

CADFEM Consulting

ANSYS® Fluid-Structure-Interaction Analysis

Acoustic Excitation of Structural Vibrations
in a Mill due to Plan Sifters

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Task

A plan sifter (Fig. 1) is a device where granular media for food industry are separated by oscillating motions. These low-frequency motions raise suspicion to excite large vibration amplitudes in the glass walls or doors of a mill. The task is to identify this potential transfer mechanism by FEM and to take action for vibration reduction.

Solution

A finite element mesh for the room cavity is generated (Fig. 2). The three cutouts in the mesh on the right show the idealization of the sifter geometry. First an acoustic modal analysis is performed assuming rigid walls. As a result the 1st resonance frequency is identified together with its mode shape (Fig. 3). The typical half wave resonance is approved, as expected, by analytics for this rectangular cavity. So far no amplitude information can be obtained from those results. In order to compute the vibration amplitudes of the large elastic glass windows a harmonic analysis is performed that takes into account fluid-structure interaction at the sifter walls and at the glass windows. ANSYS FLUID30 elements have both pressure and displacement degrees of freedom and thus allow the excitation of the cavity by given sifter motions. The acoustic cavity vibration will then give rise to structural vibrations. As an example a vibration pattern of the glass front (left wall of Fig. 3) is presented in Fig. 4.

Customer Benefit

Based on this model the customer can check the influence of different parameters, e.g.

- adding acoustic damping layers to walls,
- adding another room wall to increase the 1st acoustic cavity mode,
- checking for the benefit of shifted excitation phase angles for the three sifters,
- testing the influence of slightly out-of-tune frequencies for the shifter excitation.

This way the physical background of the problem and the sensitive parameters can be identified by a rather simple simulation model and promising measures can be proposed without the need for expensive on-site experiments.



Fig. 1: Sifters in a mill.

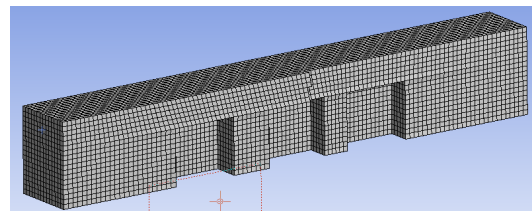


Fig. 2: FE mesh of the room's acoustic cavity.

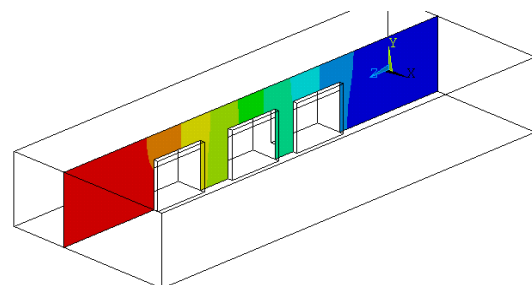


Fig. 3: 1st acoustic resonance of a sifter room.

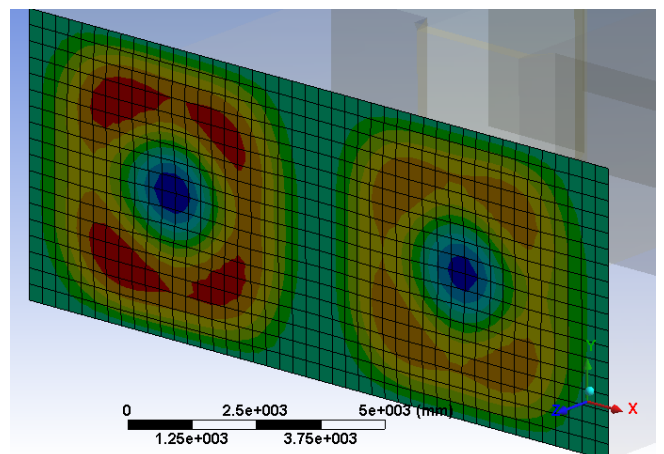


Fig. 4: Excited deformation of the glass front.

By Courtesy of Bühler AG, Uzwil, CH