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Novel digitally-manufactured wooden beams for vibration reduction

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Abstract

The low modal mass and stiffness of timber floors impose a number of motion-control challenges to the structural designer. These difficulties can often led to the implementation of sub-optimal solutions, such as the addition of supplemental mass and stiffness in the form of concrete slabs, that conflict with the claimed sustainability and lightweight advantages of wood. In this paper, we present a novel beam configuration that enhances the vibration comfort response of timber flooring systems while retaining the original environmental benefits of wood in construction. By taking advantage of modern digital-fabrication tools, we devise, test and analyse new beam configurations that incorporate flexural resonators tuned to key structural frequencies of the system. These resonators are integrated into the body of the beam and the structure is sized to satisfy typical strength and stiffness demands. A series of numerical, experimental and parametric studies demonstrate the vibration absorbing capabilities of the new designs and the feasibility of their implementation to satisfy current occupant comfort criteria.

Keywords: building occupant comfort, wood, 3D printing, testing, band-gap structures

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