On the 'Wing... #112

Dr. Aldo Toni's TFW-01

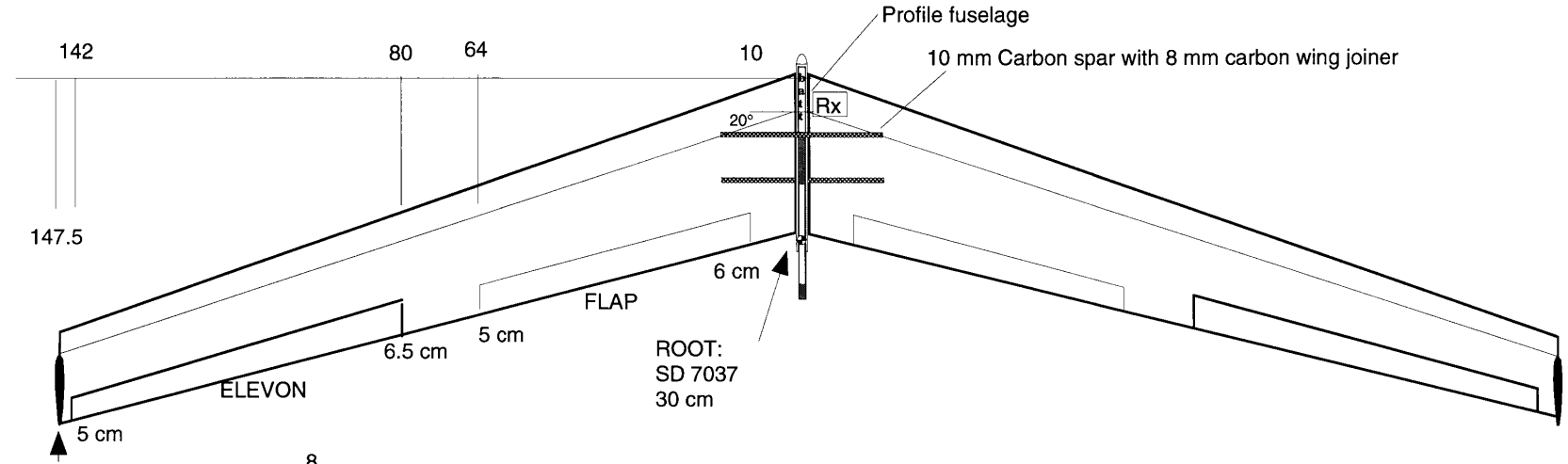
This month's design is named TFW-01 by its designer, Dr. Aldo Toni. Aldo is a specialist in biomedical technology as related to orthopedics and trauma, and works in the Technology and Materials Laboratory at the Rizzoli Institute of Orthopedics in Bologna, Italy.

Aldo first started building model aircraft in 1970, and entered thermal duration contests for a number of years. With his friend Casadei, he designed and built the glider which Casadei used at the first F3B Championships in South Africa.

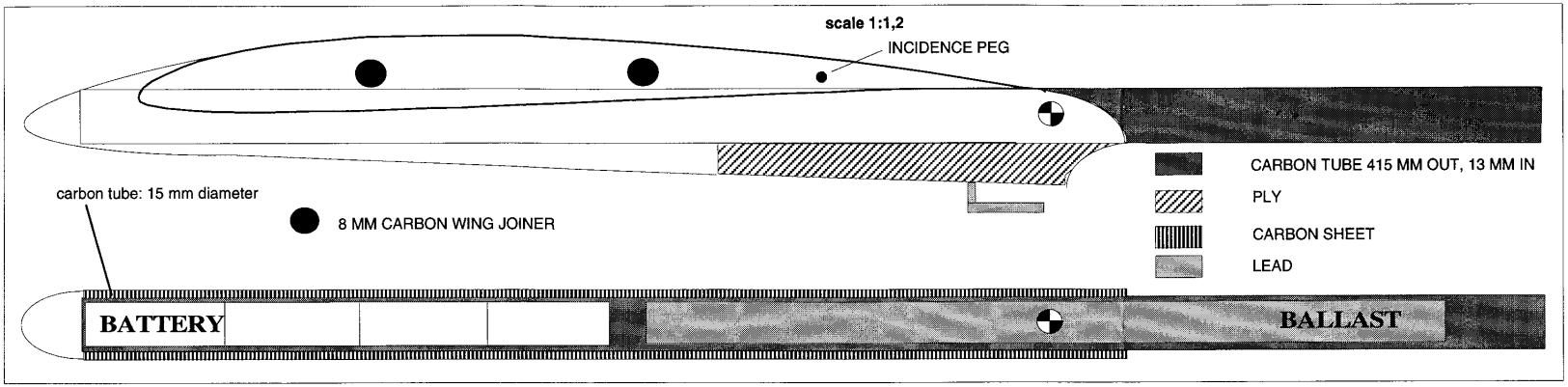
After a hiatus of several years for education, family, and career, Aldo returned to RC four years ago. He found thermal competition almost dead. With some friends, he founded the Association for Thermal Flight (AVOT). This organization has been extremely successful: there is now a AVOT Cup and an Italian FAI-F3J Championship. Additionally, an Italian team will attend the F3J WC in England in August 1998! Aldo is the F3J National Manager, and he is currently in third place nationally, so he has a good chance of being part of the team.

