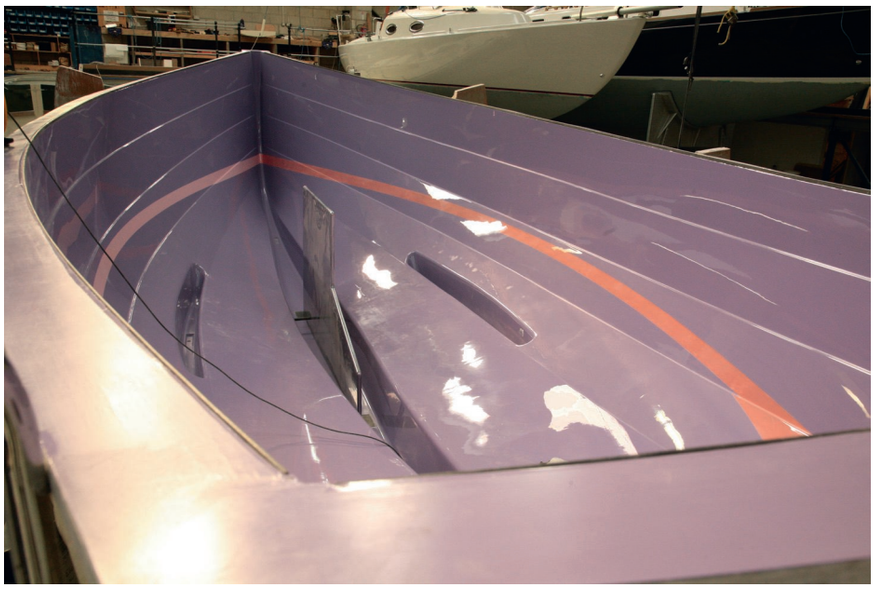
After the wet-and-dry sandpaper comes an orbital polisher with polishing compound

It's just as important to prepare the recesses for the keel and bilge runners as it is the flat surfaces: no corner can be ignored

Sanded, polished and waxed: the inside surface is now almost ready to receive the hull laminate

The aluminium male mould for the centreplate case is carefully polished…

…before being lifted up and lowered into the hull mould



The case mould in place, lined up and looking good. It's called a male mould because the laminate will be laid up on its outer surface, whereas the hull's mould is female and laid up on the inner surface

Fixing the case's mould into the bottom of the hull mould involved drilling through the two heavy layers of glassfibre laminate and 2.5cm (1in) of solid aluminium…

….before inserting the bolts. Four bolts were needed. The large bolt head further aft is for one of the release plates in the bottom of the keel

Starting the lay-up

When a mirror-like finish had been achieved inside the hull mould, the lamination of the first hull began. It was to be moulded in off-white gel coat, with contrasting mazarine blue for the boot top and the upper topsides between the guwale and the rubbing strake. The areas to be gelled in blue were masked off (the boot top had been gelled a contrasting colour in the mould to define the masking line) and the blue gel coat was applied by brush. The following day, once the blue had cured, the masking tape was removed and the rest of the gel coat applied over the hull and back-box moulds.

On top of the gel coat came the skin coat: the first layer of structural glass laminate in the form of two 1.5oz layers of chopped strand mat (CSM) saturated with polyester resin. In the laminating process, the mat is positioned by hand according to the laminating schedule and the resin worked in to it by long-handled rollers. Part of the skill is to ensure total saturation of the mat. No areas must be left dry, because otherwise it's more prone to water absorption and there will be voids beneath the gel coat. Corners in deep, narrow

The skill is to ensure total saturation of the mat

recesses are particularly hard to laminate properly – and if they're too narrow, the laminators simply can't get their rollers all the way down. It's generally less of a problem in hulls than in decks, where the corners of cockpit coamings and other upstands (which are recesses in the mould) are often afflicted by chips. In these cases the pressure of a finger nail is sometimes enough to break through the gel coat to reveal a void and the dry mat beneath.

