What Span for an Open Class Sailplane?

Gerhard Waibel, designer at A. Schleicher, Segelflugzeugbau

Presented at the 15th OSTIV Congress, Räyskälä, Finland (1976)

This paper gives results of flight tests of an Open Class 20 m span ASW 17, which was compared in level flight with 21 m and 19 m span versions of the same model.

The variation in span was achieved by the use of different wing tips, *not* by telescoping the wing.

The flight tests were done by the Abteilung of the DFVLR and I thank Mr. Zacher for allowing me to use these unpublished results.

For the 1974 World Gliding Championships at Waikerie, Australia the West German team prepared each of their Open Class sailplanes with different span wingtips. However, the Jury did not allow the use of different spans during the competition and still today the rules at World Championships do not allow such a sailplane.

It is the intention of this article to show the technical advantages of the ability to change the span.

Fig. 1 shows wing areas and empty weights for the wingspan variations.

Fig. 2 shows level flight performance data of three different span ASW 17's at empty weight plus 90 kg pilot. These polar curves are the results of comparison flight tests between the 20 m span D-1110 and the 19 m and 21 m versions of D-2119. Separately D-1110 (20 m) and D-2119 (21 m) were compared in flight tests to the 18 m Cirrus of the DFVLR. It can be seen from fig. 2 that all versions have the same glide ration L/D = 49 to 50 at about 105 km/h. Below this speed the higher span sailplanes have better performance; above 105 km/h the lower span sailplanes have better performance. Even if results are all corrected to the same wing loading fig. 2 will be nearly the same as the differences in loading were not very large.

The explanation of these facts lies mainly in the effects of induced drag, which clearly confers an advantage on the long span sailplane at low speeds. The advantage at high speeds for the short span is probably due to lower induced drag because of smaller wing twist. It is unlikely that the higher drag results from profile drag of the additional wingtip surface as this surface operates well within the laminar bucket even at negative lift coefficients.

The test results show that the changes in performance resulting from different wing spans on the same sailplane are similar to those obtained for different wing loadings. Fig. 1 also shows the maximum all up weights to which the different versions have been substantiated, and in addition the corresponding minimum factors of safety for the wing bending structure. Despite the marked increase in all up weight with the lower span, the minimum wing safety factor increases.

Fig. 3 shows how much the level flight performances change if the weights are changed from empty weight plus 90 kg payload to the maximum certificated all up weight. The lower the span the more the performance range can be varied with water ballast.

In line 6 of fig. 1 are shown the maximum all up weights for constant minimum safety factor for the wing of 1.5. Only 520 kg could be allowed for a 22 m sailplane, whereas 750 kg is possible for the 19 m version without overstressing the wing bending structure.

Performance data for such widely varying wing loadings for the shorter span are shown in fig. 4. The estimated polar curve of a 22 m version, on which no ballast at all could be allowed, is also given.

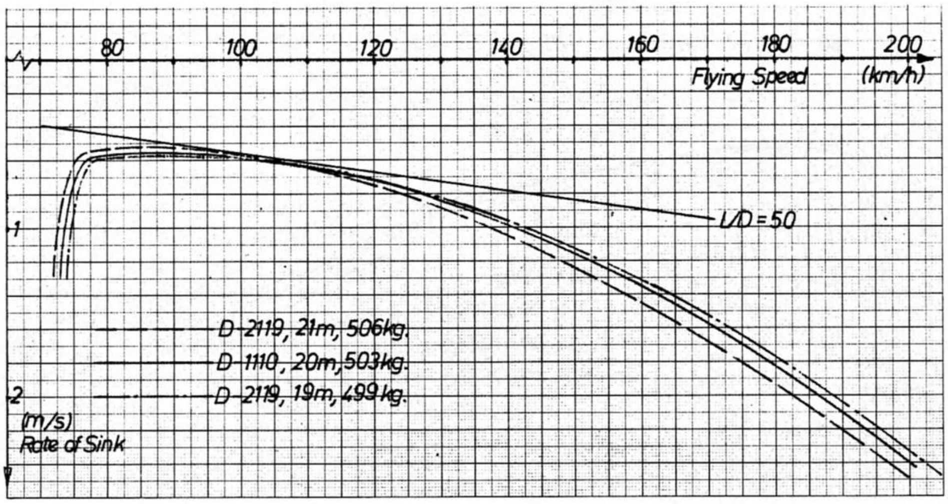
Problems mainly with the landing gear (tyre) and cockpit strength in heavy landings limit the all up weight for the low span versions. All the other structure components of the ASW 17 could be strengthened sufficiently with relatively small amounts of reinforcement.

