

Big picture Stuff:

Shown is a single slotted two element wing. This is what Oracle has.

The "twist" mechanism is a system that allows the flap angle to be progressively reduced as you go up the wing.

This drawing is based on the Patient Lady wing series, and details the system pioneered by David Hubbard and Duncan MacLane and the rest of the Patient Lady Team.

The wing pivots on its mast step and about an axis defined by its mast step and the point where the shrouds hook up. This is forward of the wing's center of pressure.

Angle of attack is controlled by a main sheet attached to the bottom of the flap and aft of the flap's aerodynamic center. Thus if the flap were free to move, the wing would fold along the axis of the flap hinges.

We control flap angle by limiting how far we allow the wing to fold.

The primary control of flap angle or camber is a limiting tackle between an A frame on the #1 element and the boom at the bottom of the flap or #2 element. This control is similar to the rotation control on most beach cats and fundamentally works the same way. As a result, the wing can be tacked and gybed without having to adjust or reset the flap controls,

Attached to the boom are control arms that connect to control arms aloft. There are control cables that connect these to the upper control arms. The geometry of the control arms match each other, so that when they are connected by cables, the upper control arms repeat the flap angle set by the A frame at the bottom of the wing. The cables cross inside the mast, so that the wind pressure folding the wing at the bottom is used to pull flap angle in at the top. Very clever this bit, but it's nothing compared to what comes next.

In order to wash out the flap angle aloft, we need to be able to vary how hard we pull the upper control arms. We do this by allowing the individual deltas to lag behind the boom, and therefore not enforce the same amount of camber throughout the section.

The cut outs in the deltas, allow them to be eased by allowing the roller to move forward.

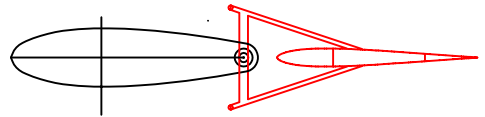
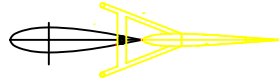
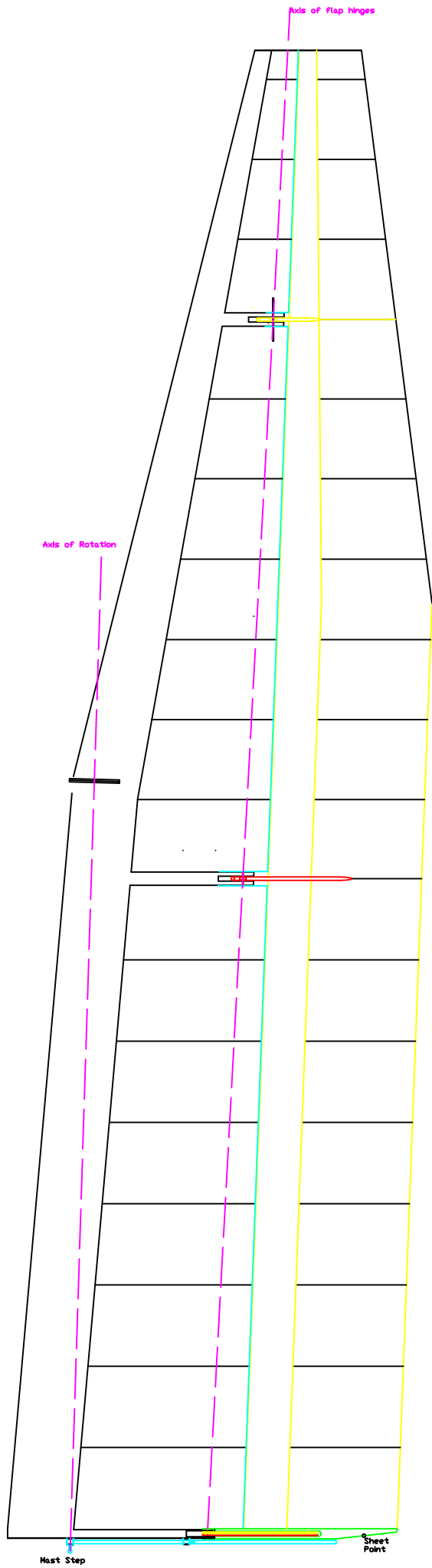
The shape of the cut out determines how the flap twists and the comparative shape determines how the twist is configured,

