CORRESPONDENCE

The Scope and Limitations of the Photoelastic Method of Stress Analysis —A Correction

(*The following correction to his paper, published in the March* 1953 JOURNAL *has been received from Colonel H. T. Jessop.*)

10*th March* 1953.

Sir,—In the course of my written replies to the discussion which followed my lecture on 27th November 1952, I quoted in reply to Mr. Hickson some results from a mathematical solution for the stresses in a sphere under diametral compression. The authors have since informed me that they have found an error which invalidates their solution, but unfortunately this was discovered too late for a correction to be made in the report published in the March number of the JOURNAL.

The three paragraphs containing reference to this solution (p. 138 right hand column), commencing "Another exact solution . . ." and ending ". . . to stress-concentration problems on a boundary," should therefore be deleted. In their place I should like to add the following:—

"The results in such solutions, however, dealing with stress-concentrations on the boundaries of semi-infinite solids, will not necessarily be comparable with those in cases where the effect of the stress-concentration may tend to alter the distribution over the whole of the stressed body. What the effect in such problems will be it is impossible to predict. It may be that Mr. Hickson's tentative principles will eventually be shown to hold in such cases also, but until more evidence is available I prefer to treat the Poisson's ratio effect as an entirely unknown factor."

H. T. JESSOP.

Stressing of Circular Frames

17*th March* 1953.

Sir,—With reference to the paper by K. J. Dallison, "Stressing of Circular Frames in a Non-Tapering Fuselage, p. 161 of the March 1953 JOURNAL, I note that he gives me credit for the invention of what he describes as "an alternative method of solution for moment and tangential loading." I should like to point out, as I did in my paper in the JOURNAL (November 1946), that the method was used in N.A.C.A. Technical Note 929, 1944. I may have elaborated it somewhat, but the original idea was not my own.

W. J. GOODEY.

17*th March* 1953.

Sir,—With reference to the very interesting paper by K. J. Dallison I would like, if I may, to discuss an aspect of the subject which Mr. Dallison does not appear to have dealt with and which could, in my opinion, be of importance.

It is not infrequently the case that aircraft fuselages are designed, in the interests of structural efficiency, so that the applied skin shear stresses have greater values in certain localities than the appropriate shear buckling stresses, and this state is allowed provided that permanent deformation and failure of the skin, among other things, do not occur under the prescribed conditions of the design case. Similarly, fuselage bending moments are applied under which that part of the skin in compression is accepted although not fully effective.

A result of this is that the shear modulus G is not necessarily fully effective and will, in general, vary about the section perimeter depending on the magnitude of the local shear flow applied. If, under fuselage bending the skin in compression is not fully effective, the section principal axes will no longer coincide with the section axes of symmetry but will undergo a translation towards the tension fibres and a rotation depending on the direction of the axis about which the applied resultant bending moment acts. The effective shear moduli, the section principal axis location, the section bending modulus, etc., will have unique values for given values of applied bending moment, shear force and torque.

Stress configurations such as these occur at stations along the fuselage which are remote from points of load application, and consequently must be particularly significant in regions of shear distortion where load—transmitting frames are located. The skin in the region of such a frame might be reduced in effectiveness by the loads applied at the frame, or by the local frame loads in combination with the effects of loads already applied to the fuselage elsewhere and transmitted to the skin and its associated stringers in the region of the frame.

It follows that the frame and skin shear flow analysis can no longer be based on the assumption of symmetry about an axis in the plane of the frame or fuselage section; the number of unknown shear flow values (x_p) to be determined will be substantially increased as a result.

A more serious difficulty would, I think, be the assessment of the skin effective shear modulus and its variation around the fuselage section perimeter in the neighbourhood of a frame. It might be possible to introduce into Mr. Dallison's energy expressions additional terms to account direct for the modification to the shear modulus and for the ineffectiveness of the skin in compression. Alternatively, a procedure of "successive approximations" could perhaps be adopted whereby as a first step assumed values of G are introduced to calculate an approximate shear distribution. The second step would be to re-estimate the shear modulus variation around the perimeter using, in association with the compression on the skin, the shear distribution already calculated; a second estimate of shear distribution based thereon being made, and so on.

I would be very interested to hear Mr. Dallison's views on the foregoing. Also, could he please say whether there is any experimental work to indicate the effects of buckled skin on the shear flow distribution around a frame?

B. SARAVANOS, *Associate Fellow.*

In reply to Mr. Saravanos:—

1. *Variation of the shear modulus.*

(*a*) *Overall* changes in the shear modulus would have only a small effect on the shear distribution at a flexible frame and none at all at a rigid frame. Thus a change of 100 per cent. in the value of the shear modulus would merely double or halve the value of A/B, with small change in the shear distribution.

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