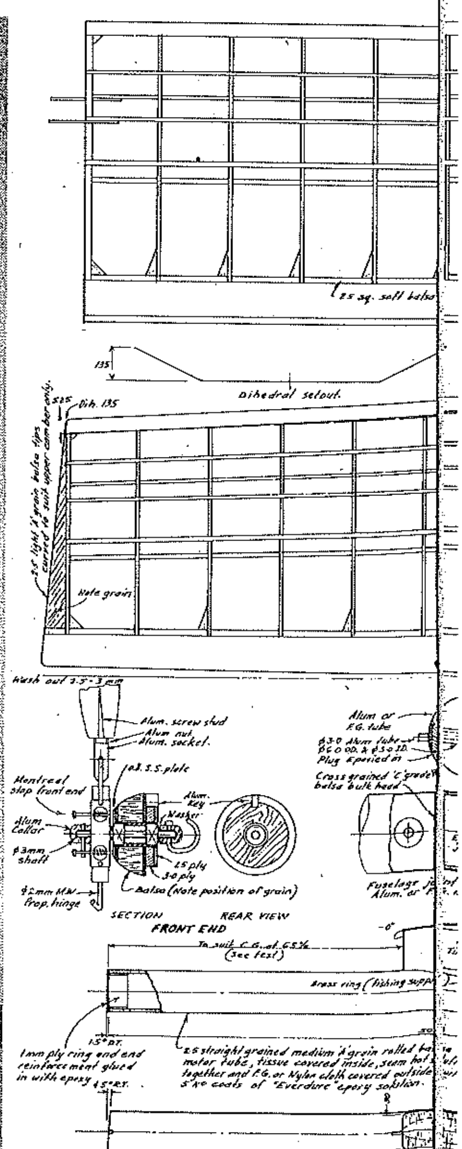
Waltzing Matilda

J. P. Van Leuven

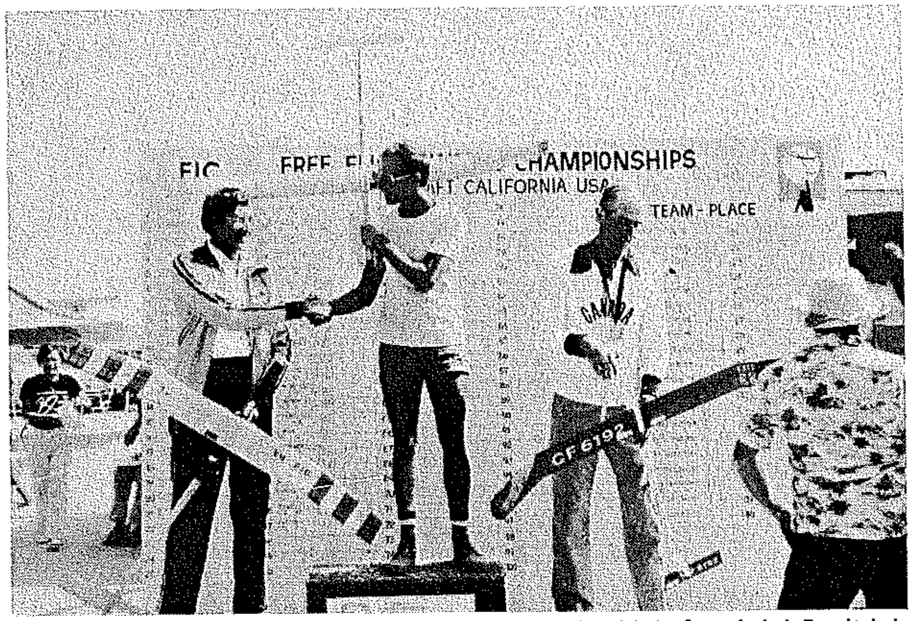
THE WALTZING MATILDA Wakefield, which placed second at the 1979 Taft World Championships, is a variant of a typical Australian design. Her longer tail moment, dihedral in the tailplane, and the ARA-D prop airfoil (as featured in the *1979 NFFS International Symposium Report*) added up to a design that could hold its own against the best in the world. It is all due to the way the model is trimmed to fly, which I will now describe.

The model originally had the center of gravity (CG) at 65%, but this was changed to 66% in the

The author poses with Waltzing Matilda. Photos by Peter de Visser.



