

Operational Modal Analysis for Structural Condition Evaluation of a Bridge

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ABSTRACT: This paper addresses the subject of structural condition evaluation based on the dynamic characteristics experimentally evaluated. A study is presented, that was developed in a bridge, with more than 30 years of service, which has clearly visible cracks in the piers, as a result of expansive reactions in the concrete, as well as other structural deficiencies. In this bridge, dynamic characterization tests were carried out in order to perform a better evaluation of its structural condition and to quantify the effects of the visible damage in the global structural behavior. The dynamic tests are described and the identified dynamic characteristics are compared with the ones computed with finite element models, so that some conclusions can be derived in what concerns the structural condition of the bridge.

1 INTRODUCTION

Structural condition evaluation is one of the potential applications of the experimental identification of the dynamic properties of structures. In this domain, several studies and research projects have been developed, both in laboratory and in real structures that were going to be decommissioned, to check the potential of considering the dynamic characteristics for structural condition evaluation and damage detection (Kato and Shimada, 1986; Kramer et al., 1999; Feltrin, 2002; Maeck and De Roeck, 2003). If the modal identification is performed with the data collected from ambient vibration tests, then this approach can be applied without introducing restrictions to the normal use of the structures, which means, in the case of bridges and viaducts, without traffic interruptions. The dynamic characterization tests can, therefore, be considered as a non destructive testing technique that can be applied to evaluate the dynamic parameters that reflect the global structural behavior of constructions.

For vibration based inspection and monitoring of structures it is generally required that an initial condition or virgin state (Rytter, 1993) characterization is performed, when the structures are intact and clearly undamaged. This implies that dynamic tests should be performed shortly after the end of the construction, in order to do a dynamic characterization as complete as possible. This is one of the objectives, to which due consideration has been given, in the great majority of the reception tests of bridges and viaducts performed by the Structures Department of LNEC, in which the authors have been actively involved in recent years.

When performing studies of structural condition evaluation of constructions with already a large number of years of service, the most common situation is, however, that the referred initial dynamic characterization was not performed, which, of course, creates difficulties in the consideration of the dynamic characteristics for the objective of those studies. In these cases, one way to try to take some conclusions about the condition of a structure, from the experimentally identified dynamic characteristics, is to compare these with the ones computed with analytical or numerical models of the structures that are being evaluated (Koh and Perry, 2010). However,