Risk-Targeted Probabilistic Seismic Hazard Analysis for Siraf Port

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1. Introduction

One of the major problems facing most of the world's major metropolises and cities is natural hazards. In seismic countries, one of the most catastrophic is the earthquake event. Using statistical and probabilistic methods called seismic hazard analysis it is possible to ensure the safety of structures against earthquakes. Every year, a lot of researches have been done to determine the hazard of earthquakes around the world; Therefore, it is necessary to use new and up-to-date methods based on which seismic hazard maps can be updated in Iran. In this study, using a probabilistic approach and risk-targeted hazard analysis approach according to ASCE 07-10, the seismicity of Siraf port in Bushehr province was investigated.

2. Materials and Methods

In the present study, in order to investigate the seismic status of the site, a set of historical and instrumental seismic data with a time coverage up to 2019 up to a radius of 150 km was used and seismic sources were modeled. For this purpose, seismic sources in the desired area, using geological maps and satellite images, were determined and a suitable model of seismic sources in the region was presented.

The list of earthquakes that occurred in the project area was made through documents, books, and Accelerometer. The defect in the catalog were eliminated by using the Kijko -Sellevoll method. In order to achieve the Poisson distribution of events, foreshocks and aftershocks were eliminated using Gardner and Knopo methods and Grünthal method. Finally, seismicity parameters were calculated based on data analysis in EZ-FRISK 7.43 (2010). The results of seismic hazard analysis using the probabilistic method for Siraf port are presented as a risk-based at the design level for a return period of 2475 years.

3. Study Area

Siraf port is located in Bushehr province near Kangan city in the south of Iran, between the south and southwest of the country (27.6667 °N, 52.3425 °E). It is one of the oldest ports in Iran, which is located between Kangan port and Assaluyeh port.

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The geological structure of the site follows the general trend of the Zagros with a northwest-southeast trend. The location of the site from a geomorphological point of view has a flat and plain topography and from the point of view of structural zones of Iran, it is located in the folded Zagros (Darvishzadeh, 1991).

4. Results and Discussion

4.1. Determining the maximum horizontal acceleration of the ground motion

Using the results of the probabilistic method, the parameters of the maximum acceleration values of the horizontal component of the site at the seismic levels of operation basis level (OBL), design basis level (DBL) and maximum consider Earthquake (MCE) are 0.11g, 0.39g and 0.61g, respectively.

4.2. Risk-Targeted response spectrum for design level

The design response spectrum based on risk concept (ASCE 07-10) for this site has higher values in the entire period interval (approximately 12%) than the design spectrum with a probability of exceedance 10% and 2% in 50 years.

The increase in the values of the risk-based spectrum in the site compared to the uniform hazard spectrum is due to uncertainty in the collapse capacity of the designed structures. Therefore, the probability of collapse and failure of structures designed according to this spectrum by changing from one place to another and by changing the shape of the seismic hazard curve, leads to the probability of non-uniform collapse.

According to the Hazard Zoning Map of Iran in Regulation 2800, the location of the site confirms the level of high seismic hazard and the amount of acceleration of the design is 0.3gacceleration. While the earthquake hazard analysis of this region with a probability of exceedance 2% and 10% in 50 years has determined the parameters of maximum horizontal acceleration 0.61g and 0.39g, respectively.

The spectrum estimated in Standard 2800 is based on 10 percent probability of exceedance within a 50-year period with a Return period of 475 years. In seismically active areas where earthquakes occur most frequently, such as the west, southwest, and south coasts of the country, this method may be a logical one. But in areas where earthquakes are less common or the sensitivity of the area or site is important, the prediction of an earthquake with a return period of 475 years is under-predicted; Therefore, the definition of a maximum considered earthquake with a 2 percent probability of exceedance within a 50-year period with a Return period of 2475 years should be reconsidered.

Finally it is worth mentioning that the estimated probability of collapse in 50 years for a structure designed for the probability of exceedance 2% in 50-years, with the 2/3 factor, is indeed more geographically uniform than that designed for the probability of exceedance 10% in 50-years ground motions, without any factor.

5. Conclusion

Due to the high seismicity of Iran and especially the high importance of the southern regions of the country, it is recommended that the spectrum of regulations of the country

(including standard 2800) be extensively studied and updated. Therefore, it is recommended to modify the spectrum in these regulations by updating the design spectrums of these regulations, using the methods available in valid standards such as ASCE7, in which earthquake estimation has been done properly. And for very important areas (including Tehran, Bushehr and Tabriz) due to the hazard of earthquake and irreparable damage, it is recommended to use the design spectrum based on the concept of risk-targeted according to ASCE 7-10.
The results of the study indicate that the seismic values of the spectrum obtained according to Regulation ASCE 07-10 are different from the proposed values for this area in the 2800 standard. The reason for this is the uncertainty in the seismic design of the structure that the risk-targeted approach is able to take into account and leads to achieving a uniform level of geographical distribution to prevent the collapse of the structure.

Keywords: Earthquake Hazard Analysis, Asce7 Standard, Siraf Port, Risk-Targeted Ground Motion, Seismicity

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