Here is a Wakefield FF design from Down Under that placed second at the 1979 World Championships. It is a carefully thought out ship, relatively uncomplicated, with reasons for all of its unique features.

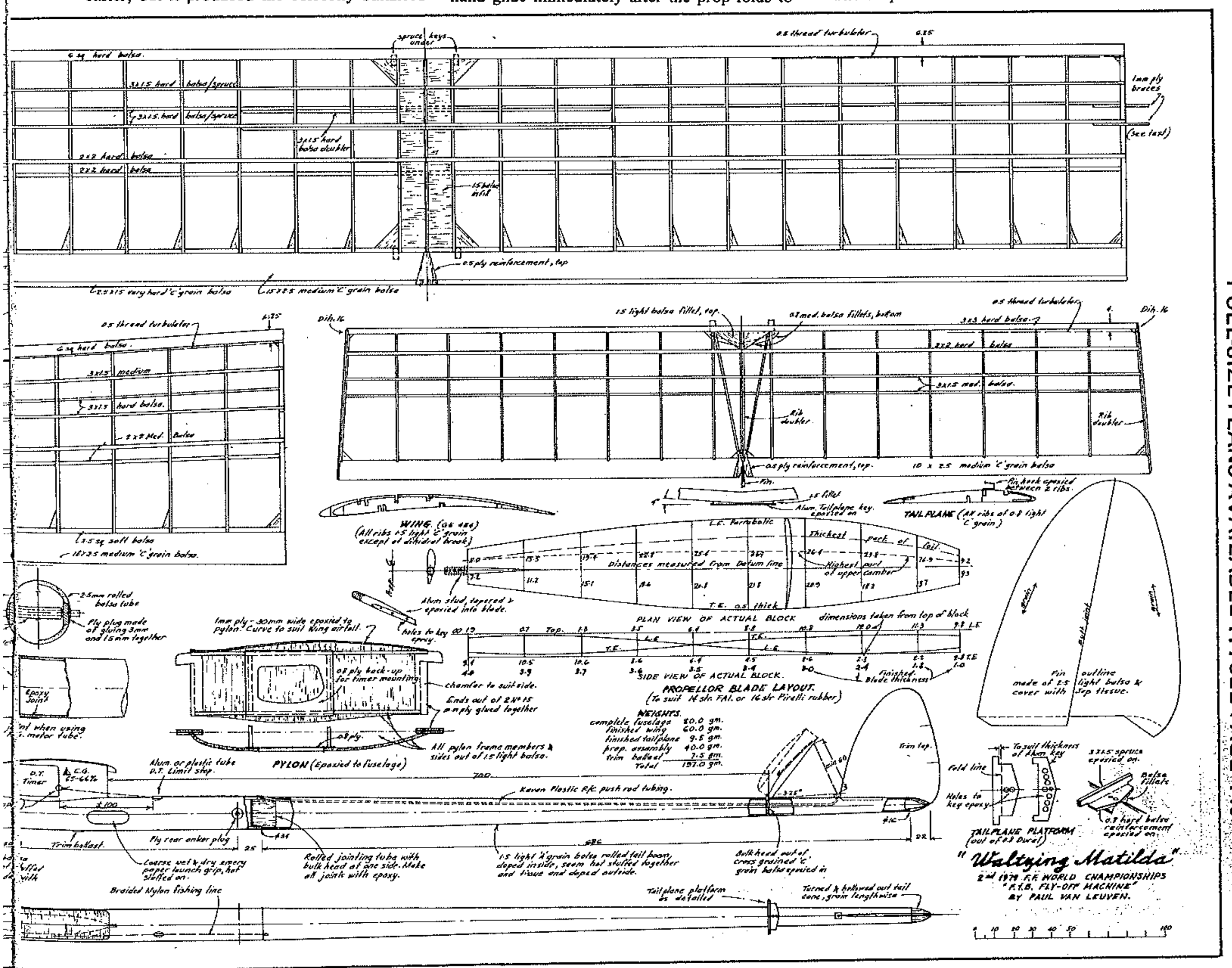


The author (left) at the 1979 FF World Champs, accepting handshake from Itzhak Ben-Itzhak.

field by moving the strapped-on weight; an improved glide was obtained.

