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Utilization of EPPO Strong Motion Network Records for the Determination of Rational Seismic Loads for Masonry Monuments

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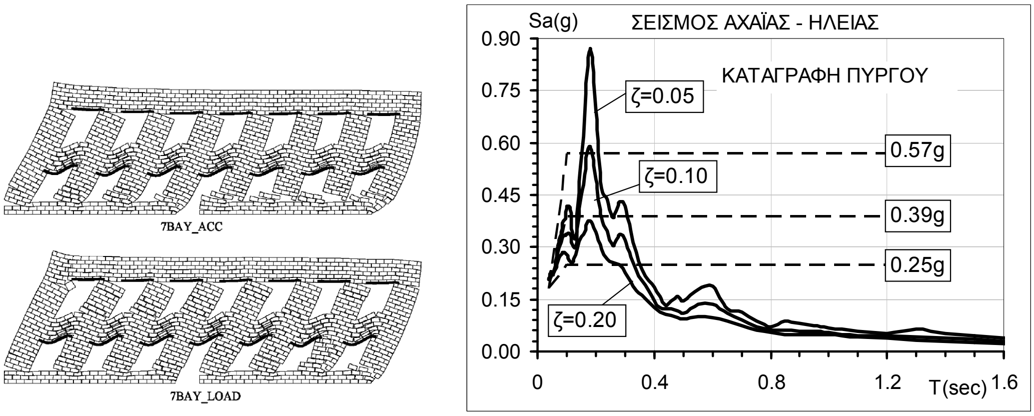
In present work, selected experimental data of the last 25 years are used together with the inelastic analysis of masonry frames, Salonikios et al. (2003) and the postprocessing of the records of EPPO Strong Motion Network in Northern Greece, Salonikios et al. (2009), for the estimation of rational seismic loads that are appropriate for the seismic evaluation and/or upgrade of existing masonry Monuments. The estimated rational seismic loads have significantly lower values than the seismic loads that are suggested by modern seismic codes. It is commonly accepted that modern codes usually suggest very high seismic loads. This happens even in the case that in these codes are foreseen provisions appropriate for masonry structures. These provisions usually refer to modern masonry buildings where is possible to provide high strength. Through the literature review was found that in existing unreinforced masonry buildings is possible to be developed an “equivalent” damping around 20%. Also was found that the eigenfrequency of masonry buildings is reduced at 2/3 - 1/2 of the elastic one and the corresponding reduction of the stiffness is at least 50% of the elastic one. These reductions happen close after the “yielding” point of the “equivalent” bilinear elastoplastic diagram of the structure. The performance points of such structures are located after that “yielding” point.

Through the nonlinear analyses of masonry frames, given in chapters 3 and 4 resulted the base shear that these frames is possible to resist and its value is 25% of the total vertical loads of the frames. This value was found for the models with nonlinear frame elements and for the models with discrete brick – mortar joint elements. The models, where bricks and mortar joints were simulated by continuous elements, had higher strength than two aforementioned models. Also the strength of the frames was higher in the case that the seismic loads were applied at the location of every joint, with value proportional to the mass of each node (including all vertical loads at each level).

Through the postprocessing of recorded accelerograms of strong earthquakes resulted spectral accelerations with values around 70%g. The corresponding normalized accelerations resulted 50%g and correspond to damping 5%. By considering “equivalent” damping 20% (as was found above) the normalized spectral accelerations resulted around to 25%g that are close to the value noticed above as the resisted accelerations of the examined frames. These spectral accelerations were found for the records of Achaia – Ilia earthquake. For this earthquake were not observed any collapses of monumental masonry structures at the stricken area with the exception of some local damages and local failures. This way, many of the conclusions - suggestions of the present work are confirmed. It is also concluded that additional experimental and analytical research effort is necessary in the aforementioned fields for the legislation of the conclusion of the present work.



Left: Discrete brick – joint frames, inelastically deformed and **Right:** Normalized spectral accelerations for various “equivalent” damping percentages, Achaia – Ilia earthquake, recorded at Pyrgos.