PENUMBRA.4

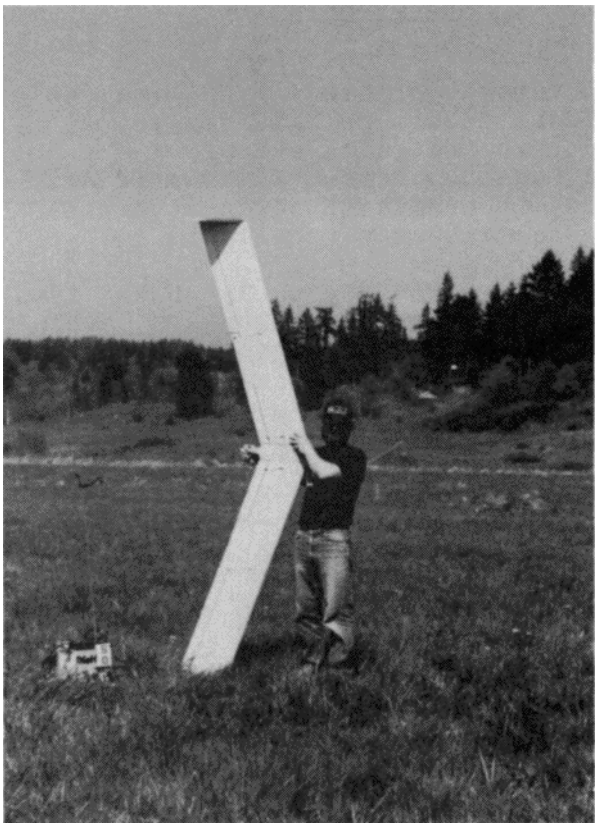
The fourth version of our flying wing design had its first flights on Saturday the 20th of April! Under the watchful eye of Dr. Walter Panknin, Penumbra.4 put in six successful flights out of seven attempts. Thermal performance was excellent.

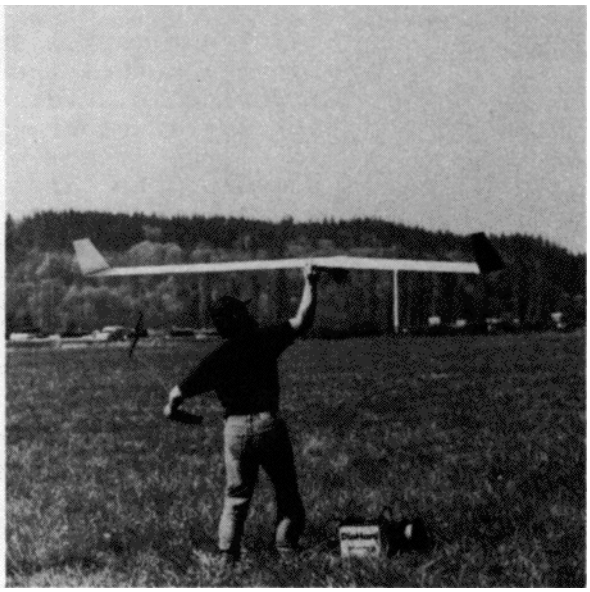
Dr. Panknin gave the "Flying Rainbows" flying wing presentation at the 1989 MARCS Symposium, an event covered in this column (RCSD 09/90). Walter's designs are of tapered planform with a root chord of sufficient length to completely enclose receiver and batteries. Structurally, his wings are of foam with wood veneer skin. Walter prefers using the Eppler 222 as the root section, and the Eppler 230 as the tip section.

Penumbra.4 utilizes a constant chord wing and the EH 1.0/9.0 airfoil. It has a shallow fuselage, and construction is of foam and fiberglass with a carbon fiber reinforced spar. Other than the wing leading adge and control surface faces, there is no wood in Penumbra.4's construction. Penumbra.4, therefore, stands in direct contrast to Dr. Panknin's creations.

Test flying Penumbra by the hand toss method was not completely successful. It is very difficult to get sufficient speed, even while running across the field into the wind and throwing as hard as possible. In an effort to get satisfactory glides from hand tosses, a too large amount of up trim was put into the elevons. The first winch launch attempt thus ended in a veer to the right and a spin to the ground. No damage was incurred, however, so the wing-fuselage junctions were retaped and some adjustments made. Elevon trim was lowered by three clicks and the towhook moved forward about 1.5 cm.

The second and all subsequent attempts were completely successful with no tracking problems noted. While it should be possible to reduce the elevon up trim and move the CG and towhook locations rearward, achieved launch height was completely acceptable. Flaps were not used during tow.



