THE EARTHQUAKE DISASTER PREDICTION AND DECISION SUPPORT SYSTEM IN SOUTHERN AREA OF FUJIAN PROVINCE IN CHINA

Xiaoxian WANG[1] And Xiangrong HUANG[2]

SUMMARY

The Earthquake Disaster Prediction and Decision Support System is a subject of Demonstration Project for Earthquake Prevention and Disaster Reduction in Southern Area of Fujian Province in China. The subproject will integrate the technical achievement, Function of governments and the public participation. The main technological ways are to carry out seismic zoning research and vulnerability analysis both in single building and building group as well as life line constructions in Zhangzhou City, Quanzhou City and Xiamen City. By comprehensive the results of two aspects, we get the earthquake hazard prediction results for hypothetical earthquake with difference magnitude. Also, we manage the results gotten above by using GIS and make the preplan for earthquake resistance and disaster relief. The aims of all these works are for improving the ability of earthquake prevention and disaster reduction, especially for the ability of emergent reaction and disaster relief, and for improving hazard management of urban area.

INTRODUCTION

Southern Area of Fujian province in China where have the background of destructive earthquakes occurred is located in the north segments of southeastern coastal seismic belt, Fujian China, which is the most active seismicity belt. Three cities of Xiamen, Quanzhou and Zhangzhou in the area are situated in the southern segment of the Chang-le fault belts, which are characterized by the intersecting structural faults and strong seismicity. Therefore, the area has been under the intensified monitoring and surveillance in the past several years.

Southern area of Fujian province in China is the area open to the outside world early in China with high population density and developed economy. A moderate strong earthquake will cause severe economic loss and deaths or injuries. With the further opening to the outside world and the rapid economic development, the high-rise buildings and lifeline engineering as well as the further concentration of population increase very quickly. Based on the factors above, we will carry out seismic hazard prediction and disaster reduction counter-measures for the urban area so as to improve the earthquake-resistant abilities, take some measures for seismic hazard prevention with the aim of reducing effectively the loss from the seismic hazards. These are necessary and importance. The government greatly supports the regional construction of the earthquake disaster prediction and decision support system.

The system is one part of the demonstrated project for seismic hazard prevention and reduction in Minnan Area, South Fujian province. Which is also a part of the major project of China Seismological Bureau.

[1] Seismological Bureau of Fujian Province, Fuzhou, China Email: Ap35@sdb.csdi.ac.cn
[2] Seismological Bureau of Fujian Province, Fuzhou, China Email: Ap35@sdb.csdi.ac.cn

OVERALL TARGETS

The targets of the system are to establish the countermeasure system for seismic hazard prediction and disaster reduction. The system will target the three cities of Xiamen, Quanzhou and Zhangzhou, and carry out the prediction and estimation of the possible seismic hazard to find out the weak points in earthquake resistance with the information technology and modern seismological science and technology. The countermeasures suitable for the situation of the cities will be made and performed. The implementation of these countermeasures will make it possible for the three cities to withstand the impact of strong earthquake.

The effects of the system will be the followings: Quantitative estimation of possible seismic damage for urban area can been given by prediction of seismic hazards of buildings and lifeline engineering and find weak points, it will provide science basis for formulating rational prevention emergent decision and engineering improvement, save expenses and get larger economic effect.. Seismic-geologic hazard surveying and seismic risk analysis will provide reliability basis of city management. It is useful for making the best countermeasures so as to plan city development and to use land. A computer-aided decision making and dynamic management system will be developed for routine service to urban construction, and prompt estimation of earthquake hazard and the ability of emergent response of disaster relief.

TECHNICUL AND SOCIAL MEASURES

To carry out analysis of earthquake risk in Xiamen, Quanzhou and Zhangzhou city, To survey possible seismic-geologic hazard at field, To finish vulnerable analysis and seismic micro-regionalization investigation, so as to get the results of earthquake hazard prediction for hypothetical earthquake with difference magnitude. Then proceed to formulate counter-measures of earthquake prevention and disaster reduction. Also, To manage the results gotten above by using GIS, build the information management and computer-aided decision making system. Above work is not only technical, but also social, the organization work of task-implementing was lead by the Provincial Government of Fujian and China seismological Bureau, the operation was carried out by Fujian seismology Bureau and the local governments of Xiamen, Quanzhou and zhangzhou city. Fundamental material investigation is assumed to the city seismology Bureau, urban district governments and communities. Main technical work are carried out by specialists for Fujian Seismology Bureau, geological institute of China Seismology Bureau and institute of mechanic and Engineering of China seismological Bureau.

