Dynamic Monitoring of a roadway bridge supported by a plain concrete arch

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Summary

The bridge under study is an arch bridge built in 1940, whose main structural element is a concrete arch without reinforcement that spans 80 m. Since it is one of the bridges with larger span constructed in Portugal during the Second World War period, involving a plain concrete arch, this bridge is an important Portuguese landmark. Due to the construction of a new hydroelectric power plant in the vicinity of the bridge, the bridge was equipped with a vibration based Structural Health Monitoring system, in order to continuously observe the impact of the construction activities on the structural integrity of this historical bridge.

This paper presents the main characteristics of the structure and of its monitoring project, including a description of the monitoring hardware and software that is complemented with the analysis of the results associated with more than two years of continuous tracking of the bridge modal parameters.

Keywords: dynamic monitoring; structural health monitoring; arch bridge; modal analysis; temperature effects.

1. Introduction

This study is focused on an arch bridge built in 1940, which is composed by a roadway deck supported by a concrete arch without reinforcement that spans 80 m over the Tua River, a tributary of the Douro River, in the Northeast of Portugal. Thanks to the peculiar characteristics of the structure, its age and its location in a particularly interesting valley in a region classified as UNESCO World Heritage, it is considered an important Portuguese landmark (Fig. 1).

In 2011, it was started the construction of a new hydroelectric power plant at Tua River, with a dam about 600m apart from the bridge to the upstream direction (Fig. 2). As it can be observed in the plan presented in Figure 3, the power house, the substation and the water outlet are adjacent to this bridge. Furthermore, since the dam is also going to be used to store water pumped from the Douro River, the river bed below the bridge is being deepen in order to create an adequate channel from the Douro River to the water outlet.

Therefore, before the beginning of the construction of the power plant, in June 2011, the Laboratory of Vibrations and Structural Monitoring (ViBest, www.fe.up.pt/vibest) was contracted to equip the bridge with a vibration based Structural Health Monitoring system, in order to continuously observe

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