After the gel and skin coats had cured overnight, the laminate was built up. Each day saw further layers of 1.5oz CSM being applied to one side or other of the hull and

Blue gel coat has already been applied to create the contrasting stripes above the waterline and below the gunwale. Now it's an off-white gel coat for the rest of the hull

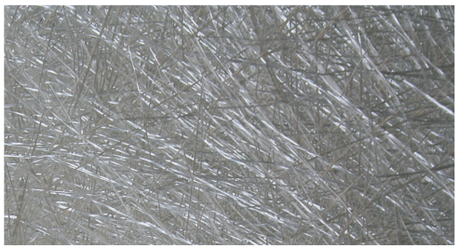
ABOVE Laminate is applied to one side of the mould one day, then allowed to cure overnight before the mould is rotated the other way. Note the air-extraction ducts. LEFT It's essential to make sure the resin is worked into all the corners, like this bilge keel

Terms and techniques

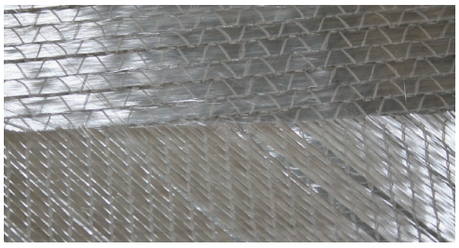
Some of the terms used in boatbuilding are in general use in other contexts. This is how they're used here:

CHOPPED STRAND MAT (CSM)
■ A mat made of glass fibres that are randomly orientated and held together by a binder. The binder dissolves in resin so the mat can be formed into different shapes.

ROVINGS
■ These are formed of the same basic strands of glass. They're bundled together to form rovings, which are then loosely woven and/or stitched together. The rovings can be aligned at different angles depending on the loads in the structure.



Chopped strand mat has the fibres orientated randomly and held together by a binder...



...while rovings are aligned in specific directions. In this quadrilateral cloth, they run at 0°, -45°, 90° and +45° and are woven and stitched together. Both sides are shown

LAMINATING
■ The process of constructing a hull using layers of mat and resin

LAYING UP
■ Interchangable with laminating. The 'lay up' refers to the hull structure or laminate

MOULDING (VERB)
■ Another way of describing laminating or laying up

MOULDING (NOUN)
■ The laminated structure

When the moulding is complete, the back box can be removed. It would be impossible to laminate the aft end of the keel and get the hull moulding out of the mould without this removable section

The first hull is now moulded but remains inside the mould while work starts on tooling up the interior and making the templates for the bulkheads

centreplate case. Because the hull mould is tilted over to about 60° to allow the laminators to work from the factory floor, only the lower half of the hull mould and the upper side of the plate case can be worked on in any one day. Gravity doesn't allow mat and resin to be applied and to cure successfully on a downward-facing surface. The mould is therefore rotated each day so alternate sides can be worked on.

Building up the layers

In the Crabber, where strength and simplicity are more important than saving weight, the glassfibre cloth is all chopped strand mat except in way of the chainplates, where some woven rovings help distribute the loads. Rovings are also used around the top of the centreplate case. In boats where a higher strength-to-weight ratio is called for, stitched and woven rovings are used more extensively in the hull.

A laminate is usually thickest in the bottom of the hull. David Thomas, the designer, specified a total of 18oz in the keel and the bottom 'plank' each side. This continues up the stem and the middle of the transom, which is also reinforced with plywood, and gives a total thickness of around 13.5mm. In the English-speaking world, laminate weights are usually measured in oz/sq yard even when other measurements are metric.

In the middle section – extending to 15cm (6in) above the waterline in accordance with Lloyds' requirements – the layup is 12oz, while the rest of the topsides are 9oz.

To even out any colour variations, the final layer of laminate includes some pigment in the resin.

Finishing off involves trimming the sacrificial lip around the gunwales. This is built as part of the moulding to provide extra rigidity when it's being lifted out of the mould. PBO

NEXT MONTH
Making the deck plug