SEISMIC PERFORMANCE OF RC BUILDINGS SUBJECTED TO MAINSHOCK-AFTERSHOK SEQUENCES

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Reinforced concrete structures deteriorate while in service due to routine use and exposure to extreme conditions such as earthquakes and corrosive environment. Serviceability of existing structures in urban cities is a formidable challenge for engineers. Deterioration in reinforced concrete (RC) buildings and bridge piers are well-known. Degradation in strength and stiffness of RC components under seismic loading is due to spalling of cover concrete, crashing of core confined concrete, strength and ductility of longitudinal reinforcement due to buckling and low-cycle fatigue, loss of bond strength between longitudinal reinforcement and concrete. Moreover, corrosion has a sever effect on reduction of cross section area of reinforcing bars, loss of ductility and cracking of cover concrete. Therefore, considering the uncertainties associated with seismic hazards, ground motions and deterioration in structures, quantitative seismic risk analysis and loss estimation are essential for existing structures. This research aims to investigate the post-earthquake performance of existing RC structures in the framework of performance-based earthquake engineering (PBEE). The objective is to improve the accuracy of reliability assessment of RC buildings by integrating uncertainties in ground motion prediction and nonlinear dynamic analysis. The results of this study will help building owners, municipalities, insurers and policymakers to make decisions on their investment priority of building renovation.

This paper presents some parts of an extensive study on the seismic performance of structures subjected to mainshock-aftershock sequences (Goda and Salami, 2013). Extensive set of ground motions including megathrust earthquakes with real as-recorded mainshock-aftershocks and detailed structural models including deterioration is considered. To model the deterioration accurately, a new methodology to calibrate rectangular RC sections is used (Kashani, 2014). The novelty in this study is the improvement and implementation of fibre-type models to include all critical degradation features due to inelastic longitudinal bar buckling, low-cycle fatigue and bond-slip. The concept is to use hysteretic material model instead of uniaxial steel material for longitudinal bars. The calibration and validation of the fibre-type RC components is conducted using the PEER experimental column database. Figure 1 shows the force-deformation response for numerical prediction and experimental result of two different columns. It can be seen that, there is a good agreement between experiment and simulation. Moreover, having the calibrated fibre-type model, nonlinear dynamic response of RC buildings considering ground motion and structure uncertainty is investigated. To be more specific, series of RC buildings located in Tokyo with different configurations is designed hypothetically based on current Japanese seismic codes and standards. The results highlight the impact of ground motion characteristics and components deterioration in long term performance of RC buildings.

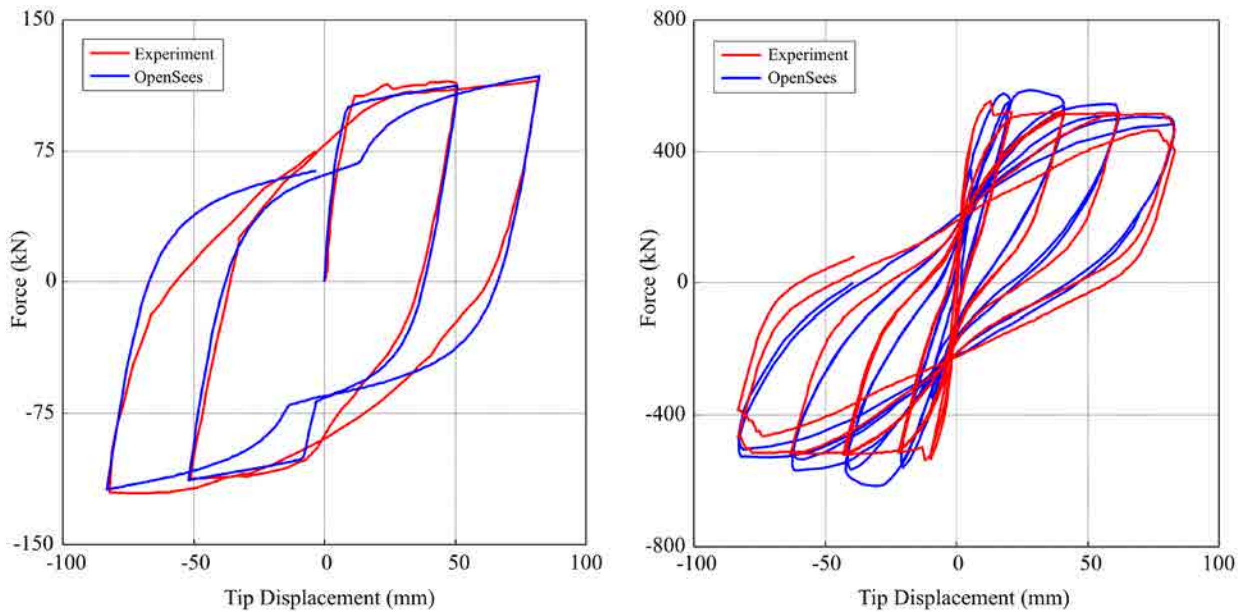

Figure 1. Comparison between experimental and numerical force-deformation responses; (right) Tanaka and Park, 1990, No. 7; (left) Ohno and Nishioka, 1984, L1

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