Building Buckle Up

Graeme Bird of Adhesive Technologies explains the unusual construction details of the new Rocket 40, Buckle Up

IN ORDER to produce a lightweight hull, a core material as light as the PVC foams was necessary. This could not be done with any timber except end-grain balsa. Two main problems exist with using end-grain balsa for lightweight hulls. Firstly, it is difficult to prevent it absorbing more resin than necessary when laminating face laminates, adding unwanted weight. Secondly, a mould is required to form it.

With Duracore, a new timber veneer/balsa composite, we got around both these problems by gluing a timber veneer to each surface with a phenolic glue film in a hot press. The veneer stops excess resin absorption, and the balsa can be cut and jointed into planks that can be used over the frames as you would plank a cedar strip composite boat.

We decided to build the boat in female instead of male frames. This way we could complete all but the outside surfaces of the hull, and when we faired and finished the outside surface it was fully supported with no movement possible. Also, the boat was built in a small factory and would have to be slung in ropes to turn over. We only wanted to do this when the boat was structurally complete to avoid damage.

The construction procedure was as follows:

Frames and set-up. Temporary frames made from 20mm x 300mm pine were marked from full size loftings and cut out. These were braced so they would stand square. Position alignment was checked with string lines and a dumpy level. A laminated oregon stem, ash gunwales and oregon keelson were fitted.

Female jig assembled with laminated cedar/ash frames being made up.

In order to maximise stiffness, it was decided to use evenly spaced permanent frames throughout the boat at the designed stations. These frames were made from eight laminations 8mm x 25mm of western red cedar with two of silver ash capping the inside of the frame; total dimensions 65mm deep x 25mm wide. The temporary frames were used as a form, with blocks simulating hull skin thickness between the jig and laminated frames, which were then removed, cleaned up, sanded, then stored for later use.

Hull planking. The hull was planked with 15mm thick x 35mm width Duracore balsa veneer composite planks. Balsa was 12mm thick with 1 x 1.5mm meranti veneer each side.

Planking started at the turn of the bilge upwards to the gunwales and down to the keel. West Epoxy, modified to a lightweight thixotropic adhesive with microsphere blend, was applied to the edges of the planks before they were fastened to the temporary frames with double-headed nails until the glue had dried. The planks were run out over the gunwale and butt jointed to the inset oregon keelson.

The double-headed nails were removed and the interior power-sanded with belt and disc sanders to a smooth finish. Nail holes and any voids were filled. The interior surface had a saturation coat of West System epoxy applied with a roller, laid off with a brush and allowed to cure. This was lightly sanded before glassing.

One layer of 17oz double bias was laid fore and aft, the fibre orientation being ± 45 degrees. An extra layer was added to the area under the keel frames. This was laminated with West Epoxy. A lightweight nylon fabric, called peel ply, was also laid over, wet-out and left until the resin was cured.

Planking with Duracore balsa veneer began at the turn of the bilge.

Cloth wet-out was achieved by pouring mixed resin direct from the mixing container onto the dry glass and spread out with a squeegee held quite flat, thus forcing the resin into the fabric. Then a few minutes later with the squeegee held more upright, excess resin was lightly removed from the laminate, but still leaving it slightly resin-rich.

The peel ply was then laid on and a metal roller/squeegee combination used to wet it out thoroughly, insuring it was laying down hard on top of the glass without air bubbles or ripples. Any remaining excess resin is removed at this time.

Once the epoxy had cured, this peel ply was torn off the laminate surface, taking with it all surface contamination, to leave a fair matt finish that required very little preparation for the next stage.

In keeping with the West System tradition, a high class, clear-finished, timber interior was desired. The weight of glass fibre used on the hull was too much to allow clarity through to the hull planks. Therefore it was decided a decorative veneer would be used on all visible interior hull surfaces. For this 0.7mm African ash was chosen. This was laid at a 30 degree angle forward from the vertical and vacuumed down onto a bed of epoxy adhesive in four manageable sections.

Fitting permanent hull frames. The permanent frames were returned to the boat to be fitted. Edges to be fastened to the hull were bevelled to fit, then fluted and held in place by six brass screws put in from the exterior.

Ash keel frames, 12mm ply bulkheads and an ash capped 12mm ply "I" section sister keelson were cut, fitted and glued into place.

The laminated frames were glued, but not filleted on the top sides, but fillets were added under bunks and floors. For additional load spread, all bulkheads were filleted and glass taped with 17oz double bias.