Why the Thermal Flying Wing (TFW) projects? First of all because he loves "'wings," then because he likes to experiment.

Aldo says, "In the thermal flight envelope, two things are relevant (besides pilot skill, which is still THE key factor!): parasitic drag and inter-thermal efficiency.



F3J - THERMAL FLYING WING



Just about any plane can stay up for minutes in thermals, but thermals are evasive, and sometimes they are far away from were you ping from towing. So you need a low drag glider able to escape sink efficiently! Isn't that the picture of a flying wing?

"Well, I know very well that things ("'wings," if you stick to precision) are a little more complicated. Lift generated by 'wings carries more drag than conventional wings (but less parasitic drag!). For 'wings, keeping wing loading comparable to standard gliders requires a low-weight-but-still-strong construction. This is not an easy target! To control pitch you need a swept geometry, which worsens the wing surface lift properties, not to talk about the need of wash-out for the outer panels. Well, you could work with plank geometry, but then the reflexed airfoil would generate more drag anyway.

"So what? To cancel fuselage, rudder, and elevator parasitic drag, I'm climbing the "big rock" of pitch control with more drag and less lift, looking for some advantages!

"My experience is still short, and I did not see yet anybody solving the problems. This makes me even more interested in 'wings. I read about the project of less stable 'wings controlled by gyroscopes, forecasted as possible improvements of efficiency of wings, together with Hans-Jurgen's efforts to use moveable C.G. It's

not very clear to me how this could improve the 'wings in thermals, as it seems to me that real improvements could only be expected for multi-task contests, as F3B.

"For thermal contests I would like to work more on airfoils and on in-flight modifications, both for LE and TE. In fact, the 'wing has no inter-thermal efficiency problem, but suffers a lot in its ability to circle tightly and work small,

DR. ALDO TONI'S TFW-01

root chord	30 cm (SD 7037)	aspect ratio	12.7
tip chord	17 cm (SD 8020)	wing area	70.5 dm2
span	300 cm	wing loading	21.27 g/dm2
sweep	20° along c/4	aerodynamic center	32.28 cm behind LE at root
weight	1500 g	CG	31.8 cm behind LE at root
calculated for C_L	0.6	static margin	0.02 c/4
average chord	23.5 cm	geometric twist	-3.0°
taper ratio	0.566	aerodynamic twist	-6.0°

vanishing thermals. Beside that, minimum sink rate is usually higher than for standard designs. What if we could adapt the airfoil camber to slow and better climb in a thermal? To balance the higher camber, I would then need adjustable aerodynamic wash-out, either with outer airfoil camber or with geometric wash-out modifications!

“Many servos (up to 12), gyroscopic pitch control, and computer transmitters may help the project — this is experimenting! Team work is required for such a project, but unfortunately modelers usually want to build and fly well-tested models, and don’t like to spend time (and above all, money!) on projects with a high rate of failure!

“So I’m alone. For sure I need help in choosing the airfoil and defining its modifications for the next project. In the meantime I will continue to test fly my TFW-01 (Thermal Flying Wing). My program for next month is to check the influence of different flap deployment angles on pitch control and the thermalling properties of the model.”

The fuselage in the photo is a provisional one, designed to protect the wing from hard landings during first flights. Also, contrary to the included plans, the winglets shown on the prototype are not tapered. TFW-01 has been successfully launched via winch with the hook one centimeter ahead of the CG. If the tow hook is placed too far back, TFW-01 will loop smartly!

Aldo used the Panknin formula from our web site to calculate the required wing twist. TFW-01 uses four servos to control elevons and flaps. See the included table for all other technical information regarding TFW-01.

The rear of the fuselage is empty, and provides space for ballast. However, Aldo has not yet felt the need to add any. The main problem, as he sees it, is that most F3J aircraft are loaded to between 30 and 34 g/dm^2, while his TFW-01, at 21+ g/dm^2, acts as if it is loaded to 42 to 44 g/dm^2. To get a wing loading comparable to a conventional F3J glider, TFW would have to be built for a wing loading of just 15 g/dm^2. Since the present model exhibits a small amount of wing flutter at “ping” when winch launched, such a light weight model seems at this point to be next to impossible.

Aldo has promised to keep us informed of the results of future experiments. All information received will be relayed to *RCSD* readers through this column.