# Ferdi Galè's "Ubãra"

The pitch stability of tailless planforms is always of concern to the designer. In the case of "plank" planforms, stability is achieved by reflexing the camber line of the airfoil from approximately c = 0.75 to the trailing edge. This change in airfoil contour affects the moment coefficient of the section, and the airfoil is self stabilizing when the coefficient is positive.

Swept 'wings, on the other hand, rely on washout - geometric, aerodynamic, or both - to achieve pitch stability. Four methods of determining the washout angle and twist distribution have been previously explored in this column. It is generally accepted, when speaking of swept tailless planforms, that a combination of more twist and a more forward CG create a more stable aircraft.

Our good friend Dr. Ing. Ferdinando Galè, author of "Tailless Tale," "Structural Dimensioning of Radioguided Aeromodels," and other books, described his experiences with a new tailless design in a recent letter.

"I am enclosing a picture of an experimental tailless I built recently. It is a free flight HLG which was intended to be a 'proof of concept' 'craft... to realize a larger radioguided version later on.

"The lifting area between the two vertical plates has a flat bottom airfoil set at four degrees, while the outboard stabilizing tips are just flat plates set at minus four degrees. The cuspidate tail, *a la* Horten, has a reflexed trailing edge. The initial idea was to alleviate the burden on the two stabilizing tips. The adjustable elevons, of thin aluminum, had to be set at neutral because Ubãra turned out to be ultra stable. The measured glide ratio is about 9:1, which is not bad for such a rough arrangement.

"Now the funny part of the story. After many hand launches, the tips were so damaged that I decided to tear them off before scrapping the model (that is, handing it to a young admirer, son of a neighbor). Then, big surprise! Without the stabilizing tips the model is as stable as with them. The glide path seems to be better, too.

"Perhaps if you mention this experiment in your 'On the 'Wing...' column, some keen readers may offer useful comments and suggestions."


Why did the removal of the wing tips not adversely affect Ubãra's flight performance? Was flight performance actually improved, and if so, why? How can this information be productively used in future designs? Ferdi's experiences with Ubãra certainly raise some interesting questions, and we would very much like to hear readers' thoughts.

# Ubãra: Conclusions

In the August issue of *RCSD* we described a free flight HLG designed and built by Dr. Ing. Ferdinando Galè.

Ubãra, a swept wing design, featured an elongated root chord which formed a cuspidate (bat) tail. The root airfoil was a reflexed section. Ubãra's wing tips, which were flat plates, were set at -8 degrees to the root airfoil and separated from the main wing section by vertical plates. Ubãra flew very well in this original configuration, but flew better after removal of its wing tips.

We asked, in our column, for reader input regarding this change in flight performance. Nat Penton sent in what we consider the best explanation for the change in Ubãra's performance:

> "The extreme incidence settings of the outboard tips was trimming the wing to fly at a high CL with attendant high drag.
>
> "It is not surprising that removal of the tips resulted in better performance — lower profile drag and dramatically lower induced drag. It also provided some weight reduction and a CG shift in the desired direction. The L/D improvement should be dramatic.
>
> "A less dramatic comparison could have been made if the incidence of the tip plates was adjustable, although it would still be a more draggy arrangement than the final version."

Interestingly, none of the submitted explanations directly examined the effects of the reflexed center section on the glider's stability and subsequent performance. Rather, the focus seemed to be on the wing tips which were removed.

Ferdi's main point, and one which we attempted to reinforce, was to draw attention to a case where the chosen tailless planform and airfoil combination provides too much stability (and hence too much drag).

Ferdi stated, "The initial idea was to alleviate the burden on the two stabilizing tips. The adjustable elevons, of thin aluminum, had to be set at neutral because Ubãra turned out to be ultra stable... Without the stabilizing tips the model is as stable as with them. The glide path seems to be better, too."

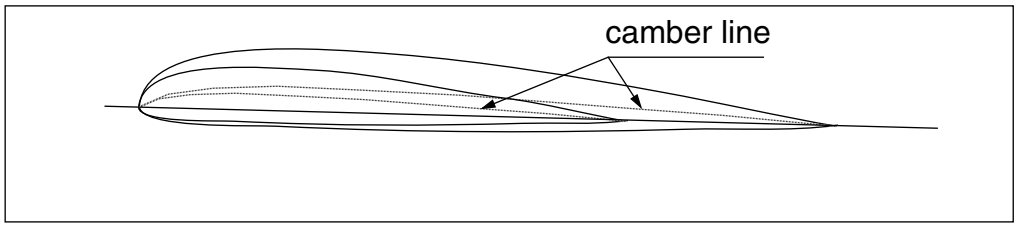


Figure 1

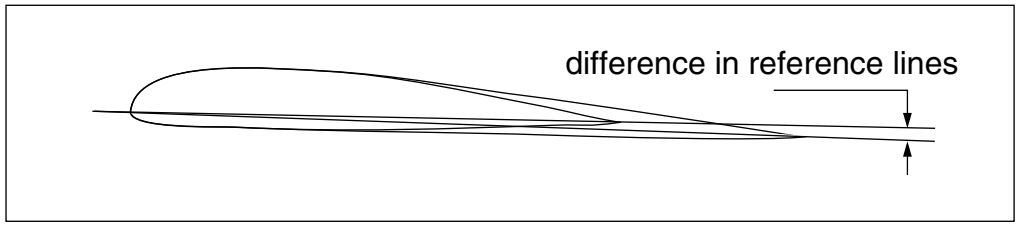


Figure 2

Thermaling is said to be improved by incorporating the bat tail configuration. But published reports have thus far described bat tails which are constructed by either simple enlargement of the entire root section (Figure 1) or by extension of the root section camber line well past the normal trailing edge (Figure 2). Notice how these methods affect the reference lines, and hence angles of attack, of the two sections. Since most modern high lift sections incorporate positive aft camber, bat tails have been a means of significantly improving lift, but at the same time increasing the wing's already strong negative pitching moment. This negative pitching moment must always be fully counteracted for stable flight.

