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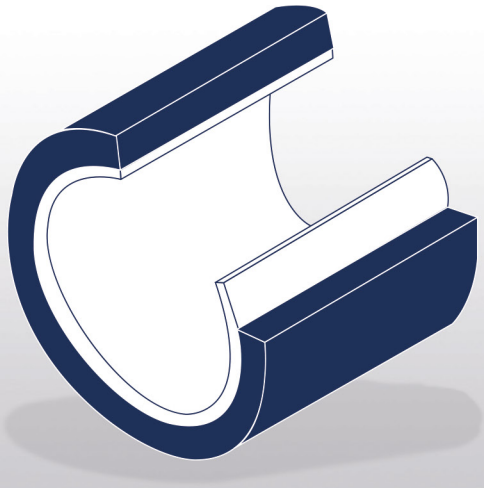
Simulation is more than Software®

Running like Clockwork



Tribo-X inside ANSYS

CADFEM ANSYS extension for the analysis of hydrodynamic bearings

Mastering complexity

The structural behaviour of shafts with journal bearings depends to a high degree on the dynamic characteristics of the lubricant film in the bearings. An established method for the simulation of the lubricant film formation is elastohydrodynamics.

With Tribo-X inside ANSYS journal bearings can be analysed quickly and easily within ANSYS Mechanical.

The goal is the correct dimensioning of the bearings as well as the realistic consideration of speed dependent stiffness and dampening effects within dynamic FE analysis.

The main benefits

- Complete integration of Tribo-X inside ANSYS for the analysis of journal bearings
- Short run times due to the high performance of the Tribo-X solver
- Consideration of the elastic deformation of the bearing during operation
- Identification of rotational speed dependent bearing coefficients
- Parametric workflow

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Tribo-X inside ANSYS

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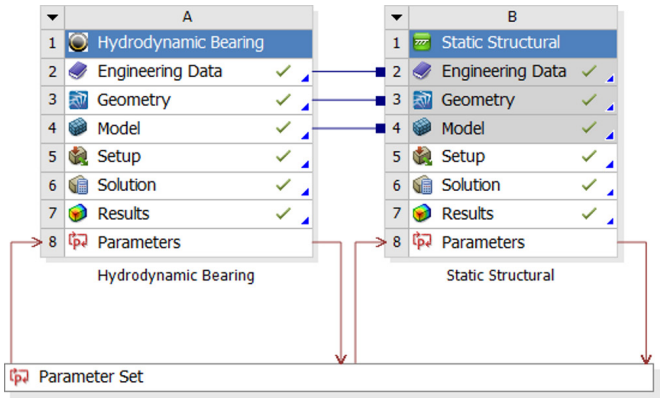
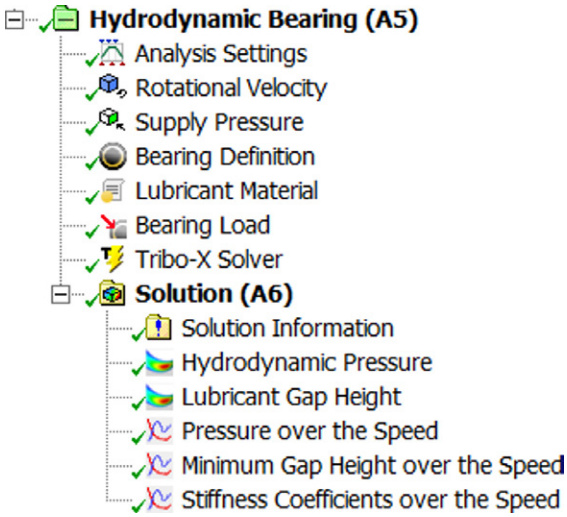
Coupling of hydrodynamics and FEA

The analysis system 'Hydrodynamic Bearing' couples both the hydrodynamics in the lubrication gap and the deformation of the structural using finite element analysis. Within this process the generalized Reynolds differential equation is solved by the Tribo-X solver. All the bearing characteristics are described in ANSYS Workbench using the geometry model and operating conditions such as loading and rotational speed. These are implemented in the Workbench project tree as load objects.

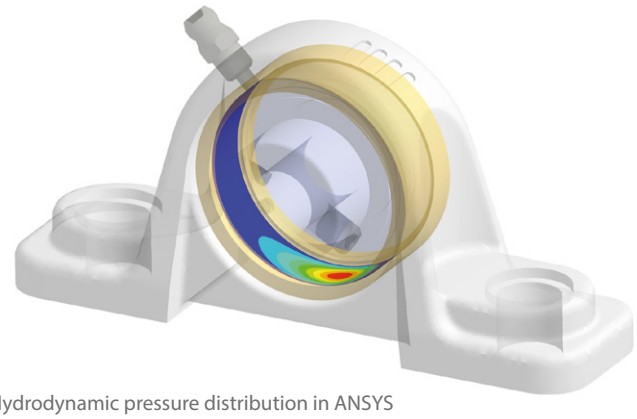
The results of the Tribo-X analysis enable an assessment of the load capacity of the journal bearing. Fast variation analyses help to adjust the bearing design according to the loading scenario. For the identified bearing design the coefficients can be directly transferred to ANSYS Mechanical allowing rotational speed dependent stiffness and damping coefficients to be included in further rotordynamic analyses. The consideration of the elastic deformation of the bearing allows a more precise computation of the lubricant gap which in turn leads to a more reliable bearing design.





