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The story behind a blind prediction of a 3-storey infilled reinforced concrete building

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Abstract: Over the last few years the seismic behaviour of infilled reinforced concrete (RC) structures has been the focus of numerous experimental and numerical studies. A big effort is being made by the scientific community with the aim of increasing the knowledge regarding the seismic response of these types of structures and improving the numerical modelling accuracy to predict their expected behaviour. In 2015, a blind prediction contest was organized by the Faculty of Civil Engineering Osijek with the main goal of inviting the technical and scientific community to predict the nonlinear seismic behaviour of a 1:2.5 scaled 3D building structure. The three-storey infilled RC structure was subjected to ten incremental earthquake sequences on a shake table test. The blind numerical analyses were performed knowing only the specimen geometry, reinforcement detailing, material characteristics and the actual ground motions recorded during the testing. In this context and, in view of the author's participation success, the present paper mainly aims at presenting the key aspects of the adopted numerical methodology (and related difficulties) which proved to yield good results, while also providing some insight regarding key problems in numerical simulations of infilled RC s tructures seismic behaviour.

Keywords: Blind Prediction, infilled RC structures, Seismic behaviour, Numerical modelling

1. INTRODUCTION

In the context of seismic scientific testing, works developed in the last years and in particular resorting to shaking tables, which usually happens with the objective of providing additional information not available from simpler experimental tests. In 2015, the FRAmed–Masonry Composites for Modeling and Standardization (FRAMA) Blind Prediction Contest 2014 [1] pretended to evaluate different modelling strategies proposed by different international teams/experts that were challenged to predict the experimental response of a scaled three-storey infilled RC structure that will be subjected to ten increased and scaled ground motions where the authors team became in the first position. This research work aims at describing the modelling strategy adopted by the author in terms of the RC structure and infills masonry walls modelling.

2. MAIN RESULTS

The experimental program associated with the FRAMA Blind Prediction Contest [1] initiative was performed in DYNLAB at IZIIS shaking table with the support of University of Osijek (Croatia) and is briefly described in this chapter. It basically involved of a 1:2.5 scaled infilled RC structure (Figure 1) under uniaxial ground motions with increasing intensity. The shake-table test specimen was a 1:2.5 scale model that contains two parallel connected planar frames, with two bays and three storeys, making the structure of the gross dimensions of 4.6 m in length, 2.8 m in width and 3.9 m in height. The RC structured is filled with masonry walls with openings in certain bays. The structure has been designed for medium ductility levels according to the EC8 provisions

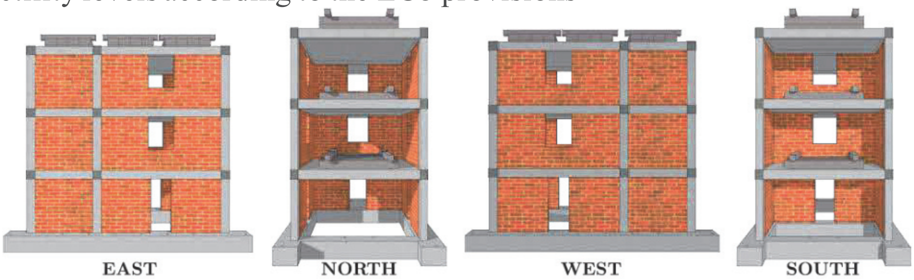
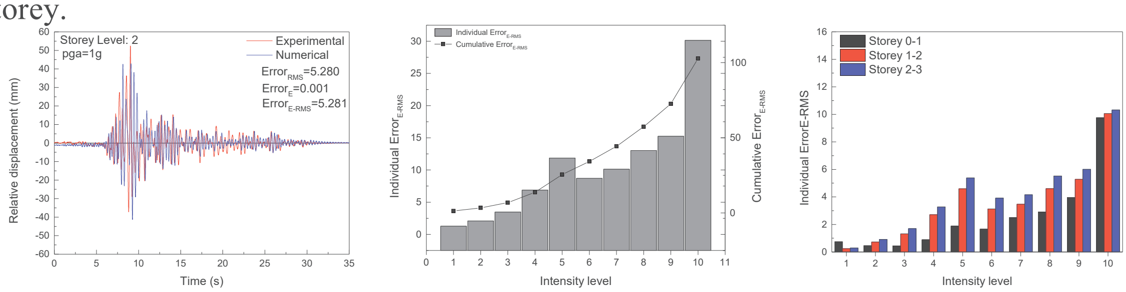


Figure 1 – 3 storey masonry-infilled RC frame and reinforcement details Lateral views.

Figure 2 shows the comparison between the experimental and numerical relative displacements. It can be observed in Figure 2b that the error obtained on 5 different levels was lower than 10 and only for pga=1.2g the error was higher than 30. The error is progressively increasing with the increasing pga demand, however for pga=0.4g the error is slightly above of those observed before which reach an $Error_{E\text{-}RMS}$=11.86. It can be observed that the error obtained in the prediction of the 3rd storey displacement is around 2-2.5 times higher than the obtained for the 1st storey and 1.25-1.5 times the ones achieved for the 2nd storey.



a) b) c)

Figure 2 – Main results: a) relative displacement; b) invidual error; and c) individual erro per intensity level.

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