CORRESPONDENCE.

To the Editor of the AERONAUTICAL JOURNAL.

"THE DESIGN OF SPARS WITH OFFSET PIN JOINTS."

DEAR SIR,—This most interesting Paper suggests the following remarks :—

Further advantages of the method.—The symmetry of bending moment in each bay gives the best case for shear. The greatest shear is exactly half the load on the bay, which is the lowest value possible, and it occurs at both ends.

Any uncertainty as to wing tip effect or local variation of wing section is confined to one bay and does not vitiate the calculations for the rest of the spar.

Small modifications suggested.—On each side of a joint the spar must be left solid. It is the stress where the full spindling begins, and not at the end of the bay, that we want to make equal to the maximum stress in the middle of the bay. Then in §11, L is the length of the spindled portion, and the length of the bay is greater by the amount left solid at the ends. The offset moment required is increased by this treatment.

Equation (M_{2n}) of §7 assumes that the drag and flying wires are equally offset; this is not essential. If the drag wire is centred, $P_n - P_{n+1}$ must be replaced by the component parallel to the spar of the flying wire tension.

Other considerations.—If the aerofoil is not deep enough to allow the required offset, we cannot get the ideal distribution of moment, and the best that remains may be an unsymmetrical arrangement which sacrifices much of the compactness and directness of §4 and 11. A continued beam may come closer to the ideal than the most offset pin joint practicable.

It is current practice to obtain equal stresses at three points by varying the lengths of solid spar at the two ends of the bay; but this can only be done if the maximum bending moment in the bay is greater than either fixing moment.

The fact that several points are stressed up to the elastic limit might arise from needless local stresses at some of the points and indicate bad design as well as good. The better criterion is total weight for strength. Concrete examples only can show whether the saving on the bays is partially discount or turned into a loss by additions to the fittings. There are not only pins and spar boxes to consider. Each pin-jointed section of a plane would have to be covered with fabric separately, involving duplicate wide ribs and end stiffeners. This might have some advantage, however, in a large aeroplane where the size of an individual plane section is decided by transport considerations.

Example.—The top front spar of the "Parnall Puffin" consists of an overhang, whose length is fixed by folding considerations, and two bays, with a pin joint on the neutral axis at the centre section, the special fitting here requiring a solid length of 7in. As designed the weight of the two bays is 10.4lbs.

The process of §11, with the assumption of 5in. solid on each side of the intermediate strut, indicates a possible saving of 1.2lbs. The bay spacing is unaltered; the offset for the intermediate pin is 4.1in. and for the inner pin 1.06in. Since the half depth of the aerofoil is 2.25in., the former offset would have to be considerably reduced, and the total saving of weight would probably be less than 1lb., which would not compensate for the losses entailed, in spite of the fact that the gain on two bays is available to make up for the loss on only one joint. On the top rear spar the saving is .315lb., with an offset of 2.5in.

The theory may work out differently on a large aeroplane, and more examples would be very welcome.

Summary.—The saving of weight would have to be very clear to make up for the loss of rigidity and increased complexity of erection and rigging. The present suggestion is that, on small craft at any rate, where a hinge already exists the design may be definitely improved by offsetting the pin; but the gain would rarely warrant a pin joint that was not needed for other purposes.

Yours, etc.,

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