EXPERIMENTAL ASSESSMENT OF INDUCED DAMAGE ON MASORY WALLS THROUGTH STATIC PRESSURE SENSORS (SPS)

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Abstract
Total or partial collapses occurred in recent and past years for structures and infrastructures have shown even more the importance structural control and health monitoring of the built heritage. For what concerns masonry structures, these are often affected by slow irreversible deterioration mechanisms that can jeopardise structural stability in the foreseeable future. In other cases, modifications of the original configuration of bearing elements, due for example to architectural needs, may be the cause of critical stress states of the adjacent structural elements.

Structural health monitoring (SHM) is aimed at the continuous measurement of key slow-varying parameters, with the scope to identify such mechanisms and stress alterations at a very early stage and eventually suggest the adoption of timely intervention strategies. In most cases, SHM is performed using data from dynamic monitoring. This methodology is quite effective but more oriented to give answers addressing the dynamic behaviour. On the other hand, static monitoring using sensors is in an earlier stage of development, but it is a potentially emerging aid to the interpretation of the evolution of the internal stress state of masonry elements due to degradation and damage phenomena.

In this paper, a new static SHM monitoring system layout making use of two typologies of pressure sensors is presented and experimentally tested on two ½ scaled-masonry specimens (2500 x 1250 mm) representative of a wall with two window-openings (and therefore three vertical bearing elements). The two masonry specimens are arranged with calcarenite and clay masonry, respectively. Each bearing element of the specimen is equipped with two different typologies of pressure sensors, namely capacitive pressure sensors (cPS) in a stacked layer body of FR4 glass epoxy and Kapton, and piezoelectric pressure sensors (pPS) in ceramic body. Sensors are embedded in the mortar joints in two ways, to simulate both the use of PS in the cases pre-installation (new masonry elements) and the post-installation (existing masonry elements). The tests are carried out by applying in a first stage a constant vertical load at the top of the specimens to induce the service load. In a second phase, the collapse of the central bearing wall is simulated through a progressive reduction of its cross-section up to the collapse.

Results of the tests will show the capacity of the proposed SHM monitoring system layout to follow the vertical stresses during the tests and provide information about the stress redistribution among the bearing elements. The interpretation of data is finally used to provide an assessment framework to be used for static structural health monitoring in the case of early-stage damage detection.

Keywords: *Structural health monitoring, pressure sensors, masonry, induced collapse, damage detection*