Modifying the Quality Fiberglass “Javelin”

Earlier this year we had a chance to talk to Steve Savoie of Gotham Maine. Steve had constructed a “Javelin” and was very pleased with its performance, despite a relatively high wing loading brought on by “overstrengthening.” The “Javelin” is a true flying wing which is extremely easy to build. Balsa sheeted foam core wings and solid balsa elevons promote rapid construction of the basic airframe, while installation of radio gear entails only some hatch cutting and a bit of foam removal.

Several members of the DownEast Soaring Club, Steve’s flying group, expressed interest in modifying the “Javelin” for the specific purpose of improving its performance on the slope, and Steve contacted us for advice. Here are a couple of questions which Steve relayed to us.

Carl Trottier: *“Since the wing has no twist (washout) and is designed to fly in level flight with the elevons reflexed 1/8", can I transpose the reflex into washout and fly on the slope without reflexing the elevons and thereby producing less drag with a cleaner wing?”*

The “Javelin” planform, depicted in Figure 1a, incorporates several features designed to make construction easy and set-up simple, but there are necessary compromises in other areas.

The “Javelin” elevon reflex produces a down force which provides the positive pitching moment necessary for stability, but does so across nearly the entire span. Reflexing the root airfoil is not necessary and is probably detrimental to overall performance. The “Javelin” quarter chord line is swept back 22 degrees, so twisting the wing (washout) would be more efficient.

Figure 2a shows the original geometry of the “Javelin” wing at the end of the elevon; Figure 2b shows the same section’s geometry when the elevon trim is replaced by an equivalent amount of wing twist. The twist value works out to be very close to 1.5 degrees, as noted on the drawing. This is a reasonable amount of wing twist, and could be easily incorporated into the wing during construction, particularly if custom cores were made. The Panknin formulae indicate this is the amount of twist to used for a design C_L of 0.25 with a static margin of 0.02; these are average values for a responsive aircraft designed for slope flying.

