Estimate the Seismicity Parameters of Buin Zahra in Qazvin Province

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ABSTRACT
Qazvin province, according to population and industrial concentration and locating close to Tehran and placing on the road intersection, has particular importance in economic and political point of views and the security of the province is important. One of the important discussions in this province is to resisting buildings against earthquake. In order to build new towns and cities and for designing earthquake resistant structures, recognizing the strong movement of the earth which expected to occur during the lifetime of structure is of special importance. The best way to understand the characteristics of strong ground movements is to obtain the plot of land movement such as strong ground acceleration in the event of moderate to large earthquakes and the seismic zoning maps. Therefore, in this study, obtained seismic zoning map parameters, using data from a global network of seismographs, was investigated and determined. Therefore, the earthquake data were collected, prepared and processed.

KEYWORD
Seismic parameters, seismic zoning map, risk analysis, Qazvin province.

INTRODUCTION
Seismic (Earthquake) is a natural event, generally occurred due to the slip of solid crust of the earth's plates, which is caused at the fracture. This event is associated with the release of the elastic energy caused with sudden vibration of pages each others. Using the release of this energy in a situation near the location of faulting (faulting zone), vibration produce in which cause destruction of buildings. With seismic waves, earthquake, landslide in the ground level, increases with the destruction domain so that points near the center of the weak-superficial earthquakes or superficial earthquakes are suffered. Therefore, the knowledge and familiarity with seismic as a source of the earthquake and full understanding danger Zone of cities and villages, could be assisted in the immunization of structures particularly important buildings. Locating industrial and popular new locations without consider of the earthquake risk in that range is uncompleted operation which is causes irreparable damages. In order to the design of earthquake resistant structures, recognizing the strong movement of the earth, which is expected to be occurred during the lifetime of structure is quite important. The best way to understand the characteristics of the strong ground movements is obtain the plot of land movement such as: strong ground acceleration in the event of moderate to large earthquakes and the seismic zoning maps. So in the earthquake prone regions of the world after identification, collecting and recording strong ground movement of active or semi active faults, which will begin to construct maps about the number of earthquakes in the range of mentioned regions, With so many research, they achieved results that are results in seismic zoning maps and the parameters of strong ground movement and the maps for each site would be used based on the predicted earthquake on the structures. Qazvin province, according to population and industrial concentration and location in the vicinity of Tehran and placing on the road intersection, has particular importance in economical and political point of views and the security of the province is quite important. Therefore, in order to prepare the seismic zoning map of the province, existing geological maps along with eight regional reports in this area was prepared and semi-active and active faults were identified then the data on historical and recent century earthquake was collected to 150 km radius and tectonic map of Study Area, with 1:500000 scales was prepared.

GEOSLOGICAL SETTING
The study area in Qazvin province is located on longitude coordinates 51°00 to 48°00 and latitude is 37°50 to 34° 50' (Fig.1). The geological structure of the study area is located in the Alborz and central Iran [1]. Morphology of Qazvin province include the mountainous area, mountain rang and alluvial deposits. The study area (Boein Zahra) subsidence of the mountain peidmont of the Alborz Zone. This area are

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located along various fault on the alluvial deposits of the Alborz climbing[2].

![Location map of the study area in Qazvin province](image)

**Fig 1: Location map of the study area in Qazvin province**

**MATERIAL AND METHODS**

The study was conducted using data from the World Wide Seismology Seismicity parameters determined range. Finally, the information obtained will be used for the analysis of seismic hazard area.

**2.1. Preparation, completion and processing of earthquake data**

**2.1.1. Preparation and completion the list of earthquakes**

In order to provide the event of earthquakes in the twentieth century that occurred in Iran, we used from Iranian earthquake data set such as A.M.B, which is collected by[3]. It should be noted that the number of sides [4,5] has announced an approximation based on historical earthquake intensity approximately five degrees is defined. So empty is not an error.

Removing of these errors have a huge earthquake parameters such as geographical coordinates of the epicenter of the earthquake to be checked carefully. Otherwise, the results will be worthless and the technical and scientific validity. Given the magnitude of the earthquake, according to reports Mb or M or Ms, there should be a parameter. Therefore, the earthquakes that have been reported to them both Ms or Mb extract and [4] equation for converting and integrating them has been used.

\[ \text{Ms} = 1.613 \times \text{Mb} - 3.71 \]

**2.1.2. Processing the list of earthquakes and to Poisson earthquake events**

List of earthquakes in the seismic hazard estimates for the calculation of seismic parameters of the study area, such as earthquakes, earth and space domains are independent of each other, the subordination List of earthquakes of the Poisson distribution (Coefficient Poisson) requires that foreshocks and aftershocks of the earthquake are removed from the list.

**2.1.3. Removing pre-shocks and aftershock from the list of earthquake events**

Seismic phenomena can unconditionally at any time and place to be independently. So according to pre-earthquake and post-earthquake risk in particular, can detect major earthquakes. So by removing foreshocks and aftershocks, many major earthquakes also do not have to be removed. [6] a period in which the number of earthquakes greater than a certain limit, the timescales of foreshocks and aftershocks consider this range to be removed from their data.

