VIDEO ARTICLE

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Vibration Serviceability of Modern Pedestrian Structures

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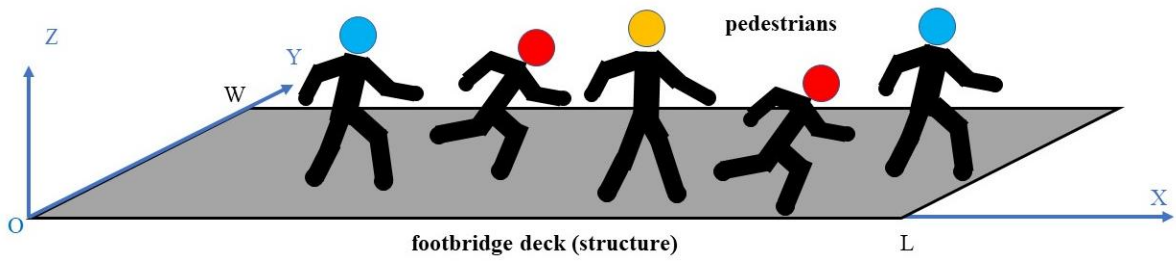
Graphical Abstract



Abstract

Pedestrian structures, e.g. footbridges, are important infrastructures. Modern pedestrian structures tend to apply lightweight and high-performance construction materials. On the one hand, the application of modern materials realizes the needs of aesthetic shapes and large open spaces for these structures. For instance, the glass is increasingly applied to footbridge decks built in scenic regions to attract tourists. However, the application of modern materials also leads to the slenderness of these structures, of which the natural frequencies are close to human-induced excitation frequencies. In other words, modern pedestrian structures are often sensitive to human-induced excitations. Excessive vibration levels of the structures may be excited under human-induced loads. To ensure the safety and the comfort of the pedestrians, it requires to control the vibration levels within the relevant comfort limits. Thus, vibration serviceability under human-induced loads often governs the dynamic design of modern footbridges. It is essential to understand the vibration serviceability of modern pedestrian structures. This presentation provides an overview of the recent advances in the vibration serviceability of modern pedestrian structures. First, the basic design criteria of modern pedestrian structures are reviewed. The corresponding drawbacks of the current codes and guidelines are pointed out. Next, some basic research effects are summarized: for instance, how to simulate realistic walking behaviour of the pedestrian crowd on a footbridge; how to consider the crowd behaviour in the design of pedestrian structures; how to characterize or model the dynamic properties of pedestrian structures; how to take into account the uncertainty of the structure model and the crowd load model; how to reliably predict the vibration levels of the structure during the passing of a pedestrian crowd, etc. This lecture may provide some new insights and inspirations for future fundamental research and industrial applications in the relevant domain of the structural dynamics and vibration serviceability of pedestrian structures related to emerging materials.

Keywords: Lightweight and slender footbridges; vibration serviceability; human-induced vibrations; crowd behaviour; modern construction materials.

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Biography of Presenting Author

Xinxin Wei receives his engineering education, academic training, and professional experience in China (e.g., Tongji University in Shanghai) and European (e.g., KU Leuven in Belgium and RUB in Germany). His research interests mainly include crowd dynamics, human-structure interaction; structural dynamics (e.g., human-induced vibrations), vibration serviceability evaluation, structural system identification and vibration control of civil structures; machine learning applications in civil engineering; uncertainty propagation and uncertainty quantification in civil structures, etc. His research results are published in top-tier journals, e.g., Mechanical Systems and Signal Processing, ASCE-Journal of Bridge Engineering, Structural Control & Health Monitoring, International Journal of Structural Stability and Dynamics, etc. One of his papers is the 'Most Read' paper in the Journal of Bridge Engineering. He develops several research toolboxes and patents for fundamental research and industry applications. He serves as reviewer for international journals, session chair and organizer for international conferences, working group member for international association, (co-)teacher of civil engineering courses for master level students, and (co-)supervisor for several master theses. He is invited speaker for several international conferences and seminars. He also has many opportunities to be involved in engineering projects. He is recognized by being awarded Excellent Scholar Award, Excellent Presentation Award, State Scholarship Fund, etc.

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