World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:9, No:05, 2015

Finite Element Analysis of Oil-Lubricated Elliptical Journal Bearings

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Abstract : Fixed-geometry hydrodynamic journal bearings are one of the best supporting systems for several applications of rotating machinery. Cylindrical journal bearings present excellent load-carrying capacity and low manufacturing costs, but they are subjected to the oil-film instability at high speeds. An attempt of overcoming this instability problem has been the development of non-circular journal bearings. This work deals with an analysis of oil-lubricated elliptical journal bearings using the finite element method. Steady-state and dynamic performance characteristics of elliptical bearings are rendered by zeroth- and first-order lubrication equations obtained through a linearized perturbation method applied on the classical Reynolds equation. Four-node isoparametric rectangular finite elements are employed to model the bearing thin film flow. Curves of elliptical bearing load capacity and dynamic force coefficients are rendered at several operating conditions. The results presented in this work demonstrate the influence of the bearing ellipticity on its performance at different loading conditions.

Keywords : elliptical journal bearings, non-circular journal bearings, hydrodynamic bearings, finite element method
Conference Title : ICME 2015 : International Conference on Mechanical Engineering
Conference Location : Montreal, Canada
Conference Dates : May 11-12, 2015