Abstract

Title: **Dynamic Response of Structural Timber Flooring Systems**

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Degree: **Doctor of Philosophy (PhD)**

Date: **October 2009**

The dynamic response of structural timber flooring systems can cause vibrational serviceability problems in terms of discomfort experienced by the occupants. A unified method to control timber floor vibrations has not been established to-date. The vibration problem is manifold. The complexity and the limited amount of research with respect to timber floor vibrations have shown an urgent need for further investigations.

This thesis has focused on the effects of structural and non-structural modifications on the dynamic performance of timber flooring systems by using experimental data from sixty-seven full-scale flooring systems for analytical investigations so as to identify structural configurations and vibration parameters, which are promising to further the design against disturbing vibrations. The collected data have also been used to identify weaknesses of current design criteria and to build and validate a finite element (FE) model for eigenproblem analyses of timber I-joist floors. The experimental work has been carried out with support from industry, and part of the investigations with respect to the design criteria has been conducted as Visiting Scientist within a Short Term Scientific Mission of COST Action E55 at VTT - Technical Research Centre of Finland in Espoo, Finland.

The significant effects of floor make-up and different configurations on their dynamic response are examined, with specific interest to stiffen dynamically sensitive locations targeted, and the most promising designs (configurations) are identified. The important effects of damping on the dynamic performance of flooring systems are addressed by determination of damping ratios from the full-scale experimental work. The results were then used to perform a series of statistical studies to identify and recommend more appropriate damping ratios for design of bare light-weight timber flooring structures based on a number of distinct structural properties. The computer-based finite element analysis has been successfully used to model a series of timber flooring systems incorporating timber I-joists for predicting modal parameters and their relative changes due to structural modifications. The analysis has demonstrated the significant influence

of assigning spring stiffness at the supports and at the interface of deck and joists on the floor responses.

Overall, this research has helped to achieve a much broader knowledge and greater understanding of dynamic response and vibrational characteristics of timber flooring systems, and has made a contribution to identifying improved structural design and furthering vibration prediction and assessment. Undertaking of any such measures and future work as suggested in this thesis could significantly contribute to the improvement of the structural design and the design to Eurocode 5 if results are incorporated in future revisions. This would lead to fewer nuisances for residential occupants and enhanced quality of life.