Cockpit and deck framing. Tasmanian oak carlins were fitted into place over the bulkheads. Foredeck beams were laminated from the same materials as hull frames, with sidedeck beams sawn from western red cedar fitted with ash caps.

All deck beams were joined to hull frames with a solid ash knee reinforcing the gunwale joint on the inside of the frames. A threaded 6mm stainless steel rod was run from hull frame through knee into deck beam and glued into a over-size hole with epoxy to take any tensile loads.

Three Tasmanian oak stringers were run each side from the for'ard anchor well to transom, notched into deck beams. The cockpit was made from plywood, sides 6mm, seat sides 9mm, framed up with oregon.

Decks and cockpit floor. A different version of Duracore was made up for the deck. It consisted of 9mm end-grain balsa with two meranti and one ash veneer each side. Each 2400 x 1200 sheet weighed 15kg.

These sheets were pre-coated with two coats of West Epoxy on one side and orbital sanded to a smooth finish. They were then fitted and glued down to the deck frames and stringers, held with temporary screws. The sheets were scarfed together on the boat. The balsa veneer sheets were able to be bent to take the deck camber, except for the bow which was laminated separately.

Because all timber used in the boat was pre-coated with West Epoxy and sanded prior to fitting, the interior just needed a light sand before finish coating, cutting down a lot of work. It also prevented resin or glue spills from staining the clear interior finish, and spills could easily be wiped off the resin coated surface.

Cockpit seats and floor were made from the same material as the deck.

The hull/deck join was glass taped over the outside with 17oz x 150mm width double bias tape.

The cabin roof was previously moulded as the hull was fitted, completing the major structural work of the boat. The boat was then turned over in two rope slings attached to four chain hoists, which in turn were attached to the building's roof beams. It took six people two hours to turn the boat.

Outside hull glassing. The Duracore planks were cleaned up and sanded smooth enough that glass could be laid onto it without the possibility of voids. Screw holes, etc, were filled and the planking saturation-coated with West Epoxy. This was then lightly sanded in preparation for the glass.

One layer of 17oz double bias was laid across the boat with 1-2in overlaps at each edge of the cloth. Peel ply was then applied.

Once cured, the peel ply was removed and preparations for final full fairing begun.

Hull fairing. Because of the attention this boat would get and the unusual hull shape which could emphasise any unfairness, a good final fairing job was required. This we achieved with a method which we have been perfecting with the fairing of aluminium hulls over the last two years.

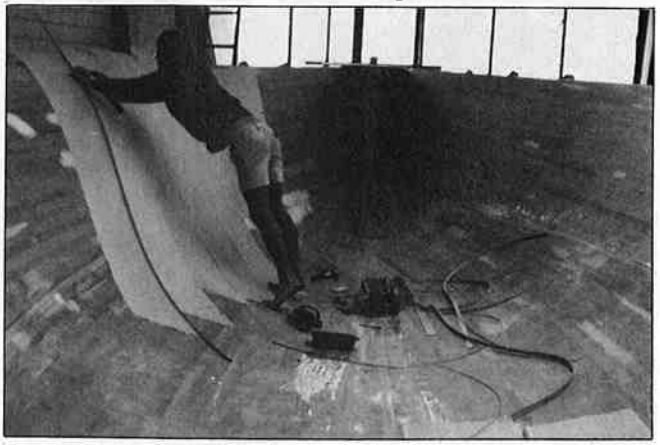
It starts with the application of neat, precisely shaped epoxy beads around the hull. A flat steel cement trowel has notches cut in at a spacing of about 60mm. These notches are 4mm wide and, in the case of this boat, 6mm deep. The depth of the notch is determined by the fairness of the hull after it has been checked with a batten. Importantly, the distance of the end notches from the ends of the trowel should be half the regular notch spacing.

A bog mixture of phenolic microballoons and West Epoxy is blended to a wet, paste-like consistency. A batten is held to the hull across the boat and used as a guide for the trowel.

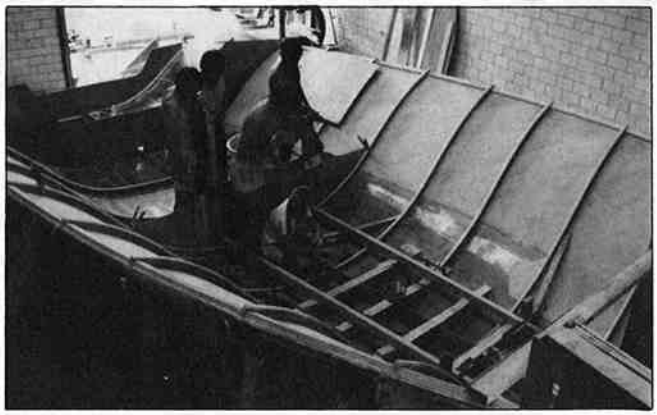
With the non-notched edge of the

Peel ply was torn off by hand when epoxy cured.

