Proceedings of the:
1999 ASME Design Engineering Technical Conferences
September 12-15, 1999, Las Vegas, Nevada

DETC99/VIB-8270

THE INTEGRATION OF STRUCTURAL AND FLUID FILM DYNAMIC ELEMENTS IN FOIL BEARINGS PART II: A NEW APPROACH TO THE PROBLEM

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ABSTRACT

In Part I of this investigation a survey was made to see how the two-tiered construction of foil bearings, consisting as they do of two generically disparate elements, one hydrodynamic in nature and the other following the laws of elasticity, have been modeled in order to obtain integrated values of bearing stiffness and damping. Here a series of experiments is reported showing that serious discrepancies exist between results obtained from conventional dynamic models and test results. A new approach to the problem is here taken in modeling the two-tiered dynamic system of foil bearings. For this purpose a series of analytical solutions were obtained for different spring and dashpot arrangements. A basic approach was taken in considering the foil bearing as consisting of a two-degrees-of-freedom system. Differences in amplitude of vibration and phase angles were plotted for the different models. Similar data were obtained separately for the hydrodynamic and structural regimes. The solutions showed substantial differences in the amplitudes and phase angles between the two domains. It is concluded that treatment of foil bearing dynamics should be based on a two-degrees-of-freedom model. Suggestions are made for an analytical and experimental program to put the technology of foil bearings on a sounder basis than has been the case heretofore.