Seismic Improvement of Historical Masonry Structures

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Editorial

The restoration of historical masonry structures, especially, consolidation of main structural members, is becoming a crucial important issue. Therefore, the structures need restoration to survive their life as a result of aging and increasing load demand. Many historical structures have been restored in order to resist these effects [1]. Masonry constructions are typically complex structures and there is lack of knowledge and information concerning the behavior of their structural systems, particularly in what regards their seismic response. These structures are more massive than today’s structures and usually carry their actions primarily in compression.

According to results of the work developed within the ICOMOS 2001 recommendations, a thorough understanding of the structural behavior and material characteristics is essential for any project related to the architectural heritage. It is recommended that the work of analysis and evaluation should be done with the cooperation of specialists from different disciplines, such as earthquake specialists, architects, engineers and art historians. In addition, it is considered necessary for these specialists to have common knowledge on the subject of conserving and upgrading or strengthening the historical buildings [2].

In historical structures, restoration processes have become necessary because their life cycle of structural and non-structural members is completed due to natural result of material structure, environmental conditions and/or user errors. One of the most important intervention decisions in restoration stages carried out in historical buildings is known as retrofitting of the structure. The choice technique of retrofitting of the structural members is becoming a very important issue in the scope of restoration of historical masonry structures belonging to the cultural heritage. Additionally, it should be decided to optimally preserve such buildings’ original forms and to make interventions to increase the building’s service life; in this regard, it is important to preserve the structures’ historical identity and constructional value. Therefore, retrofitting applications have become essential to prevent the damage level and to have adequate level of structural strength in order to resist dynamic effects such as earthquakes. In this editorial, it is aimed to underline the significance of conventional and modern techniques within the scope of laboratory tests and numerical approaches in recovering the historical structures.

A number of researches have been carried out to investigate the seismic resistant of historical masonry structures [3-25]. Asteris et al. [3] present a methodology for earthquake resistant design or assessment of masonry structural systems. Abruzzese et al. [4] evaluated the risk of collapse of the Huzhu Pagoda, one of the oldest masonry pagodas built in the XI century. In the study, mechanical properties of the masonry material have been obtained by experimental tests on small specimen and the mechanical behavior of the structure has been evaluated via numerical models. The static analysis of this ancient pagoda constitutes a prerequisite base for the evaluation of its structural behavior leading to a suitable maintenance program. Mahini [8] proposed a macro-modelling approach and the performance of a CFRP-retrofitted in historical building. The brick and adobe, prism samples of the building have been modelled by commercial code, which uses smeared-crack materials and eight-noded isoparametric, solid elements. Valluzzi et al. [9] investigated that the structural rehabilitation of monumental area. In the paper, after a general presentation of the main properties and of the most relevant deterioration phenomena of the principal parts of the monumental area, the methodology that is being used for the structural diagnosis, for the implementation of guidelines for the future interventions and for the maintenance of the restored conditions are presented.

Barbieri et al. [13] performed a structural analysis of a historic masonry building subject to significant static instabilities due to an overturning of the longitudinal facades related to ground settlements. Aktas and Truer [14] focused on seismic evaluation and strengthening of Nemrut monuments.
The simulations showed vulnerability of cut-stone blocks separating from one another under seismic action, and simple strengthening solutions were proposed. Mele et al. [18] analyzed a basilica-type church in order to assess its structural behavior and seismic vulnerability. For this purpose, an effective two-step procedure has been used, consisting of static and dynamic linear analyses of the structural complex, and in another studies, nonlinear push-over analysis of the single macro-elements. Bernardeschi et al. [21] described the numerical techniques implemented in the finite-element code NOSA for structural analysis of masonry constructions.

Masonry structures in many countries worldwide are characterized by inadequate resistance to earthquake effects. The using of appropriate techniques for retrofitting of historical masonry structures should be made a decision by the reference to additional structural system and members as well as repair and retrofitting on period after built of the mentioned structures, and this fact is evaluated in terms of the protection original identity as well as the cultural value of the structures. The opinion presents an overview on the retrofitting of historical masonry structures in terms of seismic resistant. Retrofitting techniques of historical masonry structures are mostly affected from the scientific and technological advances. Accuracy of retrofitting methods depends mainly upon analyses of the structures and classification techniques. The efficiency of the retrofitting for historical masonry structures is related to the suitability of the used methods or techniques with retrofitting principles.

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