School of Computing, Engineering, and the Built Environment
Edinburgh Napier University

PHD STUDENT PROJECT

Funding and application details

Funding status: Self-funded students only

Application instructions:
Detailed instructions are available at https://www.napier.ac.uk/research-and-innovation/research-degrees/how-to-apply

Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.

Project details

Supervisory Team:
- DIRECTOR OF STUDY: Dr Aamir Khokhar (Email: A.Khokhar@napier.ac.uk)
- 2ND SUPERVISOR:

Subject Group: Built environment

Research Areas: Civil Engineering, Structural Engineering, Structural Mechanics, Timber Engineering

Project Title: Human Induced Vibration in Floors – an Investigation to assess influence of construction parameters on vibrational performance of residential timber floors

Project description:

Traditional timber floor systems are usually composed of a series of parallel timber joists (eg. solid and engineered I-joist or laminated veneer lumber) which support wood-based sheathing. This produces a lightweight two-way rib-stiffened structural system. Due to this, timber floors have a tendency to produce high level of vibration when excited by human footfalls. When such high amplitude of vibration occur they can cause discomfort in the occupants. High level of vibration is strongly influenced by the across-joist (transverse) construction details. Enhancing stiffness across the

joist (transverse) direction has been found to be an effective means, to some extent, of mitigating excessive vibration levels in wood floors [1]. Various construction methods have been introduced to increase the transverse stiffness. Examples of such are reducing the spacing of floor joists, adding an extra layer of wood sheathing or concrete topping or adding additional partition walls. Moreover, investigators have reported that adding a row of between-joist bracing spin along the width of the floor at mid-span is the most economical and effective approach [2]. However, despite their widespread application the mechanisms by which the above construction parameters function have not been fully elucidated. Hence, their performances have not been optimized.

The overarching aim of the project is to investigate the influence of optimum effectiveness of construction parameters to obtain satisfactory vibrational performance timber floors. This will be delivered by experimental and numerical approaches. It is widely known that controlling static deflection under a point load at the floor centre and increasing natural frequencies are reliable indicators of the vibrational serviceability of timber floors [3]. Therefore, a series of solid and engineered wood joisted floors will be tested under static and dynamic loads. The influence of geometric arrangements and rigidity of construction parameters and their connection stiffness to joists will be studied. These tests will assist in looking at how modification of construction parameters enhances the transverse stiffness and at what extent influences on static deflection and natural frequencies. Based on test results, analytical and numerical models will be developed to investigate further the vibrational performance of timber floors.

The results from experimental and numerical studies will be used to develop a generalised approach that can be used in predictive models to calculate the structural response of timber floors to static and dynamic loading conditions and can be incorporated into a design procedure for controlling vibration in wood-based floors. This research will provide an in-depth understanding of the vibrational performance of timber. This could be a valuable contribution in timber structures, especially, for industry and for design codes.

References:

[1] Onysko., DM. 1985. “Serviceability criteria for residential floors based on a field study of consumer response” Project 03-50-10-008, Forintek Canada Corporation, Ottawa, Canada.

[2] Khokhar, A., Chui, Y., & Smith, I., 2019. “Influence of between-joists bridging elements on the static and dynamic response of wood joisted floors”. Engineering Structures, 188, 362-368

[3] Smith. I. & Chui. Y., 1992. “Construction methods for minimizing vibration levels in floors with lumber joists” Canadian Journal of Civil Engineering. 19,833-841.

Candidate characteristics

Education:

A second class honour degree or equivalent qualification in Civil Engineering, Timber Engineering, Mechanical Engineering

Subject knowledge:

- Structural Mechanics
- Structural Analysis
- Finite Element Modelling

Essential attributes:

- Experience in fundamental experimental work
- Competent in structural analysis, structural mechanics
- Knowledge of timber as an engineering material, Eurocodes
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes: