Building the Blowfish

The idea:

For quite some time I'd been wondering about using MDF as a composite core material. It's many many times cheaper than foam core or plywood. MDF is also much harder, so less laminating materials (epoxy resin and fibreglass) are needed to achieve suitable strength and puncture protection. While MDF is not a particularly light material, the finished Blowfish only weighed about 30kg As this project was and experiment to see if this could be done, keeping the cost down was important. I did not want to burn too many Dollarydoos if it all turned bad. The unpainted cost was just under AU$700 including spars and oars.

My plan was to use 3mm MDF so I could achieve the curves I thought I needed to keep the whole boat rigid. If the boat had flat surfaces, then these would be need to be supported with frames and stringers and I wanted to avoid that if I could.

The Blowfish needed to be a tender for our 7 meter yacht. So it needed to float about 300kg. I wanted it to be as dry as possible, so I gave it generous topsides. Anyone who's motored in a RIB in anything other than flat calm would know that they can cover passengers with a good deal of spray. The Blowfish should also tow, fuss free, at about 8 knots. I also wanted to be able to row it, sail it and fit a small outboard to it if need be.

In the end, it's met all my expectations and more. I'm delighted you've shown an interest downloading this small document and hope you have a go at building your Blowfish.

Noisy Andrew.

Contents:

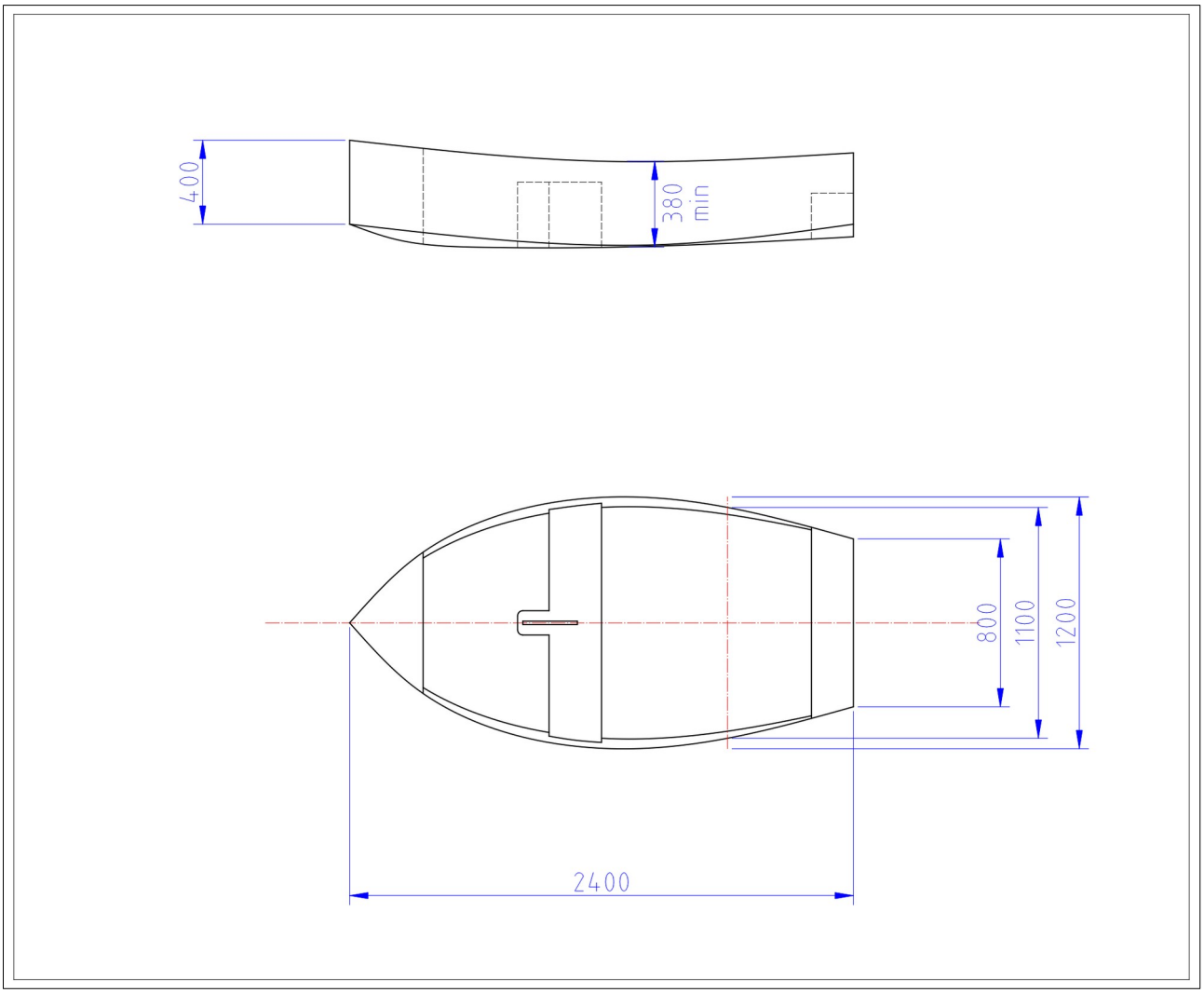
The Blowfish rule:

It was always the case that if this project worked, I'd make it available for others to build. While the hull shape of a Blowfish is not critical, I did want to outline a few measurements for other builders to follow so we had a small amount of class conformity. Below are a list of things I'm going to call The Blowfish Rule. As the little boat is based on a 2.4 x 1.2 meter sheet of 3mm MDF, you'll see these numbers appear a few times in the rule. I've kept the tolerances generous, so a beginner need not worry too much about what they are doing.

- Length from stem base to transom plane 2.4 meters (+/- 50mm).
- Beam from chine to chine at any point 300mm either side of half boat length 1100mm (minimum).
- Beam across the transom from chine to chine to be 800mm (minimum).
- Beam across gunwales at any point 1200mm (+/- 50mm).
- No part of the topsides shall be less than 380mm chine to shear.
- The stem shall measure 400mm (+/- 20mm)
- Port and starboard topsides shall meet at the stem to form an angle of between 80 and 90 degrees as viewed from above the deck, looking down. The stem may be plumb or racked forward. If the stem is racked, the rake shall be no more than 10 degrees.
- MDF to be used in all elements except transom, gunwales, forward bulkhead and fore deck. Other timber may be used for construction cleating and decorations. Fibreglass and epoxy may be used as required to maintain stiffness and sound structure.
- The boat shall have a centre case, a place to mount a rudder, rowlock holders and a suitable outboard mounting.
- The mast shall be unsupported by rigging. All spars will be shorter than 2.4 meters.
- The sail shall be no larger in total area than 2.88 meters^2 (the area of a full sheet of MDF). The sail can be any configuration the builder desires
- Hull and topsides shall not be white.

Hull drawing as per rule:

Shown below is a drawing to be showing how all the measurements should be observed. Forward stem rake is optional. Bulkheads, centre case and seats are show as hidden detail.

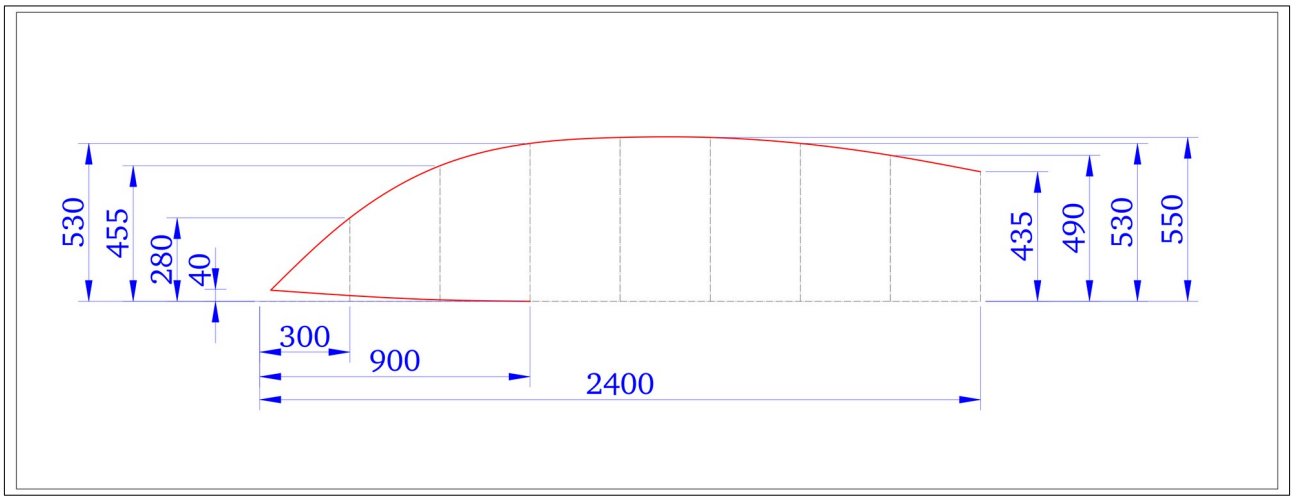


Lofting the Hull:

I started this project with a set of design ideas. But the general shape was arrived at by eye (with all the design criteria in mind). I did this by laying a full sheet (2420mm 1210mm) of 3mm MDF on the floor. I marked out 4 critical pints on the chine curve (the outer edge of the bottom of the hull). Then I used a flexible batten to loft a curve on to the sheet of MDF with a pencil. I hammered small nails into the points I'd marked and used them to hold the batten in the curve. I marked out the dart in the bow sections similarly. The dart should be a fairly even curve, though it should straighten for the section closer to midships so it does not create an unsightly "peak" at it's origin (a little past the 900mm mark).

This shape is not actually super important. Other builders may like to tweak these measurements, within the rules, to suit them selves. Once one side is marked out. Cut carefully along the line with a jigsaw. Then use the off-cut to mark out the matching curve on the other side of the hull.

Below is the curve I used. Reverse lofted from the saved off cut.

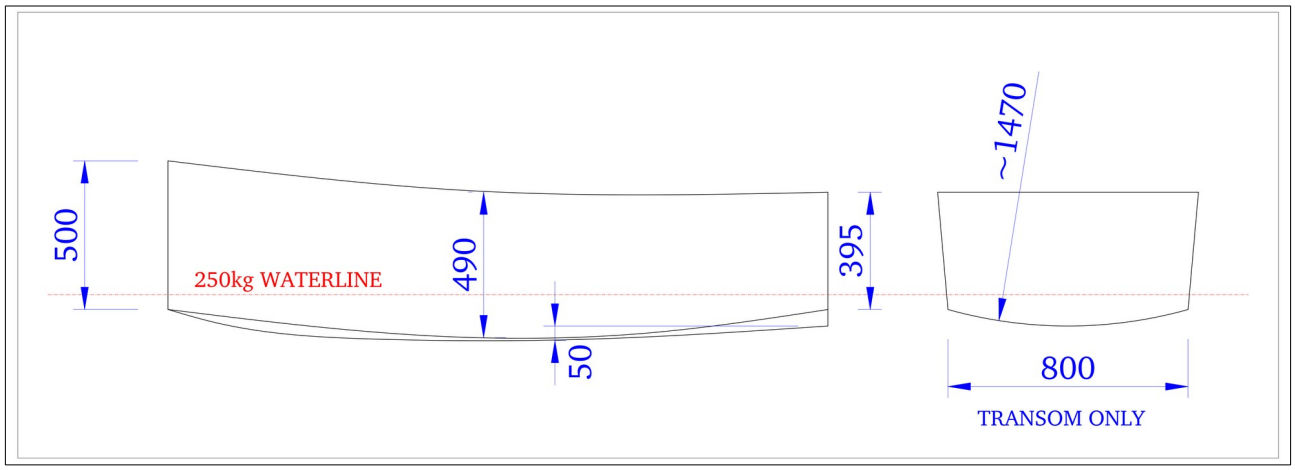


Note that I made a mistake and the 40mm dart in the bow makes the hull 30-35mm shorter. A little rake in the bow and the gunwale overhang makes up for this.

Warping the hull:

Once you have the hull (base) cut out. Next you should close the bow dart to form a vee in the bow. This helps keep the hull rigid in the bow area. This is done by drilling a series of 5mm holes along both edges of the dart. Each hole should line up with it's opposite exactly, so they can be pulled together with a small cable tie. I spaced the holes about 150mm apart and centred 12mm from the edge. Though they were closer together right at the bow. Once you have a pleasing vee in

the bow and it's symmetrical (See Image) place glue dobs along the dart to hold the edges together. I put a radius in the end of a 25mm knife and used this to firm the glue dobs. I did not glue the vee in the bow before adding the topsides and transom. But in hind sight I think it's probably a good idea. See the section **gluing surfaces together.**



I made the stern rigid by putting a gentle curve, approximately 1470, in the transom. The midships section of the Blowfish is kept rigid by the centre seat and a little bit of rocker though the middle of the hull (50mm). By doing this, the whole hull is kept surprisingly rigid without any stringers (longitudinal ribs). See the diagram above for transom curvature and midships rocker. I made the transom with some scrap 18mm plywood. I did not have a piece big enough to make the transom in one piece and if I built another Blowfish I would find a piece big enough.

