IABSE Symposium 2019 Guimarães
Towards a Resilient Built Environment - Risk and Asset Management
March 27-29, 2019, Guimarães, Portugal

Ambient Vibration Testing, Dynamic Identification and Model Updating of a historical bridge.

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Abstract

The proper maintenance of bridges is nowadays fundamental and unavoidable. These structures have to be preserved and technical works are usually essential to ensure its correct preservation. In this respect, it is common to use the finite element method as a numerical technique to assess the structural behaviour of this type of structure. However, when it comes time to face a historical construction, it is well known the high level of uncertainty surrounding the definition of the parameters that characterize it. Material properties, connections between structural parts or construction process are aspects that can cause significant changes between the classical numerical results and those experimentally identified. Among non-destructive techniques, finite element modal updating allows for adjusting the numerical model on the basis of dynamic characterization of the structure. This study presents the implementation of this process on the bridge of Posadas (Cordoba, Spain), a historic construction designed by the famous engineer Eduardo Torroja in 1957. The singularity of this historical construction lies in its special configuration, a concrete deck with inverted bowstring steel trusses, which can only be found in two other examples in Europe.

Keywords: Operational Modal Analysis; non-destructive technique; model updating; genetic algorithm; historical bridge; dynamic characterization.

1. Introduction

Nowadays, a great concern exists about the correct conservation of historical bridges. This is not only for its important cultural and artistic value, but also for security reasons. Hence, the evaluation of their structural health is basic. In the last decades, the huge advances in computer science has made possible to afford the calculations of detailed finite element models to evaluate the safety of this kind of structure. But creating a mathematical model that exactly reflects the behaviour of such complex structures presents many difficulties, as replicate the geometry, characterize the properties of materials or introduce the boundary conditions, among others.

It is well known that the identification of modal parameters of a structure (natural frequencies, vibration modes and damping ratios) by means of non-destructive dynamic techniques presents great interest in the field of building numerical models: the models can be calibrated by the experimental data. To this end, some mathematical algorithms are needed. The calibration of the model implies the comparison of the theoretical

https://doi.org/10.2749/guimaraes.2019.0152
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