THE EF5 STORY :

The EF5 has become known throughout Australia as the highest performance hang glider around.

Here is some background to it -

I first started hang gliding in 1974, but I was very disappointed with the limitations imposed by the miserable performance of the early rogallos.

So I decided to design something better. I rejected rogallos in favour of rigid wings for two reasons -

a. Because as an engineer I wanted to design something reasonably precisely with predictable performance. A rogallo is too undefined to simply and reliably evaluate stresses and strains.

b. The stability characteristics of a rogallo are a bit shady too. Conditions such as stalling in a steep banked turn can result in bad sideslip degenerating into a luffing dive; or high speed in turbulent air can result in a low angle of attach and subsequent sail inversion producing a large negative pitching movement (tuck) which often ends in a luffing dive, an outside loop or an inverted dive.

The above conditions are more often than not fatal and not for me.

In the relm of rigid wings, in 1974, one naturally looked at the ICARUS 5 as perhaps the ultimate in performance but unfortunately it is very impractical in that it doesn't fold.

The criteria are thus -

1. Safety - not to be compromised.
   Stability: The glider should right itself from any abnormal flight attitude (e.g. inverted) without the need for dynamic correction by the pilot.

b. The stall should be a gentle mush, with no tendency to drop a wing, even in a stall while turning.

c. Erection: All wires, bolts, etc., which are connected as part of the erection procedure should be able to be readily viewed (i.e. it should not be possible to misassemble the craft, or to leave something off without this being immediately obvious).

d. Load Factor of 6-9 g.

2. Practicality

a. The glider must be easily transportable, i.e. fold up into a conventional royallo-sized package.

b. It must park in winds without tiedown equipment.

c. As short a set-up and breakdown as possible.

3. Construction
   Should be as simple as possible to minimise labour expended, and to minimise expensive parts, or those difficult to obtain.

After much deliberation, I chose a swept rigid wing configuration with dihedral and washout, for the following reasons -

i. For maximum performance, aerodynamic principles dictate certain wing shapes which are most practically realised with a rigid wing.

ii. A swept wing with rip-rudders and washout has extremely good stability and stall characteristics. The washout acts like up-elevators as well as preventing tipstall, and furthermore, because the tips are the last to stall, the centre of lift moves back in incipient stall situations, which automatically brings the nose down before a full stall is entered. With dihedral and drag rudders, truns are automatically co-ordinated - the drag rudder causes the wing to yaw in such a way that the outside wing has a greater angle of attack (and therefore more lift) which rolls the craft into the turn.

The one thing now remaining to complete the wing configuration, is the wing form. Having satisfied the prime requirements of stability and safety, considerations of performance will decide the plan form, that is, one must consider minimising drag, and in particular, induced drag. It can be fairly simply calculated that the induced drag is a minimum for a wing with a spanwise elliptical load distribution (e.g. a uniform wing with an elliptical plan form). See fig. 1.

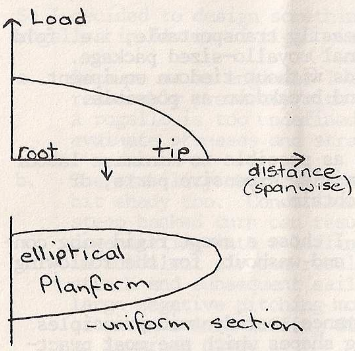

FIG. 1.

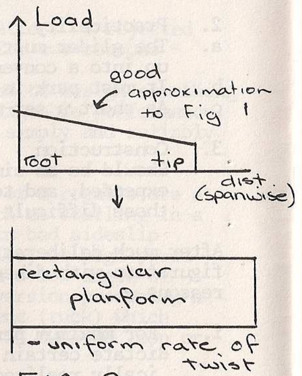

FIG 2.

There are, however, several other ways of achieving this -

a. Changing the lift characteristics of the airfoil section along the span.

b. Spanwise geometric twist (e.g. washout).

c. A combination of the above.

If we consider a wing of uniform chord and section with a twist such that the tip angle of attack is approx. half that of the root of the wing (see fig.2). Fig 2. shows the load distribution in that case, which is not a bad approximation. I chose 7 deg. so as to reach this

approximation at about minimum sink speed where induced drag is mot significant. The approximation is even further improved by having a more lightly cambered tip (dotted line in Fig. 2).

After careful consideration of many other designs as well as my own experimental findings, I settled on the following values :

Sweep 15 deg. (150 deg nose angle)
Dihedral 7 deg.
Washout 7 deg.
Span 10.1m (33.3')
Area (14.7m2) (160 ft.2)
Chord 1.4m

The EF5 flew straight off the drawing board with a few adjustments necessary to the hang point. It has both excellent performance and stability characteristics.

The standard EF5 has been the top performer now since its release in 1977.

Last year I released a second model for heavy guys and/or light weather freaks - EF512, 12m opan (40'), 17.6m 2 (190 ft. 2) area.

This has about 15% better min sink than the standard but high speed performance is not quite as good.

There are now more than 50 in the air and to my knowledge there have been no structural failures and no injuries. This perfect safety record is due to the EF5's exceptional stability which is mainly due to the tip rudders and dihedral, allowing you to keep full control even in severe turbulence.

Further information including kit details and prices is available free of charge from :-

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BOX HILL NORTH, Vic. 3129 Safe Flying E.Fagan.B.E.