

Final Results / Decisions

I started out trying to ascertain what would be the best shape for our new sails. Conventional aerodynamic theory shows that the entry / luff shape can help give lift / drive in a good direction to help a yacht to have good windward performance. Basically what I found is that the luff of a soft sail can not be optimised for ultimate performance in the way that a fixed shape could be, such as a wing sail or one with fixed shape battens similar to a hang glider. I have therefore simply tried to find the best shape for our soft sails.

All the advice given to me and published by Arnie, Slieve and David Tyler has proved correct.

The first two sets of trials basically showed that the soft cloth (curtain lining material) replicated the actual sail better than the sail cloth. This is because the sail cloth is too stiff to take a good shape with the size of panel I was using.

All of my tests and sail making are based on conventional aerodynamic knowledge where the maximum camber is placed forward and from all examples that I have seen will give lift in a direction consistent with good windward sailing.

Once again I must stress that these are 'rough science' tests carried out aboard Ti Gitu using the wind and whatever was to hand that could be used. They are not exact but I believe give a reasonable indication of what happens.

We are using the 'shelf' method of constructing the sail, where a section along each batten is cut to the required camber and sewn between each flat panel. (The other method of producing camber which is also used, is to cut the edge of each panel to the camber, where it joins the batten.)

The tests showed that at larger cambers (8% and 10%) a shelf is formed giving a good shape from the front to the rear. However the aft part of the sail tends to belly rather than have the flat section that would be best.

I tried reverse camber in the aft section to try to obtain a flat shape but could not make this work and so have accepted that the aft section will not be optimised. On the full size sail I have also hollowed the leech by 2.5cm between each batten to both help pull the aft section flat and stop leech flutter. The results will be observed when we test our new sails while sailing.

As the camber reduces (4% and 6%) the shelf has a diminishing effect and the sail tends to take up a uniform roundness top to bottom. However with the tests carried out with the sail cloth it appeared that the stiffer the canvas the better the shape of the panel at lower cambers, so I believe that panels with 6% will still have a good shape, at least to begin with.

Before the cloth ages and softens.

I decided that for the lower 4 panels of each sail we would use 8% camber and for the 2 top panels 6% and then carry out further experiment for the 2 fan panels.

It appears that the softer cloth better replicates what will happen when the sail has aged and the sail cloth softened and using the soft cloth shows that the actual camber of the panel is larger than the designed 'shelf' camber. (See test 1) This led me to the conclusion that a maximum of 8% shelf camber will be correct for Ti Gitu. (It may well be that more camber would be good but we can not afford the cash or time to go too radical) 8% camber will in practice give 10% + when the sail ages.

Using the shelf method gives a slightly greater measurement of cloth top to bottom than by using Arnie's chain method which it would appear seems to suit the stretchy cloth Arnie uses better.

I used the method suggested by Slieve to draw the shape of the camber (See test 1) with maximum camber at 35% aft. Using the drawing of the camber it showed an entry angle of approximately 21 degrees for the 8% camber and an entry angle of 14 degrees for the 6% camber. (I have no method of predicting up wash etc. so assumed the angle from the drawing to be correct.)

I attached 'tell tails' to the front of the panel and screwed one of my navigation protractors to the side of the panel. I could therefore see the actual angle of the panel to the wind. What I found was that with the 'tell tails' flying correctly - as they would on the jib of a normal yacht's sail - the closest entry angle was roughly 4 or 5 degrees more than predicted from the drawing. (Very exact measurements of this were difficult) I assume that this is the same for all sails, they need a small angle of attack to hold the sail in its desired shape.

Assuming the worst angle of an extra 5 degrees, at a camber 35 degrees aft this gave an entry angle of 26 degrees for 8% and 19 degrees for 6%

I measured roughly the angle off the bow of Ti Gitu's existing sails when hard on the wind which is around 20 degrees.

Adding the two together which gave an angle of 46 degrees, made me realise that without possibly finding a method of altering the position of the sheets, perhaps with a track, we may not point very well. We will be very happy to make 45 or 50 degrees off the wind with a choppy sea but with the camber at 35% this was getting a bit close for comfort.

I therefore decided to alter the position of the camber to 40% aft which gives a slightly better entry angle. The total entry angle of the sail with 8% camber at 40% aft gives 21 degrees and 6% camber at 40% aft gives 16 degrees. I have therefore decided on a camber

40% aft of the luff. It may be that this is not needed but we must be reasonably conservative due to money and time.

