An overview regarding spreaders on the Swift Solo Mast

What follows is not intended to be the final word regarding the Swift Solo mast. Instead it is intended to explain the theories that led to the removal of the primary spreaders. Hopefully, it will spur discussion with some knowledgeable folks and we'll all learn something useful. In a few weeks we will provide loos gauge reading while under way (actually sailing). I had done this before while developing the rig but my memory is not what it should be.

When I can find enough time, I will begin experimenting with a mast with no spreaders at all. I hope to have it completed so I can use it in Florida. My idea is to also eliminate all metal hardware and attachment devices above the gooseneck. If successful, it will substantially reduce weight, cost, windage and rigging time.

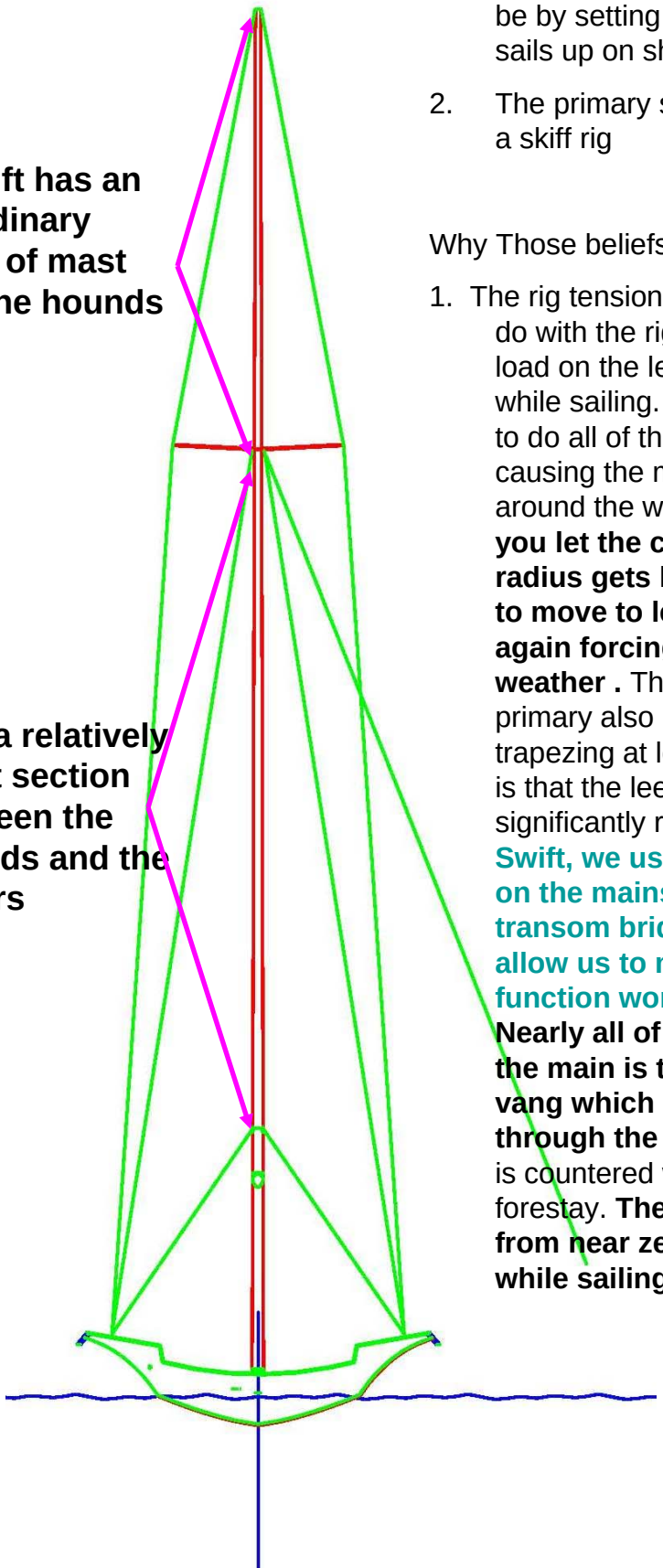
I look forward to your comments

Bram

Julian Bethwaite sailing 001 with primary spreaders

The Swift has an extraordinary amount of mast above the hounds

And a relatively short section between the hounds and the lowers

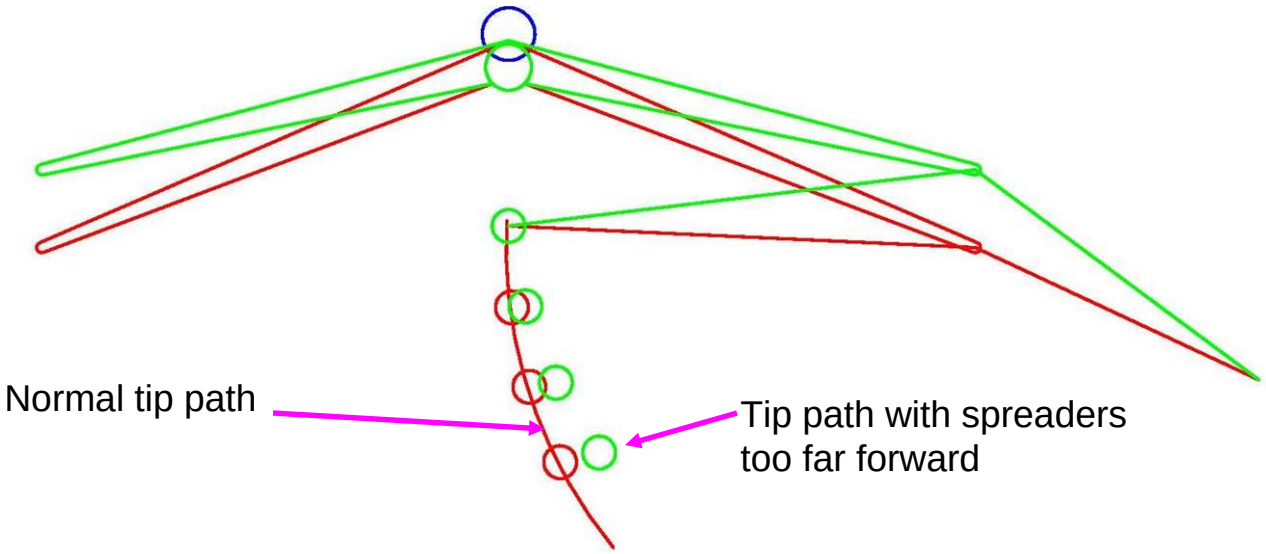


Two Commonly Held Beliefs

1. You can tell what your sail shape is going to be by setting the rig tensions and putting the sails up on shore