Journal bearing coefficients

The vibration behaviour of complex shafts mounted with journal bearings is mainly influenced by the stiffness and damping characteristics of the bearing lubricant. The related coefficients are directly linked to the hydrodynamic load capacity of the lubricant at a given rotational speed. Depending on the loading situation and rotational speed of the shaft, the coefficients may vary significantly which results in different system behaviours. That is why Tribo-X inside ANSYS computes the stiffness and damping terms of the lubricant for each operating condition.



Hydrodynamic pressure distribution in ANSYS

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Cavitation and load capacity

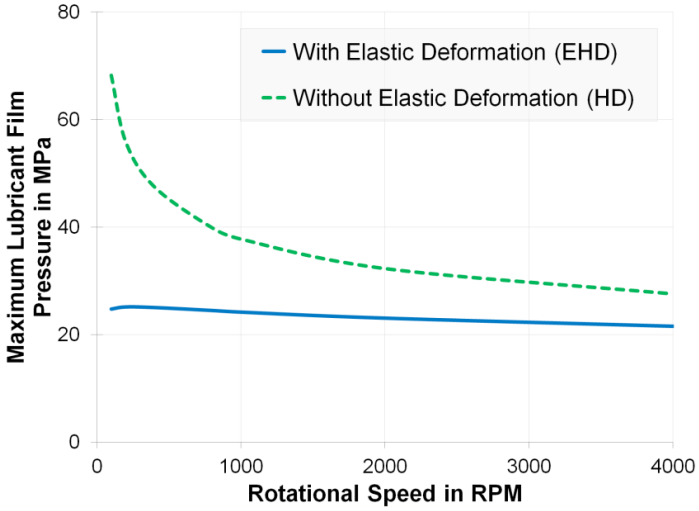
In divergent lubrication gaps cavitation can occur. For a correct simulation of the heat balance or bearing coefficients the cavitation effects should be represented by adequate algorithms. These are implemented in Tribo-X which allows a combination of highly accurate results and ultra-short computing times.

Bearing deformation (EHD)

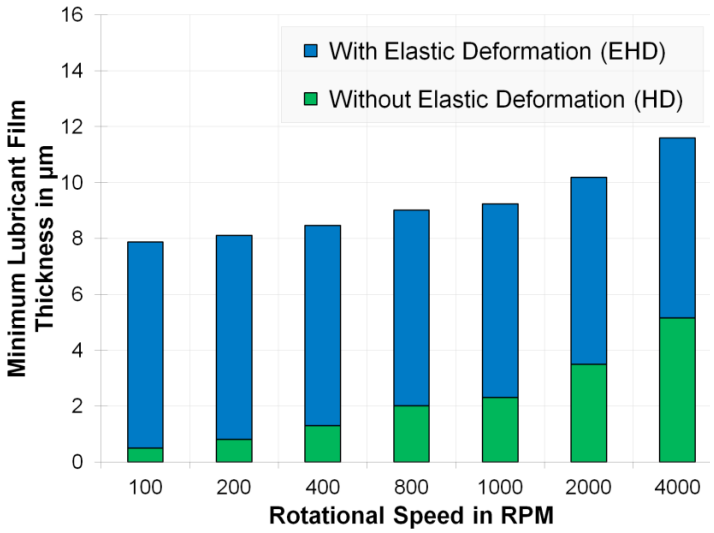
Since bearing deformation, due to lightweight design or high loads, can affect the lubricant film formation, it is important to take them into account. Tribo-X inside ANSYS allows such influences to be included in the elastohydrodynamic (EHD) analysis. Elastic deformation of the bearing allows the gap size to be modelled accurately, especially at low shaft speeds, high loads or low structural stiffness, thus helping to optimize the bearing design and prevent bearing damage.

Parameter studies

The high performance of the EHD solver Tribo-X results in very short computation times, allows to easily perform sensitivity studies inside ANSYS. In the first step, a variation analysis may focus initially on the bearing itself in order to narrow down the design envelope. In the second step, a continuous workflow coupling the bearing computation and the FE analysis considers the design parameters of the bearing and shaft simultaneously. This allows a holistic optimal design of bearing-shaft-housing system.



Lubricant film pressure with and without consideration of elastic deformation over rotational speed



Lubricant film thickness with and without consideration of elastic deformation over rotational speed

Tribo-X inside ANSYS

CADFEM ANSYS extension for the analysis of hydrodynamic bearings

Technical information

System requirements: ANSYS Workbench from version 19.1

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For more than 50 years the Chair of Machine Elements and Tribology of the Institute for Machine Design has been actively working to address technical and scientific issues related to friction, wear and lubrication of different machine elements. Tribo-X is a software package developed by this chair for 3D-simulation of TEHD-contacts.
www.tribo-x.com

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