Using an ambient vibration test to identify damage in a sculpture

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Abstract

This paper describes the studies conducted to assess damage in a sculpture. These include a numerical model and an ambient vibration test based on a dense mesh of points to identify the fundamental natural frequencies and the corresponding modal shapes. From the comparison between identified and calculated modal parameters, it was possible to identify a region of inflexion of curvatures of the second-order vibration modes at a particular location that was associated with a local fragility of the structure. A posterior removal of the cladding evidenced a highly degraded area at this location.

Keywords: Damage identification; Ambient Vibration; Numerical model.

1 Introduction

The study focuses on a sculpture located at the campus of the Porto School of Economics, in Portugal. The sculpture structure is an obelisk, a pillar made of reinforced concrete with a height of 18.5 m above the ground, with an "X"-shaped cross-section covered by brass plates (Figure 1). The observation of a partial detachment of the brass cladding due to the corrosion of the reinforcement (Figure 2) motivated the conception of a conservation and rehabilitation project by the Owner of the structure [1]. This project included the removal of the brass cladding, the repair of reinforced concrete and the application of a new brass cladding. However, upon the starting of dismantling the brass plates, relevant vibrations were observed. The fear regarding the potential existence of severe damage along the pillar of the reinforced concrete structure underneath the brass cladding motivated the study here described, which included the development of a numerical model and the corresponding calibration based on an ambient vibration test. The paper describes the main observations and results, evidencing the importance and value of dynamic testing in the assessment of the damage.

Figure 1. The Obelisk, general view

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