Foamie Design challenge – Double surfaced Wing

Many lightweight models built using 2mm wallpaper foam use a simple curved single surfaced wing. This is normally reinforced with a single balsa spar to give it some rigidity. However, it is actually very easy to make a much more rigid, 'proper' double surfaced wing. What I'll do here is describe the way I went about this, I am sure that 'other methods are available'.

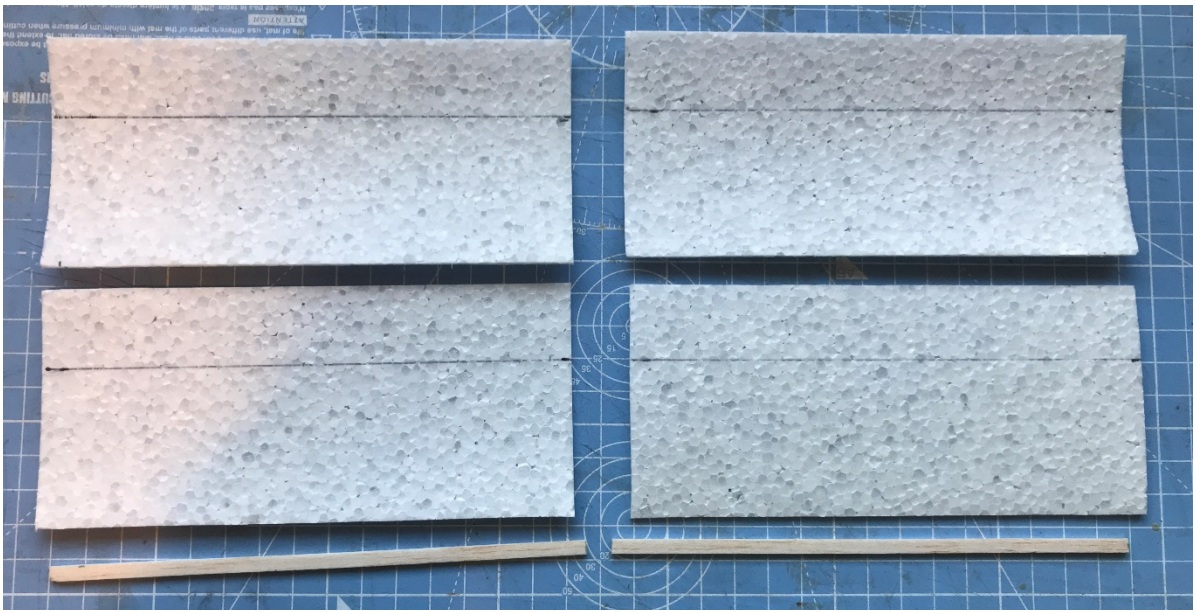
The first step of course is to decide on the size of the wing. The span is easy, the rules limit this to 13"(325mm). If you are building a scale model then the cord is set for you, if you are designing from scratch you need to decide what to use and I suggest a nice wide wing with lots of area. I set my wing size to be 310 x 70mm. Each wing panel is therefore 155 x 70mm and there are four panels (left, right, top and bottom). Rather than try to mark out accurate rectangles on the foam, I made a card template and cut around this.

HINT:-If the foam tears when you cut it then you need a new blade!!!!!! It cuts very well with a new scalpel blade.

You now need to mark the spar position, so using a pen that won't damage the foam, mark a line 23mm from what will be the leading edge of each panel.

If you have cut the panels from the foam in the right direction they will all be curved in the cordwise direction. That's fine for the upper surfaces but not for the bottom ones. These can be flattened by ironing, I used a covering iron on a medium setting, you will know if it's too hot!