Once the transom is cut out, it is glued into the hull sheet to provide the stiffening curve in the aft section of the craft. Use temporary screws to hold it in place. Once the glue is cured, remove the screws and fill the screw holes next time you have some glue or filler mixed.

Marking out the topsides:

A sheet of 3mm MDF needs to be ripped down the centre for the port and starboard topsides. As the outer edge of the hull will now be much longer than 2.4 meters. A short length needs to be joined onto the end of each panel to achieve this. I did this after I put the topsides on as initial I was going to trim the length of the Blowfish down to match - so the boat would be shorter than 2.4 meters - but gladly, I decided against this.

My initial plan was to build a simple boat based on 2.4 meter sheets. Not one that was 2.4 meters long. I've very please I changed my mind on this.

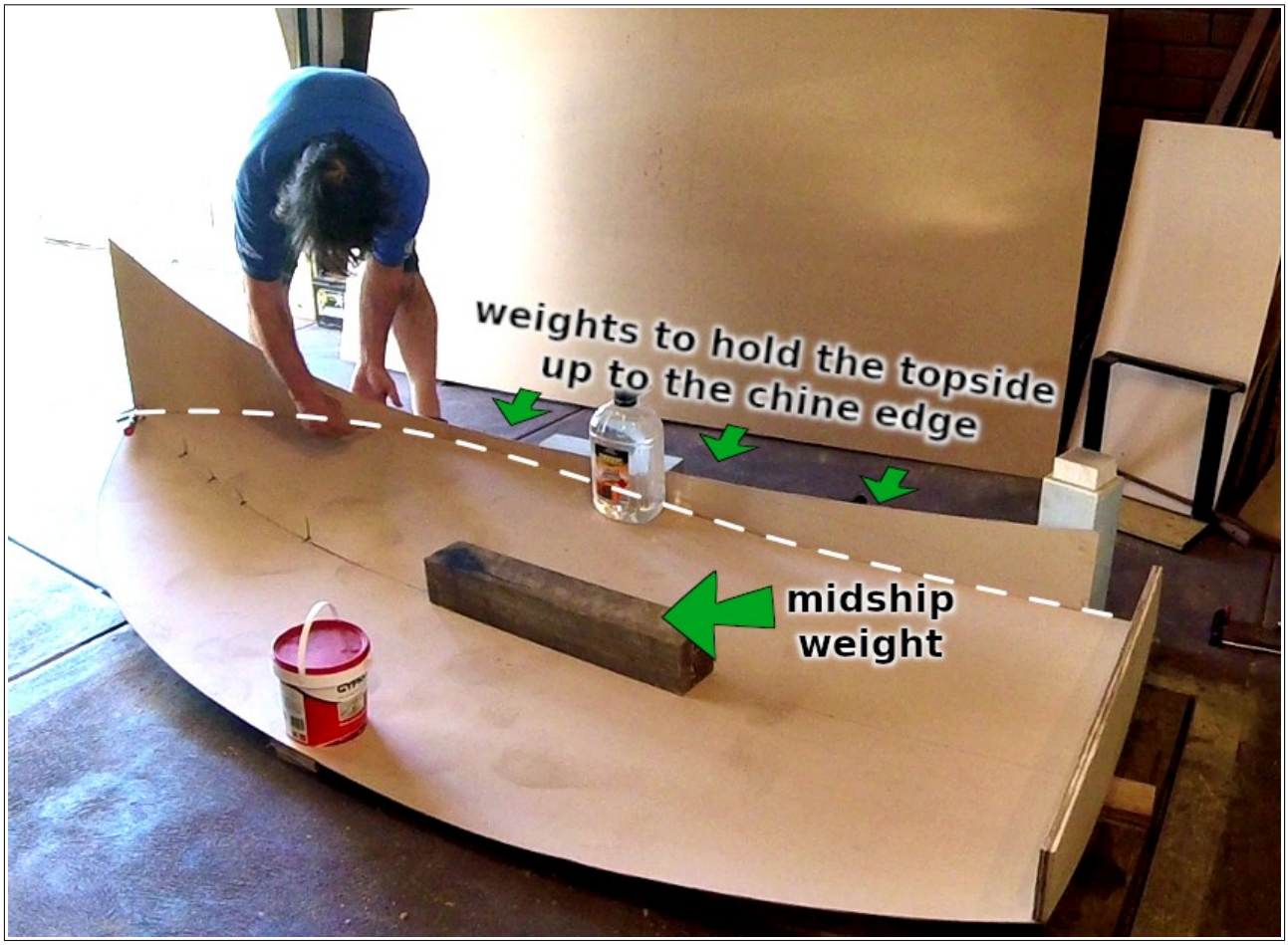
Similar to how I made the bilge panel, I marked out one topside and then used that as the template for the other. Keeping your boat symmetrical is the aim here and is not as straight forward as you may think. Having accurately cut panels will help.

To mark out the topside I first set up the bilge panel on a FLAT surface. I used my workshop floor. The Blowfish is flat across it's midships. But has some rocker or rise as the hull form moves back towards the transom. Before marking out the topsides I cut some large wooden wedges out of some scrap 45x70 scrap timber. I made the wedges about 200 mm long and a full 70mm high. I used

some weights (house bricks would be fine) to hold the midships down. Then slid the wedges under the chines on both sides until I had the shape I was looking for. I also supported the Bow vee with another wedge.

With the bilge panel now solidly pinned to the floor and the chines wedged up to provide a rise/rocker I liked, I offered the topside panel up to the side of the bilge panel. 3mm MDF is easily flexible enough to bend around the curve for the chine. Make sure the topside is resting evenly on the floor. Then slide piles of bricks, or other heavy weights up on the outside to support the now vertical topside panel. Then use a soft lead pencil or felt tip pen to mark around the inside where the topside panel touches the chine. See image below.

I marked the off-cut from the bilge panel and then transferred the curve to the topside panel. But I think you could just use the topside panel directly without my extra step? Occasionally i imbarrase my self over complicating things. I had about 6 wedges slid under various parts of the bilge panel to support the shape I wanted. If you have already glued in a full size transom (unlike what is shown), you'll be able to pop a few temporary screws into it to hold that end of the topside panel while you mark.



Stitching the chine:

The chine is stitched, with cable tires, the same way the bow dart was stitched. However getting both edges to meet uniformly was a frustrating challenge. I managed this by cutting out a hand full of 100x50 rectangles out of some scrap panel and then screwing them temporarily to the underside of the bilge panel so they hung out well past the chine. This way the topside could rest on them while I was tightening the cable ties. This was a great help in getting the two edges to meet evenly at the chine.

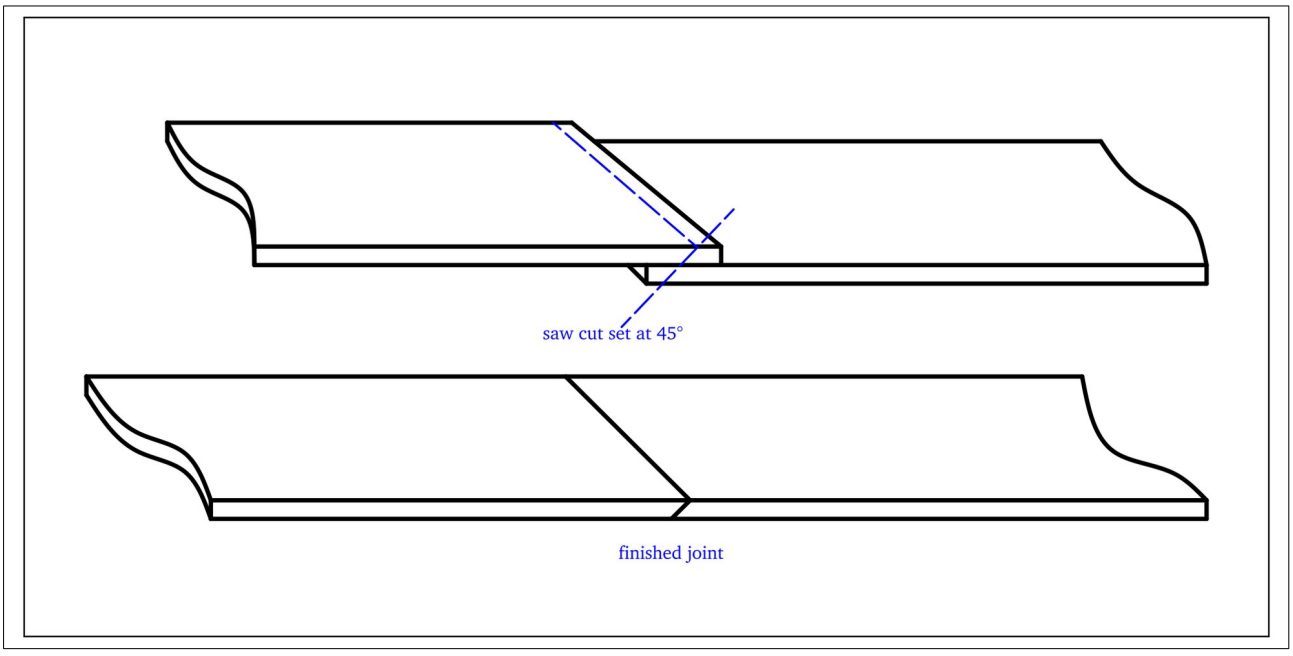
As we are going to sheath the Blowfish in glass and epoxy, any holes left by screws will be hidden.

A note about the topside length:

If you look at the picture of me marking out the chine on the topside. You can see that the panel is too short and had to be extended. I feel like I should have extended the topside to the correct length before marking it out and stitching the topside to the bilge panel. With hindsight shouting at me from across the bar, here's how I think I would have done that.

After ripping a full panel (1200x2400mm) of 3mm MDF down the centre. I'd have cut 600mm off the end of another sheet. Cut this in half to get two panels approximately 600x600mm. I'd clamp each of these to the end of each of the topside panels with a small overlap. With a saw - circular or jigsaw - set at 45º, cut across the overlap.

This will give a matching 45º cut on both panels that can form a sort of poor mans scarfe joint. Glue these two pieces together on a piece of polyethylene plastic. Epoxy, or basically anything, will not stick to polyethylene so when the glue is cured you'll be able to peel the plastic off. This join will not be terribly strong, but it should hold together well enough to allow you to mark out the topside, stitch it to the bilge panel. If you were worried about this, you could lay up a 100mm strip of fibreglass on the outside of the topside before continuing.



Getting everything true:

With the hull stitched together, you'll find the boat is still quite "floppy" (very technical term). If you just apply glue dobs now, without making sure it's the shape you want, you'll find you have an odd shaped boat when the glue cures. Yes I know the blowfish is an odd boat anyway, but still... Once the glue is dry, despite there being no bulkheads or any other structure the little boat is surprisingly stiff. So it's really important to get everything symmetrical, port and starboard, and supported well, before any glue is applied.

So before I applied any glue. I temporarily screwed a thwart across the midships. Used a spirit level on the thwart and transom, then wedged up the chines so they were level. I also cut out a temporary gusset to set the bow angle and screwed that in temparalily.

Looking above you can see I placed little "strips" of glue. When this was cured, I cut the cable ties and ran fillets all the way around every join. I think if I had made the cable tie holes closer to the edge. I could have filleted over the top of the cable ties and just left them in. They are soft and the bits protruding outside the hull would just sand away.

I modified a 50mm putty knife to apply the fillet. For tighter radius fillets I used a doctors tongue depressor. You can buy these in bulk from most fibreglass supplies shops. But a greater radius is easier to laminate around.

Gluing:

On the Blowfish and pretty much any work I do, I mix my own filler and glue. West System - and many others I'm sure - will sell you additives to add to their epoxy resins to make suitable glues and fillers, aka bogs. But as I've always had pretty good success with my own concoctions. It's just what I do. The only advantage to me is a few less powders in the cupboards and I can make a softer glue that's easier to sand fair if I feel that's required.

I have bags of 3 "powders" in the cupboard that I can add to resin to achieve what I'm looking for;

- A bulking agent for filling. QCell
- A thixotrope to stop bogs sagging as they cure. WacaHD
- A microfiber to add strength to anything I feel needs it. West System 413

In the Blowfish, the 250gsm fibreglass sheathing will be 2 layups thick on the outside of the chines. So I expect this to carry much of the hull loading and shock resistance. So the filleting glue I used to join the topside to the bilge panel does not need to be very strong. As such I used 50-50 QCell and WacaHD. If I was looking for a stronger adhesive I'd add microfiber (which is much tougher to sand and fair).