2. The primary shrouds do most of the work on a skiff rig

Why Those beliefs are Wrong

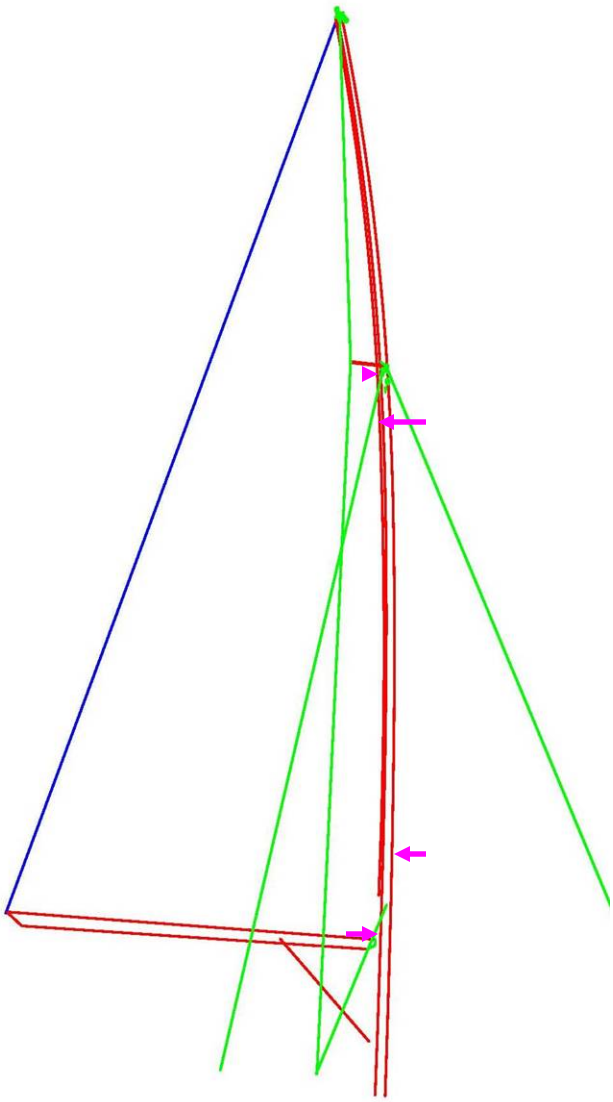
1. The rig tension you set on the dock has little to do with the rig tension while sailing. The load on the leeward cap shroud goes to zero while sailing. This leaves the windward cap to do all of the work. That work consists of causing the mast tip to rotate in a radius around the windward cap spreader tip. **As you let the cap shroud tension off, that radius gets larger—allowing the mast tip to move to leeward a fixed amount before again forcing it to move aft and to weather .** The pressure on the windward primary also reduces nearly to zero while trapezing at low angles. The surprising thing is that the leeward primary typically sees a significantly reduced load as well. **On the Swift, we use little downward component on the mainsheet because the leeward transom bridle leg is always slack to allow us to make the joint auto sheeting function work properly. (see next slide). Nearly all of the leech tension load from the main is transferred to the boom and vang which is transferred to the hull through the lowers.** This lower shroud load is countered with increased tension on the forestay. **The load on the lowers goes from near zero on the shore to extreme while sailing to weather.**



