Sound insulation of clamped single panel and infinite double panel system by addition of poro-elastic resonators

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Poroelastic lamellar metamaterial is proposed to face the sound transmission loss dip of the double panel wall. The metamaterial is a network of compressed melamine foam beams clamped to the panel. First, measurements of the sound transmission loss of a clamped single panel in a rectangular duct is performed. It is shown that the lamellar metamaterial increases significantly the sound insulation around the first bending resonance of the panel between 200 Hz and 400 Hz. Several sizes of poroelastic beams allows to spread the effect on a larger frequency range. Dissipation mechanisms are further studied by mean of a finite element model: structural and viscous dissipations dominate around the first beam resonance frequency while thermal dissipation increases slowly with frequency. The concept is then studied on a infinite size double panel configuration by mean of a periodic finite element model. The resonance of the metamaterial is tuned to the double wall resonance. The influence of some parameters like poroelastic material density and incident angle is discussed. To conclude, this work shows that the proposed concept is an effective way to avoid the sound transmission loss dip of a finite-size panel and a double partition in the low frequency range without adding discrete and heavy resonant systems. Moreover the poroelastic nature of the metamaterial allows to take advantage of both resonant and sound absorption properties.