Polytarp Balanced Lug Sail with Flexible Reefing Battens

Want a cheap, quick to make, yet good performing sail that requires NO sewing? This sail can be made in less than a day and it should last for at least three seasons.

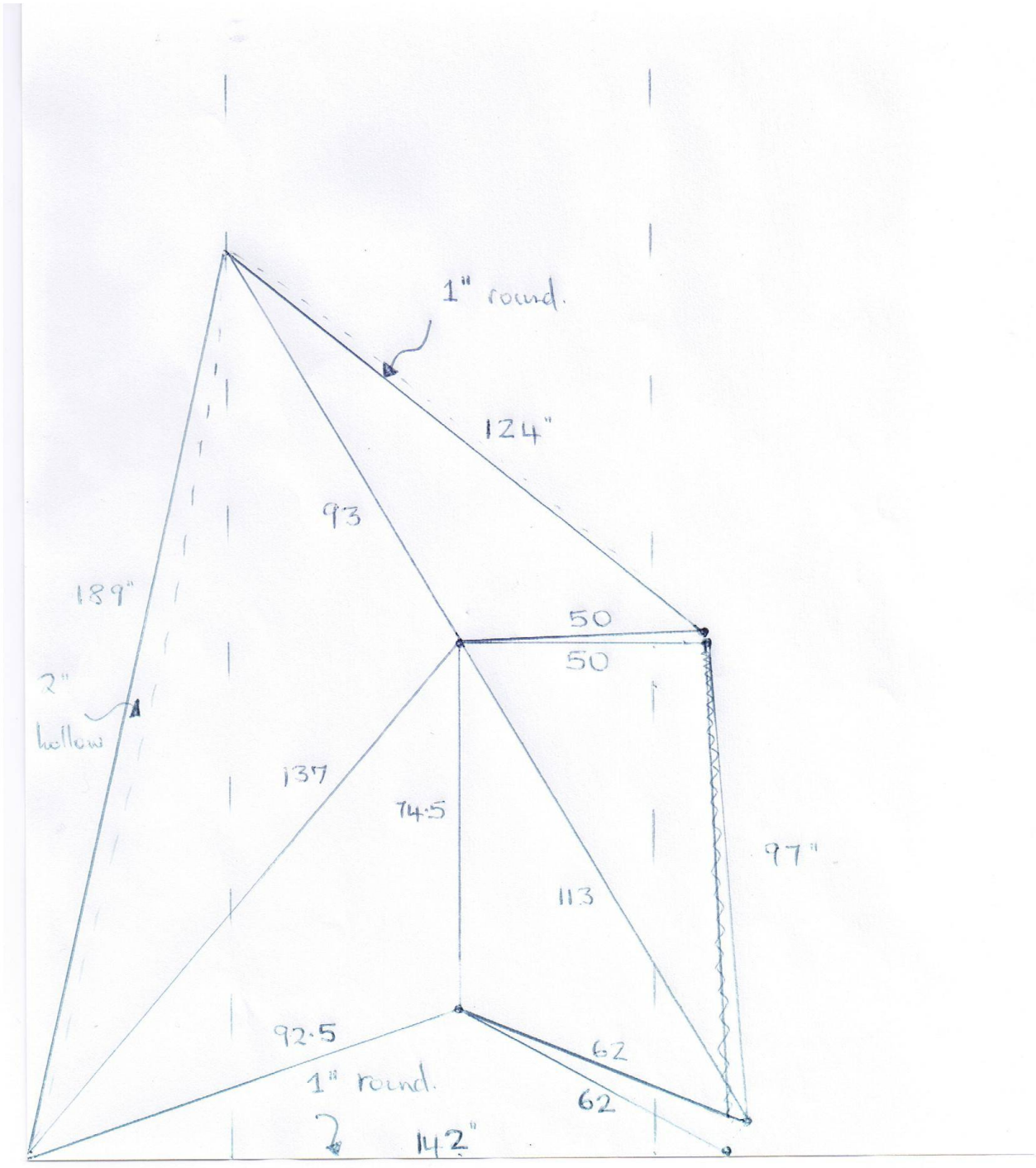
Shaping a Lug Sail

Flat sails are poor performers. The ideal sail has around a 10% draft to chord ratio with maximum draft just forward of it's centre.

To introduce camber into a lug sail all you need is:

1. Two darts with the lower dart being between four and five times wider than the upper dart at the luff.
2. The upper dart should run parallel to the sail's foot, ending at the throat of the sail and beginning on the intersection of a line drawn between the peak and the tack.
3. The lower dart should end at the tack and begin on the intersection with a vertical line dropping down from the beginning of the upper dart such that the start of the lower dart is the same distance vertically from the foot of the sail as the start of the upper dart is from the head of the sail.
4. The leech needs to be hollowed while the head and the foot need to be rounded.

I took my boat plan's lug sail measurements for the foot, leech, head and luff, scaled them appropriately on a piece of paper and applied the above four rules. This gave the following measurements for my new 113 sq ft lug sail.



<<RigPlan.jpg Lug Sail Plan using darts for camber>>

Cutting the Sail

I marked the sail out using a tape measure and marker pen on the garage floor. Because the sail is a collection of triangles, you can't go wrong, the measurements are either true or they're not. Next I cut out the sail perimeter remembering four things:

1. Cut two inches outside your lines to fold the polytarp back on itself later.
2. Remember to account for the hollow at the leech and the rounds on the head and foot.
3. The darts are NOT to be cut out. They are extra material that will get folded back on itself later.
4. Don't be tempted to use any existing edges of the polytarp. If you do, the existing bolt ropes and buckles in the polytarp will cause trouble later.

