PAPER REF: 4074

# ASSESMENT OF THE STRUCTURAL BEHAVIOUR OF A REHABILITATED IRON PLATFORM ("EL CABLE INGLES") BY THE APPLICATION OF OPERATIONAL MODAL ANALYSIS AND MODEL UPDATING

**Javier Fernando Jiménez Alonso**[(*)], **Andres Sáez Pérez**

Department of Continuum Mechanics and Structural Analysis, University of Seville, Seville, Spain

[(*)]*Email:* jfjimenez@us.es

## ABSTRACT

The main purpose of the present contribution is to validate the structural behaviour of an iron platform, built in the earliest of the last century, and which has just been rehabilitated for pedestrian use (balcony to the sea). Due to the size of the structure and its location on the bay of Almeria, the quantification of the success of the structural rehabilitation has been made by the identification of the dynamic characteristics of the loading platform under the ambient excitation. Once these parameters are been known, a finite element model of the structure, previously performed with normative values of the different constituent elements, has been updated. The updating process was based on the minimization of the mean square error between the dynamic characteristics of the experimental and numerical structure, considering as system variables the change of the modulus of deformation of the ground and some structural elements from the platform.

***Keywords:*** operational modal analysis, model updating, early twentieth century structure, rehabilitation.

## INTRODUCTION

The structure, known as "El Cables Ingles" (Fig. 1), is a mineral loading platform located in Almeria (Spain) that belongs to the society "The Alquife Mines and Railway Company Limited", and it's an example of the iron architecture from the earliest of the century XX. Its construction was completed in 1904 and linked the railway station to the port. Its design, that had an eclectic style, characterized by the use of new materials, followed the guidelines of Gustave Eiffel's school. In 1998, the platform was declared a cultural interest monument from Andalucía. Subsequently a project, for its rehabilitation and use, was drafted. Two phases of action were defined. First, the process of consolidation and strengthening of the structure, and secondly, its transformation into an exhibition center, with a restaurant and a leisure complex. In addition, its deck will be used as a viewpoint to the bay. In September 2012, upon the rehabilitation work had finished, the Property requested to the Department of Continuum Mechanics, University of Seville, a study of the actual behaviour of the structure in order to validate the test results presented by the construction company.

## RESULTS AND CONCLUSIONS

Due to the constraints, size and location, imposed by the platform, it was decided to conduct this study by adjusting a detailed finite element model of the mineral loading, from the dynamic characteristics of the structures identified by an operational modal analysis.

First, the detailed finite element model (FEM) was carried out (Zivanovic, S 2006). Secondly, an ambient vibration test was conducted to characterize the dynamic behaviour of the structure by the application of two algorithms, frequency and time domain (Magalhaes, F. 2010). In order to correlate the experimental dynamic results and the analytical finite element model, such model was adjusted using the model updating techniques to actualize the theoretical models from dynamic measurements (Friswell, M.I 1995 and Teughels, A. 2003). The parameters considered in this setting were the modulus of elasticity of the different elements of the platform (Ferreira, J.L. 2007) and the coefficient of horizontal stiffness around the piles (Caetano E. 2009).

Fig. 1 - Lateral view of "El Cables Ingles" structure.

As a result of the study, there isn't any area whose modulus of deformation has an anomalous value, and therefore the performance on the structure can be valued as adequate.

## ACKNOWLEDGMENTS

The authors are pleased to acknowledge the Property and the Architect (Mr Ramón de Torres), for the support and the availability supplied during ambient vibration tests. Author's special thanks are also addressed to Mr Javier Garrido, Head of Plannig of Almeria city.

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