Fig. 5 shows the cross country speed of the 21 m sailplane as a function of Rate of Climb (dashed line).

Fig. 1

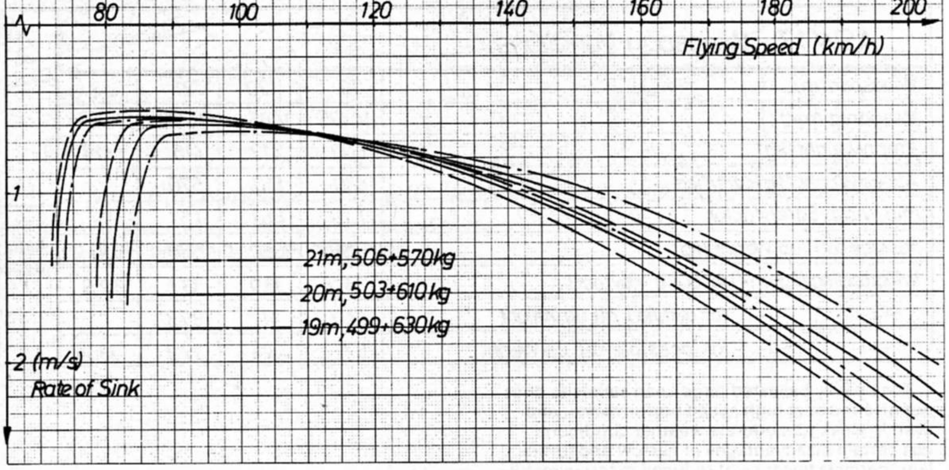
ASW 17 Wingspan Variations				
Wingspan (m)	19	20	21	22
Wingarea (m^2)	14.425	14.85	15.28	15.67
Emptyweight (kg)	409	413	416	~419
All up Weight (kg) certified	630	610	570	
Min. Wing Safetyfactor	1.79	1.63	1.5	
Possible all up Weight (kg)	~750	~660	570	~520
Wingloading (kg/m^2) for 90kg Payload	34.6	33.9	33.1	32.5
–„– –„– for certified all up Weight	43.7	41	37.3	
–"– –„– for possible all up Weight	52	44.4	37.3	33.2

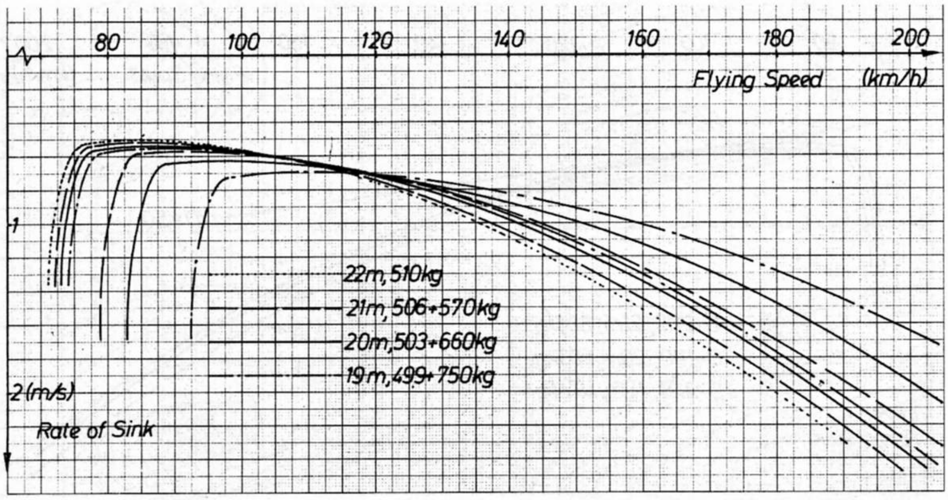
1. The heavily ballasted large span sailplane does not give the best high speed performance, and even in weak to moderate weather conditions has certain disadvantages in narrow and turbulent thermals because of reduced manœuvreability compared to low span versions.

