Recent Advances in Dynamic Testing and Continuous Dynamic Monitoring of Large Bridges

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Summary

This paper shows the current potential of Dynamic Bridge Testing techniques by presenting recent applications developed at the Millau Viaduct (France) and at the Humber Bridge (UK), and stresses the usefulness of Continuous Dynamic Monitoring, by describing fully automatic implementation in two recently constructed bridges in Portugal (Infante D. Henrique Bridge and Pedro e Inês footbridge, controlled with TMDs), enabling not only the automatic issuing of alert messages whenever some undesirable threshold is exceeded, but also vibration based damage detection using natural frequency shifts, after removing the influence of factors like temperature and traffic intensity on the modal properties.

Keywords: ambient vibration tests; modal identification; continuous dynamic monitoring; alert systems; damage detection.

1. Introduction

During the last few decades, the performance of dynamic tests in large bridges (e.g. cable-stayed or suspension bridges) has been made using centralized dynamic measurement systems, requiring the cumbersome use of very heavy and expensive exciters and kilometers of electric cables, and employing simple identification techniques, with limited degree of accuracy and objectivity.

Recent technological advances in the field of dynamic measurement equipments for ambient vibration testing of large Civil structures (e.g. extremely low noise high sensitive accelerometers, high resolution A/D converters, time synchronization with GPS, etc), together with remarkable progress in output-only modal identification techniques, have opened very promising perspectives for Dynamic Testing of Large Bridges and Special Structures along different phases of their life cycle (construction, commissioning, normal service or rehabilitation) [1] [2].

In addition, very recent developments have also been made towards the integration of such hardware and software tools in modern continuous dynamic monitoring systems [3] (either working as alert systems or used for vibration based damage detection), allowing completely automatic and objective processing of all data regularly recorded at different large structures and transmitted through the Internet.

In this context, the main objective of this paper is two-fold: (a) to show the current potential of Dynamic Testing techniques by presenting recent applications developed on two outstanding large structures, the Millau Viaduct (France) and the Humber Bridge (UK); (b) to stress the usefulness of Continuous Dynamic Monitoring systems, by describing their fully automatic implementation in two recently constructed bridges in Portugal (Infante D. Henrique Bridge and Pedro e Inês footbridge, controlled with TMDs), enabling not only the automatic issuing of alert messages whenever some undesirable threshold is exceeded, but also vibration based damage detection using natural frequency shifts, after removing the influence of factors like temperature and traffic intensity on the modal properties.

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