The wing has differential tip washout. The whole left tip panel of the wing is set to minus .5 degrees relative to the center section. This gives 3.5mm of washout on the left tip and only 2.5mm on the right. This feature not only made the model handle the motor's torque during launch easier, but it produced the correctly balanced bank in the glide as required by Frank Zaic's theory. It also enables the model to go into a left-hand glide immediately after the prop folds to stay in the thermal that you (hopefully) have launched into.

The tailplane dihedral contributes much to a



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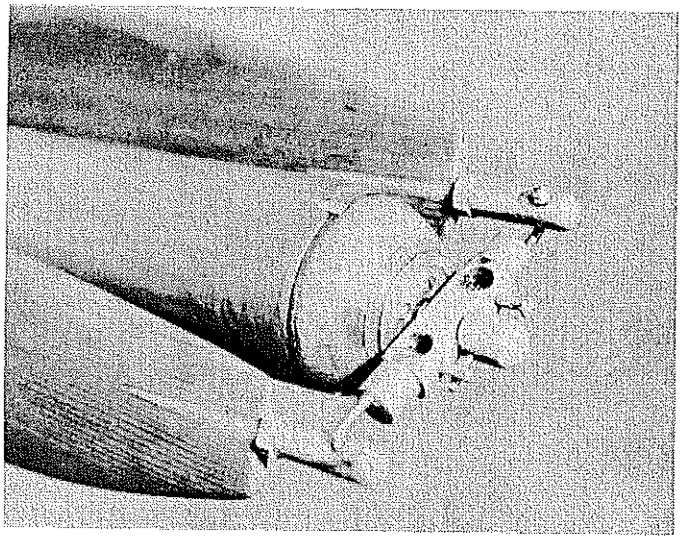
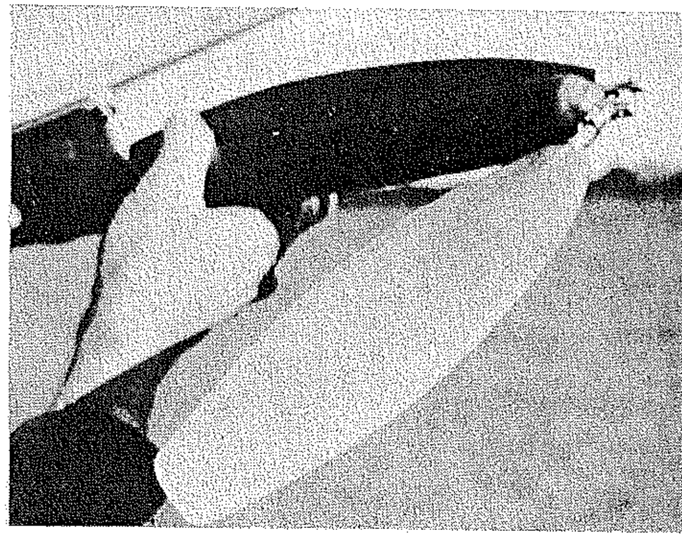
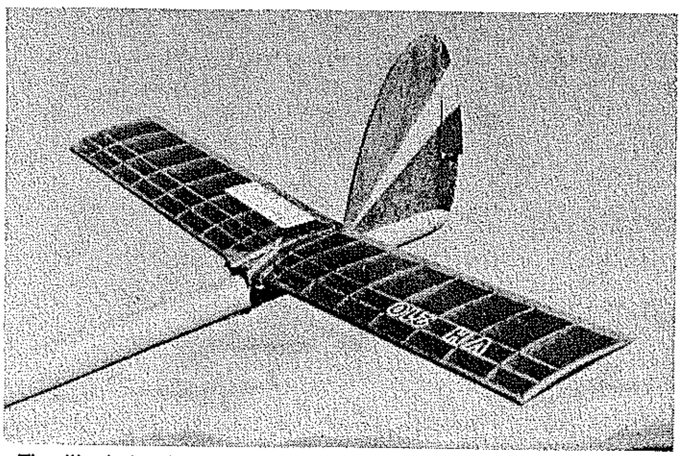


