# Vibration serviceability performance of prefabricated cross-laminated timber steel rib composite floors

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## Abstract

Timber-based composite floors are gaining ascendancy as potential competitors with mainstream steel-concrete composites due to the increasing emphasis on sustainability in the construction industry. This paper investigates the vibration serviceability performance of an innovative prefabricated timber-steel composite floor module. The floor features a cross-laminated timber (CLT) panel joined to cold-formed steel beams using self-tapping screws as shear connectors. The vibration response of the floor module is simulated through the finite element method considering both modal and transient analyses, and its structural performance is evaluated using criteria specified in international design codes and standards. The results provide insight into the vibration behaviour of steel-timber composite floors in residential applications.

**Keywords:** Sustainability, vibration serviceability, CLT-steel composite, lightweight floors, prefabricated construction, finite element modelling

## 1 Introduction

Steel-concrete composite floors have been leading in the construction industry for several decades. However, there is a nascent paradigm shift towards environmentally friendly alternatives, chief among which are timber-based floor composites. Their foremost advantages include easier assembly, disassembly and reuse of components, and the reduction of on-site waste, assembly time and carbon emission.

Advances in material and construction techniques, such as seen in the development of engineered wood products and composite construction technology, have enabled the design of longer floor spans with less material and mass [1]. However, with floors increasingly becoming lighter, the spotlight is now on their vibration performance. The design of lightweight floors is mostly governed by their serviceability requirements, at the apex of which lies compliance with code-based criteria for vibrations [2]. Vibration due to human activity is considered the most prominent floor serviceability issue [3].

This paper focuses on the assessment of the vibration performance of an innovative prefabricated CLT-steel composite floor to provide insight into its dynamic performance under walking and jumping actions. Effects of boundary conditions, damping ratios and load paths on the floor's vibration performance are included.

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