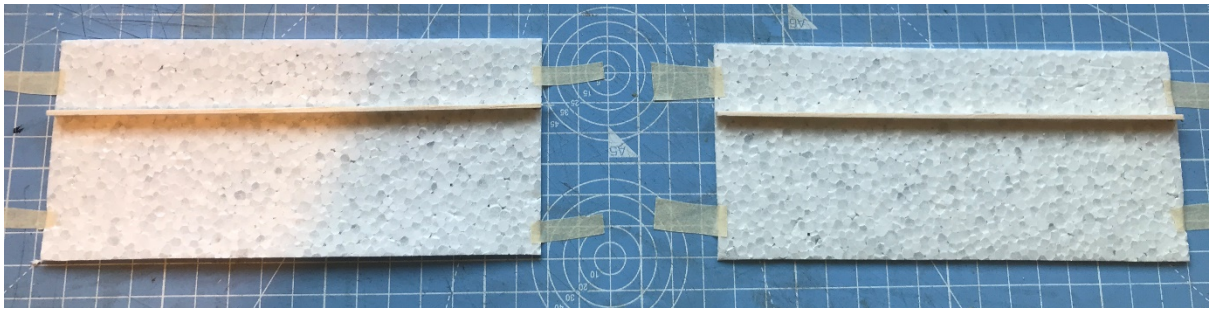
Next you need two spars. It cut these from some light 1.5mm balsa and made then 4mm deep, that gives a wing section that 'looks about right'.



You should now have a kit of parts like this :-

To attach the spars to the lower surface I first used masking tape to secure the lower surfaces to the cutting mat, this ensures that they stay flat. I then put a bead of UHU Por along the spar position

line on each of the bottom surfaces and along one edge of the spares. Leave for 3 mins then CAREFULLY put the spars into position, lightly press down and that its, the joint is already dry! No, you can't reposition it if it's wrong. It should now look like this :-



Hint:-Only use a tiny piece of masking tape over the foam and maybe reduce its 'tack' first or else it might tear the foam when you remove it later.

To attach the upper surface to need to run a bead of Por along all the mating surfaces i.e.

Lower surface on top of LE, TE and Spar

Upper surface, below the LE,TE and spar position line

Leave for 3 mins and then VERY CAREFULLY, press the upper surface LE into position, then press it on the spar and finally press it onto the TE. Carefully remove the tape and you should now have a wing section that looks like this:-

The next step is to put a small radius onto the leading and trailing edges. I used some 600 grit wet&dry, used wet for this.

Hint:-Don't try to sand the joint line, the POR doesn't sand and just makes a mess!

OK, you now have two wing panels and need to join them. The first step is to set the dihedral angle and that will depend on whether this is to be a high wing or low wing model. Actually, I'm looking at a mid-wing and choose 20mm under each wingtip on my normal basis of 'it looks right'. So, set the wing halves up, propped up by the appropriate amount and you will find of course that they don't meet properly in the middle. You need to sand in the correct angle at the roots. This is possible but the foam moves around a bit as you do it so don't expect the fit to be perfect. You can push the two halves together to remove a gap and in any case, POR will to some extent fill a gap. So, POR on both sides, wait 3 mins, offer the two sides to each and set them down propped up to dry properly:-

Once its dry, you should now have a completed wing :-

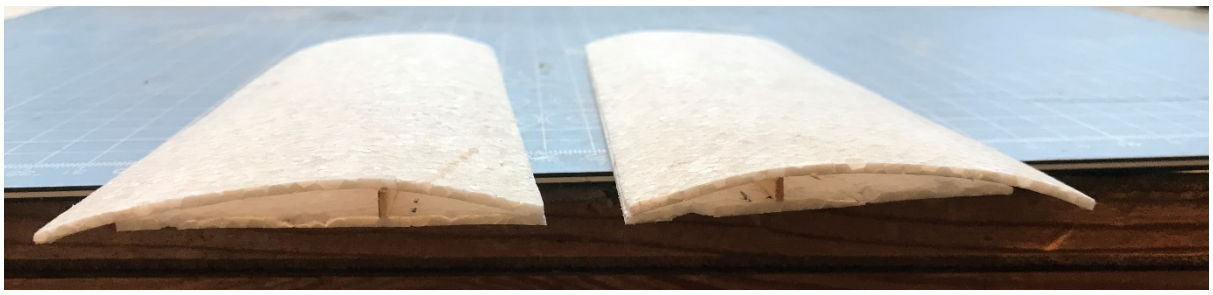
So far so good. However:-

A rectangular wing is a bit boring and unadventurous.