(I must stress that all these measurements are not exact and just give a reasonable approximation of what is happening)

One thing I did notice was that the tell tails continued to fly over a wide angle. This seems to indicate that the sail will not be as fussy about being sheeted correctly compared to our current flat sails. Sailing Ti Gitu next spring will tell all.

Fan Panels.

I altered the wood of the test panel shape to that of the 2 fan panels which are virtually identical in shape on Ti Gitu. Again I used double sided tape to attach the cloth to the wood. What I found was that as predicted by Arnie - using 20 or 25% of the lower panel measurement for camber gave a good shape and by measurement found that 25% gave a camber of 6%.

This is using the very soft cloth. In practice from the lower panel tests by making the panels with a shelf - a slightly larger measurement will be needed.

I settled on putting this camber at 50% along the yard and top battens. I have procured a long batten to draw this shape.

Sail Cloth.

The original sails on Ti Gitu had, in our opinion, not lasted well. They had suffered from UV degradation. We are reasonably diligent regarding covering them in a similar manner to that reported by other cruisers, but they did not last. I therefore became interested in using other types of cloth.

David Tyler had used awning cloth for one of his sets of sails but found that it did not stand chafe well. Junk rig designer Tom Colvin recommends using Top Gun which is another awning fabric. It is also less expensive than sail cloth. I contacted Mr Colvin and had a couple of long emails from him regarding Top Gun.

It was clear from these exchanges that Mr Colvin views things in a very traditional way due to his experience of sailing working schooners etc. He favours very heavy cloth and therefore favours Top Gun which he reported that he rarely removed or covered.

I obtained a sample of Top Gun and also attempted to contact the manufacturers twice

asking them for their opinion about using the cloth for sails. I did not receive an answer.

I also asked on the forum of anyone with experience of Top Gun and had one reply. This was from Scandinavia where there is little UV degradation and whose sails are only used for summer sailing and were only two years old. However the owner was happy with the cloth.

I tried to scrape the coating of the Top gun with my thumb nail and found as David Tyler had suggested that it came off revealing the thread underneath.

I also tried a rough test to compare Top Gun with sailcloth by rubbing it with sand paper. With this test it appeared overall to resist chafe and the amount of chafe to totally wear through is similar to the sail cloth but chafe did quickly leave the underlying threads unprotected. I also tried constantly bending / folding the cloth and found that the covering cracked and flaked off.

I was concerned with the long term performance and so discounted Top Gun.

I then started to look at sail cloth. I asked Hayward's (the supplier of the original Ti Gitu sail cloth) for information on how long they would expect their Clipper canvas to last in Mediterranean sunlight. They said they could give no indication.

Our original sail maker in consultation with the sail cloth manufacturer advised that probably our original sails of 7oz cloth would have been better at 8oz.

I also contacted Contender and although no figures were given they did give me the following information.

1/ All sail cloth will degrade (burn through) in sunlight. It must be covered when not in use.

2/ UV resistance is achieved by coatings and will only help the sail to last around 20% longer than uncoated.

3/ The thicker the thread the longer the sail will resist UV (burn through) and chafe. Thread thickness is known as the denier.

4/ Some of their cloths have the same thickness threads in both directions. Warp being the long thread and weft (UK) fill (US) the short thread. The fabric with equal thickness threads will probably last the longest regarding UV and chafe.

5/ High aspect cloth is for conventional sails which are of high aspect (Tall) and need stronger thread in the weft or fill to stop the sail stretching top to bottom. Irrelevant for Junk rig sails. (In my opinion)

6/ Another thing is the way the cloth is woven, i.e. the tension and number of threads. This controls which threads are prominent and exposed to the UV light.

I agree with Arnie regarding his sail cloth for his purpose, but we have different problems to him, with high UV and the chafe of long distance sailing. We also want to assemble the sails in a different manner so feel that a heavy cloth will suit us better. (But probably not perform so well in light winds)

The result was that Contender's Performance Cruise 8.68oz (500 x 500 Denier) was probably best for us with their Marblehead 8.77 (360 x 570 Denier) a close second.

Our supplier had none of the Performance Cruise and could not obtain any for some while so we settled on the Marblehead.

At the time of writing I am cutting the cloth and Mo will start sewing the panels together in the next few days. We have purchased a Sailright LSZ1 sewing machine, a hot knife and other ancillaries needed for the project. I will report on how the project goes when complete and also on how Ti Gitu sails with the new sails next spring.

Paul Fay.