

Preparation of Seismotectonic Map in Qazvin Province

Mahdi Moharrampour¹⁺, Moslem Jahangir Bakhte² and Mohammad Reza Sadeghi Moghaddam³

¹ Young Researchers Club, Islamic Azad University, buinzahra Branch, buinzahra, Qazvin, Iran

² Department of civil Engineering, Islamic Azad University, Buinzahra branch, Qazvin, Iran

³ Department of civil Engineering, Islamic Azad University, Qazvin branch, Qazvin, Iran

Abstract. Qazvin province and its environment is one of our country's seismogenic area, because of special situation of its seismotectonics. The event of many earthquakes in this area manifests the necessity of related studies to earthquake. From the most important earthquakes of Iran it can be called Buinzahra and Roudbar-Manjil that are situated in the area. In the subject, the analysis of earthquake hazard, Seismotectonic map and more preparing the hazard maps of earthquake can be guide. In this research Seismotectonic map has been produced for Qazvin province. The work includes four stages: 1-To get acquainted to geology characteristics of studied area 2-To add information about seismicity and seismic source for studied area 3-To estimate the seismicity parameters of studied area by using the most effective and modern ways and methods

Keywords: Seismotectonic map, earthquake, Qazvin, hazard map

1. Introduction

Earthquake is a natural event that is usually made by slipping or moving the related plates to Fracture of earth solid crust. The event is followed by releasing abundant elasticity energy of sudden quake of these plates to the others. By releasing this energy, violent quakes makes destruction of building in this regions which near to the fault happening (faulting zone). In addition to Earthquake, slipping and passing the waves of Earthquake in surface and into the earth can increase the ruins. The points that are situated in center or near the center bear the most rate of hurt and damage. So getting acquainted to seismic sources as resources of earthquake and knowing the danger of damage which threaten cities and villages, can help to make safe of buildings and constructions especially important buildings. Finding location of modern population and industrial centers with knowing the danger of earthquake is unimperfect affair that follows irreparable damage. In the subject, the analysis of earthquake hazard and preparing the hazard maps of earthquake can be guide. In this project earthquake danger plan for one of the seismic zone of our country, Iran, Qazvin was prepared.

2. Materials and Methods

2.1. Studied area and the used Data

The studied area is located on (48) to (51) geographical length and (34.5) to (37.5) geographical width. Earthquake statistical and the related parameters to earthquake were used in two groups historical (before 1900) and instrumental till 2010.

2.2. Examining and studying the seismic sources

The ranges of the studied earthquakes are related to the recognized faults, which are located in that area. There are about 52 fundamental seismic (faults with more than 10 kilometers length) in the studied area.

⁺ Corresponding author. Tel.: +989385502422; fax: +984225316.
E-mail address: m62.mahdi@yahoo.com.

Moving one of these faults can cause big and horrible earthquake. For example some of the most important of these faults, are the fault in the north of Qazvin with more than 80 kilometers length, Abeyek fault with more than 85 kilometers length, Khazar fault with about 600 kilometers length,.....

Each of them has precedence earthquake. The tensions of them are in North West, East South, West and East. Aggregation of fault fractions in North, North East, center and South of the studied area make it not safe place for living. In this project the length of each fault were gained using the references, then the majority of the fault magnitude of this area were calculated by experimental rules, Mohajer Ashjaei Norouzi (1978), Ambarsyz-Melvil (1982) [10]and Norouzi (1985). The results are shown in table (1). The table also contains the length of each fault.

Table 1: Majority of the fault magnitude

Experimental magnitude	Respective magnitude (Ms)				Approximate length (km)	Fault name	Fault number
	AV	N	A.M	M.A.N			
	6.9	7.1	7.0	6.7	48	Masuleh	1
7.7	7.7	7.7	7.7	7.7	600	Khazar	2
	6.9	7.0	7.0	6.7	40	Soleh sara	3
	6.9	7.0	7.0	6.7	45	Bina kasr	4
	7.2	7.3	7.3	6.9	75	Javaher dasht	5
	7.1	7.2	7.2	6.9	62	Kelisum	6
7.4	7.5	7.6	7.6	7.2	120	Harzdil	7
	7.0	7.1	7.0	6.8	49	Chalakrud	8
...

2.3. Qazvin province seismic and around

As we mentioned, the studied area is one of the most important seismic area in Iran and world for its special geology situation and existence of more active faults, more than 10 historical earthquakes happened in this area and around and they caused more criminal victims such as, the oldest earthquake in this area was in Segzabad in three thousand years before Christ[11],[4]. This village is located in 8 kilometers west of Boeinzahra, archaeology study shows that three thousand years before Christ, the big and horrible earthquake also happened in this area that the culture of the region was destroyed totally and another historical earthquake of this area is related to one that happened in 1119 (A.D) that the magnitude of it is 6.5 in scale of surface waves. This earthquake is may related to the movement of one of the fault near Qazvin city and the movement of fault in North of Qazvin is more possible [4]. The instrumental earthquake were registered in this area are abundant, such as the biggest earthquake with the most criminal victims in Iran is one that happened in Boeinzahra 1962 and Rudbar-Manjil 1990. The recent earthquake killed more than 30000 people and Avaj earthquake in 22 Jun, 2002 with 6.5 magnitude of surface waves had more than 200 victims and several hundred traumatic so these results show that emphasis on the earthquake hazard in this area is so important[7].

