The D. F. S. REIHER

By B. S. SHENSTONE

Wally Setz

Continued from the July-August Issue

WHEN the Reiher was designed the German Airworthiness Requirements for Sailplanes contained no definite stiffness requirements. In addition no definite requirements for flutter prevention or aileron reversal existed. Whether or not changes have been made since 1940, the writer is not in a position to know. The old empirical requirements that the natural vibration rate of the wing in bending should be greater than 120 per minute was very rough and of doubtful value. This being the case and not wishing to undertake any fundamental flutter investigation, the D.F.S. based the Reiher wing on successful earlier sailplane wings. The two types chosen as standards were the Sperber and Fafnir II. The Sperber was a moderate performance type of 49.3 ft. span (15 m.) which had been built in some numbers. Fafnir II was a special high performance type only one of which had been built.

A comparison of these two types and the Reiher is given in Fig. 11 and Table III. The main difference between Reiher and Fafnir II is that the latter had much more taper and a thicker wing root and hence a smaller value of C (cantilever ratio). Due to the great taper it had to have much more washout. The Sperber wing was brought into the picture because it was a typical short stiff wing.

Fig. 11. Comparison of Wing Plan Forms

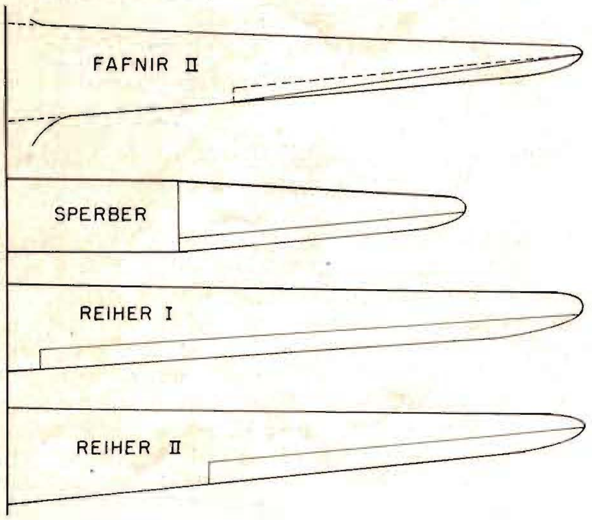

Fig. 12 compares calculated bending deflections across the span for the three types for ultimate load in Case A* (equivalent to old CPF or high angle of attack case) assuming that E for spruce was 1,565,000 lb./sq. in. Considering the thinness of the Reiher wing it is not surprising that it was somewhat more flexible than the Fafnir wing.

Vibration tests showed that the Reiher wing had a rate of 125 per minute in bending. This being rather close to the limit, the wing was redesigned for greater bending stiffness. This involved thickening the root from 188 mm. (7.4 in.) to about 210 mm. (8.3 in.) the section thickness ratios remaining the same except near the tip as shown in Fig. 4. The effect was to decrease the bending deflection under ultimate load in Case A from 181 cm. shown on Fig. 12 to 141 cm. shown on Fig. 13. The calculation done for E of 1,565,000 lb./sq. in. was shown by test to be pessimistic the results being about equivalent to E of 2,565,000 lb./sq. in. as shown on Fig. 13. In addition the vibration rate was raised to 150 per minute. The wing weight remained unchanged.

This is an interesting example of how, by changing the wing shape, some control over its structural characteristics may be achieved.

So far only bending deflection has been mentioned. The torsional deflection requirement for the Reiher was also based on successful past types. The trouble was, as usual, that existing types had very variable torsional stiffnesses. For ultimate load in C case (dive) the twist on satisfactory types varied between 6° and 17°. The one with 6° was highly tapered with diagonal plywood nose covering. The other had much less taper

* For full details of German Glider strength requirements see the Journal of the Royal Aeronautical Society, Aug., 1938.

TABLE III

Type		Fafnir II	Sperber	Reiher I	Reiher II
Span	ft.	62.5	49.3	62.5	62.5
Wing Area	sq. ft.	189	165	208	208
Aspect Ratio		20.4	15.1	18.64	18.64
Taper		4.1	2	2.15	3.1
Cantilever Ratio		37	40	50	46
Ultimate Factor		8	8	8	8
Wing Weight	lb.	298	..	328	328
Tip %				10%	10.8%
Root %				13.5%	13.5%
Washout				4.5°	5.7°