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Code-Oriented Floor Acceleration Response Spectra of RC Framed Buildings Accounting for Nonlinear Response of Masonry Infills

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Damage surveys that followed the occurrence of strong earthquakes have shown that code provisions may result in wrong estimation of the safety of masonry infills (MIs), which is generally carried out through simplified methods. The types of damage observed for MIs are usually a combination of, or an interaction between, in-plane (IP) and out-of-plane (OOP) mechanisms. The IP drift ratio is generally reduced at the upper storeys of buildings, where the OOP drift ratio increases due to an increase of seismic acceleration. Significant OOP damage may also take place at the lower storeys where the highest values of IP drift ratio are attained. The present work is aimed at identifying the effects of the IP and OOP nonlinear modelling of MIs and their mutual interaction on floor acceleration response spectra. To this end, a spatial one-bay multi-storey shear-type model is considered as equivalent to infilled RC framed buildings, having MIs made with two 12 cm leaves of clay hollow bricks. Additional variability of the following design parameters is considered: number of storeys (three, five and seven); behaviour factor (low, 1.5, medium, 3, and high, 4.5); OOP strength of MIs, with lower and upper bound values corresponding to one- and two-way arching mechanisms, respectively. A recently proposed computer code including a five-element macro-model [1], comprising four diagonal OOP beams and one (horizontal) central IP truss for nonlinear modelling of MIs, is considered for the numerical investigation. The proposed algorithm modifies stiffness and strength values of MIs in the OOP direction on the basis of simultaneous or prior IP damage and vice versa. Moreover, a lumped plasticity model describes the inelastic behaviour of RC frame members. Biaxial spectrum-compatible accelerograms are considered at life-safety limit state provided by the Italian seismic code. A simplified code-oriented formulation for the assessment of floor response spectra of infilled RC framed structures is proposed. Nonstructural maximum acceleration is firstly evaluated by means of vertical and nonstructural amplification factors. Continuous wavelet transforms are used to calibrate parameters that define the resonance region width, accounting for moving resonance due to nonlinearity and higher modes effects. Parabolic and Gaussian curves are considered in order to reproduce pre- and post-resonance regions, respectively. Finally, code-oriented proposal is compared to exact floor spectra of MIs evaluated in the common range of OOP vibration periods (i.e. 0-0.3s).

REFERENCES

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