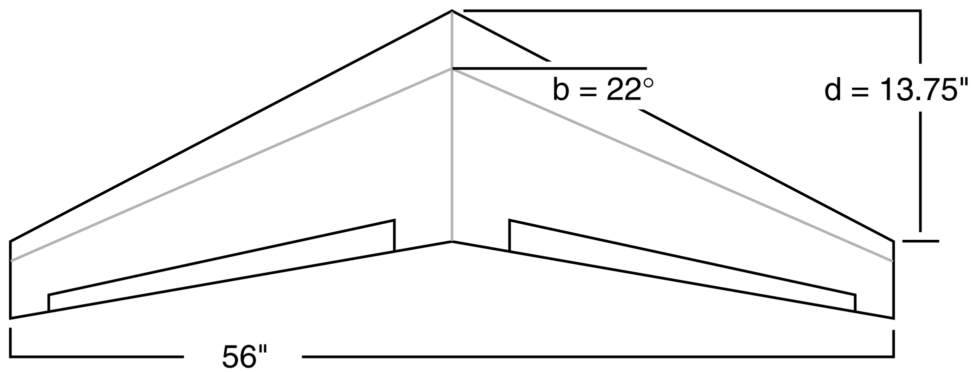

Figure 1a

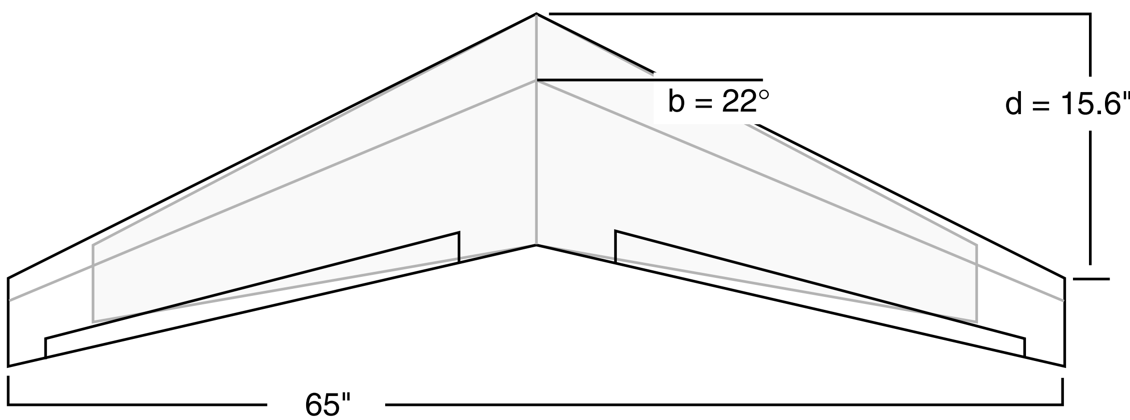

Figure 1b

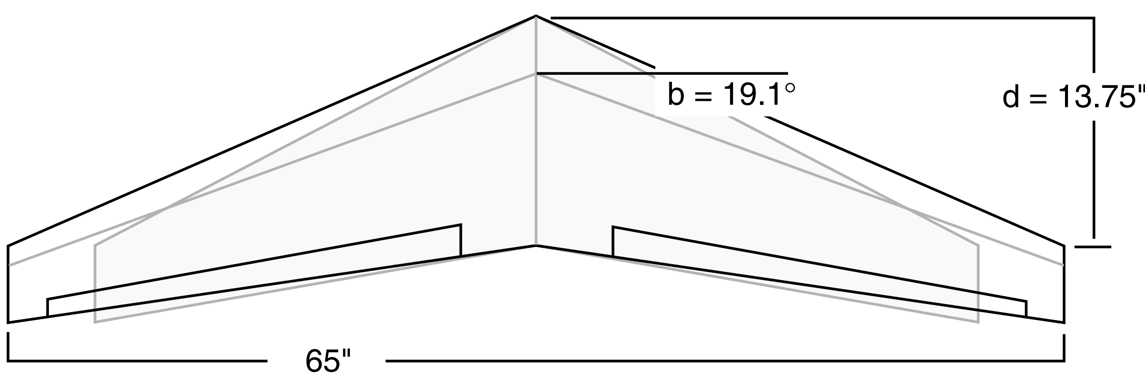

Figure 1c

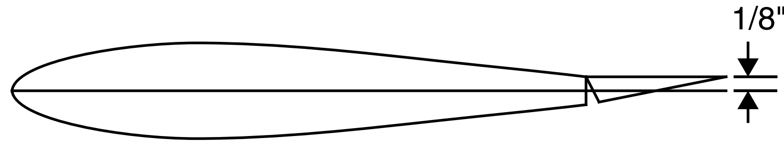

Figure 2a

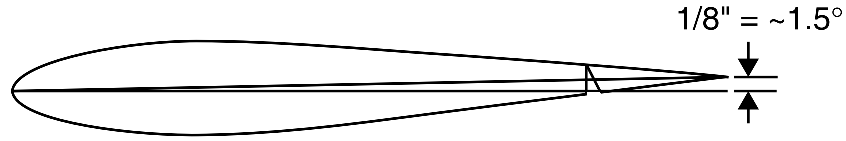

Figure 2b

The original “Javelin” uses a symmetrical section without twist, so inverted flight is simply a matter of reversing elevon trim. Exchanging wing twist for elevon trim makes sustained inverted flight more difficult, as the required down elevon trim will be significantly greater. Using twist instead of elevon reflex may reduce overall drag in normal flight, but there will be a substantial increase in drag during sustained inverted flight.

Walter Mudget: *“Can I keep the original 15" root and 5" tip chords and increase the wingspan from 56" to 65"?”*

Adding a few inches to the “Javelin” span increases the aspect ratio, and the larger size will make it easier to see. There are two ways of increasing the wing span: keep the sweep angle, β, constant as shown in Figure 1b, or keep the sweep distance, d, constant as shown in Figure 1c. As can be seen in the accompanying Table, the wing twist values remain very close to that established for the original 56" span, regardless of which of the two methods is used to increase the wingspan.

