BIM-based methodology for the seismic performance assessment of existing URM-RC buildings

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The use of reinforced concrete (RC) in retrofitting interventions on existing unreinforced masonry (URM) buildings has been spreading all over the world since the beginning of the twentieth century. However, many of these mixed URM–RC buildings have revealed to be particularly vulnerable to seismic action, and the interaction effects from coupling RC structural elements to URM loadbearing walls is still a contentious issue for most of the research community. Considering their constructive complexity, with different structural modifications over time, these URM-RC structures may take advantage of innovative and practical tools for a fast and reliable seismic performance assessment.

The main objectives of this work are: (1) To investigate the suitability of the use of RC in the seismic strengthening of URM buildings; (2) To assess the vulnerability of current mixed URM-RC buildings to earthquakes based on the pushover analysis of Equivalent Frame Models (EFM); (3) To improve existing mechanical-based models for Out-Of-Plan (OOP) failure mechanisms; and (4) To develop an efficient BIM-based tool for the automatic creation of EFM from the original BIM architectural models to be exported and analysed in a structural analysis software. This BIM environment aims to streamline the numerical modelling and structural seismic analysis of existing URM-RC buildings, taking advantage of the interoperability between the BIM modelling software and the numerical analysis software. For that purpose, a BIM-based computational tool (Dynamo script, see Figure 1) has been developed for the automatic creation of the EFM.

The validation of the presented methodology is based on the discussion and comparison between the experimental test results from a shaking table test campaign from the literature, and the numerical results obtained with Finite Element Models (FEM) (see Figure 2).

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FIGURE 1
Scheme of the models from BIM to EFM.

FIGURE 2
Influence of the out-of-plane (OOP) resistance.