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Experimental investigation on the galloping instability of a long-span suspension footbridge

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ABSTRACT

The static and dynamic tests of a 1:10 section model in a wind tunnel were conducted in order to investigate the aeroelastic stability of a long-span suspension footbridge (prototype section), as well as to propose the corresponding aerodynamic countermeasures. First, dynamic response tests of the prototype model in vertical and torsional motions were carried out for three angles of attack (α = 3°, 0°, -3°). The results show that the galloping instability occurs at α = 3° and 0°, observed for the first time. Then, several aerodynamic countermeasures are proposed to improve the bridge stability and confirmed by the dynamic tests of the model. It is found that the openings set on the vertical web of section model (web openings section) prevent the galloping effectively for all three attack angles. Finally, the static tests of both prototype and web-opening models were performed to obtain the aerodynamic coefficients, which were further used to investigate the galloping mechanism by applying the Den Hartog criterion. The Den Hartog coefficient of the prototype is negative for α = -2° to 7°, the minimum value being -1.93, suggesting negative aerodynamic damping, while that of the web-opening model was negative only for α = -2° to 0°, the minimum being -0.12.

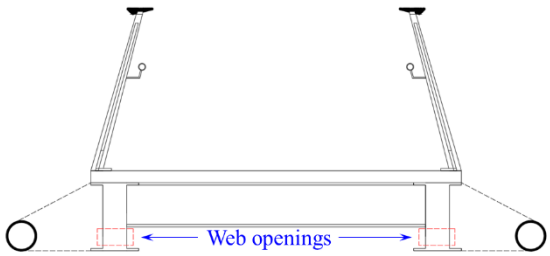

Fig. 1 Schematic diagram of openings on the vertical web

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