Here are some other possible modifications which can improve the “Javelin” performance:

- As we said earlier, the size and location of the elevons could be improved. Their span should be reduced and chord enlarged, and the area concentrated in the outboard portions of the wing panels. See Figure 3.

- For those interested in flying the “Javelin” in light lift, a measurable increase in performance can be obtained through the use of a cambered wing section. We chose two of the EH series of airfoils for inclusion in the Table. The EH sections have low drag values and extremely low pitching

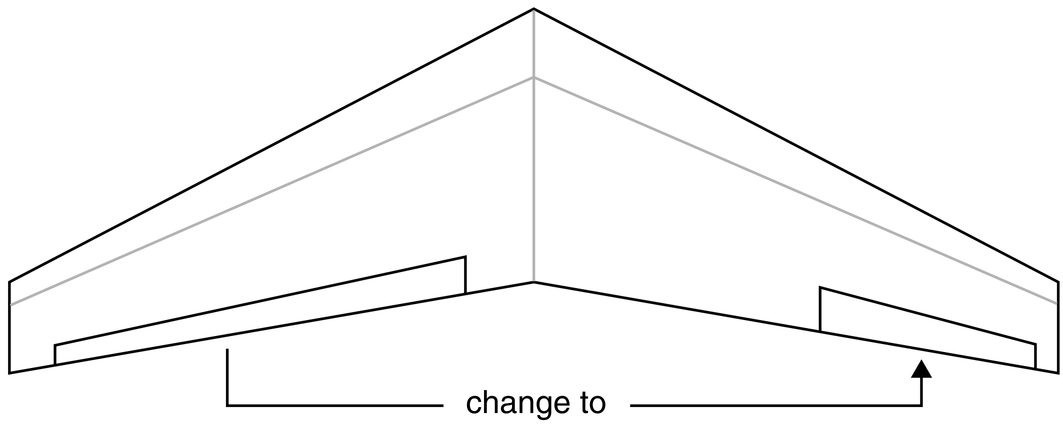

Figure 3

Span	AR	Sweep Angle, b	Area	Wing Loading*	Airfoil	Req'd Twist‡
56"	5.6	22	560	7.5 oz/ft^2	Symmetrical	-1.38°
					EH 1.0/9.0	-1.24°
					EH 2.0/10.0	-1.19°
65"	6.5	22	650	6.4 oz/ft^2	Symmetrical	-1.12°
					EH 1.0/9.0	-1.00°
					EH 2.0/10.0	-0.96°
65"	6.5	19.1	650	6.4 oz/ft^2	Symmetrical	-1.29°
					EH 1.0/9.0	-1.16°
					EH 2.0/10.0	-1.11°

* based on a total flying weight of 29 ounces
‡ based on a design C_L of 0.25 and a stability factor (static margin) of 0.02

moments, yet are capable of very high lift. These attributes make them very attractive choices.

- The “Javelin” airfoil is almost 12.5% thick. While this gives a large amount of room for radio gear, using a thinner wing section will cut drag and produce a slightly lighter airframe. A section with 7.0% thickness, for example, provides over an inch of height at the “Javelin” 15 inch root. There is sufficient volume for one of the new slim-line receivers and a flat battery pack, and the outer portions of the wing remain thick enough to house small servos for direct drive to the elevons. Coordinates for thinned renditions of any section can be obtained quite easily with some of the available airfoil plotting programs. This opens some intriguing possibilities for those interested in 60" slope racing.

The “Javelin” planform provides a good basis for experimentation, and readers interested in making modifications for improved performance have several options open to them in addition to those mentioned above.

A scene from the First Japan National RC-HLG contest.
Photo courtesy of Paul Clark.