1. Above you can see that the mast tip can only bend to leeward the amount that the caps will allow. After that it must bend only aft and to weather in the arcs shown. The red tip and arc is with the recommended spreader rake. The green tips represent the arc the mast is forced into with the spreaders raked forward as some I've seen. You can see that the green spreader will make the mast seem less flexible. As caps are loosened the tip moves to leeward and the arc become proportionallt larger.
2. Because the windward cap is always tight, primary spreaders in our case could not affect tip bend to leeward—only fore and aft. As you can see from all of the photos taken from astern, the mast remains significantly in column side to side without any primary spreaders
3. While primary spreaders can induce some forward bend, whatever force that is present to induce that bend will also be there to restrict active mast bend (gust response). Gust response is only possible fore and aft and is improved by our large free span distance from the lowers to the mast tip.
4. Most skiffs must have primary spreaders because the span from the lowers to the primary shrouds is too long unless the mast is designed to be very stiff in that section. Such a design would seriously reduce tip activity because of the cantilever effect.

Here you can see that the leeward leg of the transom bridle is slack—even while close hauled. If we were to use the bridle/sheet for leech tension as on most other skiffs, we'd need to double or triple the purchase on the uni-sheet*, and the slack you see hanging below my legs would be dragging in the water, That purchase would make rapid trimming impossible and mark roundings much more difficult. It would also destroy the synchronization between the two sails. We use a very powerful lever vang to generate the required leech tension. This places a large load on our lower shrouds

* Unit-sheet—the combined single sheet system that trims both the main and the jib.



There is a little pressure on the leeward primary (less on the windward shroud), therefore primary spreaders are capable of slightly reducing forward deflection. But that is a overstatement because there are two overwhelming cantilevers that come into play that tend to negate most of that affect.

The booms forward thrust caused by the vang / leech load transfer, forces the mast forward at a point approximately 10 inches below the lower shrouds. **The cantilever caused by that load resists forward bend immediately above the lowers.**

The forestay is attached several inches above the primaries at about the level of the trapeze wires. **Any tension on the primaries also tries to invert the mast—counteracting the bending force cause by leech tension.**

I've included virtually all of the pictures I have of Swifts going to weather from directly astern in the PDF presentation. You can see from those photos that **the mast section from the primaries to the mast base is either dead straight or, if the caps are off a bit for bigger breeze, it only begins to bend from a foot below the hounds upward.**

There is a situation when trapping high and carrying a lot of vang (like Unfortunate Events) that **the pressure on both primary shrouds goes nearly to zero. The mast is being held up by the lowers, the trap wire, the windward cap the forestay and the wind.** The high angle places enough pressure on the windward rail to offset the tripping moment of the daggerboard.

It may sometimes be desirable to reduce lower mast bend in favor of more upper bend. That could have been accomplished by simply pulling some of the rake out of the mast—which is what should have been done. If you look closely, most of the bend is very low in the mast—right at the lowers. Raking the mast forward a bit would have tightened the lowers and moved the majority of bend much higher up the mast. Since upper mast “activity” is a function of the amount of free span on either side of the hounds, you can see that restricting the bend well down at the lower shrouds leaves a more active mast than restricting bend at lower spreaders which would be much further up the mast. If we were experiencing sideways bend—especially toward the slot, primary spreaders would play a useful purpose.

The benefit of cap shrouds—what happens when you change the setting

In this photo, notice that the mast in the Swift is dead straight sideways until you get to the hounds. That is Ben Moon of Ronstan. Because he needed more power, we should have pulled the rake forward tightening the cap shrouds, the lower shrouds, and the vang in a single adjustment. That would have pulled the mast tip to weather and could have made the mast dead straight side to side as with Robert's mast on the previous page

Here you can see the difference in low bend--the black boat has tighter lowers. By pulling more rake out of the mast on Unfortunate Events, the bend could have been moved higher as it is on the other Swift. Primary spreaders could do little to improve the lower bend on Chris' boat and would likely have made the upper mast less responsive.

The lower masts are straight in both of these boats. Unfortunate events is reaching with the boom well out.

Here you can see what happens to the mast when you break a lower shroud. This ended Ron's day in this championship. The mast did not break which is pretty amazing!

Here you can see that the spreader tip is forward of a straight line. That means that any further pressure in the upper mast pulls the mast tip aft and to weather. Again pulling on more forestay and letting off the primaries an equal amount (same total tension) would have straightened the lower mast and pulled the mast tip to weather—providing more power. If the waves had been any larger, that would have been important. In flat water it is a trade off between power and pointing ability.