Proceedings of the 18th Iranian Geophysical Conference, May 2018, pages 652-655

The study of the cities of iran inrelation to seismology and distance to fault

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ABSTRACT

The purpose of the investigation of seismic studies is to provide a more accuratepicture of the characteristics ofquakingand the potential seismicity of the intended region for the reasonablespendof the administrative costs of civil and industrialprojects.The estimation of earthquake risk inseismicityregionhas great importanceforinfrastructure facilities, because the inappropriate and unprofessionalprojectscan results in the many life and financialdamages and losses.And also it causes to loss of manpower and wasteofbuilding materials.Thesafety factor should be determined by considering the useful life of the building and its importance inrelation to the environment andthenumber of people whoare in contact withitas well as the occurrence probability of earthquakein thelocation.This paper deals with the investigation of Iran's seismic situation and earthquake parametersmeasurement and as well as to review and study of the faults distancetoIran's major cities. In addition to the statistical analysison theearthquakes which their magnitudewasgreater than6/5 degree in terms of the Richter scale. Then, it was found that thedestroyed townsdistance to the earthquake epicenter was about 11 km.

Keywords: Earthquake, Risk analysis, seismicity regions and Iran

INTRODUCTION

:In general, the accurate studies of seismology in theseismicityregionsuch as Iran in terms of preventing the material and spiritual assets waste, is a case that cannot be easily passed from it, so that during thepast 90 yearsin worldwide,more than 2 million people and in Iran more than 235 thousandshavelost their life for the earthquakeoccurrence.This figure compared to the total victims is equal to 6 percentgiven that Iran's population isequal to 1percentof the world's population, so this the mortality rate indicates that theIrancountrycompared to thearea and population is incurredtheheavy losses.

From the years of 1920 to 1923, the mortality rate in Japancountrywas about one hundred thousand people whichafter the 40 yearsand by preparing and constructing the resistantbuildings against of earthquake,the mortality rate was reduced to 26 people.Hence, the role of detailed studies forsite selection and safety andurban, industrial and civil utilities is characterizedagainst of earthquake.

One of the most seismically active regions in the world isthe Alpine-Himalayan Belt which extends from the Azoresto Indonesia Anatolia locates in the most active section ofthis belt in the eastern Mediterranean and involves severalimportant tectonic structures such as North Anatolian FaultZone (NAFZ), East Anatolian Fault Zone (EAFZ), NorthEast Anatolian Fault Zone (NEAFZ) and Bitlis Thrust Belt(BTB). Therefore Anatolia has beenexposed to strong earthquakes along the history. Focalmechanisms of earthquakes in western Anatolia indicate thatintra-plate deformations arising from vertical movements areoccurring inside of the Aegean-Anatolian block. Most of thefault-plane solutions in western Anatolia represent normalfaulting, indicative of crustal extension. Tensional axes forthese solutions are nearly horizontal and perpendicular tothe general east-west trend of graben structure. The Arabianplate moves northward, and forces the smaller Anatolianplate westward between the North and the East AnatolianFault Zones as from Karliova triple junction. [1-3]showed that this motion is transferred into the Aegean in asouthwesterly direction, resulting in the northern Aegeanbeing dominated by dextral strike-slip faulting ofnortheasterly strike.The last earthquakes observed in China (Sichuan province, in May 12, 2008,Mw =7,9), in Italy(Abruzzo region and the city of L`Aquila, in April 06, 2009,Mw = 6,3), on the island of Sumatra inIndonesia (in September 30, 2009, M=7,6), in Haiti (Port-au-Prince, in January 12, 2010, Mw = 7,0),in Japan (Fukushima NPP area, in March 11, 2011) showed an insidious force of undergroundelements which brought destruction and suffering to these regions [4].Iran is one of the earthquake-prone areas and high risk, which has been considered as an objective area in the current research.According to the following table,we have:

Table(1): The comparison of the mortality rate in Iran and compared to the global average global average

1920 to 2016	The total number of morality on the earth	Th number of morality in Iran	Iran's area compared to the earth	The mortality percent
9 years	2/000/000 people	235/000 people	1%	6%

In the table (2), the initial information about the seismicity of different countries and the relevant regulations typeare presented.

