The seismic behaviour of historic buildings tested on earthquake simulator

E.Vintzileou, National Technical University of Athens

ABSTRACT

The results of recent tests on earthquake simulator are briefly presented and commented upon. Two building models (scale 1:2) were made of three-leaf rubble stone masonry. The two models (two storey high) are identical in geometry, as well as in material properties. One of the models is made of plain masonry, whereas the other is provided with timber laces at floor and roof levels. The models are subjected to adequately scaled real accelerograms along two main horizontal axes, whereas displacements and accelerations were measured at several locations. The models are subjected to seismic actions before and after the application of intervention techniques. Actually, the models are tested in the as-built state until severe but repairable damages occur. Subsequently, they are repaired, masonry is grouted and the diaphragm action of the floors is enhanced by placing a second timber pavement on top of the original one. The diaphragms are adequately connected to the perimeter walls. The models are subjected to a series of accelerograms (of gradually increasing maximum acceleration) until severe damages occur.

The results of the tests show that

(a) Both models are quite vulnerable to out-of-plane bending (due to the lack of adequate diaphragm action). However, there is a significant difference between the two models. Actually,

(b) in the plain masonry model pronounced separation occurred between the leaves of masonry, as well as significant almost vertical cracks at the corners of the building. On the contrary,

(c) the presence of timber laces has delayed the occurrence of both families of cracks. Furthermore, for a maximum acceleration almost by 30% higher, the timber laced model was significantly less damaged than the plain masonry model.

(d) The grouting of masonry was very efficient in preventing the separation of the leaves of masonry, thus, improving the overall behaviour of the models. Furthermore, the enhancement of the diaphragm action of the floors has ensured the box action of the buildings and, hence, it led to significant reduction of the deformations of both models.

(e) The strengthened models failed due to shear and rocking, at a maximum acceleration at least double the acceleration that had caused significant damages to the models at their original state. Last but not least,

(f) Both models have exhibited significant ductility in terms of displacement both at their original and strengthened state.