Reduction of sound transmission through panels by means of tuned acoustic resonators

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Introduction

When a panel is acoustically excited by a sound source, it will vibrate (Figure 1). Due to this vibration, sound is radiated to the other side of the panel. This phenomenon is called sound transmission and is mostly unwanted. The radiated sound can be reduced by means of acoustic resonators (Figure 2), which are tuned in such a way that the volume flow at the entrance of the resonators is opposite to the volume flow at the surface of the panel (Figure 3).

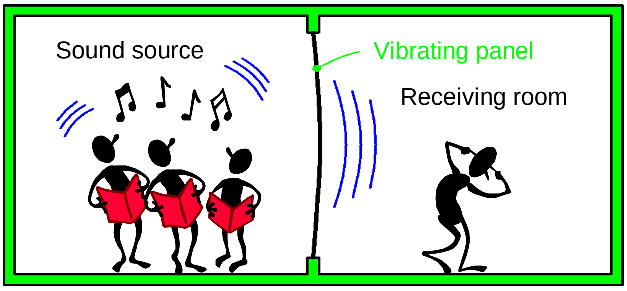

Figure 1 : Sound transmission between two rooms

Objective

The reduction of sound transmission through panels by the application of tuned acoustic resonators.

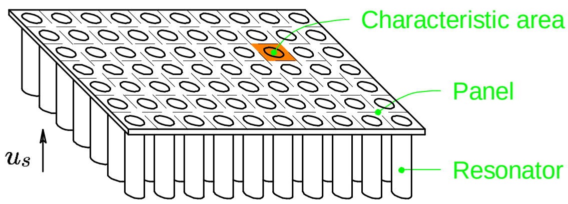

Figure 2 : Part of a panel with acoustic resonators

Methods

The harmonically vibrating panel is divided into a number of identical characteristic areas (Figure 2). The effect of the acoustic resonators is studied with a one-dimensional model of such a characteristic area (Figure 3). By solving the one-dimensional wave equations, the radiated sound pressure p_C is calculated. The radiated sound is minimised by tuning the resonator length and the porosity of the panel. These parameters determine the frequency range in which the radiated sound is reduced and the shape of the spectrum, respectively.

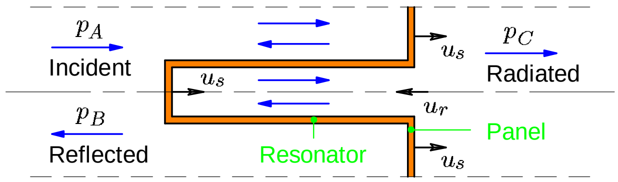

Figure 3 : Normal incidence transmission of sound through a characteristic area

Results

The sound transmission loss TL is a measure for the sound reduction, and is defined as the ratio of the incident and the radiated sound power:

$$TL = 10 \log_{10} |p_A/p_C|^2$$

Figure 4 shows the sound transmission loss for panels with different porosities Ω and a resonator length of 0.11 m.

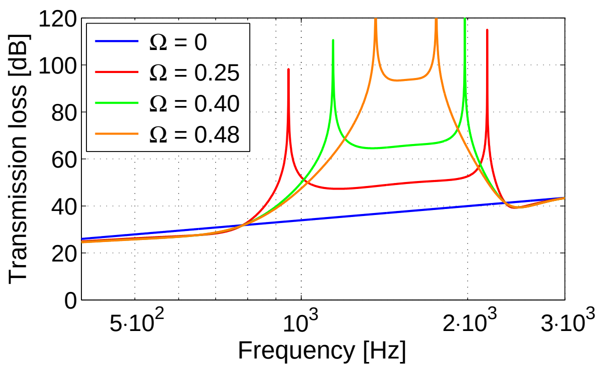

Figure 4 : Normal incidence sound transmission loss for different porosities

Discussion

Panels with acoustic resonators show a large reduction of the radiated sound over a broad frequency range, compared to a panel of the same mass without acoustic resonators (–). The next step is to study the effect of acoustic resonators on a large scale, both numerically and experimentally.

Reference

1. Hannink, M.H.C. et al. (2005) Application of acoustically tuned resonators for the improvement of sound insulation in aircraft, Internoise, Rio de Janeiro, Brazil.