Table (2): The executive regulations of earthquake in different countries and Iran

No	Country Name	Publication Year	Type of Seismicity	Type of regulations in terms of safety
1	Albania	2008	Strong	Average
2	Argentina	2009	Strong	-
3	Afghanistan	-	Strong	-
4	Algeria	1955	Average	Average
5	Australia	2010	Weak	Average
6	Austria	2009	Weak	Average
7	Germany	2012	Weak	High
8	Indonesia	2003	Strong	Average
9	America	2014	Weak	High
10	Italy	2003	Weak	Average to high
11	Peru	1999	Strong	Average to high
12	China	2014	Strong	High
13	Turkey	2014	Strong	High
14	Chile	2001	Strong	High
15	Iraq	-	Strong	Low
16	France	2014	Average	High
17	Philippines	1982	Strong	Average to high
18	India	1998	Strong	High
19	Lebanon	-	Weak	-
20	Cuba	1994	Weak	Average
21	Japan	2015	Strong	Very high safety
22	Iran	1988	Strong	Weak to Average

As it is determined from the table (2), the European countries compared with Asian and African countriesin terms of the implementation of safety regulations and retrofitting of buildingsagainst of earthquake are placed in the higher rank.

The earthquake study in terms of probabilities:

In case of having the appropriate information such as the status of regional seismicity,statistical data and maps of seismicity can be performed the different statistical studiesusing standard methods over these data, for example, it can be determined the probable largest earthquake during the lifetime of a structure with the help of this obtained method.In case ofthe accurate and correct prediction ofsmallerearthquakes and considering this point thatthe earth grab is determinable for them, thus can be specified areasonable instruction for earthquake loading. Then, the detailed studies onthe distribution ofthe magnitude size of theearthquakesaround the globein specific areassuch as the Alpine-Himalayan belt, Japan, California, the Mediterranean and Russiawas conducted by different researchersthat their beststudies as Richter - Gutenbergempirical relationship was determined as the following form:

$$\text{Log } N = a - bm$$

N: Number of earthquakes

M: Magnitude

A:Specificconstant value of each region

B: The ratio of large earthquakes to small earthquakes

In this paper, the values of a and b using the Seisan software with regard to theearthquakemagnitudefor different regions of the globe was obtained that theseresults are presentedin the following table.

Table (3): The measurement the values of a and b by seisan software

Country	B	A
Japan	1122	6.86
Canada West	1.09	5.05
America West	1.14	5.94
America East	1.38	5.79
Centra America	1.45	7.36
Peru	1.11	5.60
Chile North	0.88	4.78
Chile South	0.92	4.46
Mediterranean	1.10	5.45
Javeh	0.94	5.37
Africa East	0.87	3.80
Iran	1.18	6.02

With regard to the relationship between the magnitude and frequency, can be calculated the earthquakes occurrence probability time for a structure according to the values of a and b based on the following diagram

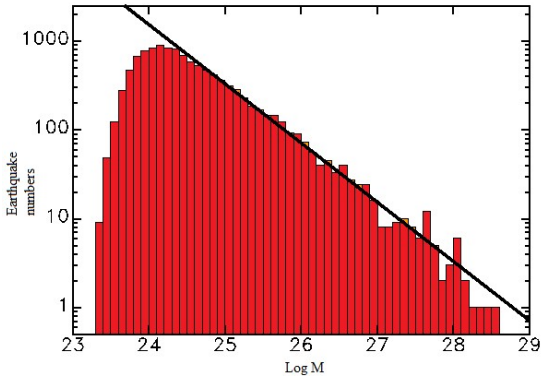

Figure (1): The Richter-Gutenberg relationship about the magnitude and frequency of earthquakes

Thestatistical status of Iran's earthquakes from the years 1959 to 2016:
From the years 1959 to 2016 AD, the number of 202importantearthquakehave been occurred in Iranwhich are as follow:

1) The number of 171 earthquakes with a magnitude of 5 to 6 degrees on the Richter scale;
2) The number of 23 earthquakes with a magnitude of 6 to 7 degrees on the Richter scale;
3) The number of9 earthquake with a magnitude of 7 to 8 on the Richter scale.

