Wind effects of a pedestrian arch bridge with complex shape

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Abstract

The pedestrian bridge over the Swan River in Perth (Australia) is designed to be a three-span arch structure. A unique feature of this bridge is that each span has two crossed arches with triangular cross-sections that vary dimensions along the arch. In addition, two cantilever extensions are connected to the crown of the central arch for aesthetic purposes. For this kind of unique structures, with complex shape and bluff sections, wind effects are challenging and their effects should be studied by wind tunnel tests, as required by most design codes. Both static and dynamic wind loads were studied in wind tunnel using scale models of the full bridge (rigid model in 1:50 scale), of portions of the arches (two aeroelastic sectional models in 1:15 scale), and of the deck (one aeroelastic sectional model in 1:10 scale). Experimental results are analysed and a procedure to assess wind effects on the whole structure is outlined.

Keywords: arch bridge; wind; vortex-induced vibrations; vibration mitigation; wind tunnel testing; scale model

1 Introduction

The pedestrian bridge over the Swan River in Perth (Australia) is designed to be a three-span arch structure, with a total length of 376 m (with a 165 m long main span). A unique feature of this bridge is that each span has two crossed arches with triangular cross-sections that vary dimensions along the arch. In addition, two cantilever extensions are connected to the crown of the central arch for aesthetic purposes. A perspective view of the general layout of the structure is reported in Figure 1, while in Figure 2 some typical cross sections along the arches are shown.

For this kind of structures, with complex shape and bluff sections, wind effects are challenging and they must be accurately studied during the design stage. As a matter of facts, due to the uniqueness of the structure, design codes require the support of wind tunnel tests on a scale model of the bridge, to assess more accurately static and dynamic wind actions [1][2].

Considering the complex shape and the lightness of the structure several aerodynamic issues should be assessed: global and distributed static loads on the whole structure, wake effect on the arches, vortex-induced vibrations (VIV) and aerodynamic stability of the deck, of the arches, of the cantilever extensions. To this end, several scales models were

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