STUDIES FOR CONTROLLING HUMAN-INDUCED VIBRATION OF TWO NIELSEN-TRUSS FOOTBRIDGES IN MALAGA (SPAIN)

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Summary

This paper describes the design, construction and dynamic control of two new Nielsen-Truss footbridges in Malaga (Spain), over two important highways, MA-21 and A-7. The footbridges are two Nielsen-Truss footbridges of different spans between 45 and 70 m, with a reduced variable depth decreasing from the centre to the end. It was no possible to make a static test of the footbridges, so the client has asked for a dynamics and modal analysis test. This was based on analysing the response of the structure to human-induced dynamic loading by pedestrian movement (walking, running or jumping). Vibrations derived from such human-induced loads can cause disturbance to pedestrians or, in some cases, resonance of the structure. Different phenomena can to light through these tests, looseness in footbridge articulations, solid friction on the expansion joints and sliding bearings. The performance of the test has considered the identification of critical natural frequencies and damping ratios, the measurement of response induced by one pedestrian, the measurement of the response induced by a small group of pedestrians and the measurement of the response induced by a continuous flow of pedestrians. These analyses were then used to re-verify the structural project.

Keywords: Nielsen-Truss footbridge; Aesthetics; Ambient vibration testing; Enhanced frequency domain decomposition (EFDD); Stochastic Subspace Identification (SSI); Finite element model updating; Operational modal analysis; Peak picking (PP).

1. Introduction

The modern trend to construct light and slender footbridges has brought engineers the need to control the vibration problems associated with human-induced walking. Longer spans have shown proneness to the “lock-in” phenomenon, associated with the lateral effects of pedestrian excitation. In effect, independently of the structural type chosen, the natural frequencies of the first two lateral modes of these footbridges most likely fall in the critical frequency of 0.50-1.25 Hz [1].

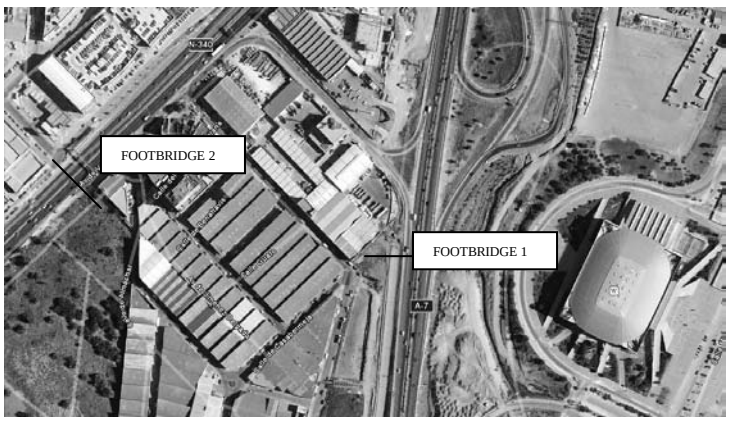

Fig.1: General Situation.

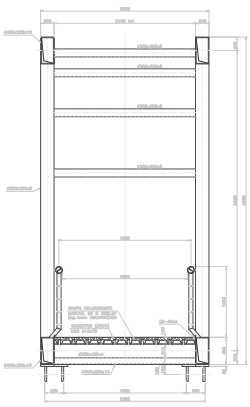

Fig. 2: Footbridges Cross Section

https://doi.org/10.2749/222137810796063607