As with all gluing, you should probably prepare the surface first. MDF has a sort of waxyness to it that is probably not great for sticking things too. So I can't help thinking giving all surfaces a quick rub with 120 grit sand paper is a good idea. I did none of this when I Glued the panels together. But I did give everything a good sand and dust off before I applied the laminate (glass and epoxy resin) later on.

You can reduce the amount of sanding you need to do after gluing A GREAT DEAL if you are neat with your glue application. The surface you want to lay your fibreglass over needs to be SUPER FAIR (smooth). Any little pit or hollow will create an air bubble. You may think that you can just slosh more resin over these to fill them up. But this is not the case.

Sand well. If you can see little dips or hollows. Mix a little more filler and sand again. This is VERY IMPORTANT for the strength and integrity of your structure.

Adding some structure:

Once the glue is cured you find your Blowfish is surprisingly rigid. The upper edge of the topside - where the gunwale will be - will still be quite floppy. But the boat as a whole, from just above the chine down, will be really "locked". This is why it was important to true the Blowfish up before you fillet glue the seams. It's at this point I added two bulkheads. One will be the rear of the centre seat. The other will be the bow bulkhead that supports the mast.

The centre seat bulkhead I marked out and offered up to the hull. I placed this 1250mm forward of the transom. This places you pretty much in the centre of the Blowfish when you are rowing or sailing it. But also means you can slide your bum forward on the seat when you have another person on the rear seat, and the boat will not be too far out of trim. No body likes a droopy stern.

I used a raw piece of MDF and fillet glued it in as shown in the picture. However if I was to do this again? I would cut out the bulkhead so that it fitted neatly. Then laminate bother sides with one layer of 250gsm woven glass and epoxy. Then glue fillet it in. Laminating this in-situ was more awkward than it should have been.

The forward Bulkhead is 350mm aft of the stem. This is where the mast step will be. Having the mast well forward, keeps the rest of the Blowfish open. It also keeps the mast support structure small and triangular. While the Blowfish only has a very modest sail, keeping this strong does not add much weight. The bulkhead was 18mm ply and I laminated it in-situ after the usual glue filleting. I used a bevel to measure the angle the cuts had to be. given we're glue filleting all the jopints, you could just fill anyvoids you crate by being too slap dash. but seriously people, lets have a little pride in our craft? I put a total of three layups around the forward fillets of this bulkhead. It will transfer quite a bit of twisting force to the rest of the hull and I wanted the fillet and fibreglass to spread that load over the largest topside area possible.

Once again. I sanded the glue fillets **A LOT** to make sure there were not voids in the laminate. Sand sand sand.

Sheathing the hull:

After the two bulkheads were in, the Blowfish is ready to be turned upside down and sheathed in fibreglass. Epoxy is usually pretty strong after 12 hours. But I waited for a day or so before I move anything. Before glassing there's quite a bit of prep work to do.

The first thing to do is sand the chines round. I ran a router with a 6mm radius cutter around the boat. But MDF is soft enough that you could work away with some coarse (40 grit) sand paper on a block and round them off by eye.

The reason for a round chine is two fold. Firstly hard edges chip and damage much more easily than soft round edges. So unless you are going to treat your blow fish with super kid gloves, round edged are the go. On one of the early sailing trips we drooped the Blowfish on the side gate of my ute. It landed quite hard on a corner of the transom, across the top edge of the steel side gate. There is no mark we could see. The other reason to round off the chines (and other corners) is that laminating over a curve is much easier than going around a hard edge. The 250gsm woven will go around a radius of about 6mm - or more - without lifting up and bubbling the minute your back is turned.

Before laminating the hull, I filled all the little holes where the cable tires were. The few screw holes where I had fastened the little topside supporting blocks. And the screw holes where I had fixed the temporary bow gusset. Remember, it is important to laminate over a fair/smooth surface as you cant just gloop resin into small voids. With the filler cured, I gave the whole outer skin of the Blowfish a good hand sand with 80 grit sand paper.

Before laminating the outer hull you should brush away/vacuum up all the sanding dust.

For my Blowfish I used plain 250gsm woven cloth. I used this as it's heavy enough to provide a tough laminate and also very cheap. On my Blowfish I used only one laminate over all the main surfaces. I wondered if this would be enough and was happy for it to fail and be repaired if it was insufficient. At the point of writing the little boat has been sailed, towed, rowed and motored for over 18 months. I have capsized it once on purpose to test it's buoyancy and stability while swamped. It has also capsized while being towed (more on that later). It it still sound in every respect.

Once the Hull is clean. measure and drape the 250gsm woven cloth over the hull. I favour using a rotary cutter to cut the cloth. I use a thin strip of MDF to cut against. Scissors also work, but if they catch they will make a mess of the weave in the cloth that can be annoying. You should be careful with freshly cut raw edges as any stray strand will cause fraying very quickly and this is annoying.

With most epoxies I've come across the ratio of fibreglass to resin is 1:1. So weighing your cloth before each laminating session to work out how much resin you need is a very good idea. I only mix 250 grams of resin each batch to ensure I have plenty of working time before the resin starts to gel (go off). The moment you sense you resin is starting to thicken or coagulate in you mixing container. Stop!! Set it aside and make sure you have worked out all your air bubbles out in the area you been laminating. As the reaction in the resin is exothermic and sped up by heat, the resin in your mixing container will go off much faster than the resin you've already applied. So you have a moment or two to clear these air bubbles.

Mix your epoxy resin to the quantities the manufacturer suggests. Many epoxies are measured by volume, but as the specific gravity of parts A and B are usually very close, you can use a set of scales. Check this with the manufacturer. Also note that if you are using West System that the ratio changes from one hardener to another. Don't be caught out by this. Once you have correct ratio, mix the resin thoroughly with some haste. The clock is now ticking. If it is a warm day, you probably only have 15 minutes max. Most epoxy systems have slow and fast hardeners. You may find this helpful if you feel rushed.

Once the resin was well mixed I dribble it over the fibreglass that has been draped over the hull. the I use a rubber or soft plastic squeegee to spread it and work out all the bubbles. When the fibreglass is properly "wet out" it will be translucent. Any fibreglass that is still white is too dry. Work more resin in to that. Make sure you have not pulled the fibreglass away from inside corners. This will not be a problem on the outer hull. But will be a concern when you come to laminate the interior. The fibreglass must be stuck down firmly to the MDF everywhere.

Once you have all the fibreglass well "wet out". Work any excess resin off the area and collect it on some scrap paper or similar. You may think loads of resin is a good idea. But this is not the case. If you have too much resin, the fibreglass may tend to float up away from the surface and as the fibreglass is the actual strength in the laminate, this is a very bad thing. You want each layer of fibreglass as close to the surface it is reinforcing as possible.

Working with resins can be a pretty messy you experience. I always have a pack of disposable latex gloves handy. Every fibreglass supply store ever will sell you boxes of these. Get them. Also buy

your self a few litres of cheap vinegar. It is perfect for cleaning un-set epoxy resin of your tools and any other place you may not want hard globs of goop.

Keep mixing small batches of resin and working away until all the fibreglass you have laid over the work area is "wet out". Then reward yourself with a good cup of tea or some such.

After the first layup:

Laminating fibreglass on a flat surface is far and away the best place to start. Because making woven fibreglass lay tight around corners, nooks and odd angles is an art all to it's self. You will find that the fibreglass that looks wet and tight to a surface, may have "bubbled up" when you check back an hour later. If this happens, your only option is to wait until the resin has cured firm, cut and sand the bubble fair to the rest of the surface and laminate a patch over it when you next have some resin mixed. Overlap any patch like this by at least 50mm on all edges.

If you have done one width of cloth, you'll see that the fibres may tend to poke up a little along the edges. These need to be sanded fair before the next layer of fibreglass is laid over the next section to

be laminated. These two areas need to overlap each other by 50mm. Obviously some of you will take a deep breath and have at the whole hull in one go. Brave folk who gravitate to the "hammer the pad to ring the bell" games at the sideshow. These people will remember to overlap the fibreglass 50mm along it's edges right? They'll also note that these joins take a little more resin to get properly wet out.

I cut 70mm strips of fibreglass and layed them over the chines, stem and transom edges so all these areas are 2 laminates think. It is important to give these areas a good sand before adding second (and maybe third) laminates as each laminate will only bond to the previous one is the surface is well prepared. Sanded and dusted clean.

Splinter WARNING:

Once the outer hull is sheathed, give it a rough sand by hand to remove any sharp fibres sticking out from the resin that may catch a casual hand. Fibreglass splinters are not only sharp. They often have barbs and you'd be a special sort of masochist to not care about falling foul of them. Also by the time you get the boat to this stage, friends and family will start to show interest. The first thing they do when they walk into your work space is feel the hull by running their hand along the surface.

Maker sure you've dealt with the splinter hazard for you and anyone else who drops by.

Outer gunwales:

While your Blowfish is still not as rigid as it's going to be when it's complete. At this stage it's certainly rigid enough for you to handle and not worry too much about it deforming to some odd shape while you work. So now you can turn the Blowfish right side up and prepare it for gunwales.

The gunwales actually add significant structure to the upper edge of the topside. Because of this I chose to do the outer edges of the gunwales before I fibreglassed inside the hull. The gunwales on my Blowfish are about 30mm wide and a little less than 30mm deep. They are made up of some scrap pine that I cut into 6x30mm strips. The pine was actually some H3 rough sawn weatherboards that were left over from a shed I'd built. It took me quite some experimenting to get a thickness that would bend around the curve towards the bow without snapping. 6mm thickness worked for me. You may have to go thinner, or may get away with a thicker section? But it's worth noting the more strips you laminate around the gunwale, the stronger it will be. My gunwale is 5 strips (with the middle one being 3mm as that needed to be the same thickness as the MDF). If you check out the image of the gunwale and all the clamps you'll note a few other things.

- I've used two bits of scrap as temporary thwarts to hold the gunwales in a profile I like. These are just cut to length and pushed in place (see the arrows)
- The end of this strip is too close to the place where I have lengthened the topside. This was a fitting up to check it all looked good before i did any gluing. I trimmed the end back about 300mm to move the scarf joint away from this area.
- You can never have too many clamps. When you glue the gunwale for real, clamp it as often as you can. glue works best when the two surfaces it's joining are as close together as possible. Say it with me "You can never have too many clamps"..

I glued each timber laminate one at a time. Waited for it to cure and then applied the next one. as my lengths of pine were not long enough to do the gunwale in a complete run. I scarf joined them at 45º. It's important that each join is at least 500mm for any join on a previous strip. Two joins too close to each other is asking for a failure should the Blowfish take a bump there. I also kept the joins away from the curvy section at the bow. I glued the two outer strips first. Then I laminated the inside of the hull. Then, when I glued the two inner strips. This left a gap down the middle where the MDF was sandwiched between the fours strips. I kept this gap as clear of glue as I could and then glued the 3mm piece of pine in last to trim this all up. In the end there was still some glue dobs

in the gap. So I ran a router down it with a 4mm cutter on it. Even with a fence on the router, this is fraught with the danger of a slip and screwing every thing up. An easier solution may be just to fill the gap with some back pigmented filler.

Whatever you decide. I think it's a good idea to have the top edge, of the topside MDF panel 5mm below the top of the gunwale so it's protected from bumps and nicks that may cause water to find it way into the MDF there.

Laminating the inside:

Before I added any more internal items - seat, centre case, mast gate, inside gunwale strips - I laminated the entire inside. This completes the sandwich construction of the hull. Once this is done, seats and other fittings can be glue filleted in and the joins those items make can be fibreglassed over.

Fibreglassing the inside is much more fiddly that Fibreglassing the outside of the hull. If you find you are having trouble? Do it one section at a time. As working on a horizontal surface is easier, don't be afraid to tip the Blowfish on it's edge to do the insides of the topsides. I actually managed to run one piece of fibreglass from one gunwale, down the top side, across the bilge panel, up the other topside to the gunwale in one go. But this was very difficult. I needed to use some tape to hold the fibreglass up the side so that it did not collapse into the bottom of the boat before I'd wet it out. also, working the fibreglass means you risk pulling it away from an inside corner (the inside of the chine) and creating a bubble that will need repairing there. Double check all inside corners and then an extra time.. ..so that would be triple check.

I would suggest doing the bilge panel first. So cut out your fibreglass to cover than and allow it to come up the topsides 50mm. Allow this 50mm for the transom and centre bulkhead too. Then tip the little boat on it's edge, as suggested above, and complete the inside of the topsides. Make sure to sand the overlaps where they occur between layups.

