

2011/12 Undergraduate Research Grant Scheme – Executive Summary

Project title:

Data-driven forcing model to estimate dynamic response of high-frequency floors to footfalls

University:

University of Sheffield

Supervisor:

Dr Vitomir Racic

Contact details:

Address: Department of Civil and Structural Engineering, Sir Frederick Mappin Building, Mappin Street, Sheffield, S1 3JD

Telephone: 0114 222 5790

Email: v.racic@sheffield.ac.uk

Student:

Alice Bleach

Project summary:

In the design of high-frequency floors, in particular in buildings which house vibration sensitive equipment, factoring in the influence of human footfalls on the vibration serviceability is of vital importance. However, footfall models available in the state-of-the-art design guidelines are derived from single footfall records yielding unreliable predictions of floor vibrations.

This study made a step forward by establishing a unique database of continuously measured footfall signals, generated by a number of individuals walking on an instrumented force measuring treadmill at a wide range of walking speeds. The force records were then mathematically modelled and the model was used to predict dynamic response of a floor structure described as a single degree of freedom (SDOF) system with variable natural frequency and damping.

The responses generated showed that resonance can occur in floors close to the high-low frequency cut-off (i.e. 10 Hz) and that damping was therefore still a significant factor. Furthermore, the results showed that the footfall model developed can predict more reliably vibration response of high-frequency floors than its counterpart available in the current design guidelines. It was also found that the shoe-type worn can influence the walking forces generated, thus impact upon the floor response.