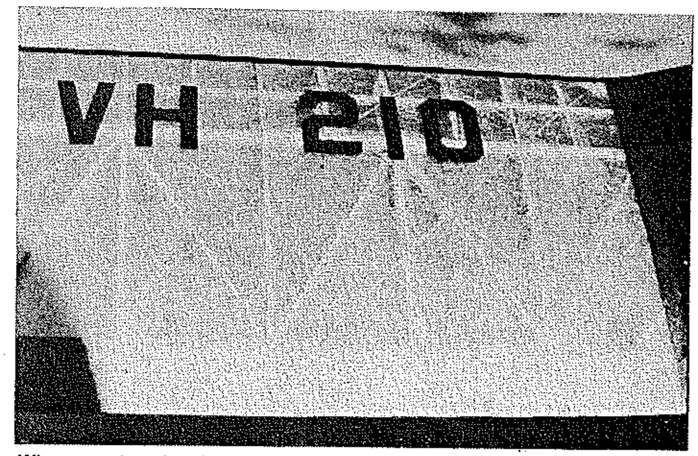
Front end was turned from aluminum bar stock. Collars hold prop wires in place. Montreal stop was made from aluminum and pop-rivet wire.



Prop blades were carved from Pacific cedar pine. They are strong and hold the airfoil profile well. See text for construction details.



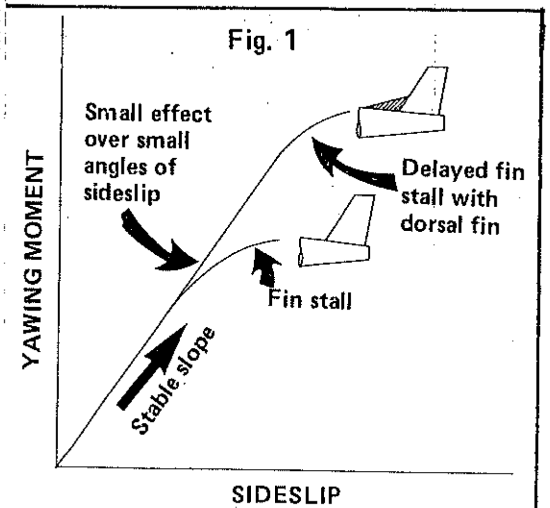
The dihedral stab positioned in front of the fin produces the same effect as a dorsal fin, helping to delay fin stall.



Wing construction includes diagonal ribs. Glass threads were added over the framework and under the covering for added torsional strength.

stable glide. The projected side area of a dihedral tailplane acts as additional fin area. This effect is described in an article by Mr. Burns in *Air International*, January 1980, pages 24 and 25.

When a tailplane with dihedral is placed in front of the fin, at acts as a dorsal extension of the fin and helps to produce additional directional stability. A dorsal fin is most effective at large angles of sideslip, as it extends the lift slope of the fin to a larger angle of sideslip and thus delays fin stall (see Figure 1). Waltzing Matilda can negotiate very tight gliding turns without the danger of spinning in due to sideslip or the yawing effect of the fin. The tight gliding circle makes it easy to stay in even a small thermal. In the glide, the model appears to waltz in mid-air, hence the name.



Dorsal fin area helps to delay fin stall at higher angles of sideslip; see text.

The rigging of the flying surfaces, with the wing at 0 degrees and the tailplane at −3.25 degrees, also provides a nose-up attitude during the cruise and glide, allowing her to take better advantage of rising air currents.

During the 1979 World Champs, the motor was wound to 110 in. oz. of torque. The model was thrown into the air, to enable it to get up to about 30 km./hr. or more. The fuselage will accommodate 16 strands of Pirelli rubber, but 14 strands of FAI rubber were chosen to fly at the 1979 Champs for the longer motor run. Using Pirelli rubber, I feel that the prop pitch could be increased by about a degree, but this has to be tested in the field.

I use a new, unstretched motor for each flight; since FAI rubber is not pure rubber, it doesn't stretch as much. I pull it out as far as possible and hang onto it for at least 20 seconds. Then I wind in 150 turns or so and watch the torque. If it goes over 40 in. oz., I can expect maximum torque at full turns. I wait until the torque drops off and settles before continuing. I proceed very slowly while coming in, stopping to let the torque drop off to avoid breaking the rubber.

During the 1979 World Champs, I broke one motor during the day, and so was one motor short for the last fly-off. I had to make the flight with a used motor. Remaking this motor into 14 strands in the field produced uneven knotting, and since time was getting short, I had to let her go with only 65 in. oz. torque. She never reached the height she could have made. If it was not for that poor motor, perhaps we could have done much better.

Construction. Apart from a few items that I will describe in a moment, construction follows straightforward building techniques, and the drawing should be self-explanatory.

Fuselage. The motor tube is long, so that the rubber will be taut between the hooks. This gives it more torque for a longer time, and provides smoother prop running towards the end of the motor run where it does the most good. The use of a Montreal stop is essential. The rear anchorage peg is designed for a winding tube. I cut out the holes for it with a punch made from brass tubing with a sharpened edge, cutting into a backup block inside the fuselage.

The dethermalizer (DT) timer is spring-activated in the *on* position, and is held at *off* while waiting for thermals. The ply backing for the timer mounting is placed behind the balsa pylon face so that the timer is drawn hard against the balsa shim to make a dust-proof seal. I leave off the back cover of the timer to save weight. I prefer a clockwork timer over a fuse, because you can launch instantly and not miss that thermal.

The DT line, which is braided nylon fishing line, runs through a tube, so it can be easily

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Society will grant a Model of the Year award to the ubiquitous Lacey.

Waltzing Matilda/VanLeuven

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replaced if necessary. I figured in a 40mm stretch in the line to pull the tailplane hard down and ensure alignment.

The pylon is the last glued piece, and is set in place with the model completely assembled to obtain the correct CG location.

Propeller and front end. The propeller requires care in carving. Use light C-grain balsa and cover with light glass or nylon cloth. The thickness shown on the drawing is the finished thickness, so the bare wood (before covering and finishing) should be .3 to .4mm thinner than that figure. Use at least three coats of epoxy, and sand smooth with wet-or-dry sandpaper between coats to achieve a glass-smooth finish. Note that the ARA-D airfoil section has its thickest part at approximately 22 to 24%, and that the leading edge must be parabolic in shape. This airfoil not only gives more thrust, but also produces better traction power in the cruise mode, where others tend to fail. Check frequently with calipers to be certain that both blades are exactly the same; also, make certain that they weigh the same.

I used a dural stud to connect the prop to the hinge, so that it could be adjusted to the required pitch for the best prop/rubber combination. I found that 31 deg. at 70% from the hub is the best for 14 strands of FAI rubber. One needs to fabricate some sort of prop pitch gauge to check the blades in the field.

The nose block is hard balsa turned with a drill, and the ply faces are epoxied on later. If you use plenty of dope between stages of turning and sanding, the balsa will not split. Aluminum round bar stock is used for the Montreal stop. The ends are turned down, and holes are drilled to suit. A groove on one side locates the pivot wires, which are retained by a collar drawn over the ends. One could also use nylon thread and epoxy to bind the pivot wires. The stop pins are made from "pop" rivet wire; they have a groove filed in to locate a M.W. circlip that holds the springs in place.

Flying surfaces. It is best to trace the wing tip on tracing paper and build the wing tip on it, then reverse it for the other one. The tip construction

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is sort of a "poor man's Hoerner tip;" it is light and strong. All surfaces are covered with light modelspan and are doped with 50/50 three times. After trimming, seal all surfaces with one coat of polyurethane varnish.

Trimming. After the normal incidence adjustments, one should make a series of 1½-min. test flights on approximately three-fourths of full turns to adjust the glide. At 66% CG, the gliding turns should take at least 18 to 20 seconds to complete, and should be about 75 feet in diameter. If she loses height too quickly, open out the turn or shim up the trailing edge of the tailplane.

Constantly check the wing and tailplane seating location, and keep an eye out for warps. Use a shifting weight to arrive at the best CG location in the glide. She should glide with a distinct bank and with the nose up. Carry out these tests often; no two flights will be in the same weather conditions, even on the same day.

Finally, try maximum power flights of one minute duration to get the climb right. Adjust down and side thrust so that the climb is similar each time; she should make 2½ turns on the way up. My model was trimmed out so fine that I never worried (or even looked), providing I had gotten 110 in. oz. of torque.

Launch checklist. Make a habit of going over this checklist before each release (remember Murphy's law!):

1. Note that the nose plug is properly fitted.
2. The DT line is OK and properly hooked up.
3. The DT timer is functioning and set to the proper time.
4. The wing and tailplane are properly seated.
5. The trim tab and warps are the same as you had before.

To ensure success, one can leave *nothing* to chance. Failure is only one's own mistake; that's why I prefer a simple Wakefield that "flies itself." Happy flying.

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AMA Building Fund

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our new home by raising this $2 per member. Beyond that, there is another thought to consider; If each member were to donate $14.27, the entire building, *including all*