African Ash veneer was laid on exposed interiors.



Laminated frames, made earlier, were glued in place.



Keel frames and ply bulkheads were fitted and glued.

trowel, a light smear of bog is trowelled from keel to gunwales on both sides of the batten. A good amount of bog is then applied to the notched edge of the trowel with a putty knife. The trowel is pulled around the hull along the edge of the batten, leaving five beads of epoxy bog.

The beads should be crisp-edge and any dags of bog removed, or they will cause problems later. The initial thin smear of epoxy is mostly removed when the beads are applied, but it ensures the beads stay on the hull and don't peel or roll off as they tend to do when trowelled on a dry surface.

When the entire hull has beads applied and cured, the beads are sanded with 40 to 60 grit sandpaper attached to one metre-long torture boards. The boards are normally held on a diagonal and moved fore and aft or athwartships. Long battens are used to check fairness.

This sanding operation is relatively quick as only about one tenth of the hull surface area is being sanded. Care should be taken to ensure a minimum of 2mm depth is left on the beads in high spots, so an unbroken bog film can be applied later to the hull surface without having to obtain a feather edge to a high, unfilled area.

With a straight-edged cement trowel the bog is now applied to the hull using the pre-shaped epoxy beads as a guide. the bog should be as runny as possible, but still able to stay in place on the hull without sagging. The balloons should be mixed very well into the epoxy, leaving a creamy consistency without lumps. A power drill with mixing heads is best used.

The bog is applied to the hull from the keel down and takes about three screeds with the trowel. The trowel should only be moved parallel to the beads, as any movement across them may cause voids to form on the back side of the beads. Any dags on the hull will also cause voids in the screeded bog.

The angle and speed of the trowel on the final screed is important in obtaining the desired finish. The trowel should be held at about 25 degrees to the hull and moved at a speed which causes the bog to remain flat behind the trowel. Too fast, and bulges will occur between the beads; too slow and hollows will appear. This method is capable of fairing 95% of the hull surface with minimum additional filling.

Once cured, the bogged hull was sanded with 80 grit paper on orbital sanders to obtain the final faired surface. As always, small areas of touch-ups were needed.

The bogged hull was then coated with a liberal coat of pigmented West Epoxy that nylon peel ply was laid onto. There were three good reasons for this:

All low density epoxy bogs are somewhat porous. A coat of West Epoxy all but prevents water absorption;

The bog has a relatively soft surface somewhat easy to damage and scratch. the layer of resin significantly hardens the surface;

The pigmented layer of resin lets you know when sanding later undercoats when to stop sanding, and if you should stop a few strokes too late, the hard resin layer helps prevent the accidental sanding of a hollow in the easy-to-sand bog. The peel ply causes the resin coat to mirror its surface rather than the hull surface, thus the resin fills sanding marks and other small imperfections.

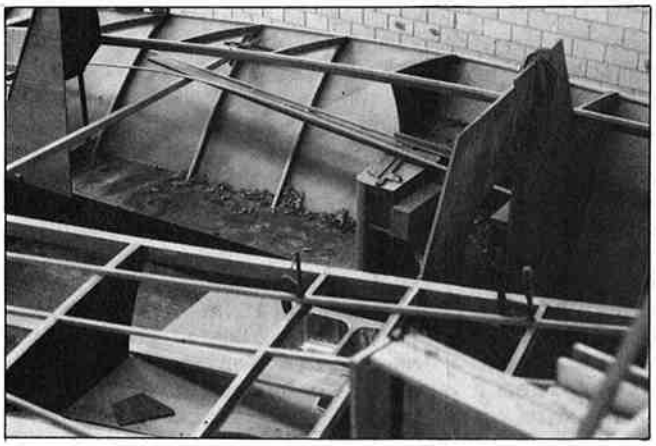
The peel ply was removed, edges touched up and four coats of a high build, easy to sand undercoat sprayed on, each coat a different colour.

The undercoat was then orbital sanded, starting with 120 grit paper and working back to 400 grit wet and dry, prior to proof top-coating.

Interior finish. The Rocket 40 was

(Continued on page 72)

Tasmanian Oak carlins, cedar/ash deck frames in place.



Interior trim included Silver Ash and Australian Cedar.