The investigation of the fundamental material is also public work. Under organization and coordination of urban and district governments, in order to ensure finishing investigation with science rapid and good manner, investigation is assumed to urban district government, street office and residential area community. The name, address and telephone, for the office and the enterprises and facilities were given by Urban Statistical Bureau. The building and its construction in urban areas were investigated in detail. Urban areas and its type were recorded and classified, these obtained materials were input to computer. The material of building, lifeline engineering were collected, form power supplied bureau, communication bureau., post and telecommunication bureau, water conservation company. Fire brigade and public health bureau. In order to obtain correct material, we had organized ordinary investigators to study how correctly fill out the form for investigation.

MAIN ACHIEVEMENTS

In studying prediction of earthquake disaster for Quanzhou City, we had obtained following main achievements.

Seismic risk analysis:

According to distribution of earthquakes (Ms>2.5 and Ms <4.7) and medium-strong earthquakes with Ms>4.7 and latest research results about safety evaluation of major engineering field in few ten sites, using regional seismic-tectonic map of Fujian province, zonation map of potential earthquakes of Fujian province, collection of intensity map of historical earthquakes and scenario earthquakes and their intensity map, showing Quanzhou City located in the areas with intensity of   grade.

Seismic-geological damage analysis:

To understand the field classification, Division of seismic-geological hazard, distribution of Iso-depth line of basement rocks, distribution of liquefaction of sandy soil. Mountain body slip. Rock collapse. Distribution of mud layers and comprehensive influence field distribution of donation of seism-geological hazard in Quanzhou City.

According to the site classification map, Quanzhou City located mainly in the red terrain, belonging to II type of site; other sites are of III type. The depth of basement rock is in less than 40 meters. Liquefaction of sandy soil mainly took place in the valley of Jinjiang river and southeast part of Quanzhou City. The Holocene mud layers over 5 meters in thickness of Quanzhou City mainly located in the southeast and northwest parts, soil sliding and rock collapse distribute in the front of southwest and northeast mountains of Quanzhou City. Depend on the characteristics above, we divided into weak, medium and strong hazard areas. Finally, the earthquake, and show the normal and abnormal areas of intensity of Quanzhou City correspond to the center and southeast of Quanzhou City respectively.

Building vulnerable analysis:

We conclude eight kinds of single building, five kinds of group building and their photos in Quanzhou City, and collect the photos of destructive earthquake worldwide. And get the overall distributed and important buildings' map of Quanzhou City. Registration map of main units of Quanzhou, Distribution of 92 communities in QuanZhou City and Inquiry of predicted hazard results. It indicates that the high rate area locate in the southeast parts of the city.

Vulnerable analysis of lifeline engineering:

Based on the characterization of infrastructures of lifeline engineering. We mainly analyzed vulnerability of water supplied system, power supplied system, communication system, Telecommunication system, by the GIS system, we can carry out network analysis, and give space distribution of earthquake damage, according to the vulnerable result map of water supplied system under the intensity of VIII grade in Quanzhou City. The middle grade destroyed area located in the northwest parts of the city, two bridges will be destroyed in middle grade; under the intensity of 9 grade, most parts of tube of water supplied system will be destroyed in middle grade, few part in heavy grade.

Induced disaster analysis:

We mainly analyzed induced disaster caused by fire and flood and make prediction of disaster and give distribution map of oil stations and map of defense abilities of anti-induced flood in the city.

Analysis of economic losses, casualty and death analysis:

We make evaluation of casualty and death and direct economic losses of building and life-line engineering under different intensity, and get distribution map of economic losses in QuanZhou City, economic losses with two hundred millions more occurred in east of urban area, peoples of casualty and death with one thousand more also in the east .

Countermeasures for earthquake prevention and disaster reduction:

It divided into four times stages that is mean time, pre-earthquake, co-earthquake and after-earthquake, and to distinct the different countermeasures in different time stage. Especially, to make estimation of future earthquake disaster, evaluation of abilities for earthquake prevention and disaster reduction in urban area.

Information management and computer-aided-making system for earthquake prevention and disaster reduction:

By the GIS techniques, to establish information management system including collection, arrangement and classification of date and 140 basic geographical data and about 70 analysis models of necessity of goods and material of emergent relief. Information management of earthquake prevention and disaster reduction and auxiliary decision system consists of four parts, that is information management system, estimating seismic hazard system, auxiliary decision system and ordinary management system. Information management system

provides various information of preventing earthquake and reduction hazard in the city. Evaluation system for seismic hazard can prognosticate comprehensive intensity influence, seismic hazard distribution of destroyed buildings and lifeline engineering and induced disaster, and to give estimation for casualty and death and economic losses, therefore to formulate correspondence countermeasures.