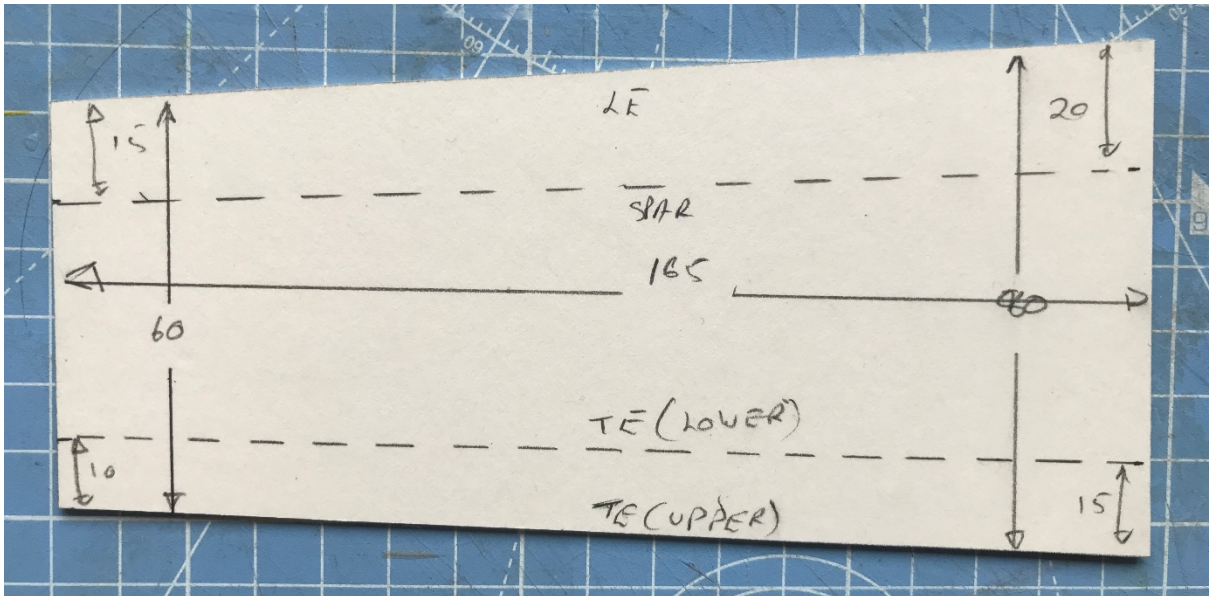
The trailing edge is 4mm thick, looks a bit clunky and maybe not very aerodynamic

Joining the wing halves at the correct dihedral was a bit hit and miss

So for my next wing, it was going to be tapered, it was going to have a dihedral brace and going to have a section as below, this now gives a 2mm thick TE rather than 4mm, much neater:-



Clearly now the upper and lower wing panels are going to be different, the lower one being narrower. I made the half span 165mm, the root cord 80mm and the tip cord 60mm. The template, with the spar position and bottom panel TE positions marked on it looks this :-

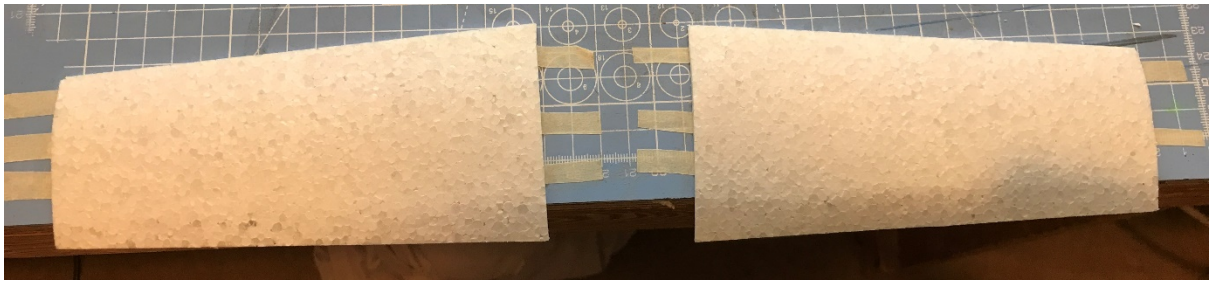


One point to note is that after I took this picture I realised that by making the spar 25mm back from the LE at the root (rather than 200mm as shown) then the spar would be straight through when the panels were joined.

The spar should also be tapered, so its 165mm long, 4mm deep at the root, 3mm deep at the tip.

The kit of parts looks like this:-

Now proceed as before but this time, the TE of the upper panel has to hang over the edge of the bench:-



To join the wing panels I made a dihedral brace from very thin (0.5mm) ply, 4mm deep:-

I glued the brace into one panel first, then added the second one later:-

I hope these notes are useful and have got the ‘thinking juices’ flowing on this subject