Experimental investigation of sound reduction by thin air layers

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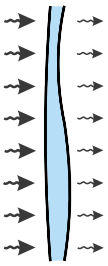
Introduction

A thin air layer between two flexible plates can dissipate a significant amount of vibrational energy by its viscous and thermal behaviour.

Reducing low frequent sound



Low frequent sound is usually reduced by introducing large amounts of mass in a structure. The objective of this research is to investigate if the viscothermal effects in thin air layers can be used to reduce low frequent sound. Applications are for instance motor shielding or silent walls.

Figure 1 : Sound reduction by a thin air layer

Tools

Tools with which the viscothermal wave propagation in relation with fluid-structure interaction can be studied have been developed.

Finite elements Acoustic elements which take into account viscous and thermal effects and which enable full fluid-structure interaction are implemented in the B2000 Finite Element Program.

Experimental setup With a special experimental setup the influence of the airgap on the dynamical behaviour of a double wall panel has been investigated.

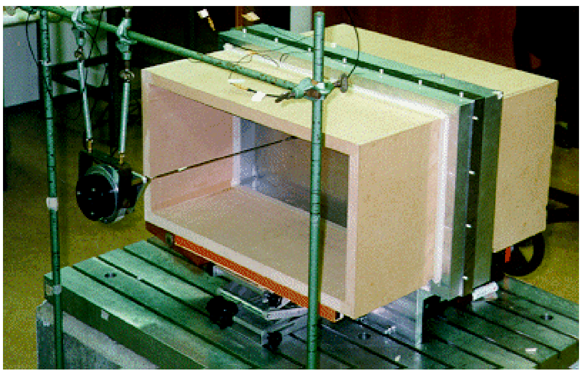


Figure 2 : Experimental setup

Experimental Method

The method is based on the energy balance. The energy which is dissipated in the airgap (W_{dis}) is calculated from the energy fed to panel 1 via the shaker (W_{in}) and the radiated acoustic energy (W_{rad}):

$$W_{dis} = W_{in} - W_{rad}$$

The radiated energy W_{rad} is measured with a sound intensity meter:

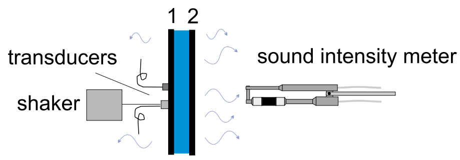


Figure 3 : Intensity measurements on double walls

The calculated and measured Energy Loss W_{dis}/W_{in} show the effectiveness of thin air layer(s):

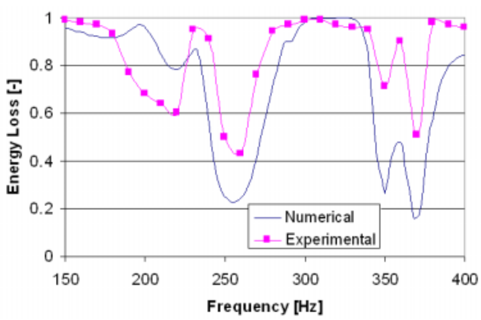


Figure 4 : Experimental and numerical results

Conclusions and further research

The dissipative behaviour of a viscothermal air gap has been demonstrated both experimentally as numerically. The step to practical applications will be made.

References

1. Basten, T.G.H. et al (1998) Low frequent sound reduction by thin air layers, poster presented at the first EM Symposium, Rolduc.
2. Beltman, W.M. (1998) Viscothermal wave propagation including acousto-elastic interaction, Enschede, PhD-thesis.