Discontinuity effects in dynamically loaded tilting pad journal bearings

This paper describes two discontinuity effects that can occur when modelling radial tilting pad bearings subjected to high dynamic loads. The first effect to be treated is a pressure build-up discontinuity effect. The second effect is a contact-related discontinuity that disappears when a contact force is included in the theoretical model. Methods for avoiding the pressure build-up discontinuity effect are proposed.

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Measurement and Calculation of Frictional Loss in Large Two-Stroke Engines
The total frictional loss in a large two-stroke marine diesel engine is rather well determined. However, the contribution (size and distribution) from the different machine elements are not well known. The aim of this study is to establish methods to measure and calculate friction in the piston assembly and guide shoe system for a large two-stroke marine diesel engine. These components are the two major contributors to the total friction in a two-stroke marine diesel engine. The piston pack represents approximately 60% of the total mechanical loss at full load and the guide shoe system 23%. The rest of the mechanical loss is situated in the piston rod 2%, piston skirt 3% and main bearings and connecting rod bearing 12%. Information about the friction distribution can be used in future design of these machine elements.
Theoretical models for determination of frictional losses for both aforementioned bearing types are presented.
Experiments revealing the size and distribution frictional loss are carried out. The results of the friction measurements are used for verification of theoretical models. This requires additional information such as oil film thickness, pressure and
temperature. These parameters are measured and compared with simulations. Studies concerning reduction of the overall frictional loss for both bearings are carried out.

**Measurement of oil film thickness and friction force on a guide shoe bearing**
An experimental program was carried out in order to reveal oil film thickness, and friction force of the guide shoe bearing of a large two stroke marine diesel engine. The experiment was conducted on a full size engine located at the research facility at MAN B&W Diesel A/S. The experiment was conducted such that the influence from the experiment on the characteristics were as small as possible. The objective of the experiment was to determine the frictional loss of this bearing and to check whether a suggested numerical model was applicable or not. Some future aspects for this bearing are presented regarding optimization.

**Shaft centre orbit for dynamically loaded radial bearings**
The aim of this work is to demonstrate how to utilize the bearings damping coefficients to estimate the orbit for a dynamically loaded journal bearing. The classical method for this analysis was developed by Booker in 1965 Booker1 and described further in 1972 Booker2. Several authors have refined this method over the years. In 1966 Jorgen W. Lund published an approach to find the dynamic coefficients of a journal bearing by a first order perturbation of the Reynold’s equation. These coefficients made it possible to perform a rotor-bearing stability analysis for a statically loaded bearing. In the mid seventies Jorgen W. Lund pointed out in lecture notes that the dynamic damping coefficients of the bearing could be used to find the shaft orbit for dynamically loaded bearings. For simplicity the "Short-Width-Journal-Bearing Theory" is used as a basis for finding the damping coefficients in this work, but the method is general and the damping coefficients could have been found also by numerical solutions.
On the interaction between structure and oil film of a guide shoe bearing

A solution procedure for the determination of the oil film thickness of a guide shoe bearing for a large two stroke marine diesel engine is presented. Based on a previous study considering oil film thickness of a guide shoe bearing with rigid structural parts a model for the interaction between structure and oil film is implemented. The model takes into account the elastic deformation of the bearing parts. An iterative procedure for determining pressure, deformation and squeeze velocity is applied. The results are compared to a traditional calculation of rigid components. The model of the structure is a 3D finite element model and the oil film description is made using a 2D finite difference mesh.

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Projects:

Experimental and numerical investigation of friction, power loss and lubricant transport between a piston ring and cylinder liner in a heavy duty diesel engine.
Overgaard, H. T., Project Participant, Department of Mechanical Engineering, Solid Mechanics
Klit, P., Project Participant, Department of Mechanical Engineering, Solid Mechanics
Vølund, A., Project Participant
11/09/2017 → …
Project: Research

Investigation of Different Piston Ring Curvatures on Lubricant Transport along Cylinder Liner in Large Two-Stroke Marine Diesel Engines
Overgaard, H. T., Project Participant, Department of Mechanical Engineering, Solid Mechanics
Klit, P., Main Supervisor, Department of Mechanical Engineering, Solid Mechanics
Vølund, A., Supervisor
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Project: Research

Measurement of lubricant film thicknesses by laser induced fluorescence
Overgaard, H. T., Project Participant, Department of Mechanical Engineering, Solid Mechanics
Klit, P., Main Supervisor, Department of Mechanical Engineering, Solid Mechanics
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01/03/2017 → …
Project: Research

Statiske og dynamiske egenskaber af hydrodynamiske glidelejer på vindmøllers hovedaksel
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Award relations: Statiske og dynamiske egenskaber af hydrodynamiske glidelejer på vindmøllers hovedaksel
Project: PhD
Smøring af stempelringe i store 2- og 4-takts dieselmotorer
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01/01/2004 → 31/08/2007
Award relations: Smøring af stempelringe i store 2- og 4-takts dieselmotorer
Project: PhD

Diesel Engine Tribology
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01/09/2015 → 10/01/2019
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Project: PhD

Numerical Simulation of the Hydrodynamic Behaviour of the Lubricant Oil Film in Large Two-stoke Marine Diesel Engines
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Project: PhD

Minimering af friktionstab i 2-takt skibsdielsemotor
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Innovationsfonden
01/04/1999 → 17/02/2003
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Project: PhD

Lubricant Transport across the Piston Ring with Flat and Triangular Lubrication Injection Profiles on the Liner in Large Two-Stroke Marine Diesel Engines.
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Klit, P., Main Supervisor, Department of Mechanical Engineering, Solid Mechanics
Vølund, A., Supervisor
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