The positioning status of Iran's cities against of the faults:
This paper deals with the statistical studies of Iran's citiesand the largecitiesand overcrowded towards of theseismicityfaultsand in general,Iran's citiesare divided into two categories [5, 6].
1)The cities whichhave placed on the fault orwith the little distance of the faults;

2)The cities whichhavelocated on the twofaultsangleoron theinternal bisectorof thetwofaults.

Generally, the most of Iran's citieshavelocated on thefaultandthe earthquakehashappened in thesecitiesandthe places whereare locatedof two faultsconfluence and have severely shaken, but it does not mean that if every citydoes not have a history of seismicityin where the big earthquake will not happen,for example,Tabas city with thousands-yearhistoryabout three hundred years ago,onlya microseism earthquake was experienced. But, however, in the year 1979an earthquake with the magnitude of 7.7 degrees on the Richter scale was faced.As well as, thecities such as Shiraz, Sari, Qazvin and Babolhave the great distances of the faults.But, however, thelarge earthquakes have occurred in the mentionedcities, because these cities are located on theinternal bisectorof thetwofaults.

Table (4): The Iran's cities distance to the earthquakes epicenter

No	City Name	The distance from the fault to KM	Fault length	Earthquake history	The occurred earthquake magnitude
1	Tabas	Nearthe fault		Has	7/5-7/8
2	Qir and Karzin	1	60	Has	7/1
3	Dorood	1	100	Has	7/4
4	Salmas	5	40	Has	7-7/5
5	Dasht Beyaz	6	120	Has	7-7/5
6	Buin Zahra	8	50	Has	7-7/5
7	Baghan	12	40	Has	7-7/5
8	Kohak	10	50	Has	7-7/5
9	Kerman	10	50	Has	7/1
10	Saravan	30	230	Has	7-7/5
11	Kermanshah	17	170	Has	7-7/5
12	Babol	35	300	Has	5-6
13	Sari	35	300	Has	6-6/5
14	Kazeroon	15	200	Has	5-6
15	Neyshabur	12	20	Has	5-6
16	Ardebil	20	65	Has	5-6
17	Urmia	20	65	Has	5-6
18	Esfahan	60	350	Has	5-6
19	Birjand	17	100	Has	6-7
20	Qom	10	50	Has	5-6
21	Mashhad	1	90	Has	5-6
22	Yazd	Along the fault	-	Has	4-5

The most of the Iran's citiesmostly have builtin the hillside of themountains andaccording to thetopography of Iran, the distance of mountaintop and the cities centers, on average,are between 10 and 20 km, soaccording topassof themany faults from thelong distanceofcitiestoearthquakecenters will beabout 15 to 20 km, for example, thestatistical analysis ontheearthquakes which their magnitude weregreater than 5.6 on the Richter scale, which indicates that the destroyedcitiesdistance to theearthquake epicenter was about 11 km.
As well as, according to the construction philosophy in the Iran's villages near of the aqueducts andthewater outlet placefromfountains which were located innearof thefault and fractures, so theIran's urbanand ruralcenters have locatednear of thefault oron the fault.
Table (4)dealt with the investigation and study oftheIran'scities and their distance to the near ofthe faults.
According to this table, it was determined that the most of Iran's big cities are located near the faultand this issue has the close relationship with the morality rate and damages throughoutthehistory.

Results:

1-With regard to theIran'sareacompared to theEarth'ssurface area, the morality rate andthe earthquake damages in Iran is very high.
2-By measuring the ratio of large to small earthquakes in Iran, this amount is not the same in everywhere.
3-The European countries compared with Iran in terms of the implementation of safety regulations and retrofitting of buildings againstof theearthquake are placed in the higher rank.
4-The most oftheIran'scities have built within the distances of 10 to 20 kilometers of the faults which this issue causesthemorality increase in Iran.
5-By having the values of a and b and the earthquakes gravity andfrequency distribution of aftershocks, can be achievedthe biggest probable earthquake in a region
In conclusion, the large earthquakes have occurred in Iran like its other regions and will occur in thefuture. For this reason, seismicity studies should becontinued for minimizing the losses of life and propertycaused by earthquakes. Therefore, the tectonics features andactive faults and activity of the region should be definedcarefully and followed continuously.

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