Other awkward angles, edges and corners can be dealt with using a small paint brush. Load the brush with plenty of resin and dab away. Once the fibreglass is wet out (translucent), carefully work excess resin away from the area so as it's not over saturated. Remember what i said about the fibreglass "floating up" away from the surface you are trying to laminate it too. another thing you can do in areas where edges are awkward, is lay up the area with small pieces of fibreglass cut on a diagonal. this means the fibres will go around the corner/edge at a much more gentle angle and they will be less likely to want to bubble up away from the surface you are laminating too.

This technique will be useful around the bulkhead up at the bow and down the inside of the stem. I applied 3 layers of fibreglass over all of these corners as the mast and sail will exert quite a moment (twisting force) over this area. Remember to sand well between each layer.

Finishing the internals:

Once you have the inside fully fibreglassed, it's time to finish the gunwale. Treat this the same way you did the outer two strips. Remember that you can never have too many clamps.

Once I had the gunwale complete we took the boat to a friends swimming pool and tested it's buoyancy. I wanted to make sure it floated sensibly with two people in it. this would also give me a clue as to the position of the centre seat. Because at this point I was not sure if the bulkhead I had installed should be the front of the seat or the rear. It turned out it was the rear. This also assured me it was reasonably stable. Small boats are inherently unstable when loaded.

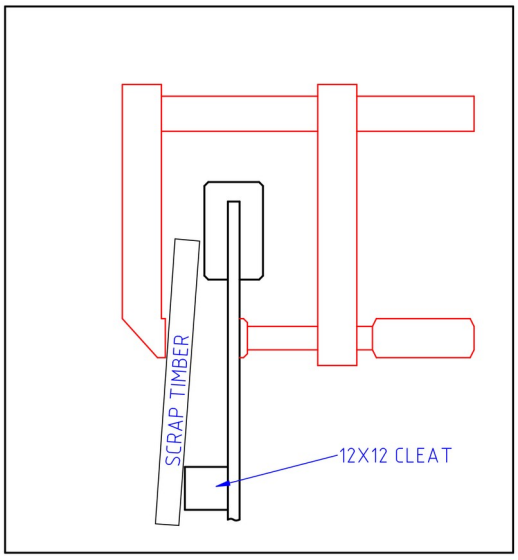
The seats and centre case came next. I did not want the centre case to interfere with the space in the middle of the Blowfish too much. this meant it had to be part of the centre seat and forward of it. But this was not a problem as the mast is stepped well forward. So the centre of effort of the sail will also be forward. The centre of effort of the sail should be almost vertically aligned with the centre of lateral resistance of the hull if a boat is to sail well. My Blowfish as built will sail in a straight line with the rudder lashed in the centre. In this configuration you can actually steer the boat by leaning it from one side to the other. A very good test of balance.

I made the centre case and installed this in the Blowfish next. It is a strip of hardwood front and rear with 3mm MDF sides. After cutting all the pieces out and assembling it loose I laminated both sides of the MDF before glutting it together. then i rounded off the outside front and rear edges and fibreglassed around the outside of them. while the Blowfish will not travel at any great speed under sail. The centre case needs to be strong enough to survive the occasional grounding. One of the joys of this little boat is taking it sailing in small lakes and waterways that are pretty much too shallow for anything else. You can basically go sailing it in knee deep water.

To fit the centre case you need to plumb the boat. I supported it on two horses with the wedges I mentioned earlier steadying it dead level. I have a few lengths of 50mm aluminium tee section that I use for straight edges. I put one of these across the boat and placed a spirit level on it to this end. Then I ran a string line from the peak of the bow to the centre of the transom. Held in place by two small nails (small nail holes can be easily filled later). I made a tee shaped packing piece out of two bits of 18mm plywood screwed together. I slid this into the centre case and used two strips of 3mm MDF, some clamps and small nails to hold the centre case true while I glued filleted it in. the centre case is 20mm wide. So I taped some cardboard on either side of the tee shaped packing/alignment piece so that it was a neat fit. I ruled a line, fore and aft along the top of the tee piece so I had an eye reference to make sure that, by the string line, the centre case rand true to the centre line of the boat.

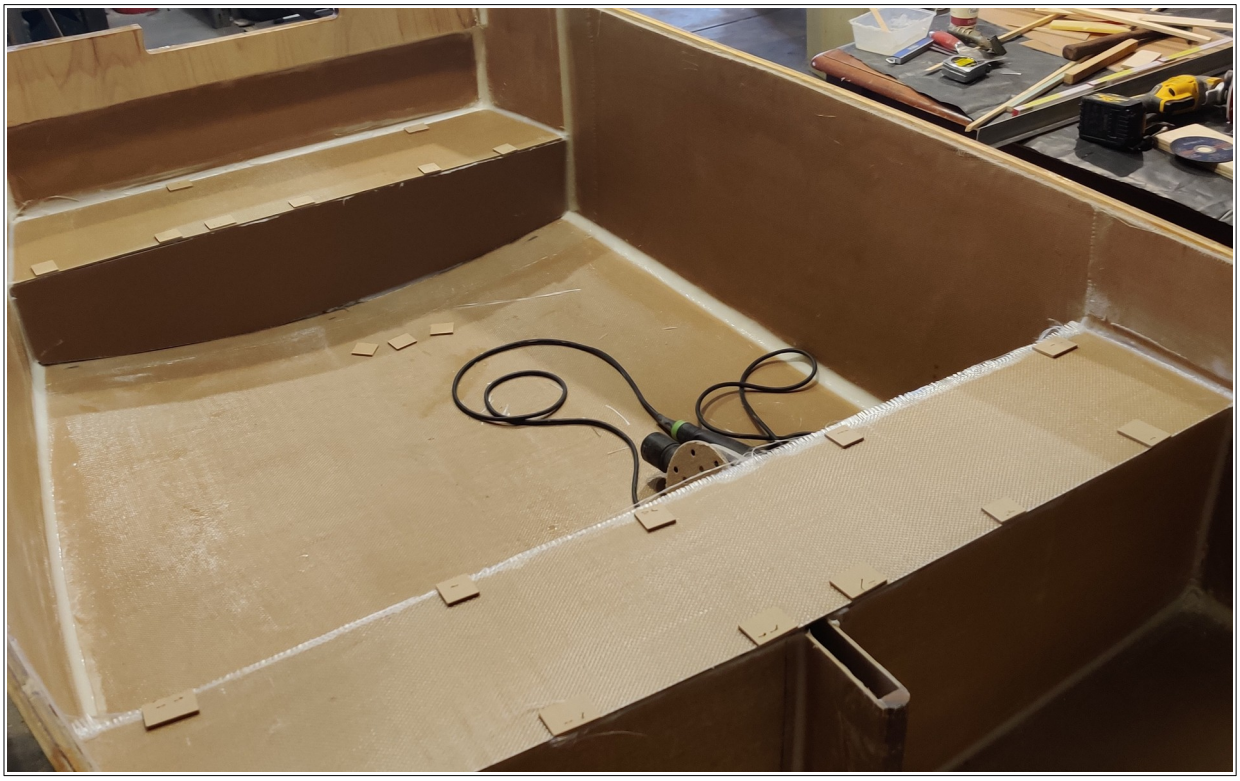
As the boat was level. I was able to use a spirit level vertically to check the centre case was also vertical (since we levelled the boat with wedges first). Once the glue is cured you can measure and fit the bulkhead that forms the front of the seat. this is done in the same way as the centre bulkhead was fitted. Once again, I would fibreglass all these panels before fitting them. Then once the glue fillet is cured, sand it well and fibreglass over it with a 75mm strip. Note that I kept the packing piece inserted into the centre case to ensure it did not narrow while the glue set. The centre board should be a neat fit without being too tight. We'll discuss making that later.

This is also a good point to put a rear seat bulkhead in also. The two seats and forward bulkhead space create buoyancy in the case of a capsize or swamping. It's worth noting that this buoyancy needs to be sufficient to float the boat and the person bailing it out, with enough free board to to allow this whole process to be successful. Note the drawing at the end of this section for dimensions of my Blowfish.



Now that you have the three seat bulkheads glue filleted and laminated in with 75mm strips of fibreglass, it's time to put the tops on the seats. As there was no way to get inside the seats to glue filet and laminate these joins. I needed to add some 12x12mm pine cleats to pin the upper surface of the seat too. I think these cleats should be fitted around all the edges of the seat. They can be held in place with clamps easily except the outer end of the seats. On the end of the seat you need to extend the reach of a clamp with a scrap of timber. If you are running out of hands arranging clamping situations like this? You can tape the piece of scrap in

place. Or what I did, use some Blutack poster putty. When gluing these cleats in pace, be sure to clean away the ooze along the edges when you have all things organised and secure in a way that leaves you pleased.



Once the cleats are secure, give the top edge of the bulkhead and seat a rough sanding. Like the bulkheads, cut the seat tops out of 3mm MDF. Make sure they fit nicely, then fibreglass both sides of the seat top. Then glue the seat top onto the cleats on the top of the bulkheads. Give the area under the seat a rough sand before you apply the glue.

Do I say "sand stuff" too much? Anyway, sand stuff.

Like all glued surfaces, you need to clamp the seat tops down. I used small nails though small square scraps of MDF. This means, when the glue is cured you can lever up the small piece of scrap and get to the nail head to pull the nail out. Glues, well applied, are great. Nails or screws are not needed and will only let moisture into the MDF over time.

Note the centre case extends in front of the seat. in hind sight I should have cut the seat out to cover this. This would have made an odd little protuberance to fibreglass before sticking the seat down. But I think this would have been less fiddly work than what I was left with. I could have made the seat extend to the front of the centre case. But something about the little bit of extra space inside the boat forward of the seat appealed to me.

At this point you'll feel you are really starting to get somewhere. But actually you're just at that road house, halfway to where you're wanting to be. Looking at the pie warmer and thinking that morsel is actually much nicer than it is. Leave it there. Pay for your fuel and move on.

The cold fact is, by hours toiled, you're about half way.

With the seat tops glued down and the nails or screws removed, it's time to prepare the top edged of the seat for laminating. Once again, coarse sand paper these to a 6mm radius so that a 75mm fibreglass strips will lay smooth around it. Wrap a 75mm strip around every edge. While using a rubber squeegee is great for wetting out large flat areas of laminate, working fibreglass into corners is often best done with a disposable 50mm paint brush. I use a "poking" action to forces the fibreglass down on to the surface I wish to reinforce. Then if it looks like there is too much resin there you can wipe the excess away. As always, the trick is to wet out the fibreglass with "just enough" resin. too much may cause the fibreglass to float up away from the surface you are trying to reinforce.

Slotting the centrecase:

After turning the Blowfish back upside down, I found the centrecase using a measuring tape. I drilled a hole of approximately 10-12mm and check where about this was with a torchlight or feeling about with a bit of wire. Once you have your bearing you can open up the centreboard slot in the bottom of the boat with a jigsaw. cut the hole smaller than the centercase and do the final shaping with 40 grit sandpaper glued to a flat piece of timber. I call this a sanding stick and there's a picture in the tools section of this book.

Sand the bilge panel back so the edge just lines up with the inside of the centrecase. DO NOT over do this and sand away the fibreglass on the inside of the centercase. once you have a flush edge between the bilge panel and the inside of the centrecase, sand all around the edge to a 6mm radius for Fibreglassing over.

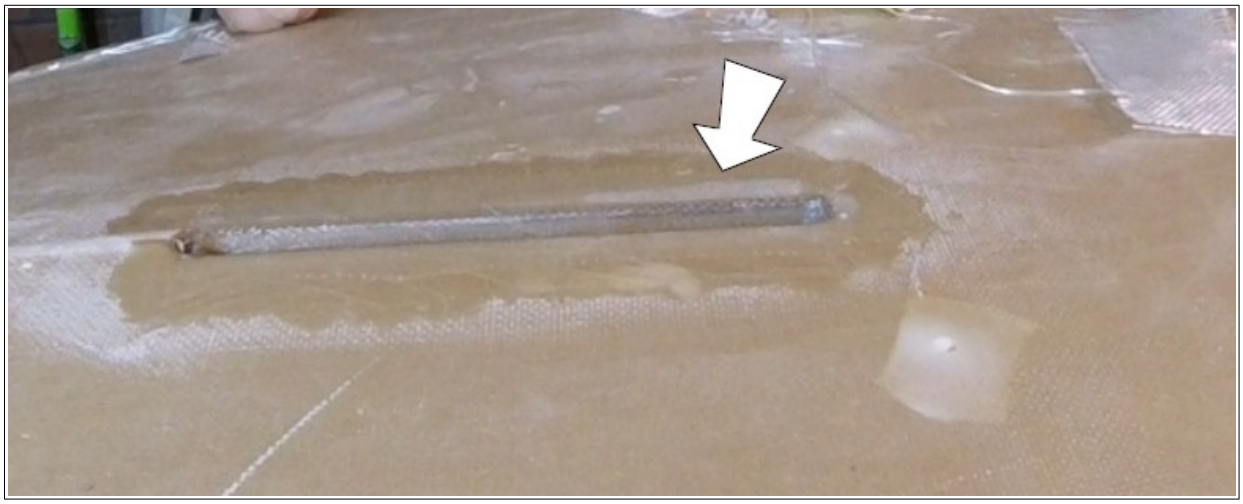
I cut my slot out with my router with a 6mm bearing cutter as a guide. Then swapped to a 6mm bull nose cutter. Then some hand sanding to finish off and prepare the surface so the next layer of fibreglass will bond properly.

