The Zoning of Earthquake-Induced Earthquake Hazards using the AHP Model

Ali M. Rajabi[*1], Hossein Khosravi[2]

1. Engineering Geology Department, School of Geology, College of Science, University of Tehran, Iran
2. Department of Civil Engineering, University of Qom, Qom, Iran

Extended Abstract

(Paper pages 635-658)

Introduction

In general, landslides, in particular, earthquake-induced landslides, are among the phenomena that have caused great damages in recent years in Iran and the world. Although many studies have been done on the identification and description of landslides in general, the study of landslides caused by the earthquake, especially in Iran, is at the beginning stages. In a few studies, some landslides and some of their characteristics have been introduced. A magnitude 7.7 earthquake occurred in the Guilan Province was occurred on May 31, 1990. This earthquake is one of the most important earthquakes in Iran history due to its magnitude and occurrence of landslides. In various studies, the most important landslides have been listed. The development of quantitative and qualitative studies on earthquakes that have caused many landslides (such as the Manjil, Avaj, Firoozabad, Kojur, Sarein and Ahar and Varzaghan earthquakes) increase our understanding of natural disasters and, consequently, the management of the dangers resulting from them. The purpose of this research is to identify the factors affecting the occurrence of landslides caused by earthquakes, to determine the impact of each on the occurrence of this phenomenon, and also to prepare a map of earthquake hazard zonation hazard by utilizing the methods used in this research. In this study, hierarchical analysis method has been used to prioritize the factors

affecting the occurrence of landslide and also the zoning of earthquake landslide hazard in the study area.

Research Methodology

The study area is located between 49° 30□ and 49□ 45° and latitudes 36º 00 □ 45" and 36º 30□ 52" with a surface area of 309.30 km^2. In this research, in order to zoning the earthquake-induced landslides hazard, in addition to providing a map of landslides, seven factors influencing the occurrence of this phenomenon were identified and examined. These factors included elevation, slope, arias intensity, friction angle, adhesion, curvature of the slope and aspect. In this research, Analytic Hierarchy Process (AHP) method, one of the multi-criteria decision making models, was used with two approaches to using expert knowledge and data and expert knowledge together to prioritize the factors influencing the occurrence of landslide. Finally, two landslide hazard zonation maps were prepared. In a hierarchical analysis method using expert judgment, to determine the priority of different criteria and sub-criteria and converting them to quantitative values, pairwise comparisons were used.

Results

The results from the paired comparison show that the relative preference of the factors is the Arias intensity, friction angle, slope angle, cohesion, aspect, elevation and curvature, respectively. The results obtained from the verification of the models and comparison of the maps prepared using the mentioned methods show that the method in which the expert judgment and data is simultaneously used is more in line with the map of the region of landslides.

Conclusion

According to the results, a method in which the expert judgment and data were used simultaneously, the sum of quality index (Q_S) and the accuracy value (P) for them were calculated 0.40 and 0.016, respectively. However, in a method in which only expert judgment was used, the sum of quality index (Q_S) and the accuracy value (P) were estimated 0.37 and 0.006, respectively.

Indeed, hierarchical analysis method (AHP), which uses the expert judgment and data were used simultaneously, to determine the priority of criteria and sub-criteria, has a better performance than the other model and its results are closer to reality. In addition, it also works better in distinguishing very high risk zones.

Keywords: Zonation, Manjil, earthquake induced landslides, AHP

*Corresponding Author: amrajabi@ut.ac.ir