Numerical Simulation on Seismic Performance of Retrofitted Masonry Wall in Historical Buildings Damaged in Earthquake

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ABSTRACT

Due to the characteristics of lower strength, anisotropy, heterogeneity and poor ductility, historical masonry structures usually demonstrate poor seismic performance. During earthquake, the damage severity of masonry structural members varies with their real capacity mostly. To avoid waste and save resources, the following retrofitting strategy would be determined in comply with the cost effective principal corresponding to the severity level of the damaged buildings. The mechanical properties as to the seismic performance of the critical load bearing walls in the damaged buildings could be improved by retrofitting and repairing. However, how to reasonably and effectively estimate the seismic performance of the retrofitted wall with some level of damage could be the most critical and challengeable point.

Based on the finite element analyses, simulation method for the seismic performance of retrofitted masonry wall with damage in earthquake is developed in this paper. The stress and strain hysteretic model for the retrofitted wall element is proposed in considering of three stages effects: original damage, retrofitting or repair, and reloading. According to relevant codes and research results, the damage level of components is classified in terms of the loss level of the axial and shear capacity as well as the deformation capacity. Damage patterns, hysteretic relationships between different retrofitting methods in terms of the external rebar reinforced mortar layer and external fibre reinforced layer are compared and analysed. The calculation formula for seismic capacity and hysteretic skeleton curve of retrofitted masonry wall with different damage level are developed. The operational cost effective retrofitting schemes for masonry walls with different damage levels are proposed.

Case study shows the numerical simulation process of the seismic performance assessment as well as the damage-based seismic design for retrofitted historical masonry components damaged in earthquake.

Key words: Earthquake damaged wall; seismic performance assessment; external

mortar layer; external fiber layer; hysteresis effects.

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