Design of Sonic Crystal Windows for meeting the Trio Challenges of Providing Natural Ventilation, Daylight and Noise Mitigation

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Traffic, construction and noise from human activities are common noise sources in major cities. Excessive noise can cause stress and health impacts. Sonic crystals have been reported as noise barriers for the reduction of traffic and environmental noise. The main aim of the study is to investigate the phenomenon of sound attenuation in sonic crystals using computer simulations and experiments as well as the design of a window incorporating sonic crystals for traffic noise mitigation. Bragg's law is one of the governing laws that are used to predict the center frequency of the band gap whereby sound is attenuated. The proposed sonic crystal window structure is in the form of multiple arrays of tubular columns with suitable spacing to target noise reduction for the frequency range of interest. In addition, other features such as noise absorbing materials and Helmholtz resonators can be incorporated into the tubular structures. The space and openings through the periodic tubular structures ensure a balance of natural ventilation and daylight. Finite Element Method (FEM) is also used to analyze two-dimensional (2D) and three-dimensional (3D) models as close to reality as possible. Experiments were then carried out to determine the similarities and differences between experimental and simulation results.

Keywords: Sonic crystals, Noise mitigation, Environmental noise, Finite element analysis