Fibreglassing the join between the centrecase and the outside of the bilge panel is probably the most difficult laminating you'll do on the whole job. It has tight corners and the inside is not easily accessible. But it is SUPER important to get this right. Any void in the laminate here will probably lead to water getting into the MDF core. Something I consider worse that onion ice cream.

This is one of the place where it may be preferable to cut your 75mm strips of fibreglass at 45° to the weave. Paint some resin on the inside of the centrecase and around the outside of the bilge panel. Then on a sheet of scrap card or something - I used poly plastic taped to a the workbench - wet out the strips of fibreglass with a brush. Do this gently so as not to frey the strips. then pick them up and apply them to the join. a bit of gentle working with the brush you used to wet out the fibreglass and you should be done.

Keep a suspicious eye on joints like this for bubbles developing. Remember, the fibreglass MUST be tight to the surface you want to reinforce. The image blow shows a void/bubble I had to deal with on my Blowfish. Sand the bubble away, fair and re-fibreglass that area.

One final thing is the small skeg I filet glued to the aft part of the bilge panel. This helps keep the Blowfish true when towing and makes rowing a little easier. It's 400x75mm and shaped out of a piece of 18mm timber. Put a shallow angle on the front half of this and you're all good. i don't think the shape if this si supper important.



Once you have the bottom of the centre case finished. Treat the top, where it comes up though the seat, the same way.

I got all over enthusiastic and cut some 5mm strips of pine and glued them to the top of the seat (after giving the seat a good sand). See below. It's purely cosmetic and could be ignored. I think it added bout 2-3kg to the boat. Which is about 10%. The top of the seat will be strong enough to take a hard working bottom without this accoutrement.

Gunwales and rowlocks:

Somewhere in all these small tasks you will also find time to install the inside gunwale strips. Once again, clamp these thoroughly. Some time after this you'll find your self feeling under the inside edge of the gunwale and catch your finger on a sharp glue squeeze. So as soon as the lasnt clamp is on, before you even look at the fridge door, get a rag and clean up any glue ooze under the inside gunwale edge. You'll thank your self later.

It's the places you can not see that you forget about. Places that leave you feeling mildly regretful as time crosses off a distant square on the calendar.

After the gunwale is complete the little boat is now super stiff. turn it upside down and put a fillet of medium strength filler between the out side edge of the gunwale and the topside. I used a tongue depressor for this. You could skip this step if you like, but I think it finishes of the gunwale shape nicely.

This is also the time to fit the rowlock holders. I made these out of some local hardwood. They need enough"meat" about them to hold the rowlock bearing. Mine extend 60mm down past the top of the gunwale and are about 100mm long.

It's worth making these beefy as you don't want them to tear off the side of the boat when you're going for it after having a bet with a mate about how fast you can propel your Blowfish. I say this, because one afternoon when coming alongside our boat, I accidentally hooked and ore under the gunwale as I shipped it. This resulted in the sound of wood fibres tearing and the next I knew. My port rowlock bearing was in the bottom of the boat and we were reduced to paddling canoe style.

When I looked at the damage I could see that I'd not given the fibreglass below the gunwale a GOOD SANDING before gluing the rowlock holder on. Bad Andrew strikes again and repairs were made.

Once the rowlock holders were on I got out the sander and cleaned up the gunwale glue squeeze and removed any sharp splinters. Remember the gunwale strips were rough sawn. I put some coarse (40 grit) paper on a block and shaped the top and edges. This was just a tidy up. i plan to finish off the raw timber closer to completion of the boat.

Fairing the hull:

With the boat upside down and well supported. Now is where the fairing of the hull starts. The first thing you should do, say it with me, is sand the hull. I used an 80 grit, though if you are going to use this on a sander, go gently as you'll sand though too much of the 250grm fibreglass if you're careless. If you were going to use a machine, like a random orbit, go for 120 grit maybe? But giving the whole boat a good once over by hand with 80 grit is not much of a hardship.

I tired to smear about 1mm of low density filler over all the topsides and bilge panel. I mixed 250gms of resin as though I was laying up fibreglass. Then added 3 scoops Qcell to 1 scoop thixotrope stirring all the time, I kept adding the powders until I had a soft margarine consistency. Note that when you add fillers to resin, the resin in the pot will "go off" faster. So it's important to work in quantities that you're comfortable with.

I used a 200mm wide knife with a fairly flexible blade to apply this bog. Hold the blade of the knife at about 5 degrees from parallel to the surface and use a pulling action. Push down firm enough so the blade bends just a little. You should see a silky smooth smear appear from the trailing edge of the blade.

this may not come easily to everyone. Don't throw your tools at the wall if you find this difficult as this does take a little practice. Persevere and you'll get there. The worst case scenario is that you 'll need to let the filler set, then do some extra sanding and reapply the bog. It took me at least 2½ bog and sand applications for my Blowfish.

You'll find the edges particularly annoying. I did the topside and bilge panel first. let that set. Gave any little bog limps along the edge a quick sand. Then worked around the chines, bow and transom edges.

It goes without saying that between each coat, you need to sand and clean away any sanding dust thoroughly. The bog will not stick well to a dusty surface. Sanding of the fairing layer should be done with a long block. The hand sanding pad that I used was 230x100mm. But people who fair in boats generally use a longer sanding block than this. Resist the urge to use a power sander for the initial sanding. The bog is soft and power sanders are quite aggressive. So you may end up with half moon hollows all over your hull unless you have true power sander feels.

Having a vacuum cleaner handy and cleaning up the dust as you go is a very good idea. It goes without saying that wearing a GOOD dust mask or respirator is essential.

If you look at the image on the previous page you can see one layer of bog on the port side of the bilge panel. Don't stress if your first go ar spreading bog looks patching. Keep working away and eventually you get a nice fair (smooth) hull ready for paint. One thing you can do when you start getting close, is to buy a can of cheap spray paint and spray a very light, almost not there, most coat over the entire hull. Pick a dark colour for this. then give the hull a light sand with 120 grit paper on the long flat block. You'll sand away all the flat pits but the hollows will show up. draw a circle around these areas. Sand away with spray paint inside the circle and re-bog those areas.

You can also see the white filler fillet under the gunwale.

Final odds n ends:

To finish off the Blowfish hull there are still a few things to tidy up. As the transom is an upward facing raw edge, this will need to be sealed off from water. You could glue a piece of timber the same as the gunwale across it's top edge? But as i had made a little cut out where the tiller enters the boat, this was not going to be straight forward. What I did was use 3 layers of fibreglass flat on top of it. the trick here is you can not fold the fibreglass around the upper edged of the transom. It's a 90° corner and as I've already said, fibreglass will go around a curve, but not a sharp edge.

I gave the top edge a sand making sure the fibreglass on the inside and outside of the transom was sound right up to this upper edge. Then I Iayed up three strips 20mm wide along the top edge of the transom. Relying on the vertical edge of one laminate to bond to the flat of another laminate is not a fantastic edge and you need to be very careful sanding around here as you'll sand though the fibreglass into the transom wood very easily.

I think if I was to build another Blowfish. I'd cut a gentle concave, maybe 30mm deep, across the top edge of the transom and glue 2 x 3mm laminates of gunwale timber across the top edge to protect it. This would be much more robust that what I have and still look pleasing. Who does not like a pleasing transom?

I found a small piece of 6mm ply for the fore deck. This was glued down in the same fashion as the seat tops. The error here? the ply is 6mm thick but the gap between the top of the gunwale and the top of the MDF topside at the bow is 5mm. So I had to work away with a small chisel to get the plywood to sit flush with the top of the gunwale before I glued it down. The solution would be to let the gunwale ride up towards the bow when i glued the first outer strips on. Modern plywood, even quite expensive AA stuff has a super thin outer veneer. So any sanding more than a casual wipe may leave you with the second veneer showing though. Sand this bit less. I can't believe I said that.

I wanted to put a small horn cleat on the fore deck. So when I was gluing in the cleats for the fore deck. I also glued a piece of 10x50mm stringer from the stem to the front bulkhead. This gave me something solid to screw the cleat into though the plywood.

The front bulkhead has the mast step/support on it's rear face. This is why I chose a piece of 18mm plywood as the bulkhead and used multiple layers of fibreglass around the inside to spread it's load to the rest of the boat. On a windy day there will be quite a bit of twisting moment here as the mast in unsupported by rigging. The base of the mast is square and tapers into a round and this makes constricting the mast step more straight forward.

Other things I had to consider was that I wanted the mast to be a high out of the

boat as possible and the spar is only allowed to be 2.4 meters long. so the base of the mast step does not sit on the bilge panel. The base of my mast step is 290mm below the for deck level. I took a stab in the dark that this would be deep enough to cope with the moment the sail would apply to it in a stiff breeze.

Once again I levelled the boat with wedges and use a spirit level to ensure the mast was vertical. I fillet glued it to the front bulkhead (which had one layer of 250gsm fibreglass on it, so needed sanding). Once the glue was cured, I layed two layers of 250gsm fibreglass from the blackhead (50mm overlap), around the whole thing.

But this was not how it was initially fixed to the bulkhead. The internal measurement of the mast step it 50mm x 60mm. This allows the mast to wiggled back and forward to get it out. It also means the mast has a pleasing rake when you are sailing sheeted on. This helps the Blowfish sail up wind. Something a lug sail is not stellar at. On the first few sails the mast was made so this it was an incredibly neat fit side to side. It was quite tight to get in and out. Then on one warm day, the mast swelled and popped the mast step off the front bulkhead and the whole thing embarrassed me by falling in the water. There was not even any breeze that day. I was genuinely drifting about. As I'd always carried a little collapsible paddle. I gathered everything into the boat. Which is easy as all the spars are short and the sail is small. Then paddled back to the shore.

Also, at that point in the Blowfishe's life, the mast step was only glued on to the front bulkhead. Sanding the sides of the mast step down 1mm and fibreglassing it to the bulkhead seems to have solved the rig's issues with pointing at the sky.

The little boat has been sailed many times since and in plenty of breeze with only smiles on the face of those who boarded it.

Finally I glued two piece of hardwood in the corner between the transom and the gunwale. this adds some important structure to the transom for when you are using and outboard motor, but it also a place to sheet the sail from. A 20mm hole though these pieces make a simple main sheet fairlead.

Why I did not mask up the end grain of this piece, I do not know? I've actually made a mess of painting my Blowfish. So one day i may sand it all back and have another go.. ..I'll fix this hennas crime then.

Oars and spars:

You may feel that making a mast and some oars is daunting. But I'm here to tell you it's surprisingly not. I actually really enjoyed this aspect of the build. What's more, I used the shittiest, most budget timber I could find at my local hardware store for the task. All the spars and oars have multiple knots along them. Though they have willingly pushed the little Blowfish along for over 18 months now without complaint. The secret is to laminate them together out of multiple pieces and to make sure that while the glue is curing you have them clamped to something straight.

To test the mast I did some googling to get an idea of how much force a 2.8m² sail may exert on the mast head in 25 knots of breeze. I clamped the base of the mast, horizontally, to my trailer so that all bar 250mm of it were unsupported. Then hung a 25kg weight off the mast head. The mast definitely flexed. But giving the whole thing a bit of a "had spring" on top of the load, looked perfectly ok.

To make the mast I ripped some timer though my table saw to a 30x30mm section. Then I glued 4 of these together to make a 60x60mm section. In hind sight this could have been smaller as I ended up making a pile of shavings big enough that Amazon offered to buy them off me for package filling.

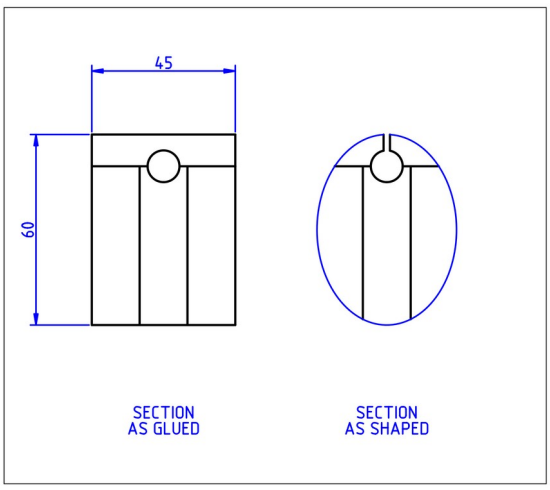
But that is the nature of empirical design I guess?

