



Name: Parthkumar G. Domadiya



PhD Thesis: Mitigation of structure borne noise in wooden panels by periodic stiffening. Aalborg: Department of Civil Engineering: Aalborg University, Unpublished.

Abstract: The PhD project is consorted with the research project "Silent Spaces". The goal of the project is to minimize noise and vibrations generated by, e.g., central heating, heat recovery and ventilation systems in the buildings, and methods of designing buildings and dwellings against sound and vibration from outside automobile, rail and air traffic. Current trend towards light-weight constructions may be of both economic and environmental benefit as it saves on material and transportation energy. The trend also requires development of new design tools against generation of noise because there is a very complicated, design-dependent trade-off between reduction of structural weight and reduction of the level of sound and vibration.

Walls and floors in light-weight timber structures are usually constructed as wooden panels. Depending on the geometry, material properties and boundary conditions, such panels may resonate at different frequencies within the audible range, leading to emission of noise. Furthermore, the panels may serve as waveguides, transmitting noise from one room to another or between floors. The objective of this research project is to minimize the transmission and emission by embedment of periodic stiffeners within the panels. Periodic structures have been studied in relation to pipes and similar one-dimensional structures. Here it has been found, that periodicity, introduced in the right manner, may diminish wave propagation significantly within prescribed frequency ranges. A similar result is expected for wooden panels, where vibrations caused by line sources as well as point sources (e.g. at joints or corners) should be analysed. The aim is to develop analytical solutions that can be utilized for design, employing a generalization of classical Floquet theory to functions with radial periodicity. A comparison with the results obtained by finite-element analyses should also be made.

Supervisor: Associate Professor Lars Andersen

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