Taping the Sail

First, stick double sided carpet tape on the darts and fold them back on themselves. I did this on both sides of the sail and then taped over the whole lot with Bear tape.

Next, decide where your reefing lines will be and make three small folds along those lines, each fold somewhat larger than the width of your battens. The folds are secured with double sided carpet tape and taped again on both sides of the sail with Bear tape.

Finally, stick double sided carpet tape around the perimeter of the sail, put the 6mm bolt rope in the centre of the carpet tape, fold it over on itself and seal the exposed edge with Bear tape. I applied extra Bear tape to the luff where the reefing lines are, to make sure those folds don't come apart under the high loads applied to the luff.

The perimeter bolt rope is key to a polytarp sail's longevity as it takes the majority of the loads from your rigging. This is why the darts and reefs must be taped up BEFORE you insert the bolt rope, otherwise the bolt rope will be trying to tear open the darts and reefs when placed under load.

<<Clew.jpg Bear taped perimeter at clew with sheet block and lazy jacks>>

Securing the Flexible Reefing Battens

Battens are used instead of reefing lines on my polytarp sail, because the battens spread the load of the reef across the width of the sail instead of focusing high loads on the individual reefing cringles which polytarp fabric can't handle.

I heated a wooden handled screwdriver with a kerosene camping stove so that I could quickly and cleanly melt a hole through the six layers of taped fabric at the reefing lines. I attached the battens to the sail through these holes using electrical cable ties. Make sure that you attach the battens on the correct side of the sail, so that they will rest against the mast, since you will be attaching fixed parrels to them shortly.

At an arbitrary distance along the battens I tied in a reefing cringle made from a piece of 12mm high quality boat rope tied around the batten in a reef knot with two oversize standing ends. At reefing time these are simply tied in a further reef knot around the boom. The second reef needs to have longer standing ends than the first reef as the reefing bundle gets larger the deeper you reef.

<<Battens.jpg Battens secured using electrical ties. Note fixed parrels and reefing ties.>>

Attaching the Spars

To attach the spars I heated the wooden handled screwdriver with the kerosene camping stove again so that I could quickly and cleanly melt a hole through the carpet and Bear taped doubled over polytarp just inside the perimeter bolt rope. I attached the spars to the sail through these holes using electrical cable ties. For extra security I doubled up the ties on the sail corners as it is here that the bolt rope takes the most strain.

Attaching the Fixed Batten Parrels

In a traditional lug sail tremendous loads are required on the halyard to prevent the sail billowing away from the mast on the good tack. A polytarp sail, even with bolt ropes, can't handle such high loads, so I borrowed the junk sail principle of fixed batten parrels. I secured the plastic clasps by simply screwing through the clasp ribbon using short stainless steel screws and washers into the battens.

The Fixed Yard Parrel

Use a loop of rope with segments from a cut up piece of 20mm electrical conduit slid over the top of it. I have never had a binding problem.

<<YardParrel.jpg Fixed yard parrel. Note wear on fabric at sail's throat. A perimeter bolt rope is mandatory!>>

Materials

1. Medium weight polytarp. Heavy duty polytarp doesn't set well in light airs.
2. UV rated cable ties
3. Double sided carpet tape
4. Bear tape
5. 6mm medium quality minimum stretch nylon rope for perimeter bolt rope
6. 12mm high quality boat rope for reefing ties
7. Two 1.5 inch * 0.25 inch flexible fir battens
8. Two plastic clasps of the type used on lifejackets and small day packs
9. Stainless steel screws and washers to attach clasp ribbons to battens
10. A small piece of 20mm electrical conduit for the yard parrel
11. Two pieces of 2 inch * 2 inch timber for the spars

Things to keep in mind

1. Flexible battens like this will bend the wrong way if allowed to protrude too far forward of the mast, destroying your windward ability. Traditional lug sails usually protrude between 30% - 40% of the yard length in front of the mast. With this sail no more than 20% should protrude in front of the mast.
2. These changes to the position of the halyard attachment point on the yard will also change the rig's centre of effort. To restore the rig's centre of effort you will need to change the rake of your mast forward. Having slight forward rake is a good thing as it means your sail will wing out automatically in very light airs.
3. Because so much of the yard is behind the mast, I added a peak halyard to prevent the peak sagging. If the peak sags on your sail you will see an immediate penalty to your windward ability.
4. The requirement for a peak halyard means that your mast will need to be longer than specified for the traditional lug sail by another 3 ft or so.

<<BoatRigged.jpg Completed rig.>>

References

1. Mike Mulcahey's article on a Polytarp Junk rig

(http://www.duckworksmagazine.com/06/howto/junkrig/index.htm).

2. Jim Michalak's article on using darts for camber (http://marina.fortunecity.com/breakwater/274/1998/1015/index.htm#Lugsails%20From%20Polytarp%201).
3. Video of sail from inside boat (http://www.youtube.com/watch?v=LWcdCNAb2Mc). Luff downhaul is too loose and the lazyjacks are too tight.
4. Video of sail from bow of boat (http://www.youtube.com/watch?v=GOegR2yPUMg). Sail is set perfectly.
5. Video of sail from land (http://www.youtube.com/watch?v=db2Jo9QAI3Y) with darts and reefing battens clearly visible against the sun.

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