The important part of this is that;

1/ the section is clamped dead straight while the glue cures. I had a scaffold plank that was stiff and true that I covered in polyethylene plastic to protect it from glue oozes. Remember epoxy (or pretty much anything) will not stick to polyethylene,

2/ you arrange the various sections to that "features" in the timber do not line up with each other. I did this by just reversing the lengths top and tail.

While I used my table saw to rip this timber down, you could use a hand held circular saw. This is obviously more difficult. But with an adjustable saw guide would be doable. Below is an image of how I glued and clamped the yard (another spar). When the glue on this had cured, these bendy bits of crappy timber were so straight that the Nullabour railway was jealous. The inset show the timber pre-glue and clamp. Note that I made two little plywood vee blocks to hold the mast while I was shaping it after the glue had cured. An old jamb cleat and a lenght of 5mm chord held what ever I was working on in place. While the mast is just a "post" with a halyard fitting at it's head, the yard is more complicated. Assuming your sail will have a bolt rope along it's head edge, the yard will need a track in it. I also wanted to taper the yard and make it a smaller section. More for aesthetics then any other reason. To this end, I laminated three pieces of 60x15 side on. Once the glue was cured I planed the "edge surface" flush. Then I ran my router with a 10mm coving cutter down the centre using a side fence for accuracy. I did this to a depth of 5mm in three passes as my cutter could have stood some sharpening.



Next I ripped a piece of 10x45 timber and routed a similar coving down the centre of that. I glued this piece on top of the pice in the previous paragraph making sure the two covings aligned perfectly. Before clamping the two pieces together I layed a piece of 10 or 9mm rope in the coving of one of the pieces. Obviously as the two pieces are clamped together the glue will ooze into the coving void. these oozes can not be cleaned out and would foul

any sail's bolt rope. Laying the rope in the cove before gluing, means that once you have the two pieces aligned and clamped, you can put that rope out and clear away all the glue ooze. I actually pulled the rope back and forth a few times before removing it totally. Once the glue is cured. Set your saw to about 8mm cut depth and run it carefully down the spar. Viola! you have a sail track.

After this you can set the spar up in something like the two vee blocks I used and get busy with a plane to arrive at the section you like. I made mine an oval, but round would be fine too I think. I finished of by cleaning up the saw cut with some 80 grit sand paper. I was really pleased just how well this worked.

If you decided you'd like a gaff rig on your Blowfish, that would be fine too and you would use a similar method to make your gaff.

As our boat was going to reference the Edward Lear poem. I made spoons for oars. Initially I was concerned that the gluing surface between the edges at the blade may not have enough surface area. So after some use they would fail. But this does not seem to be the case and the Blowfish rows very well and the oars are still sound.

the shaft of the oars are two lenghts of 30x60mm pine glued similarly to the other spars. At the blade end I glued two 80x25mm peices. cut out the profile with a jigsaw. Then got to shaping with a plane and very coarse disk on a 125mm angle grinder. I made sure to leave the blades at least 20mm thick around the edges and a little thinner in the middle of the spoons. I was worried that the blades would be too buoyant and this would make rowing difficult. But this turned out not to be the case.

After I had the shafts and blades shaped, I sanded them down and finished them with oil. I plan to discuss coatings and timber treatments later.

Rudder and Centreboard:

Making a rudder and a centreboard is really pretty straight forward and you could spin this how ever you liked. One of my considerations was making sure that neither of these things were too big. The idea being that EVERYTHING about our little Blowfish is compact and small.

First up, the size;

Centreboard is 800x180mm. And a width to fit neatly in the centrecase. This gives about 500mm of centreboard sticking out the bottom of the boat. Although this is very modest, it seems to work fine.

The part of the rudder that is submerged is 300x180mm. the part above the water will depend on how you do your rudder pintals and gudgeons.

I glued four pieces of 19x70mm timber together edge on. I also edge nailed the rudder. But I'm pretty sure this is ridiculous overkill. Once I had the outline cut out. I planed and sanded until they slid in and out of the centercase easily and had a mild foil in section. I got all excited and made a laminated tiller out of pine. Actually I did this twice as the first tiller was not long enough to be useful. A side product of trying to keep things super small. I fashioned the tiller so it would fold down the back of the rudder to keep it compact.

Paint and coatings:

You'll notice that after talking about the fairing, that I did not roll straight into dressing the little boat up in a delightful colour that we can all stand back an admire. Well stand back we shall, because i really botched up the paint. As it is, I passed the 5 meter, 15 minutes before dusk rule. With five stars. Basically I got so many pin holes in the spray job that the poor little thing looks like it's covered in teen acne.

And right now it's barely two.

My problem was that i tried to spray a two pack acrylic and got it all wrong. The paint is super hard. Wonderful stuff. But I got quite a lot of over spray and when I gave that a fine wet sand (600 grit) and buffed it. The buffing compound crept into the pinholes and refused to move.

So how should you paint your Blowfish hull? Honestly, I was to do this again? I'd roll on 3-4 layers of high build primer with a light sand in between. then use a nice exterior gloss over the top. Three to four, quite thin coats with a fine sand in between. This will be no where near as hard as my finish. but it's a cheap little boat and some small scratches will remind you of all the fun times you've had together.

Inside the cockpit you could do the same. Though I did something else. Back in the days when i used polyester resin for projects. You would finish of with a good sand (to get ris of all the sharp bits and provide a mechanical key) And then flow coat the surface. This is just resin, 3-4% pigment, 2% styrene wax and 1.5% catalyst. the go mad with the brush, you've got 20 minutes max before it gels in the pot and you need to throw that lot away and start again. This gave you a surface that could loosely be described as smooth that would take shoes, anchors and other stuff that may get dropped in the bottom of a boat. Flow coats are tough and ugly. The 2% styrene wax means the flow coat from remaining tacky after it's cured. Note that resin kits you buy from hardware stores often have this wax added. Check the label.

Inside the Blowfish I thought I'd go for a similar thing, but use epoxy. The only catches are that; Epoxy flows much much better then polyester. So if you put more than a hint of it on a vertical surface, it will dribble.
And it's no where near as opaque as polyester flow coat with is gloopy and thick (in comparison).

The way you deal with this is by doing multiple coats wet on tacky. you apply a thin coat with a fine nap roller (gloss paint roller). Then when it's tacky, but no longer wet. You roll another coat on. I think our Blowfish had 4 coats of the length of a day. It's not super opaque, but looks ok and it is a super tough finish.

West System 105 resin takes pigment at 3%. But check the data sheet about how much pigment you can add to your epoxy safely. I suspect some of them vary.

I ran masking tape and newspaper over all the surfaces I did not want to make a mess of. I suggest you do the same.

While I used UV stable exterior varnish on the fore deck. All the rest of the bare timber I oiled. The fore deck is 6mm plywood and oiling plywood seems wrong. But all the other bare timber had 2

coats of outdoor furniture oil. Two coats is a bare minimum, but I was lazy. There's less than no excuse for this as oiling timber is way way less hassle than varnishing.

I'm a big fan of oil over varnish. But this caused some heated discussion when in 2022 I delivered a talk to the Australian Amateur Boat Builders Association. Most of them seemed to think I was loopy. But here's what i like about oil over varnish.

Your timber looks natural, rather than glossy and "plastic".

Maintenance is much easier. Sure oil needs to be freshened more often, but that job is much much easier.

The Oil I use is Endeavour Garden Furniture Oil. It is a blend of Tung nut, Eucalyptus and citrus oils. So an all natural product. I sand the timber down to 120 grit. I believe this grade of sand paper still leaves the grain of the wood open so the oil can penetrate. I apply the oil with a small brush, let is stand for 10 minutes and then work it in with 240 grit sand paper. It's worth wearing a glove when you do this as it created a sawdust mud. You may need to add a little more oil as you sand depending on how porous your timber is. You'll notice the timber becomes silky smooth as you work.

If you continue down to finer sand paper grades, you can actually get your oiled timber looking quite shiny. But for this little boat, I stopped at 240 grit.

Once you're happy. Get a clean rag and buff away the sawdust mud still left on the surface. You'll be surprised at the finish you can get with a little sanding and buffing. the next day I apply the second coat. Again with a brush and a buff. But unless the condition of the timber gets away from you, you wont have to sand again.

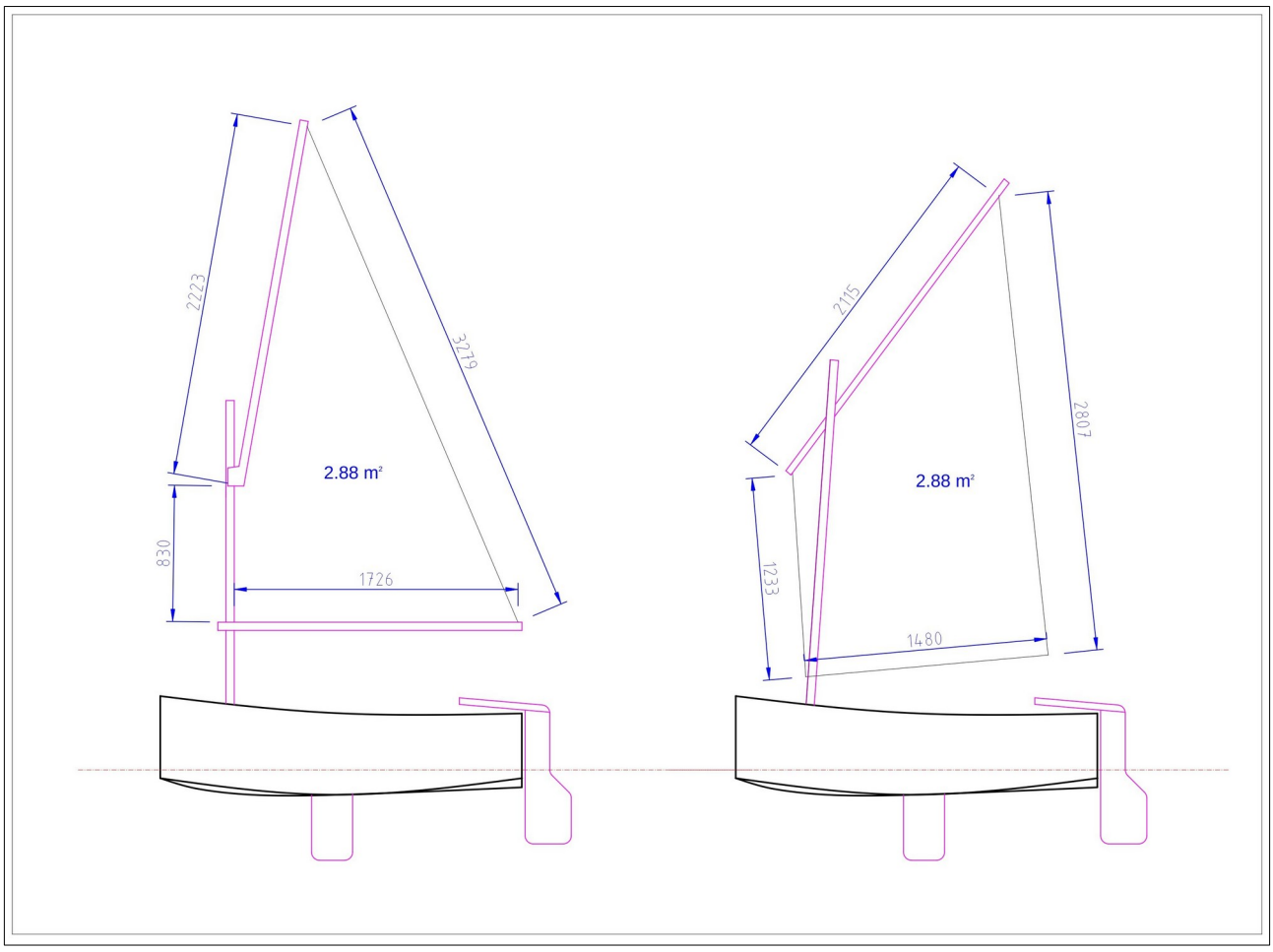
I treated the mast, yard, spoons, gunwales and seat top with this. 18 moths later it's only just starting to look like it could use some maintenance. Note that it lives on a cradle in the garden living under a cover. Though it also has had plenty of use.

The rig:

The Blowfish was always going to be sailed. So designing it around a mast, sail, rudder and centreboard was a priority from the very beginning. A sailing craft has to be balanced to work in a pleasing way. Having to wrestle your boat to keep it moving in a straight line is more frustrating than getting out of bed in the morning to find no milk in the fridge.

To this end, the centre of the sail needs to be just above, or slightly behind, the centreboard. Obviously this is a rough rule of thumb only. But for the Blowfish it works fine. with the tiller lashed amidships. I can sit in the middle of the boat and steer it simply by moving my weight from side to side. This is a very good indication I've got the balance of the Blowfish close to sweet.