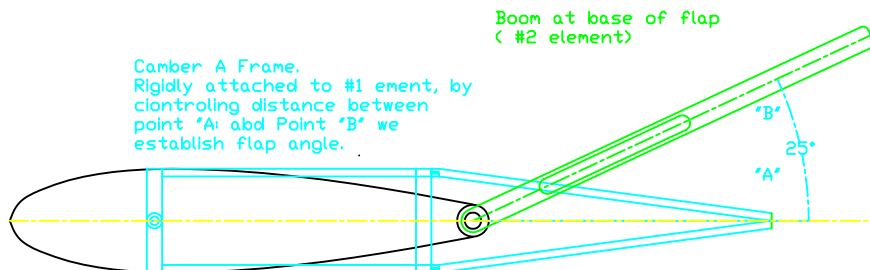
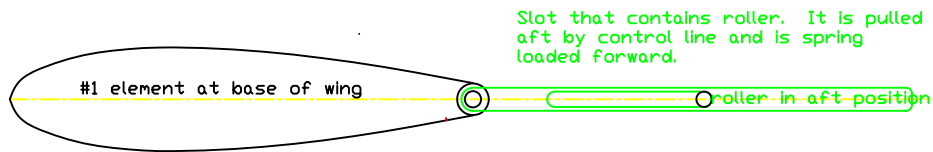
I hope the views below the wing profile demonstrate the various component parts and how they work together.

This control system has been scaled up and down many times, and has proven more robust and reliable than most others. Additional control arms and deltas can be added.

The dimensions of the components are based on measurements and my best recollection of the Patient Lady X Wing. I'm sure they are pretty close, but you should do your own homework if you are building one of these things.

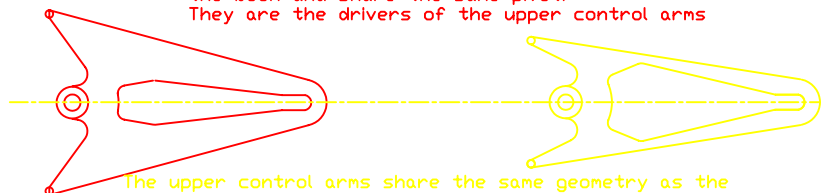
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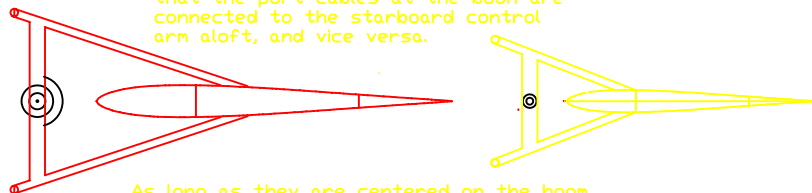


In this case 25 degrees is shown. But because the flap is not rigid in torsion, we need to add additional control points in order to maintain constant flap angle.

These things are called Deltas. They are installed in the boom and share the same pivot. They are the drivers of the upper control arms



Control cables cross inside wing, such that the port cables at the boom are connected to the starboard control arm aloft, and vice versa.



As long as they are centered on the boom... That is the clever bit with the cut outs and the roller inside the boom. Ease the roller forward and the deltas will lag behind the boom/ This reduces flap angle aloft, and simulates twist.

Everything stacked up on top of each other.  
0 Degrees camber  
Roller is all the way aft so deltas are locked on centerline of boom.  
Flap angle will be the same all the way up the wing.