Several Earthquakes of Qazvin province before the 20th century

1. The earthquake on February 12th – 15th 864 A.D (Zihajeh 249 Hejri) Rei[8],[10].
2. The earthquake on February 23th 958A.D (on Zihajeh 1st 346 Hejri) Rei-Taleghan[1].
3. The earthquake on December 10th 1119 A.D (Ramezan, 5th 513) Qazvin[1].
4. The earthquake on May 1177 A.D (Zighadeh572 Hejri) Rei-Qazvin[1].
5. The earthquake on Sunday, August 15th 1485 A.D (Shaban 3rd 890 Hejri) Polrud-Totkabon
6. The earthquake on Monday, January, 3rd (Rajab 1st 891 Hejri)
7. The earthquake on April 20th 1608 A.D (Moharram 4th 1017 Hejri) Rudbar0 Taleghan

8. The Earthquake on December 1808 A.D (The last day of Shaval 1223 Hejri) Taleghan
9. The earthquake on October 20th 1876 A.D (Shavval 1st 1293 Hejri) Koleh Darreh Bouein Zahra.
The earthquakes on 20th century (1278 to 1390 Khorshidi, 1900 to 2011 A.D) Qazvin province
1. The earthquake on Monday, May 20th 1901 A.D (Ordibehesht 30th 1380 Khorshidi and Safar 1st 1319 Hejri Ghamari)
2. The earthquake on Thursday, September 27th 1945 A.D (Mehr 1324 Khorshidi) Haryan (Alamutrud) [9].
3. The earthquake on Wednesday, April 4th 1962 A.D (Farvardin 15th 1341 Khorshidi) Qazvin
4. The earthquake on Saturday, September 1st 1962 A.D (Shahrivar 10th 1341 Khorshidi) Bouein Zahra (Aypak).
5. The earthquake on Thursday, January 16th 1946 A.D (Tir 25th 1343 Khorshidi).
6. The earthquake on Tuesday, November 8th 1966 A.D (Aban 17th 1345 Khorshidi) Smagh Abad Taleghan.
7. The earthquake on Monday, September 17th, 1973 A.D (Shahrivar 26th, 1352 Khorshidi) Marzan Abad.
8. The earthquake on Tuesday, October 30th,1973 A.D (Aban 8th, 1352 Khorshidi).
9. The earthquake on Thursday, April 11th, 1975 A.D (Farvardin 22nd, 1354 Khorshidi) Bouein Zahra.
10. The earthquake on Sunday, March 7th, 1982 A.D (Esfand 16th, 1360 Khorshidi).
11. The earthquake on Tuesday, December 20th, 1983 A.D (Azar 29th 1362 Khorshidi).
12. The earthquake on Wednesday, December 21st, 1983 A.D (Azar 30th, 1362 Khorshidi) Chalkroud.
13. The earthquake on Thursday, January 20th, 1990 A.D (Khordad 31st, 1369 Khorshidi) Rudbar-Tarom.
14. The earthquake on 2002 A.D (shaval 1st 1293 Hejri) Avaj Bouein Zahra.

2.4. Preparation of Qazvin province and around seismic map

In this study, the seismic maps were prepared in scale of 1:500000 by using quadrant seismic maps of Qazvin Rasht, Saveh, Ghom, Hamedan, Kabutarahang, Zanzan and Bandaranzali, that they were used in next parts specially in danger analysis part and earthquake hazard map. Some of the manifest traits of it are the width of the studied area, presentation the major of fault and high accuracy for finding the earthquake position. (Fig1).

2.5. Estimating the seismic parameters of Qazvin province

In this part, analyzing the seismic parameters of Qazvin province (a, b or λ, β) with Keijko- selovol (1992) were done by using the data that are related to Qazvin province seismic and around (quadrant with nonagon 48 to 51 degrees geographical length and 34.5 to 37.5 degrees geographical width).

The used data in this part were extracted from collection of basis information about Iran seismic book edited by Moein far and his co-workers in Iran seismic information bank. These data contain time and date of the earthquake event, geographic coordinate, magnitude and club depth.

In Kijko method, before inserting the seismic data, they have to be examined and analyzed, then for achieving to povason dispersion, aftershock and foreshock are omitted by comparative windows omitted and completion the earthquake schedule for surfactant waves magnitude and club depth method. In this project, melvil-Ambersyz (1992) were used for calculating the seismic magnitude in scale of surfactant waves for earthquakes which they don't have magnitude in scale of surfactant waves. The results were examined in two conditions, the first conditions, historical and instrumental earthquake were calculated with each other. Second condition, instrumental earthquake were calculated only. Finally we understood that the historical and instrumental data about one area can help us to predict the seismic hazard.

- [4] Darvishzadeh,A (1370). Iran geology, Emission of today science, Tehran.
- [5] Ghoreishi,M. Arjhang Ravesh,B. (1359), Examining the Quartz stone and faults in Qazvin. Iran geology organization, 37.
- [6] Ghoreish,M and Barbarian,M. (1370), the primary report about the horrible earthquake in Rudbar-Tarom (1369). J. Geology, Geology organization, (1370), 16, 1-29.
- [7] Analyzing report (1) Manjil-Rudbar earthquake 1369, earthquake engineering and seismology international institute, 1370.
- [8] Gholriz,M,A. (1337). Minudar or Baboljane Ghazvin, Tehran university edition, 467.
- [9] Moein far,A. Mahdavian,A. Maleki,A. (1337), Collection of Iran earthquake information.
- [10] Ambraseys,N.N.,and Melville,C.P.,A Histpry of Persian Earthquakes,Cambridge univ.Press,Cambridge,21,p,1982.
- [11] Alavi,M.,Tectonostatigraphic evolution of Zagrosides of Iran,Geology,8,144-149,1980.