The bat tail of Ferdi's Ubãra, in contrast, was a negatively cambered surface. While this did not augment lift, the resulting planform did change the quarter chord line as promoted by the Hortens (Figure 3). But the combined effects of wing twist and negatively cambered bat tail proved detrimental to Ubãra's performance — using only one of these two means of achieving the required stability would have resulted in lower drag and better performance.

Did the reflexed center section alone contribute sufficient force to overcome the pitching moment of the entire wing? Ubãra did not pitch forward, but rather flew well following removal of the twisted wing tips, so in comparison to the normal practice of twisting both wing panels, a reflexed bat tail seems to be capable of providing sufficient stability.

Would Ubãra's performance have improved if Ferdi had simply retained the outer wing tip panels and changed the bat tail to the more usual positively cambered surface? We are not sure of the answer to this question. We tend to believe the twisted wing panels produced more drag than the reflexed bat

tail. If this is so, the performance improvement, if any, would not have been so great as that seen in Ferdi's experience.

Given the choice of using wing twist or a reflexed bat tail, we would at this point tend to choose the reflexed bat tail. Based on Ferdi's experience with Ubãra, we think the reflexed bat tail option would yield superior results.

We certainly welcome further ideas and comments on this topic.

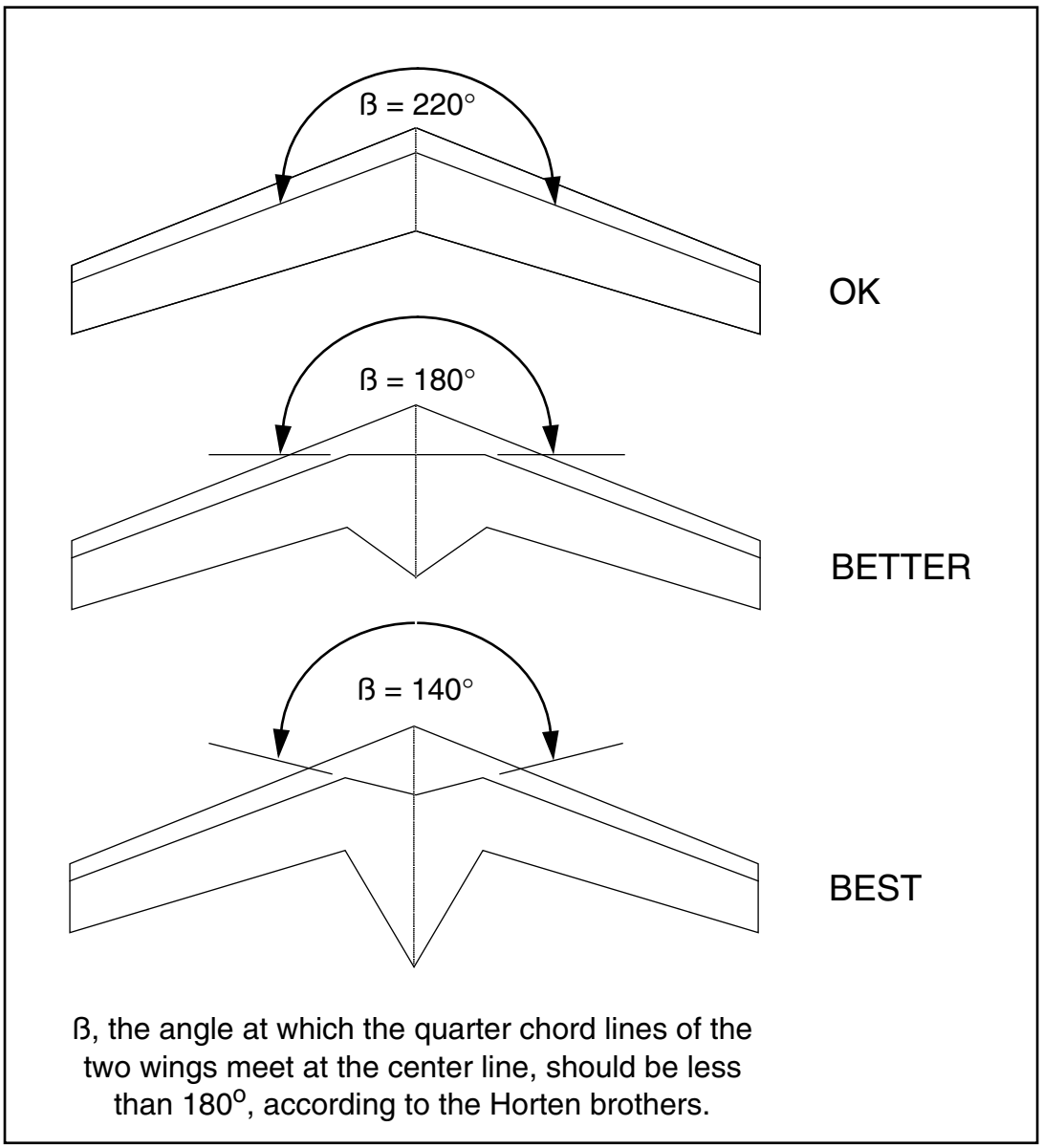


Figure 3

Rise high within the wind's embrace
and ride one with nature.

— A. M. Pierce