DISCUSSION

S. Rohde

The authors have presented an interesting analysis. Indeed, although the boundary conditions at the trailing edge of the fluid film have historically been given much attention, the leading edge, or inlet conditions, have received very little attention. In this respect, the authors’ contribution is a valid addition to the literature. It would be interesting to know if similar results are obtained for the finite journal bearings, an undertaking the authors indicate they are pursuing.

Although mathematically well set, certain physical aspects of the authors’ model puzzle the discusser—in particular the neglect of side leakage in the region \( 0 < \theta < 90 \). It is not clear that no flow occurs across the boundary (i.e., in the \( z \) direction) determined by the use of a gross continuity equation in the inlet region. Have the authors considered the use of a zero-pressure, zero-flow condition (with a source term) to determine the “inlet boundary”?

A. Seireg

This is an interesting paper that gives some rational basis to improving the accuracy of the classical hydrodynamic theory in predicting side leakage by introducing inlet conditions in line with the observations of Cole and Hughes [4].

It is unfortunate, however, that the authors did not include any experimental evidence, even in a qualitative form, to illustrate the correlation between the calculated and experimental values of side leakage within the framework of short bearing approximation. It would appear that Dr. Pinkus has such experimental data available, but as yet unpublished [2].

It is understandable that a complete disclosure of the experimental results is beyond the scope of this paper, but a sample comparison would certainly be enlightening and in order.

Authors’ Closure

The authors appreciate the discussers interest in the paper and their comments. A complete set of solutions for finite bearings with incomplete films was indeed obtained and these can be found in the authors’ forthcoming paper, reference [9]. It is not quite clear what Dr. Rohde had in mind by the phrase “the neglect of side leakage in the region \( 0 < \theta < 90 \)”. If the reference was to the physical bearing boundary, then this is correct, as this is the essence of the problem. If, as it is more likely, by boundary is meant the curved edge of the fluid film, \( 90 \), then of course, flow does occur in the \( z \) direction, and it is this axial flow combined with the flow in the \( \theta \) direction which determines the curvature and extent of the incomplete film. What is true is that in the region \( 0 < \theta < 90 \), there is no flow normal to the contour of the fluid film.

Dr. Rohde’s suggestion of trying to obtain an idea of the shape of the inlet film from a source-like inflow at \( 0 \) is perfectly plausible and has, in fact, been solved by Milne [10]. Of course, the conditions in a journal bearing are somewhat more complicated for, in addition to a variable \( h \), there are also pressure gradients at \( 0 \) impinging upon the source. On that subject, too, more is given in [9].

We share Professor Seireg’s interest in seeing a detailed comparison with experimental data but since up till now no attention was paid to the implications of the incomplete film, few available experimental results are suitable for such a comparison. What we do now is that side leakage measurements often show deficiencies of an order of 30 to 60 percent when compared with classical theory, and that the present approach reduces theoretical flows by amounts of the same order. Also experiments consistently show that the Sommerfeld Number is not the sole parameter for the dimensionless side leakage \( q \), and this too is confirmed by our results, particularly those in [9], where a new dimensionless parameter \( p_a \) related to inlet conditions, is introduced. Thus in a qualitative way there is confirmation. For a rigorous and quantitative comparison experiments in the future will have to measure precisely such heretofore neglected quantities, as inlet pressures, dimensions of inlet hole and groove, initial extent of film, etc. It is indeed hoped that this would be done.

Additional References