I decided to use a loose foot lug rig (right image). But gaff rig (left image) would work fine too.



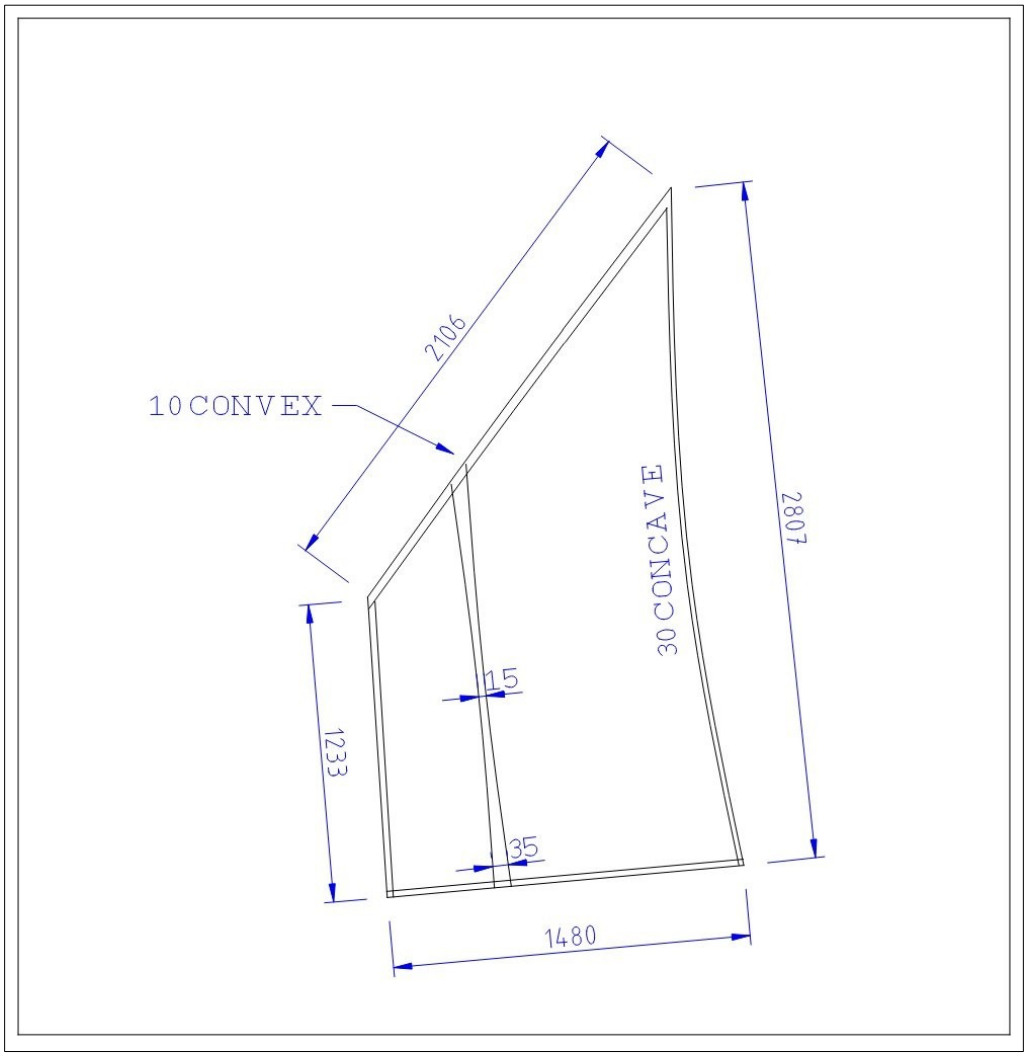
I liked the idea of not having a boom in a boat so small. this means when i lower the sail because i wish to row or paddle. there is no boom down the middle of the boat. With the lug rig, the yard and sail just drop into the boat next to me and off we go. Super continent. You can actually have a boom on a lug rig and this would make the boat sail down wind better. But I was happy to forgo that for the convenience I mentioned above.

Making the sail:

I grew up by the sea in what is now a ghastly resort town. A place who's quiet charm ran away and hid when wealthy real estate investors moved in. The one other person my age that lived in that once sleepy coastal hamlet would join me in windsurfing adventures as often as we could find breeze and free time. It was here that I made my first sails. Lofted (layed out and measured) on our large front verandah and sewed up on my mother's domestic Phaff sewing machine. There was significant trial and error and a few early sails given away to friends who did not feel bothered by odd wrinkles.

The Blowfish mainsail is a much more simple affair than a 5.5m², high aspect, windsurfer sail. This sail is about as un-fussy as a sail can be. You can make this sail with only two pieces of cloth, with one vertical seam running yard to foot. About 1/3rd the way back from the front edge.

As this little boat will sail quite slowly and need a bit of pushing along. the sail should have a good amount of "belly" in it's shape. You can achieve this by overlapping the top and bottom of the vertical seam by 35mm at the top and bottom and only 15mm though the mid section. Imagine a long flowing curve. Also mark the top edge of the sail (the edge that slides into the yard slot) with a 10mm convex curve. The greatest part of the curve should be 1/3rd of the way along the edge.



Have a peek at the drawing on the previous page and you can see all the dimensions I used for my Blowfish sail. Although, because I hacked up and old sail to make mine, the vertical seam is just a stab at what I would have done if I was making a whole sail from scratch. But I think it should give your sail the draft (belly) it needs to work well with this little boat. the 30mm concave down the trailing edge of the sail (the leach) is there to stop that edge of the sail fluttering. As sail cloth (all cloths actually) have a woven construction. They are stronger along and across the roll (bolt) as they are on the diagonal. When you are laying out this cloth to make your sail, the trailing edge should be parallel with the edge of the cloth off the roll. And the trailing edge should be parallel with the vertical seam you create.

I used ordinary white sail cloth to make my sail. this cloth is almost universally called Dacron. the cloth weight you need is in the order of 170gsm. Basically the lightest Dacron you can get your hands on. A good quality domestic sewing machine"should" be able to tackle this ok. Ask your sailcloth supplier for some double sided tape so you can stick your seams together before you sew them. This stops the "slippery" sail cloth from being basically impossible to control while you sew it. A heavy domestic polyester thread (like you'd sew jeans with) will be fine for a sail so small too.

Sew about 4 layers of cloth in each coroner. Then fold a crease on the front, rear and bottom edges before you sew those "hems". Cut a 50mm wide strip (tape), fold/crease that in half along its length and sew that along the top edge. Thread a length of 6mm rope inside the tape and then sew along the edge with a piping foot.

If this all sounds alien to you. Googling it or ask Sigorny Weaver. There's many many sewing how-too videos online.

Once the sailing is all sewed up, take it to a local canvas works and get a 10mm stainless steel grommet put in each corner.

I realise the "How to make a sail" part of this little book is very brief. And I'm a bit regretful of that. But I hope what I've given is enough for someone who has a "sewing type person" in their family to get a good enough idea of what to do. The reality is, that this sail is so small and simple, I'd be surprised if you could not get one made at your local sail makers for under $300.

Control lines and rope:

The Blowfish sail has three ropes to control it. There's a halyard attached to the yard. It goes though a block at the mast head and down to a cleat some where near the mast step. I used a horn cleat. There is a tack line that runs though a fair lead on the top of the mast step to a vee cleat. I have a 2:1 purchase on this for ease of adjustment. When you get the hang of sailing the Blowfish you'll find your self playing with this. If this is too tight or loose you'll get ugly wrinkles in the sail. when sailing upwind, you'll tend to have it tighter. And the sail looks better with it a little looser downwind.

Finally we have the main sheet. This is an "endless"system that runs from the main sail clew (lower rear corner) though a hole in one of the transom gussets. across the boat and back out the the opposite hole. Then back to the clew. You sheet the sail to the leeward transom corner when you're sailing.

Attaching fittings to the boat:

I have a fairly genuine belief that someone who's up for building a Blowfish, has a pretty solid idea how to screw little part A to bigger part B and have it successfully stay there? However I would like Blowfish builders to consider a few things..

When ever you drill a hole in the boat to put a bolt through, you are providing a way for water to get into the core material. This is bad with all core materials and MDF is no different. In this situation you have two options;

- Drill the hole 6mm bigger. fill the hole with strong bog or glue. Then re-drill the hole in the glue/bog.
- Drill a clearance hole and paint the inside with a toothpick with epoxy resin on it. Let that dry. do it again.

In both these cases. drilling though a piece of masking tape (which you leave there when bogging) will help keep this process tidy. In both cases also use a little silicone around the bolt also. In places where I was screwing something into solid timber, like the main halyard cleat, I drilled a smaller hole and dipped the screw in resin and poked a little more resin in the hole with the end of a toothpick.

Basically, be mindful of places that may become a raw MDF edge and mitigate this in the build process.

Some notes about MDF as a core material:

Before I started the Blowfish project I called up sir Google and asked what sort of history there was using MDF as a boat building material. The reply i got was a cross between eerie silence and quiet mutterings about lunacy. I left our conversation under the impression it had never been attempted. Which spurred me on a enormously. Who does not like the idea of being the first with something.

Punching some numbers into a very simple spread sheet, I worked out that if MDF failed, I'd be less than $600 out of pocket. While the MDF is way cheaper than a traditional foam core. I'd also need less than half the epoxy and fibreglass. And epoxy and fibreglass are 80% of the material cost in this project.

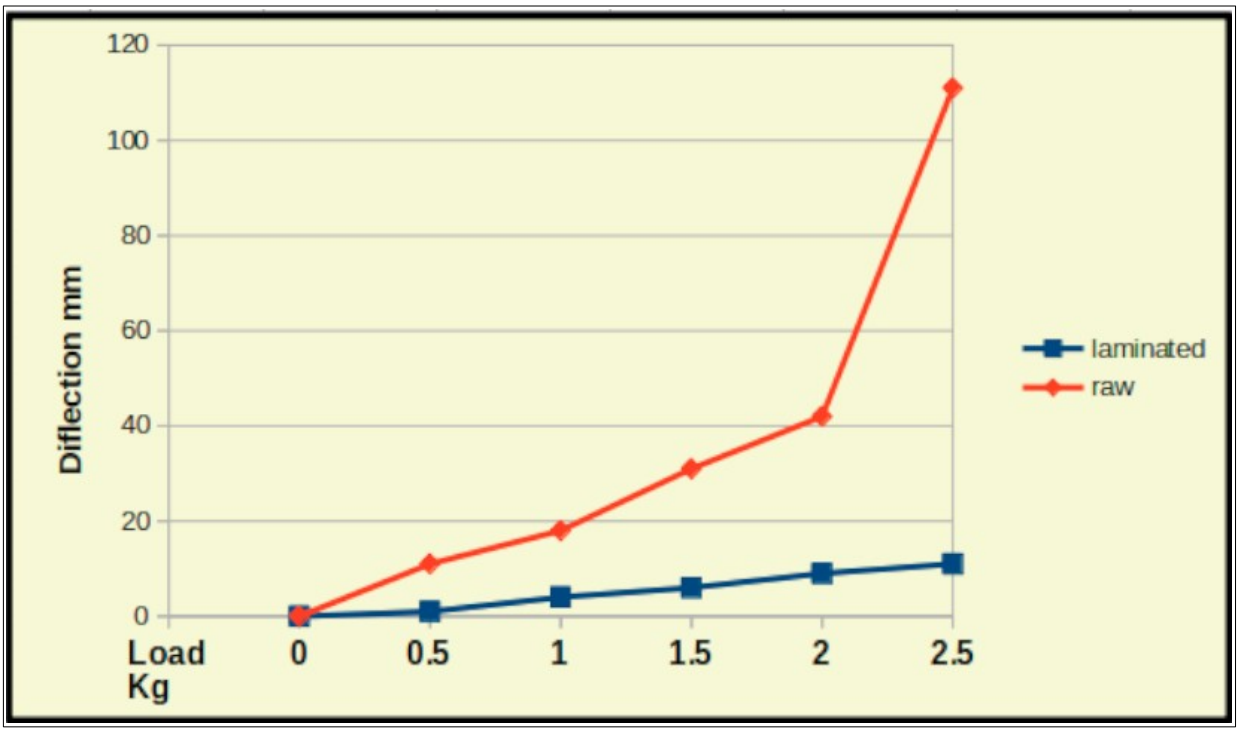
The table below is some numbers I used in my "what's it look like" process.

