Vortex-induced vertical vibrations on twin box sections

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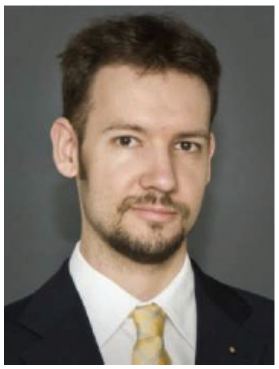

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Summary

Vortex shedding from bridge decks can lead to significant aerodynamic excitation of the structure. This is a limited amplitude phenomenon, which however can be critical to the serviceability of the bridge or lead to fatigue damage. For structures sensitive to vortex shedding an adequately realistic assessment of the problem is required.

A particularly challenging case is presented by twin boxes, where wake effects form the upstream section can affect or even cause vortex-induced oscillations. The upper steel arch bridge of Alconétar (2006, Cáceres, Spain, 220 m main span) has suffered from such excitation phenomena.

Numerical simulations of the fluid flow provide a further method for modelling the physical problem. Such methods are gaining popularity in the field of civil engineering because of their growing reliability provided by the implementation of new computational methods and the availability of more powerful computational resources.

This paper presents computational fluid dynamics simulations of the vortex-induced vertical vibrations of twin sections using the Vortex Particle Method. Different excitation mechanisms are described and the case of the Alconétar Bridge is studied.

Keywords: *bridge, aerodynamics, vortex-induced vibrations, twin box, tandem, CFD, Vortex Particle Method, Alconétar*

1. Introduction

In January 2006 a vortex-induced vertical vibration episode was observed on the Alconétar Bridge (220 m of main span, Cáceres, Spain) after the completion of one arch. Two rectangular variable depth boxes in tandem arrangement braced by X-trusses form each of the two arches. The wind began to blow at an average horizontal speed not exceeding 30 km/h and continued for more than two hours with reduced turbulence. The maximum amplitude reached up to 80 cm in the vertical axis and seriously threatened the structural stability of the arch, which could resist the wind action through the braces. Aerodynamic studies were conducted – sectional models on wind tunnel tests - and a number of deflectors were added along the whole arch to avoid or minimize such problem. Vibration episodes have not occurred again since the bridge was erected.

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