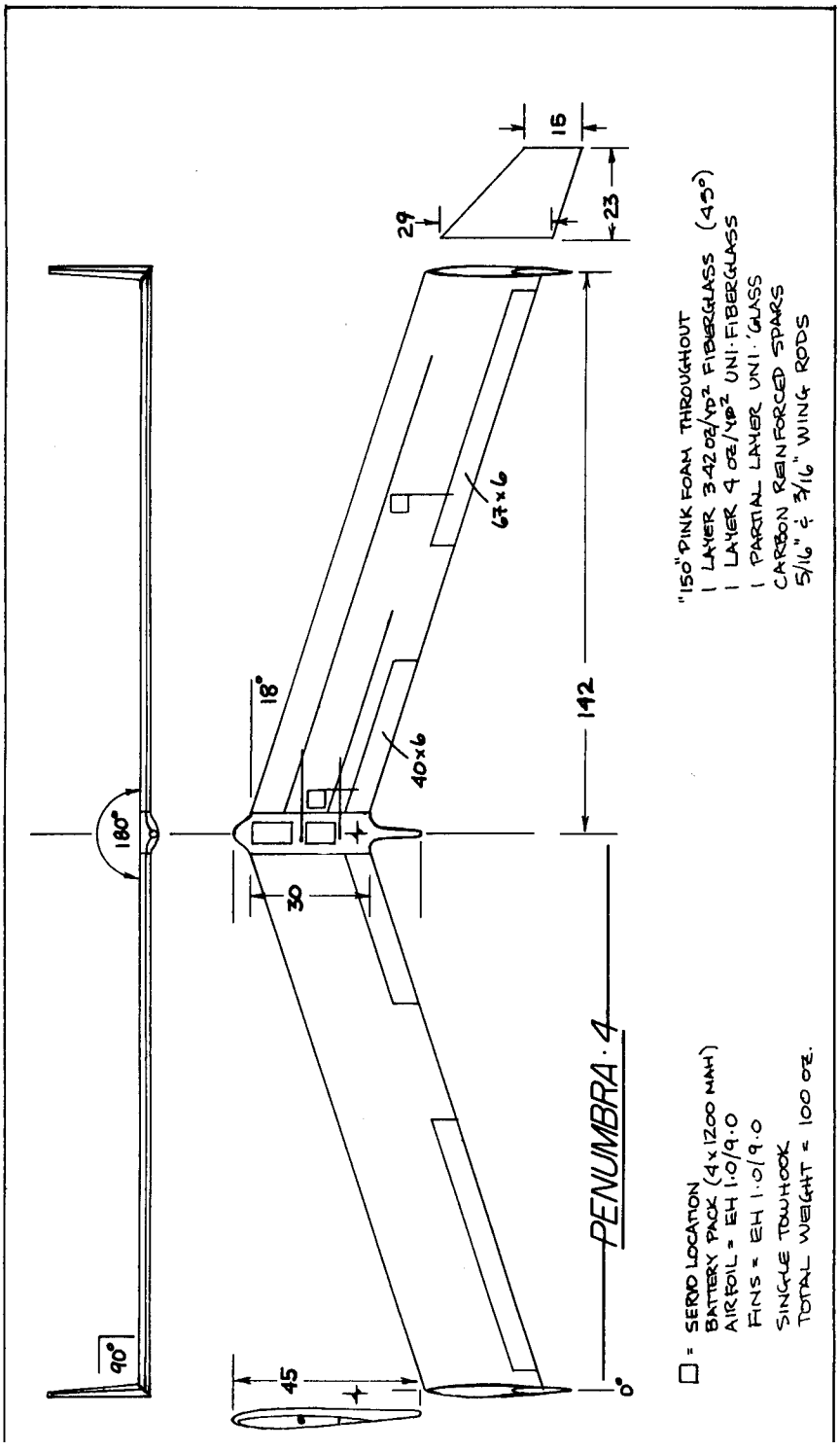


Penumbra.4 seems to be very sensitive to thermal activity, and was seen to be climbing at significant rates while traveling in a straight line. Thermal turns are a bit different than what we had expected. Our other elevon controlled 'wings, based on Dave Jones' Blackbird design, have all required opposite aileron to prevent spiraling in. Not so Penumbra. Once aileron control is neutralized this 'wing tends to come out of the turn. A small amount of right aileron must be input, therefore, along with a small amount of up elevator, to maintain a right turn.

Penumbra.4's speed range is very broad. With an approximate 10 knot breeze, it was possible to approach a hover when flying into the wind. A dive test to examine pitch recovery showed excellent acceleration and prolonged high speed flight in crosswind conditions. Launch height attained through zoom launches was very significant. Use of a small amount of positive flap during a landing approach showed the typical slight nose up pitching tendency; this was easily controlled with a small amount of down elevator. Landing speed did not seem to be affected with 20 degrees of flap deflection, but approximately 60 degrees is available.

All winch launches were accomplished by means of strong tension on the line, vigorous throwing of the 'wing straight out, and continuous power to the winch motor through the zoom. Only one minor episode of flutter was experienced, that during a strong zoom when the towline failed to come off at the appropriate time. The flutter lasted for only a couple of cycles and was extremely well damped. We do not consider this episode indicative of a significant problem.

Note: All photos for this column are courtesy of Dr. Panknin.


PENUMBRA·4
142
180°
90°
0°
18°
30
45
29
16
23
6x4
4x6
"150" PINK FOAM THROUGHOUT
1 LAYER 3.42 OZ/YD² FIBERGLASS (45°)
1 LAYER 4 OZ/YD² UNI-FIBERGLASS
1 PARTIAL LAYER UNI-GLASS
CARBON REINFORCED SPARS
5/16" & 3/16" WING RODS
□ = SERVO LOCATION
BATTERY PACK (4x1200 MAH)
AIRFOIL = EH 1.0/9.0
FINS = EH 1.0/9.0
SINGLE TOWHOOK
TOTAL WEIGHT = 100 OZ.