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SOUND RADIATION OF LIGHT-WEIGHT SLABS AND MODELING ASPECTS FOR SUSPENDED CEILINGS

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ABSTRACT

In order to set up guidelines for the design of light-weighted ceilings for timber constructions to be used by engineers in practice, investigations based on both measurements and numerical models have been carried out [1, 2, 3]. The setup and the calibration of the numerical model of the structure are outlined briefly.

A semi-analytical approach for the prediction of radiated sound is presented, which is based on Integral Transform Methods. The method can be applied in the post processing of a Finite Element computation.

Thus as a first step the structure, consisting of a timber slab, a floating floor and a suspended ceiling, is built up in a Finite Element model, where the material properties of wood and the characteristics of the system are considered. The model is parameterized in order to enable computations with varying geometry and material parameters and calibrated with the help of measurements using model updating techniques.

The velocity pattern resulting out of the FEM computation is transformed from the spatial into the wavenumber domain and from the time into the frequency domain using Fourier Transform Methods. Applying this velocity pattern as a boundary condition to the Helmholtz Equation, which results out of the Fourier Transform of the wave equation, the wavenumbers, which fulfil the radiation condition, can be selected and the pressure field in the adjacent acoustic fluid can be computed. Due to the properties of the Fourier-Transform the radiated sound power can be calculated efficiently in the transformed domain out of pressure and velocity.

In a second part of the contribution the model for the air cushion in the suspended ceiling is discussed, where a FSI-model for the acoustic fluid and the structure is compared against engineering approaches using simplifications concerning mass distribution and transfer impedances between the individual nodes at the interface.

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