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International Journal of Mechanics
Volume 7, Issue 3, 2013, Pages 335-342

Health monitoring of masonry structures in the Rione terra archeological area (Article)

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Abstract

In the paper one refers to an archeological area affected by significant tectonic phenomena, i.e. the Rione Terra in Pozzuoli. The task of preserving the standing structures, mainly made of masonry material, or those requiring a partial or total reconstruction, pushes towards the adoption of some effective health monitoring of the masonry, which allows to follow the response of old and new fabrics according to the occurring environmental changes and events. To this purpose some special instrumented masonry elements are referred to able to couple the structural and the monitoring needs.

Author keywords

Archeological sites; Instrumented voussoir; Masonry constructions; Monitoring; Preservation; Tectonic events; Vaults

ISSN: 19884448 Source Type: Journal Original language: English Document Type: Article

Cited by 1 document

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Health Monitoring of Masonry Structures in the Rione Terra Archeological Area

O. Corbi and M. Candela

Abstract—In the paper one refers to an archeological area affected by significant tectonic phenomena, i.e. the Rione Terra in Pozzuoli. The task of preserving the standing structures, mainly made of masonry material, or those requiring a partial or total reconstruction, pushes towards the adoption of some effective health monitoring of the masonry, which allows to follow the response of old and new fabrics according to the occurring environmental changes and events. To this purpose some special instrumented masonry elements are referred to able to couple the structural and the monitoring needs.

Keywords— Masonry constructions; Archeological Sites; Tectonic events; Preservation; Monitoring; Vaults; instrumented voussoir.

I. INTRODUCTION

Masonry structures usually undergo, during their life, adverse environmental conditions that may result in disease, damage and even collapse. The understanding of their behavior is not a trivial subject since the complexity of the geometrical shapes of the resistant elements, their reciprocal interactions, the different types of materials composition, textures, apparatus, constructive techniques, the complexity of the material itself in its mechanical behavior and modeling result in a number of uncertainties and non-linearity, which are often hard to be treated.

A wide literature has been developed to this aim, also largely contributed by the research group [1]-[16] which shows that many problems are still far to be solved and that current commercial software adopting some simplified elastic behavior, or reduced approaches to the problem lead to erroneous or misleading results.

Masonry structures mainly rely their structural functioning on the thrust action of its arched or vaulted resistant members. Anyway, structural elements, in response to environmental or anthropologic changes and actions or external events, may become partially or, even, completely unable to exert their structural function.

The chance of restoring their original role is deeply related to the possibility of adopting the most appropriated consolidation measures (possibly FRP provisions) may be introduced [17]-[20]), when failure has not occurred, or most advanced technologies and approaches [21]-[31] with reference also to the expected static or dynamic events [32], [33].

This objective, in turn, relies on a deep understanding of the behavior of the fabric in relation to the previously experienced events and to the possibility of properly forecasting its future response, which basically require proper theoretical tools, but also a large number of data about the structure.

To this regard one should also emphasize that masonry structures are particularly sensitive to horizontal dynamic actions and foundation subsiding, like in case of seismic events or tectonic phenomena.

Health monitoring usually appears necessary for recording the evolution of the behavior of the fabric during its life-cycle, and promptly detecting possible malfunctioning or situations that might evolve towards overall or local crisis phenomena.

Actually a proper monitoring of the masonry construction allows the follow-up of the structure and its response to the loading actions, thus representing an important preservation tool, particularly important when dealing with masonry structures.

It allows to detect possible diseases when they occur, and to undertake the necessary actions for protecting the structure from damage or from the evolution of activated phenomena or, even, prevent their activation.

Finally health monitoring allows to understand, figure out and forecast, together with the theoretical approaches, the local and overall damage phenomena and mechanisms, and their consequences.

Its usefulness then ranges from existing ancient structures, to also the newly constructed structures, that may be then checked in their status during time.

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Issue 3, Volume 7, 2013 335