Analysis of an Air Transparent Soundproof Window System & Comparisons to Physical Test Data

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Abstract

The design of windows and or other perforated structures which allow the free flow of air into & out of a building or system, while being fully soundproofed or attenuate certain frequencies is of great interest to architects and design engineers, where sound as a longitudinal wave, is difficult to separate it from its medium of propagation. In this work, we present the analysis of air transparent window system which attenuates certain frequencies of sound but allows air to pass through freely based on the work by Kim & Lee [1], which makes use of modified Helmholtz resonators as seen in Figure 1. An equivalent fully parametrized model of the air transparent soundproofed window system, including porous media was implemented in COMSOL Multiphysics® software. Two sound sources were placed on one side of the window, both emitting sound waves of frequencies between 1 & 5000 Hz, and a sound level of 80 dB. A receiver was placed on the opposite side of the window to observe the sound response of the waves through the window system. The results of transmission loss through the air transparent window obtained from the COMSOL simulations closely matched the physical test data across a range of frequencies for two different sized Helmholtz resonators observed by Kim & Lee [1], as presented in Figure 2.

Reference

[1] Sang-Hoon Kim & Seong-Hyun Lee, Air Transparent Soundproof Window, arXiv:1307.0301 [cond-mat.mtrl-sci], 2013

Figures used in the abstract

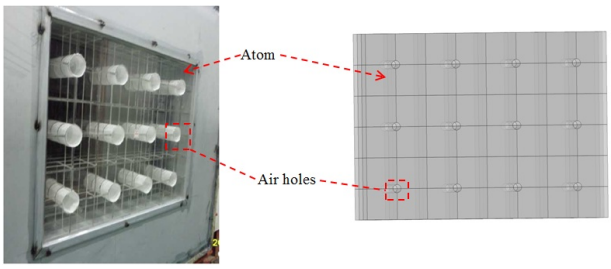

Figure 1: Air Transparent Window Illustrated Schematic of Helmholtz Resonator Cells from Kim & Lee[1] & The Implemented COMSOL Model of System

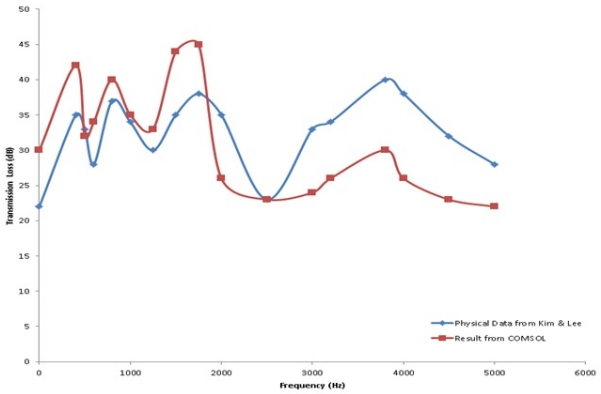

Figure 2: Comparisons of Transmission Loss vs. Operating Frequency from Physical Tests Obtained from [1] vs. COMSOL Model Results