Modal Analysis of Rotating Machines

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Abstract

Machines with rotating components are prone to vibrations because an imbalance of the rotor would always act as a harmonic excitation force to the machine. Thus oscillations close to the natural frequencies are tried to pass through fast in the run-up and cast-down or even completely avoided for higher structural frequencies. Nevertheless vibrations still occur and affect the design of the structure or limit the parameter of operation like rotating speed.

Aim of the paper is to investigate the vibrating behavior of a machinery frame with major respect to coupled elements. As a result the behavior of specified damper and structural forces in the base frame are investigated in the run-up or cast-down.

Therefore the work is split into two parts. The first part deals with the theoretical model building and description of the dynamics of the machine frame together with coupled machine parts. As a result universal mathematical models are obtained as an analytical attempt to the stated problem and for the use in various calculation programs.

The second part mainly investigates an implementation of the elaborated model into the finite element program COMSOL Multiphysics® with the Structural Mechanics Module. To get a wider impression of current design and analysis methods for investigating machine dynamic problems different solver options and tools like the Multibody Dynamics Module and the Rotordynamics Module are investigated.
Simulated models and calculated results are then compared with measured vibration behaviour from a specific machine type.

In the end a straight forward state-of-the-art solution for machine dynamic questions of rotating machines is obtained, with respect to the statement of the problem.

Figures used in the abstract

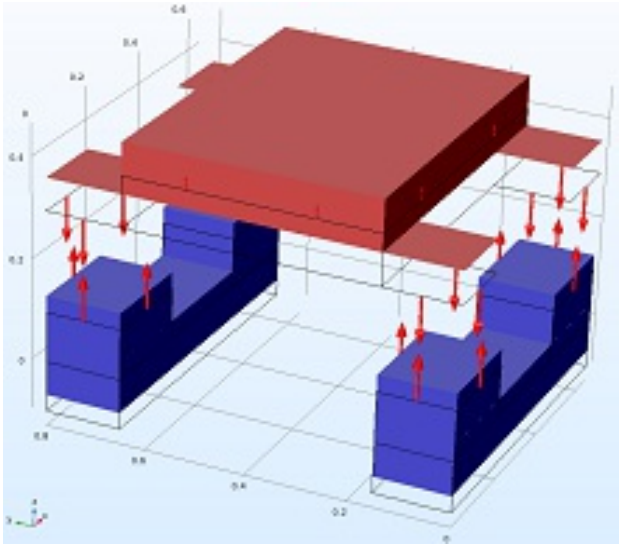

Figure 1: Component Coupling.