Pedestrian-induced lateral forces on footbridges

This paper investigates the phenomenon of excessive pedestrian-induced lateral vibrations as observed on several high-profile footbridges. The vibrations are a consequence of human-structure interaction, in which the forces generated by the pedestrians depend strongly on the vibration of the underlying pavement. An extensive experimental analysis has been carried out to determine the lateral forces generated by pedestrians when walking on a laterally moving treadmill. Two different conditions are investigated; initially the treadmill is fixed and then it is laterally driven in a sinusoidal motion at varying combinations of frequencies (0.33-1.07 Hz) and amplitudes (4.5-48 mm). The component of the pedestrian-induced force which is caused by the laterally moving surface is herewith quantified through equivalent velocity and acceleration proportional coefficients. It is shown that large amplitude lateral vibrations are the results of correlated pedestrian forces in the form of negative damping, with amplitudes that depend on the relationship between the step frequency and the frequency of the lateral movement.

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