Graduiertenkolleg 2075

Modelle für die Beschreibung der Zustandsänderung
bei Alterung von Baustoffen

Technische Universität Braunschweig

Vortrag im Gästeprogramm des GRK 2075

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Numerical and experimental investigations of the behaviour of historical stone masonry structures

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A large part of cultural heritage buildings all over the world are historical structures made of stone blocks with dry joints. Some of them, which were originally built with mortar in the joints, have experienced mechanical degradation over time and the behaviour of these structures becomes similar to those made of dry stone masonry. A number of these structures are placed in seismic active area and have been damaged due to seismic activity. With the aim of increasing their resistance, many of dry stone historical structures were further strengthened by clamps and bolts. In order to evaluate the resistance of these structures, before and after application of strengthening techniques, experimental investigations and development of reliable numerical model which could take into account all effects occurring in dry stone masonry structures, are of equal importance.

The numerical model based on finite-discrete element method for analysis of the structural response of dry stone masonry structures under static and dynamic loads is presented firstly in this work. The model includes fracture and fragmentation of the blocks as well as cyclic behaviour, yielding, stiffness degradation, failure and the influence of pulling out of the clamps and the bolts from the stone block. The verification of the model, analysis of the main model parameters and application of the model in evaluation of the seismic resistance of stone masonry structure was conducted on several examples.

The second part of the work is presentation of experimental investigations of the behaviour of the model of stone masonry structure Protiron in the Peristyle square of the Diocletian's Palace in Split, Croatia, under the seismic excitation. The Protiron was originally built at the turn of the 4th century only from stone blocks and bolts. At the beginning of the 20th century it was strengthened with clamps. A physical model of the Protiron was constructed in scale 1:4. The testing was performed on the seismic shaking table at the Dynamic testing laboratory of the Institute of Earthquake Engineering and Engineering Seismology (IZIIS) in Skopje, Macedonia, within *SeimoNuMod* research project. The testing consisted of several phases: definition of dynamic characteristics of the model; seismic testing in linear range; seismic testing in non-linear range by representative earthquake until the failure of the model. The tests provided a clear insight into the seismic resistance and behaviour of the system, the mechanism of damage and failure under intensive tests, especially in the efficiency of the connecting elements (clamps) between the masonry units (stones), which had a special role in increasing the seismic energy dissipation and protection of the structure from collapse.

Kontakt

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