THE UNCERTAINTY IN SEISMIC RISK ASSESSMENT IN NEAR-FAULT AREA

Mohammad Reza GHAYAMGHAMIAN
Professor,IIEES, Tehran, Iran
mrgh@iiees.ac.ir

Elham OLOUMI
M.Sc. Student, IIEES, Tehran, Iran
e.oloomi@iiees.ac.ir

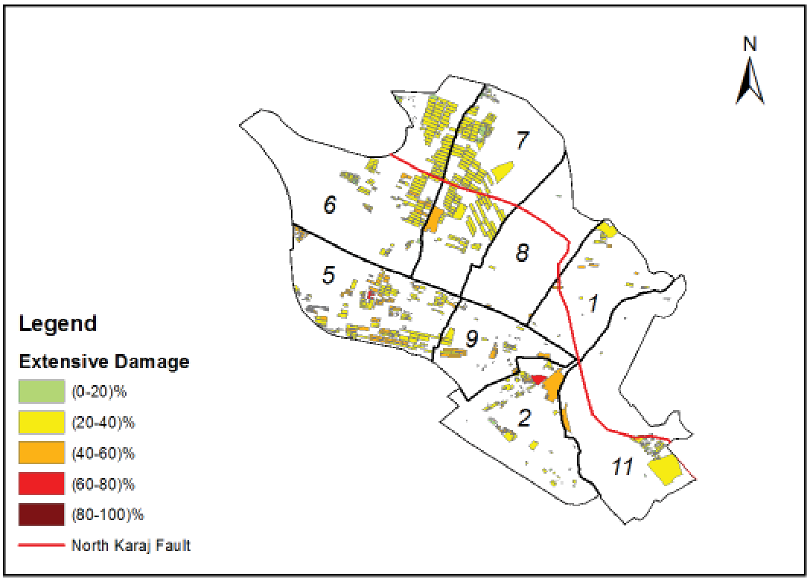
Naiemeh GOVAHI
Research Associate and GIS Specialist, Earthquake Risk Management Research Center, IIEES, Tehran, Iran
n.govahi@iiees.ac.ir

Keywords: Near-fault, Seismic risk assessment, Karaj city

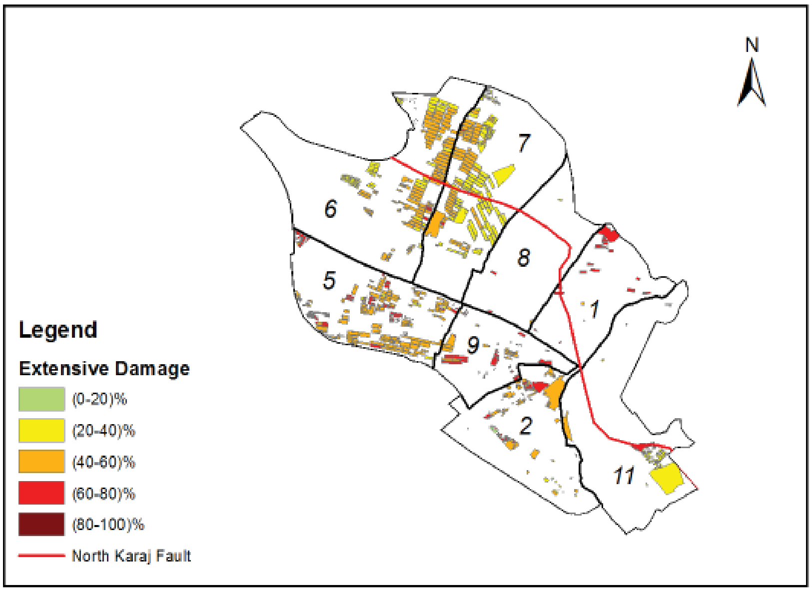
In the near-fault area, two special features referred to as forward directivity and static deformation cause the directivity and fling pulses with long period and high amplitude, respectively. The conditions for occurrence of directivity pulse are much more common than the fling pulse, which is appeared in a limited distance very close to the fault (almost 1 km). Meanwhile, the directivity pulse can be observed with large peak up to approximately 15 km from the causative fault depending on the earthquake magnitude. These pulses can seriously affect structural response and induced damage. Therefore, the vulnerability of buildings in the cities situated close to the active faults needs to be carefully treated. In the most cities in Iran like Tehran and Karaj, many regions are closely located to the active faults. This will raise an important question that the available fragility curves are good enough to accurately estimate buildings vulnerabilities for the motions including directivity or fling pulses.

One of the methods for estimating the vulnerability of structures is the use of fragility curves. These curves describe the relationship between building's damage and the strong ground motion parameters such as peak ground acceleration (PGA) and peak ground velocity (PGV). In determining and developing fragility curves by various analytical, experimental and empirical methods, the characteristics of the near-fault earthquakes are not carefully considered. This may introduce large uncertainty in the estimated seismic risk of buildings, especially in the cities located in the vicinity of active faults. Therefore, the estimated damage to the buildings subjected to the motion with directivity pulse using conventional fragility curves may not sufficiently accurate to estimate the vulnerability of buildings in near-fault area.

In this paper, the uncertainty in seismic risk estimation of the reinforced concrete building for the areas located in the vicinity of the active faults was investigated. To this end, the concrete buildings of eight areas (areas 1, 2, 5, 6, 7, 8, 9 and 11) in Karaj city that are located very close to the north Karaj fault was employed. The buildings were categorized based on the number of stories and quality of construction into nine categories. Then, the risk of building damage was calculated using two different sets of fragility curves. In the first step, the fragility curves developed using Hazus methodology for different concrete buildings in the assumed areas were used. In the second step, the fragility curves calculated using IDA method for the sets of 20 ground motions all included directivity pulse (Oloumi, 2019) were applied in risk estimation. Then, the building damage in three slight (G1), moderate (G2+G3) and extensive (G4+G5) damage levels are calculated for the assumed areas in Karaj city. The uncertainty in seismic risk estimation of the buildings was explained and discussed by direct comparison of estimated damage in different damage levels for the assumed areas (Figure 1). It was foundthat the building damage is underestimated by Hazus fragility curves in comparison with near-fault ones from %29 up to %38.



a



b

Figure 1. Estimated damage for extensive damage level, a) using Hazus fragility curves, b) using near fault fragility curves.

REFERENCES

Haghshenas, E. and Hamzelou, H. (2013). *Earthquake Geotechnical Micr ozonation of Karaj, (V olume 2).* [report], International Institute of Earthquake Engineering and Seismology, Tehran, Iran.

HAZUS-MH (2003). Multi-hazard Loss Estimation Methodology. Earthquake Model, HAZUS-MH MR1, Technical Manual, Washington D.C.

Oloumi, E. (2019). *Sustainable Urban Development Based on Seismic Risk in Near Fault Area*. International Institute of Earthquake Engineering and Seismology, Tehran, Iran.