Proceedings of the 7h World Congress on Civil, Structural, and Environmental Engineering (CSEE'22)
~~Lisbon, Portugal~~ Virtual Conference – April 13 – 15, 2022
DOI: 10.111159/icsect22.005

Seismic Vulnerability and Retrofitting Of RC Buildings Not Designed To Resist Earthquakes

I. Caliò[1], B.A. Izzuddin[2]
[1]Department of Civil Engineering and Architecture, University of Catania, Viale A. Doria 95125 Catania, Italy
ivo.calio@unict.it
[2]Department of Civil and Environmental Engineering Imperial College London, London SW7 2AZ, UK
b.izzuddin@imperial.ac.uk

Abstract - The assessment of the seismic vulnerability of existing non-ductile RC buildings, designed only for gravity loads and built before the introduction of seismic design codes in different countries, is nowadays an important field of research. These buildings are generally characterised by different sources of structural weakness which hinder the rigorous seismic assessment as well as the identification and the design of efficient and reliable seismic retrofitting measures. This lecture presents some case studies of RC framed building built in Europe before the introduction of seismic codes. Several investigations are performed on prototype buildings designed by considering the architectural features of many typical existing RC buildings built in Italy, according to old standards considering gravity and wind loading but not earthquakes. These case studies are investigated through high fidelity models using the advanced nonlinear structural analysis program ADAPTIC, which enables effective assessment of large-scale structures using partitioned modelling combined with parallel processing, and accounting for the progressive collapse scenario also considering the contribution of non-structural elements. Other programs, currently used in engineering practice, including the advanced software 3DMacro with capabilities for accurate modelling of the infilled masonry panels and automated design code checks. The seismic performance of these typical buildings before and after seismic retrofitting measures is investigated accounting for different number of floors and with and without the non-structural element contribution. The role of nonstructural infills is highlighted by means of an original plane discrete macro-element able to account for the complex interaction between the masonry infill and surrounding frame. To improve computational efficiency, which is critical when investigating the nonlinear dynamic response of large structures, a partitioning approach, implemented in the software ADAPTIC, has been adopted. The numerical results confirm that the seismic performance of these non-ductile structures is very poor regardless of the number of floors. Innovative and traditional retrofitting techniques are discussed, and the benefit of a novel device accounting for the so-called 'locking effect' is investigated numerically. A recent real application enabling a novel retrofitting strategy for residential buildings, under continued occupancy, is finally presented.