Risk Analysis & Damage Assessment of Istanbul under Earthquake

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INTRODUCTION

The hazardous areas of Istanbul with the distribution of structural damage due to different possible earthquake magnitudes with different return periods are determined and risk maps for the selected region are produced for the selected 30 districts of Istanbul. The basic idea underlying this investigation is to estimate the magnitudes of the future earthquakes by taking the past earthquake magnitudes of Istanbul into consideration. By the help of the estimated possible future earthquakes, damage distribution in the province of the city of Istanbul is achieved. According to these distributions due to different return periods and maximum earthquake magnitudes, the risk maps are developed.

METHODOLOGY

In the first stage of this project, the historical earthquake data of Istanbul which is between 1905 and 2004 is used. By using the Gumbel-Gutenberg-Richter approaches, the earthquake risk for the province of city of Istanbul is obtained. In order to estimate the maximum magnitude of a possible earthquake to occur in Istanbul within a prescribed period, four different scenario earthquakes are developed according to four different return periods of 25, 50, 75 and 100 year. In the second stage, according to these scenario earthquakes, the damage states of the reinforced concrete structures located in the region are investigated. The total number of reinforced concrete buildings surveyed is 538,977. The effect of the possible earthquakes on these structures is specified and the distribution of the damage assessment is estimated. As a result of this, risk maps of probable damage for the expected occupancy of life duration due to an earthquake of high magnitude are improved.

RESULTS

By the help of the Gumbel-Gutenberg-Richter approaches, four scenario earthquakes are obtained. These scenario earthquake magnitudes are found as 6.72, 7.2, 7.48 and 7.68 for the first, second, third and fourth scenarios, respectively. Building damages are estimated as heavily, moderately and partly damaged for each of these four earthquake scenarios. According to the first scenario, 1.6% of total buildings in the study area are heavily and 4.4% of total buildings are moderately damaged. In the second scenario, the results show that the damage ratios of heavily and moderately damaged buildings are 4% and 8.4% of total buildings, respectively, in the study area. Consistent with the third scenario, 6% of total buildings are heavily and 11% of them are moderately damaged. Finally, for the fourth scenario, the ratios for the heavily and moderately damaged buildings to the total buildings are estimated as 7% and 12.5% respectively. The damage distribution of damage states and the risk map for this most severe scenario are shown below.

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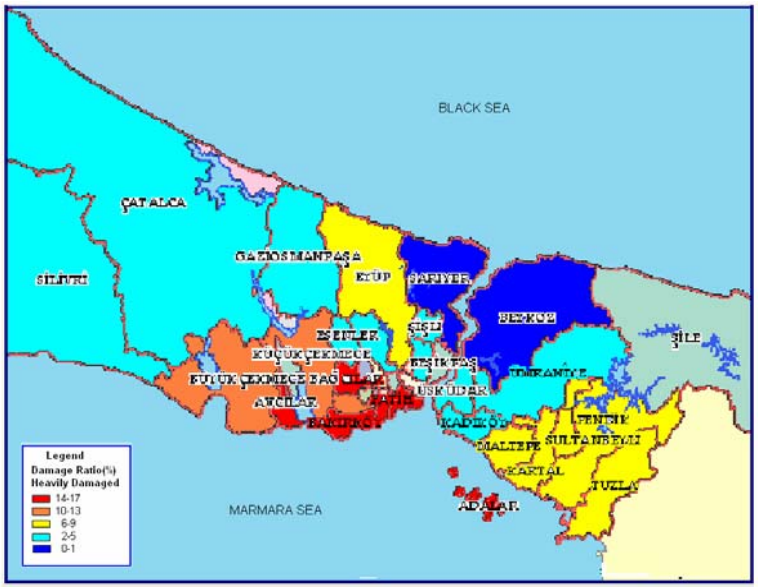

CONCLUSION

As a result of the first part of the project, four different earthquake scenarios with different return periods are obtained. According to this, it is seen that the probability of exceedance of any magnitude Mmax within its own return period is always 63%. From the second part of the project, it is concluded that the estimated building damages of the 4th Scenario which has a magnitude of 7.68 are the worst scenario for Istanbul. Since the estimated magnitude of this scenario is the highest magnitude, the results make sense and expected. Besides, results indicate the districts in the southern area of Istanbul are more heavily damaged than the ones in the northern area. Therefore, as a result of this study, it should be noted that the southern coast of the European side is the most severely affected area. Also, it might be acceptable to resident in the area which is indicated as hazardous with the assumption of a possible earthquake of 6.72 occurring in 25 years. In addition to this, the difference in damage between one district and another in Istanbul can be attributed to local site amplifications. Therefore, another reason that the southern part of Istanbul is more dangerous than the northern part is the difference of the soil type.

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