

2011/12 Undergraduate Research Grant Scheme – Executive Summary

Project title:

Vandal loading on bridges

University:

Warwick University

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Project summary:

Current trends in footbridge design have led to structures of increasing length and slenderness. Footbridges are having lower natural frequencies and are becoming more susceptible to excessive excitation from dynamic forces induced by human activities.

One of the largest uncertainties faced by footbridge designers originates from a lack of information about what excessive loads are humanly achievable. These loads are normally associated with that of a group of vandals.

A study was undertaken to quantify empirically dynamic loads induced by “vandals” jumping and bouncing in. Using a GAIT lab and an optical marker tracking system it was possible to measure the combined forces generated and to determine the ability of test participants to synchronise between themselves. The experiments were conducted with 12 participants at frequency range of 1.5 – 3.5 Hz for jumping and 2.0 – 4.0Hz for bouncing at 0.5Hz intervals.

It was found that the greatest degree of synchronisation for jumping was achieved at 2.0Hz. Bouncing in comparison exhibited better synchronisation overall. Due to a lack of perfect synchronisation Dynamic Load Factors for the first two harmonics are consistently lower for pairs than for individuals and therefore the dynamic load from vandals is always less than a simple sum of peak loads produced by individuals.