39th IABSE Symposium – *Engineering the Future*
September 21-23 2017, Vancouver, Canada

On the use minor and non-destructive methods for the safety evaluation of an historic RC bridge: the Bôco Bridge

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Abstract

Currently in use, the Bôco Reinforced Concrete (RC) Bridge, built in the early of 20th century, is one of the oldest RC bridges in Portugal. Its initial structural system, erected following the Hennebique system, was retrofitted in the 1960s to support heavy traffic, increasing the section of its structural components. However, the low quality of implemented retrofitting solution has promoted the presence of pathological processes, mainly concrete spalling and steel corrosion. In this context, the present paper shows the first results obtained during the second experimental campaign carried out on the bridge. This campaign comprised the use of several minor and non-destructive methods (laser scanning, operational modal analysis, and laboratory material characterization and mechanical tests), with the aim of improving the knowledge of the bridge and create an accurate numerical simulation (by means of Finite Element Model) to evaluate the safety level of this bridge. Results derived from this campaign, show a bridge with high load capacity, verifying the Ultimate Limit State.

Keywords: Historical construction; Reinforced concrete; Laser Scanning; Ambient Vibration Tests; Finite Element Model Updating; Safety analysis.

1 Introduction

Nowadays, transportation networks are one of the most important infrastructures of a development country. Inside the wide structural typologies presented on these networks, bridges are the most expensive and vulnerable elements [1], for which one of the most used and extended materials is the Reinforced Concrete (RC) [2].

This vulnerability, in the case of RC bridges, arises from the combination of multiple factors [3]: (i) aggressive environments, with high presence of humidity and melting salts; (ii) the concrete´s porosity; and (iii) the volumetric expansion experimented during the corrosion of the steel bars, promoting the cracking of concrete as well as the losing of mechanical adherence between it and the steel bars [4], thereby reducing the service life and structural capacity of these structures.

https://doi.org/10.2749/vancouver.2017.1058
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