

## Millennium Bridge, UK



This unusual 330m shallow suspension pedestrian bridge was a competition winning bridge for the London Millennium Bridge Trust and is the first new crossing over the River Thames for more than a hundred years. It comprises of transverse steel ribs between the cables supporting discontinuous longitudinal stringers and a lightweight aluminium deck.

The construction cost of this bridge was in the region of £18 million including subsequent remedial works. The bridge was closed three days after opening in 2000 due to excessive vibration problems and was then nicknamed "The Wobbly Bridge". The reason for closure was that immediately upon the opening of the bridge pedestrians were struggling to stand up as attempting to cross the bridge as the bridge started to exhibit large lateral dynamic motions.

Flint and Neill Limited were then appointed by the designers to provide specialist advice with regard to the vibration problems. Our role included:

- Non-linear dynamic response analysis.
- Investigation and evaluation of the nature of the synchronous pedestrian excitation phenomenon.
- Investigation of other potential influences on the response, including those due to wind excitation, in order to rule out non-critical behaviour modes.
- Development and evaluation of various potential damping solutions.

Our investigations showed that the vibration problems were arising from lateral excitation from pedestrians when they walked in step with the swaying motion of the bridge in such a way as to cause synchronous "lock on" effects. The low mass and damping of the bridge resulted in large amplitudes of vibration.

Additional structural damping was installed and the bridge was successfully re-opened in late 2001.

