

CIVIL RESEARCH GROUP SEMINAR

Wobbly Bridges & Why People Don't Fall Over?

Speaker: Dr John Macdonald, University of Bristol

Tuesday, 11 Nov. 2014, 5pm, A401, seminar open to all

ABSTRACT

On its opening day, the London Millennium Bridge experienced unexpected large oscillations due to crowd loading. This form of pedestrian-structure interaction has since been identified on several other bridges of various structural forms. The mechanism has commonly been attributed to 'pedestrian synchronous lateral excitation'. However, some site measurements show a lack of evidence of pedestrian synchronisation, including on the Clifton Suspension Bridge, results from which will be presented. In contrast to other research on the dynamic excitation, the approach to be presented considers the basic mechanism of human balance, adopting a simple model from the biomechanics field. This gives the surprising result that pedestrians walking randomly, keeping balance as normal, can effectively act as negative dampers to the bridge motion. This is in agreement with the empirical model developed by Arup from measurements on the London Millennium Bridge, leading to divergent amplitude vibrations above a critical number of pedestrians. Recent results from a state-of-the-art instrumented oscillating treadmill rig will also be presented, which compare favourably with the proposed model.

ABOUT THE SPEAKER

John Macdonald graduated with the ICE student prize from Cambridge in 1990. After 4 years with Scott Wilson (now part of URS), principally working in structural design, he commenced his research in structural dynamics at the University of Bristol. He was awarded his PhD in 2000, based on full-scale monitoring and analysis of vibrations of the Second Severn Crossing cable-stayed bridge. Part of this work directly contributed to a vibration mitigation solution for the bridge and was awarded the ICE Coopers Hill War Memorial Prize. He is now a Reader in Structural Dynamics in Bristol and has recently held an EPSRC Advanced Research Fellowship on the dynamics of slender structures, such as long-span bridges and cables, particularly focussing on wind and human-induced vibrations. He has acted as a consultant on vibrations of various structures, including the Clifton Suspension Bridge, Avonmouth Bridge and Bosphorus Bridge. He is a member of the Executive Committee of the Wind Engineering Society, was Chairman of the Scientific Committee for the 6th European and African Conference on Wind Engineering and is Subject Editor for human and human-induced vibrations for the Journal of Sound and Vibration.

