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Editorial

Assessment and Retrofitting of Building Structures: Experimental Testing and Modelling—Editorial

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Abstract: Collapse of, or severe damage to, existing buildings during strong earthquakes has resulted in significant economic losses, severe injuries, and casualties. Progress made over the last few decades has had a considerable impact on the seismic safety of modern buildings designed according to new standards. However, the majority of existing buildings in southern European countries do not meet the safety requirements set by the Eurocodes. Thus, the assessment of existing buildings not designed with modern codes and the development of effective retrofitting techniques are currently of paramount importance to society. The use of accurate modelling strategies and appropriate seismic assessment methodologies is crucial to understand the behaviour of existing buildings and to develop efficient and proper mitigation measures, thus, preventing future damage, casualties, and economic losses. The effect of non-structural elements should not be neglected, since they could play a vital role in buildings' structural performance. Another major challenge is to ensure the sustainability of renovation schemes in terms of both the environmental burden (i.e., CO_2) and economic investment in seismic regions. The sustainable renovation of existing buildings typically focuses on reducing operational energy consumption and using low-carbon materials in the refurbishment process, without accounting for structural deficiencies that could leave the building exceptionally unsafe and hamper the refurbishment investment, particularly in areas prone to seismic activity. This Special Issue focuses on innovations in the context of assessment and retrofitting of building structures: experimental testing and modelling.

Keywords: reinforced concrete buildings; seismic vulnerability assessment; seismic retrofitting; experimental testing; numerical modelling

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1. Scope and Overview

Collapse of, or severe damage to, existing buildings during strong earthquakes has resulted in significant economic losses, severe injuries, and casualties. Progress made over the last few decades has had a considerable impact on the seismic safety of modern buildings designed according to new standards. However, the majority of existing buildings in southern European countries do not meet the safety requirements set by the Eurocodes. Thus, the assessment of existing buildings not designed with modern codes and the development of effective retrofitting techniques are currently of paramount importance to society. The use of accurate modelling strategies and appropriate seismic assessment methodologies is crucial to understand the behaviour of existing buildings and to develop efficient and proper mitigation measures, thus, preventing future damage, casualties, and economic losses. The effect of non-structural elements should not be neglected, since they could play a vital role in buildings' structural performance. Another major challenge is to ensure the sustainability of renovation schemes in terms of both the environmental burden (i.e., CO_2) and economic investment in seismic regions. The sustainable renovation of existing buildings typically focuses on reducing operational energy consumption and using low-carbon materials in the refurbishment process, without accounting for structural deficiencies that could leave the building exceptionally unsafe and hamper the refurbishment investment, particularly in areas prone to seismic activity.

This Special Issue comprises ten research works, one of which is a review, and the remaining are research articles. Furtado, Rodrigues [1] performed a detailed review of the most typical damages observed in RC structures due to earthquakes. The authors proposed ten damage typologies as the most representative in post-earthquake damage reconnaissance reports. Most of them are related to the need for greater implementation of the code demands in detailing and designing the RC elements. Moreover, the non-consideration of the masonry infill walls could lead to unexpected failure mechanisms.

Hu, Li [2] developed an experimental study to investigate the behaviour of slender CFRP-confined circular RC columns under axial compression. The testing campaign comprised six specimens with slenderness varying from 12 to 56. From the tests, the authors recommend that slenderness should be less than 26.5 in practical engineering.

Yu and Park [3] investigated the benefits of using amorphous steel fibre-reinforced mortar overlay to strengthen masonry prisms. Compressive and diagonal tensile strength tests were performed, in which the authors found that the compressive and diagonal tension strengths increased by 150% and 2660%, respectively. The authors also proposed analytical equations to determine the masonry strength with this strengthening technique.

Klun, Antolinc [4] conducted an experimental investigation on using new strengthening techniques to prevent the out-of-plane collapse of non-structural masonry partition walls by using flexible adhesives and glass fibre reinforcement. Quasi-static cyclic tests were performed on eleven full-scale specimens subjected to flexural strength loadings. The authors observed an increase in flexural strength of up to 221%.

Kim [5] proposed a method for predicting the deflection of shear-critical RC beams. Shear deterioration of shear-critical RC beams occurs before flexural yielding. On the other hand, Mahmood, Mohammed [6] carried out an investigation on the impact of various gradings of sand on the compressive strength of cement grout treated with water-reducer polymer. According to the authors, the polymer has the greatest impact on improving the compression strength of cement grout compared to the other mix proportions.

Christou, Wolters [7] conducted an experimental investigation on composite dowels in transversely cracked concrete under systematically varied shear-tension loading combinations. The authors concluded that pull-out failure can be avoided by placing the dowel reinforcement as close as possible to the steel dowels, preferably within the steel dowels' recesses. Mahat, Pradhan [8] developed a numerical investigation concerning fragility functions, considering foreshock, the foreshock–mainshock sequence, and the foreshock–mainshock–aftershock sequence for a low-rise special moment-resisting frame building that represents a typical low-rise owner-built construction system in Nepal. Shao, Zhan [9] carried out a research study on the tie-cable replacement method of a half-through tied-arch bridge. The authors concluded that the pile was greatly affected by the change in the tie cable force, and the stress state of the pile should be paid more attention in the tie-cable replacement of this kind of bridge. Finally, Messaoudi, Chebili [10] investigated the effect of openings and the effect of changing the distribution of masonry panels on the global behaviour of buildings. They found that an irregular distribution of the masonry can result in the relatively fragile behaviour of the structure.

Conflicts of Interest: The author declares no conflict of interest.

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