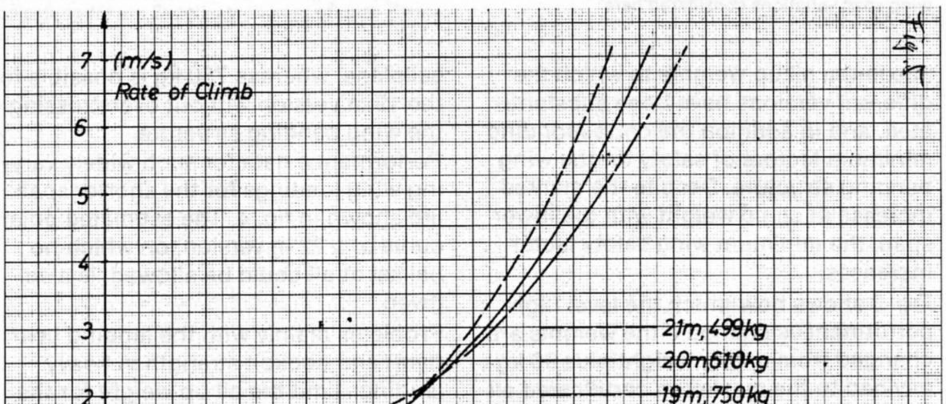


2. Structural problems resulting from the carriage of large amounts of ballast for Open Class Sailplanes can be overcome with out running into technical difficulties for the relatively small wing span variations considered here.

Also shown are the cross country speeds of 20 m, 610 kg and 19 m, 750 kg sailplanes. The variations in climb performance (poorer for the smaller spans) in a thermal having a velocity gradient of 0.015 m/sec. per metre, assuming circling at 35 to 40 degrees of bank, were taken into account.







The 21 m span version is better for very weak conditions or for long duration flights starting early in the morning and ending late. The 19 m version is better for speed attempts in very good conditions.

The 20 m version is a good compromise, not losing too much in weak conditions but being relatively good in «European weather» from 1$^1/_2$ to 3 m/sec. rate of climb.

Some remarks must be made concerning flying qualities. Flying the 19 m and 21 m span versions of the ASW 17 on the same day, one has the feeling of flying two totally different sailplanes. Whereas the 19 m ship is very fast in reacting to the controls and is very well balanced in coordination, the 21 m ship is slow and phlegmatic, suffering particularly from rudder ineffectiveness. For proper coordination the rudder should be larger. On the other hand the 19 m version has such good rudder effectiveness that the rudder could be reduced in area.

Because of the higher taper ratio the 21 m version might be expected to drop a wing sharply at the stall. However, this does not happen. Because of the great inertia of the wing such wing-drop as does occur is slow, and allows enough time for the pilot to correct it easily.

The effects of span variation on longitudinal behaviour are small. Theoretically the 19 m version has greater stability but this is also necessary to cope with the wider C. G. range which results from the greater amount of water ballast possible with the shorter span.

Flutter calculations done for the ASW 17 by the DFVLR/AVA Göttingen showed that the critical flutter speeds for wingbending/wingtorsion flutter increase with increase of water ballast if the ballast is located in front of the spar along the span.

Summary:

1. The heavily ballasted large span sailplane does not give the best high speed performance, and even in weak to moderate weather conditions has certain disadvantages in narrow and turbulent thermals because of reduced maneuverability compared to low span versions.
2. Structural problems resulting from the carriage of large amounts of ballast for Open Class Sailplanes can be overcome without running into technical difficulties for the relatively small wing span variations considered here.
3. Consideration should be given to certification and airworthiness requirements of such multi span sailplanes.
4. CIVV should think about current Open Class Rules concerning changeable with tips because of the safely aspects of the ballast problem.