Underwater metalwork, rudder and linkage

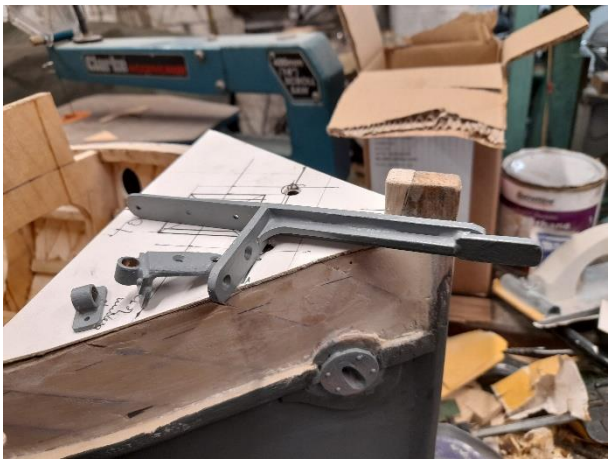
This document was written by Paul Naylor and is published here for FMES online viewing, and was written during 2025.

Sundowner build - 5

So many things were starting to pile up in my mind now that the bulk of the main hull work is done. What to do next? I decided that I would have a small break from wood and do some metalwork...

The list of metal objects with some sort of function included anchor tubes (to penetrate the hull and deck but not let water inside), the skeg supporting the bottom of the rudder stem, projecting from the keel, two more rudder pivots to mount on the transom, a collection of items for mounting inside the rear of the boat under the deck as noted earlier to transmit a servo drive to the rudder, something to mimic the real rudder control device, the rudder itself and a rubbing strip along the keel at the bow up turn. I decided that this lot had to be tackled – my natural impatience was edging me to fixing some of the decking at the rear, but I just know that if I did it without sorting out some of these details, I would regret it later. Something that I am contemplating making in due course is a propellor...but that is not required yet!

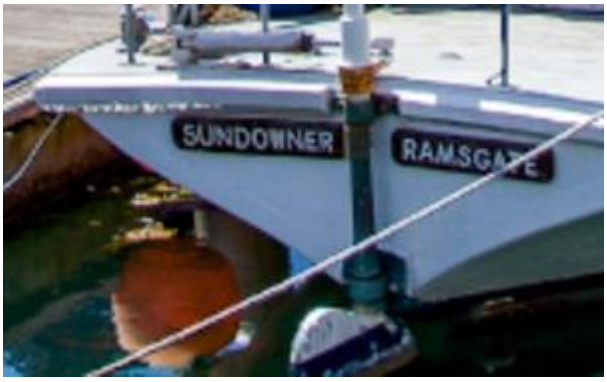
The rudder mountings/pivots and the skeg were made from bits of brass mainly silver soldered together for strength. I took the shapes and sizes from the photos of the real thing and thought about how they would be mounted, but did not mount them as getting three pivots to line up and allow free rudder movement I thought would be a challenge. I left the skeg undrilled for the bottom pivot to increase my options when I came to fit them! I also set about drilling the anchor chain holes in the bow. In the photo you can see the inserted brass tube (I had some 'in stock') with silver soldered copper flanges. These are epoxied into the holes and 'nailed' on with brass tacks that look like the real bolts. Drilling the holes was not as hard as I was expecting after marking the position of the exit holes in a card 'deck' and going up in drill size gradually. I will make flanges and sleeves to fit the deck ends when I have fitted the deck (and as a result sealed off that bit of the hull). Also in the photo is the skeg and two rudder pivots. I have primed all the metal with etch primer hence the grey colour. I also got some epoxy resin and hardener and coated the inner hull at the bow. I bought the 'slow' setting variety because I wanted the resin to have some time to soak into the wood and odd gaps in joints before it went off. The bow inside surface is still not completely set after 48 hours, and the slow set meant that on vertical surfaces it all ran down to the bottom making a small lake...hey ho.



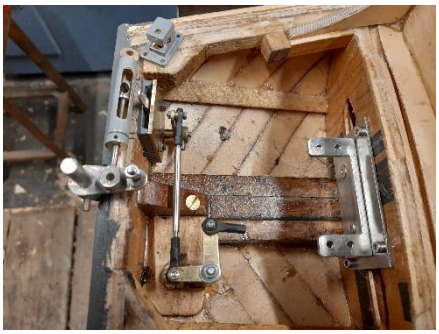
I wanted to use 6mm stainless steel for the rudder shaft (and the propellor shaft later), so I got that ordered. I have been quite careful to use only non-ferrous or stainless-steel metals to avoid rust issues. The shaft had to be quite good finish and tolerance, so I got 316 grade polished stainless rod.