Material	Weight	Cost
3 mm MDF	2.5 kg/m²	$7 / m²
3 mm BC grade plywood	2.7 kg/m²	$18 / m²
3 mm AA Gaboon plywood	1.4 kg/m²	$32 / m²
8 mm PVC foam core	0.6 kg/m²	$55 / m²
250 g/m² epoxy layup (both sides, minimum wet out)	1k g/m²	$45 / m²

If I were building a larger boat where weight was critical, MDF would look more like a poor choice. However, it must be noted that PVC foam will need two to three times as much fibreglass laminate to achieve suitable puncture protection, compression resistance and and sheer strength. This shows that the Blowfish system is more than $120/m² cheaper than using 8 mm PVC foam core. I hear people up the back muttering "tight bastard" and yes, I'll own that.

In so far as weight is concerned, a layed up square meter of foam core composite will be about 3kg. While MDF composite will be 3.5 kg. this means the Blowfish is about 5 kg heavier than it should be. While this is a significant percentage, in a boat so small I consider it a minor offset.

In the YouTube video series I did about building the Blowfish, I did some testing of the materials I planned to use. One of these was laminating both sides of a strip of MDF. Then loading it between to fulcrums and comparing it's deflection against a piece of raw MDF. It is interesting to note just how much stiffer sandwiched MDF (even panel only 3mm thick) is than plain MDF. On the graph below you can see the load I placed in the centre of the strip and the amount it sagged under that load. Given I planned to introduce as many gentle curves as I could into the design, this gave me great confidence the boat would be strong enough.



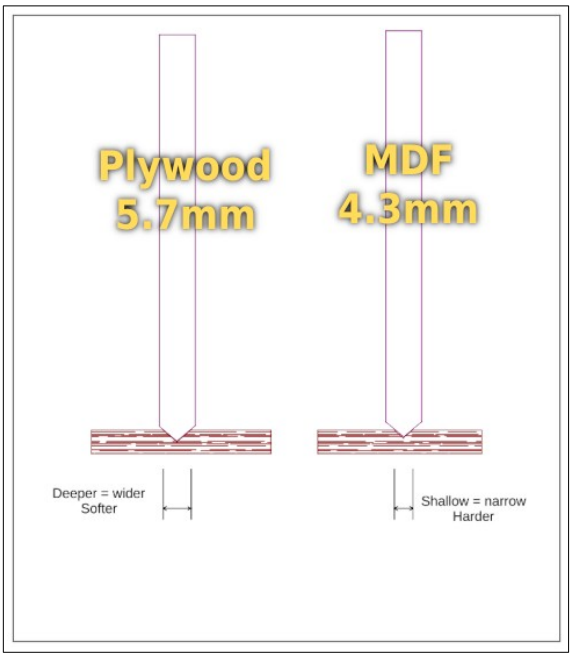
One of the other tests I did was to drop a rod with a conical point on some CD plywood and MDF and compare their puncture resistance. The more resistant a material is to puncture, the less distance the cone will intrude into the surface. You can then measure the diameter of the circular indentation and get some idea of how resistant to puncture that material is. Below is the graphic I used in the video series that shows how tough MDF is compared to plywood. The measurements on the image show the diameter of the "crater" left in the material being tested.

Dropping the conical weight onto some PVC foam would have lead to a total failure of the material and therefore no meaningful data. So I did not bother with that. But you can see that MDF is significantly more puncture resistant than CD plywood.

If you recall that the area of a circle is;

$$\mathbf{a = \pi \times r^2}$$

Then you can see that the plywood's crater is 65% bigger than the MDF crater. MDF is more uniform than plywood and very puncture resistant.



Looking after your self:

Stay clean: Obviously handling glues and resins is messy. I cover generally my mixing area with some builders plastic (taped down along the edges). I also have a box of surgical gloves handy. Getting resin on your fingers is a good way to get it everywhere else. Tools, door handles, your phone when it rings and probably up your nose if you have a boogah. Work with gloves on and learn how to take them off without getting resin on your fingers.

You'll find there are times when you need to poke at or smooth over, sticky stuff and doing this and cleaning up your self afterwards is annoying.

However, if you do get epoxy on you - or some other item - vinegar is your co-pilot. vinegar is nowhere near as nasty as acetone, miles cheaper (if you by the cleaning quality) and it doe a wonderful job of getting un-cured epoxy off stuff. If it happens to be you, give your hands - or what ever - a wash with normal hand-wash. this way you wont smell like you're about to attract sea gulls. I usually buy boxes of cheap disposable brushes and throw them away after I've used them. But if you wanted to clean your brushes out and use them again, vinegar would work.

Working Lungs: There is a lot of sanding and dust involved in building a boat. Cover up and wear a mask. I always had a pack of P2 masks with mouldable nose sections. I have an excellent nose and regular paper masks will not seal around it. If you take your mask of and you can see little dust trails around the outside edge of your nose, get better masks. I've recently bought a good respirator with replaceable cartridges. It's excellent, does not fog your safety glasses and I'm wondering why I did not do this years ago?

See previous comment about being a tight old man.

Another point about dust is cross contamination. Fibreglass dust is a terrible skin irritant. Do not let it sit idle in your work space. You mate that drops by to see how clever you are will sit in the morning break coffee chair. Get itchy dust all over their arse. Then that will follow them into their car seat or the next lounge they sit in without thinking. Causing the next person to sit in these spaces to possibly enjoy hours of entertaining rash.

Smooth Hands: If I have a lot of hand sanding to do, i wear a pair of mechanics gloves. These are light flexible cloth gloves with a thin "rubber" coating on the fingers and palms. Holding sandpaper and rubbing away will leave your fingers raw and shitty. Pupping on a pair of close fitting gloves will make this much much more bearable.

Eyes n Ears: Finally the obvious one. If shit can fly around of fast moving stuff? I'm looking at you circular saw and angle grinder. Put some safety glasses on. As I'm long sighted. I grab some +2 plastic bi-locals from the local Big Red Hammer. Also, if it needs glasses, it will almost certainly need ear muffs. I actually have a pair of Bluetooth ear muffs. They are fabulous. I always listen to music or a POD cast while I work. And if my phone rings I just tap the button on the side of the muffs to take the call.

Properly happy eyes and ears are a super important part of so much that is enjoyable. Take care of them.

Tools I used: Obviously you can't build a Blowfish with an adze and chewing gum. Well if you can it should have been you writing this document. But if you can't, then here's a list of the tools I used and how important i think they were to the project. I think our could complete the project with fewer tools than I used. But having more will certainly make things easier. I'll start with the most needed and work down to the "maybes".

- **Jigsaw.** A jigsaw is by far the easiest way to cut curves in panel. They are also a very affordable power-tool. I can't imagine any DIY person not having one in their kit and I'd call this tool essential to the job.
- **Drill.** Like the jigsaw above, it's hard to imagine someone not having some sort of power drill in their tool kit. This is also essential.
- **Clamps.** Every glue joint works better with good clamping. Or more accurately, un-clamped joints generally do not work. while epoxy adhesives are far more forgiving than regular PVA craft glue, joints should still be well clamped. I think it's essential that you have at least 12 200mm F-clamps. More is better. I even have a coupled of 400mm clamps which I used on the centreboard and rudder construction.
- **Circular saw (with fence).** Being able to rip timber (cut strips along a length of material) is essential for the Spars (mast, yard and maybe boom), oars and gunwales. A good circular saw with a reasonable fine tooth blade is what is required here. Ripping lengths of timber with a circular saw by hand does require some practice and patience. clamping the work to your horses, cutting a bit, them moving the clamps and horses and continuing is annoying. But it doe get the job done. this tool is also essential.
- **Saw horses.** While viewers will see me on the ground, working on all fours like your favourite canine. This is not recommended and generally I set the work up on a pair of horses. A few lengths of 70x35 timber over the horses would also make cutting out the topsides and bilge panel easier too. While not essential, I think horses are strongly recommended.
- **Table saw.** Once you have ripped timer with a table saw. You'll never want to use a circular saw with a fence to rip timber again. My first table saw only cost me about $300 (old man memory withstanding). Though about 4 years ago I upgraded to one that cost about $1000 and I can say you totally get what you pay for. The extra power it has and the lack of "wander" (run out) in the blade, is worth every extra cent. A table saw is not at all essential for this project, but I would recommend it and I'm pretty sure it will find use in other projects. Note that it's work getting one or two extra blades with differing numbers of teeth also.
- **Planes.** When it comes to shaping the spars, oars, rudder and centre board you'll need a plane of some sort. I have a couple of small hand planes and you could certainly get by with these. But I have a 75mm power plane too and this saw more work than the hand planes. A power plane is actually cheaper than a good hand plane. Power planes also come with easy change disposable cutters. You'll find epoxy adhesives really give the edge on your tools a bashing. So being able to quickly change cheap cutters is a big plus. A plane of some sort will be essential.

- **Chisels.** I have two lots of chisels. some good "precious" ones for mortising and the like. and a couple of rough cheap ones for hacking away at glue dags and other unmentionables. There were not too many times I needed chisels in this project. Just a few notches and clearances that possibly could have been dealt with in another way? Unlike building a proper timber boat, where your tool requirement is much more complete. A stitch and glue panel boat simplifies this need considerably. Chisels are not essential, but why don't you have them anyway?
- **Hammer.** You have a hammer right? Yep, lets move on.
- **Square and bevel.** I have a few squares of varying sizes and a couple of bevels. There are many angles in a boat and a good bevel to measure and match is essential. Every workshop should already have a 200mm and 600mm square. Essential.
- **Scissors and cutting.** Most simply woven fibreglass mat unravels like a helicopter parent who's just discovered their teenager smoking weed. So cutting it with a pare of scissors, while possible, is a hassle. I much prefer a dressmakers/crafter's rotary cutter for this purpose. Trying to cut woven fibreglass with a Stanley knife/box cutter is pretty much impossible. Though a good knife in a workshop is also essential.
- **Other knives.** Some people call these "paint scrapers", but really they are called putty or filling knives. You'll need a small one (50mm) with a rounded end for filleting and a wide, flexible one (150-200mm) for fairing. Both these tools are essential.
- **Sanders:** I have 2 sanders. A 125mm and a 150mm, both random orbit. the 125mm is just a regular hardware store brand. But the 150mm is a Festool, with a 5mm eccentric (#NotSponsored). The eccentric is the orbit the sanding pad does as it rotates. A larger orbit for coating removal and rough work. A smaller orbit, maybe 3mm, for French polishing and the like. 5mm is a nice mid point. Now a Festool sander is eye wateringly expensive. But after you've used one, you'll find cheap sanders ineffective and annoying. not to mention uncomfortable. Sanding is a horrible horrible task. So I'm happy to pony up for a top of the range tool that makes it easier. All of that said, there's no reason why you could not do all the sanding required on the Blowfish by hand. After all, it is a tiny boat. Use a nice pair of neat fitting rubber gloves if sanding by hand. A sander is not essential, but quite nice.

Glossary:

Amidships; the part of the boats hull that is roughly halfway between the bow/front and stern/rear.

Bilge; The bottom/lower part of the boats hull.

Bulkhead; A panel, that may or may not be watertight, that divides a boat into sections across it's centre line.

Centreboard; A removable vertical foil, placed along the centre line of the boat that cancels the sideways force of the sails when the boat is sailing close hauled or reaching.

Chine; A hard edge that runs for and aft in a boats hull on or close to the waterline.

Cleat; A fitting to hold a rope in some manner. Or a strip or bracket affixed to one piece of material to hold/fix too, or make it easier to hold/fix too, another piece of material.

Draft; The depth of water a boat needs to float.

Fairlead; An eye or guide to pass a rope though so that it may control something.

Foot; The bottom edge of a sail.

Freeboard; The vertical distance the sheer or gunwale is above the waterline.

Gunwale; The upper edge of the topside where the topside usually meets the deck.

Halyard; A rope that hauls a sail up a mast into a position where the sail can be used/set.

Head; The top corner (triangular sail) or edge (square sail) of a sail.

Keel; The lowest centre line of a boats hull. It may, or may not be a actual structural member.

Luff;The front edge of a sail.

Mast Step; A strong retaining point for the bottom of the mast.

Peek; The top corner of a sail. It may also be the head.

Rowlocks; Pivoting yolks/retainers that the oars work though when the boat is being rowed.

Rudder; A foil used to steer a boat. Usually mounted on the transom.

Sheet; A rope that is attached to the lower, aft corner of a sail that is used to adjust it's setting to the angle of the wind.

Skeg; A small fin, along the centre line of the hull, just before the stern of the boat. This helps the boat track in a straight line when being towed or rowed.

Stem; The front edge of the boat. A part of the bow/front of the boat.

Stitch n glue: A boar building method where two panels are stitched together with wire or similar and a fillet of thick glue is used to seem.

Stringer; A strengthening member/strip that runs fore/front to aft/rear down the hull parallel to the keel line.

Topside; That part of the hull between the waterline and the deck.

Transom; The panel that makes up the stern/rear of the boat.

Thwart; A structural member that runs across the centre of the boat from port/left to starboard/right.

Tiller; The handle used to control the rudder.

Yard; A spar used to attach the head edge of a square or rhombic sail.