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Bending, vibration and long-term performance of timber-concrete-composites floors

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Abstract

There is much potential for engineered wood products (EWP) to be used beyond low-rise residential construction when incorporating the notion of hybrid systems like timber-concrete-composites (TCC). The research presented in this paper experimentally determined the bending, vibration and long-term performance for a range of TCC systems in several EWPs. Strength and stiffness properties were validated on small-scale shear tests. Subsequently, full-size floor panels were tested for elastic stiffness and dynamic properties under quasi-static loading. Furthermore, floor panels are subjected to serviceability loads since summer 2015 with the environmental conditions and the deflections being monitored. This research provides insight to engineers into safely designing TCC floor systems for bending, vibration and long-term performance.

Keywords: Timber-concrete-composite; Hybrid construction; Multi-functionality.

1 Introduction

TCC systems are comprised of a timber element connected to a concrete slab through a shear connection. By combining the complimentary properties of timber and concrete, the performance of timber floors can be enhanced, including bending stiffness, load-bearing capacity, dynamic response, airborne sound transmission, structural fire rating, and thermal mass.

A large number of T-beam TCC systems existed for decades; however, the growing availability of panel-type EWP in North America offers greater versatility in terms of structural and building physics performance. While stiffness and strength design of TCC systems is straight-forward, there is little design guidance available in terms of vibration and long-term performance.

Hybrid systems that integrate different materials can significantly increase the applications of timber in structures, allowing current building code limitations regarding maximum number of stories to be revised. Since hybrid systems involve two or more materials, corresponding design procedures usually overlap different engineering codes and standards, rendering design and detailing challenging. The development of design guidelines is of fundamental importance to the industrial acceptance of novel hybrid solutions. Timber-concrete-composite (TCC) systems, a category of hybrid systems, were initially developed to refurbish historical buildings in Europe [1]. Research on TCC systems intensified and the resulting theories were applied in practice by the mid-1980s.

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