Planesail Zig Zag Rig Design Brief

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Design Brief – Executive Summary

Planesail is a 17.4 meter foot Walker Wingsail trimaran weighing 17 tons. Twin 38 Hp diesels give her a speed of 10 knots.

Her original biplane Wingsails rig broke and needs to be replaced.

This Design Brief has been produced by a non engineer, and is designed to form the basis for discussion.

The Unstayed Mast

The turret held the original biplane rig with an estimated weight of approx 1.5 tons on a 1 meter diameter slewing bearing.

Turret from forward.   Turret from aft.

I therefore assume the turret is strong enough to mount an unstayed mast directly on the turret. A hinged base plate can then be used to allow the mast to be lowered without the use of a crane. The mast length needs to be less than the 17.4 meter length of Planesail in order to avoid any overhang fwd or aft when lowered.

I would like to look at round tube "stock item" masts in either aluminium:

http://www.nedal.nl/engels/index.html the Faubourg design 15m long above ground – I presume if we get the version with the base plate, it will be 15m + the depth of the bury long.

or glass fibre http://www.pipexcompositepipes.co.uk/products/product.php?id=4 see M.1 Ballast & Bilge specs.

The mast can be of any diameter because it can be accommodated on the 1 meter wide turret.

The sail

The sail can be a rectangular sail 9 meters wide by 13 meters high, which allows for 2 meters above and below the sail for hoisting it vertically, and for tensioning it down.

The top and bottom of the rectangular sail is attached to horizontal round tubes 9 meters long.

Note that I envision that the top and bottom tubes are horizontal; that the mast is parallel to the luff; and that the rig is balanced such that we can entirely dispense with the mainsheet.

The balance is maintained because both the top yard and bottom boom are attached to freely rotating rings around the mast. Thus the rig is completely unconstrained and can rotate more than 360 degrees.

The bottom tube is the boom and the sail can be reefed by rolling it around the boom.

The Basic Design Question

Can a stock item mast which is less than 17.4 meters long (the length of Planesail), handle the forces of a rectangular sail 9 meters wide and 13 meters high?

Formula for calculating the wind force on a sail

http://www.sailingusa.info/cal_wind_load.htm

Load in Pounds = Sail Area * (Wind Speed)2 * 0.00431

"Success is not measured by what you accomplish but by the opposition you have encountered, and the courage with which you have maintained the struggle against overwhelming odds." -- Orison Swett Marden

http://forum.woodenboat.com/archive/index.php/t-69064.html

I pondered the same question when I was trying to decide how to rig my Gazelle. I wanted free-standing spars but Colvin's original design called for aluminum tubes supported by stays. I took a lesson from Hurricane Hugo and decided flagpoles would be fine without stays.

I drove through the Charleston area right after Hugo hit and saw trees down, power poles snapped, even a church steeple on the ground. I also saw many aluminum flagpoles standing, unharmed.

I probably oversimplified but I calculated the stress on a bare 8 inch diameter flag pole in a Cat 4 hurricane was greater than what that same pole experiences in 20 knots of wind carrying 400 square feet of sail. I based my numbers on what I had read about wind forces increasing as a square of the increase in wind speed. I disregarded how heeling reduced the exposure and came away from the exercise confident in the ability of the poles to do the job without stays. They did.