Shahrood University of Technology

JOURNAL OF RESEARCH ON APPLIED GEOPHYSICS

(JRAG)
2024, VOL 10, NO 1
(DOI): 10.22044/JRAG.2023.11236.1323

Earthquake investigation near the fault using simulated acceleration mapping and design spectrum

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Received: 24 September 2021; Accepted: 24 January 2023

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Keywords

Earthquake near the fault basin
Pulse period
Maximum horizontal velocity
Design spectrum
Simulation mapping acceleration

Extended Abstract

Summary

The locations of large cities in Iran in areas close to the faults and the activities of many of these faults have caused attention to the seismic characteristics of the areas near the faults. Meanwhile, the unavailability of near-fault field maps in these areas, and also, the weakness of design regulations in providing design spectra appropriate to the near-fault areas, lead to a detailed study and parameterization of earthquakes near the faults. The parameters of maximum horizontal velocity and pulse frequency are very important in parameterizing near-fault earthquakes and producing simulation maps. Moreover, design spectra provided for areas close to faults can be used in the design of many structures near active faults. In this study, with the help of AIC information criterion, nonlinear regression analysis and by considering the errors within and between events on a set of near-fault field maps, equations for predicting pulse periodicity and maximum horizontal velocity have been obtained. The resulting pulse model and the low frequency section of the mapping are generated. To produce a simulated acceleration, the high frequency portion of the mapping must be combined with the low frequency portion. Thus, after producing the high frequency section and its combination with the low frequency portion, the simulated acceleration map is generated. Furthermore, with the help of a set of near-fault maps and extraction of parameters related to each map, the spectrum with the characteristics of the near-fault area has been presented. The results of this study show that the produced acceleration in this study has a very high accuracy. In addition, the spectrum presented in this study can eliminate the weakness of the spectrum of regulations for the areas close to the faults. In this study, to investigate the accuracy of the results and the reduction relations, two maps of Chi Chi and Bam earthquakes have been produced. These two maps are related to two different fault mechanisms. One of the objectives of studying the earthquakes near the faults is to prepare the design spectrum for its direct use in the seismic design of structures. In this research, using a data set including information on rock and soil structures, the design spectrum and its parameters with the seismic characteristics of the areas near the faults are prepared.

Introduction

Maps recorded in areas near an active fault show that areas less than 30 km from the fault rupture zone are prone to earthquakes near the fault. Most of the maps recorded in areas near the fault are different from maps far from the fault. These differences are often seen in the time history of velocity and displacement when the two factors of progressive orientation and sustained displacement cause these differences. As it turns out, the recorded maps are limited by the progressive orientation feature. Therefore, there is a need to use simulation models of this powerful earth movement.

Methodology and Approaches

The information used in this study is a set of NGA-WEST2 information that includes the severe effects of progressive orientation. In this regard, the studied buildings are classified into two parts: rock and soil conditions, which are based on the conditions mentioned in the Iranian regulations No. 2800. The other part is the design spectrum that is, in this study, based on the rules mentioned in the valid ASCE 7 and Euro code 8 regulations. To study the simulated maps, the frequency domain maps have been analyzed with the help of wavelet transforms. In this study, with the help of a nonlinear regression analysis, the predictive relationship for the horizontal maximum velocity is determined by considering the errors within and between the events. Due to the dispersion of data, for a more detailed study of the subject, the need to data processing is considered accordingly with the help of MATLAB software. Deviation from the

data standard has been calculated and its effects on the data set have also been entered.

Results and Conclusions

The results of this study show that the use of close fault mapping and extraction of effective parameters in the design spectrum can be effective in providing an efficient spectrum. On the other hand, the production of artificial maps can solve the problem of lack of near-fault field mapping in dynamic analysis. Accordingly, in this study, each of the high and low frequency components have been generated and combined. Examination of the results of this study shows that the predictive relationships, and therefore, the production maps have appropriate accuracy. Moreover, the spectrum presented in the earthen site shows higher values for the areas near the fault than the spectrum of the regulations No. 2800.