This meant that I could finish the rudder and its mountings, so fixed the mounts with very small brass wood screws and epoxy. The top one first as it had no latitude in position thanks to a rebate in the rubbing strake, then it was a matter of offering up the others to find the best position and mark and drill the lower hole in the skeg. The point of no return came so I drilled the screw holes and fixed the mounts down. The epoxy is to hold it more securely and to fill up any small gaps between the hull and the fitting. After a small amount of fettling, the rudder seemed to operate smoothly in all three bearings. The lowest one though is quite vulnerable so I have to be careful not to knock it.

Now that the rudder is 'mountable' on the transom, I had to work out how to control it without having obvious RC linkages on the deck. The real boat uses a hydraulic cylinder working a short lever arm on the rudder shaft (see the image), and this is very visible. I spent quite a lot of time trying to find an RC servo that looked like a hydraulic cylinder. I found some (from China) but none that were anything like the small size required here. I dreamed up making one, using some sort of slave system with oil, but decided that the chances of reliable operation would be minimal! In the end I settled on a slot in the deck under the position of the hydraulic cylinder with a lever end poking though and operating the same rudder lever as a simulated cylinder. Getting the drive from a servo to this lever was about making up another lever arm internally to connect it to a servo. I discovered that RC servos came in regular sizes, so did not need to buy one to work all this out.



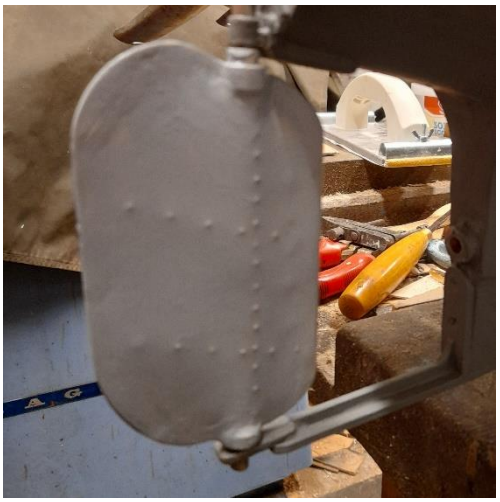
After making all of the linking levers (and finding and using some RC linkage 'ball end joints' to save making clevises) I realised that if I made a free operating simulated hydraulic cylinder, I could drive it from this lever and so I made up this too to see if it looked like working. If it didn't, I could always go back to the lever and pin I started with and a more dummy cylinder.



The photo shows the built-up rudder linkage with the simulated hydraulic cylinder shown roughly in its position but upside down so you can see where the lever end engages in the 'piston' of the cylinder. It all seems free enough but if it proves prone to jamming, I can always add a direct link from the lever to the rudder 'tiller'. This is pre-deck gluing, however I have made the deck and access hatch to make sure I can still get at everything when glued up! I also made up a servo mount (aluminium angle that I had) to suit a 'standard' servo as you can see, but have not acquired a servo or made its linkage yet. The appearance of the 'cylinder' is quite realistic, except that it is a little larger than prototype, necessary to get it to work without jamming and give an appropriate rudder 'throw'. This might cause fun later on when I make the handrail stanchions around the deck...

The last item of 'ironware' (strictly non-ferrous 'ironware' here) was the rudder. The real one is quite large, sticks up out of the water and has prominent rivets on it. I made up a cardboard template from a

photo of the real one and cut out a pair of shapes in thin brass to act like a book with the fold nearest the propellor. The rivets are simulated by marking where they go on what will be the inside and then using a moderate blow on a sharp centre punch over a lead block to make them look like rivet heads on the outside. This worked very well, but I had to keep remembering when I bent up the rudder (involving some 'persuading' etc) or filing the result not to obliterate the rivet heads! The rudder is held onto the shaft with two brass collars top and bottom silver soldered into a piece of copper tube (to maintain alignment) that the brass rudder plate was bent around. A few small rivets round the edge to secure it for soft soldering seemed to hold it all together. These were later filed away. The rudder itself and the tiller both have stainless steel grub screws to secure them to the shaft: when I fit it for keeps, I will make flats on the shaft to allow the screw to 'chew' a little into the shaft without compromising removal so location does not only rely on pressure.



I think that this concludes this section now…the next bit is gluing the rear decking down and starting to think about the rest of the deck…which will require removal of the frame extensions. Or do I finish the lower part of the hull up to the deck edge first (including the portholes) while it is easy to work on it inverted? Time for sleep thinking time….