**2.1.4. Removing pre-shocks and aftershocks in earthquake risk assessment is important**

**2.1.5. The removal of aftershocks and the results**

Several methods exist for the removal of aftershocks and foreshocks, including:

1- Manually remove the aftershocks that this method will be slow and requires a lot of skill and experience.
2- A window to window using three variable, fixed and adaptive place that is more accurate than the first method.

In this study, an adaptive window to remove foreshocks and aftershocks is used. This means that at any stage of the campaign after the removal of foreshocks and aftershocks hearts seismic event with a Poisson distribution of the fitted distribution can be effected. Work based on the Program widened the window of a minimum chi-square test in each step. At each stage of the program of external events considered in the evaluation of the Poisson distribution and trying to change the Poisson test parameters and dimensions of windows events from more than a certain percentage is not calculated.

Once the program is removed from the critical value of chi-square test, the window stops growing. This program will try to act in a way that removes the least favorable distribution of events that the Poisson distribution is
obtained. So if an aftershock outside the window of choice remained to be removed manually. At this rate, $M_{max} = 5.51$ is chosen to avoid as far as possible removed from the original quake.

**Estimation of Seismic Parameters with [7]**

(Maximum Likelihood Estimation using Heterogeneous List of Earth Quakes)

The main parameters of seismicity in a seismic area $(a,b,\beta)$ and rate coefficients for the annual event $(\lambda)$. A coefficient greater frequency of earthquakes and the seismicity of a region depends on the ratio between track different intensities. While the coefficient $b$ in any case, the concept of nature represents a zone of seismicity. It is a little different for different areas but is usually much $b ^{5/0 - 5/1}$ does.[7] method to estimate the seismic parameters of seismic events are used heterogeneously list.

In other words, this method of entering data, both historical and instrumental earthquakes and seismic data alone device seismicity parameters are calculated. Relevant results includes $\beta, M_{max}$, annual event($\lambda$), the return period $(TR)$ possibility of no event $(IP)$ was obtained. main event was made possible return. These results are provided in Table 1 and Figes2(3,4,5,6 and 7).

***RESULTS***

$\beta = 1.45 + .15 (b = .62 + .06)$  
$\lambda = 1.06 + .28 (for M_{min} = 3.00)$  
$M_{max} = 8.10 + .28 (for SIG(X_{max}) = .15)$  
Transmission coefficient = 1.83

DATA contribution to the parameters:

<table>
<thead>
<tr>
<th>Beta (%)</th>
<th>Lambda (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTREMES :</td>
<td>75.6</td>
</tr>
<tr>
<td>COMPLETE #1 :</td>
<td>12.3</td>
</tr>
<tr>
<td>COMPLETE #2 :</td>
<td>12.1</td>
</tr>
</tbody>
</table>

Table 1: The annual event rate in terms, return period and the possibility of an annual event for 1,50, 100 and 1000 years period

<table>
<thead>
<tr>
<th>Ms</th>
<th>Annual Rate($\lambda$)</th>
<th>Return Period</th>
<th>Improbability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>4.0</td>
<td>.248E+00</td>
<td>.780</td>
<td>.0000</td>
</tr>
<tr>
<td>4.1</td>
<td>.214E+00</td>
<td>.807</td>
<td>.0000</td>
</tr>
<tr>
<td>4.2</td>
<td>.185E+00</td>
<td>.831</td>
<td>.0000</td>
</tr>
<tr>
<td>4.3</td>
<td>.160E+00</td>
<td>.852</td>
<td>.0000</td>
</tr>
<tr>
<td>4.4</td>
<td>.138E+00</td>
<td>.870</td>
<td>.0000</td>
</tr>
</tbody>
</table>
Fig 2: The annual event rate in terms of magnitude

Fig 3: In terms of return period magnitude

Fig 4: The possibility of an annual event for the period 1 year

Fig 5: The possibility of an annual event for 50 years period

Fig 6: The possibility of an annual event for 100 years period

Fig 7: The possibility of an annual event for 1000 years period
EARTHQUAKE FOCAL DEPTH DISTRIBUTION OF STUDIED AREA

For this purpose, i.e., to obtain the distribution of earthquake focal depth of earthquakes this century of the data used in the project scope focal depths of the earthquakes that have been reported for consideration for worst earthquake focal depths less than km 20 have considered. Then the focal depth chart - cumulative frequency is plotted. Form (in terms of magnitude, focal depth distribution as percent frequency).

CONCLUSION

1. The Geology range studied of active zones in Iran. These ranges in other Quaternary changes confirm that it is risk prone.

2. In the range studied, a large and destructive earthquakes in history, the relatively high risk of occurrence of large earthquakes always lurking in the city of Qazvin province, Takan, Boin Zahra, Abyek, and Avaj and Ab Garm. The range of fault length is inversely any movement that can only be followed by a large earthquake.

3. The city of the province of Qazvin, Abyek and Avaj due to being located near major faults, the range of other areas are at risk Avaj particular city is located on the fault Avaj and the lack of movement on the fault near to dangerous when threatened after the city of Qazvin and later have Abyek.

4. Qazvin province 11 km north of the fault is according to studies. It is seems that the only activity of this fault is related to the Year 1119 during, which is an earthquake of magnitude 5/6 occurred. This is a reverse fault type and if the movement can cause earthquakes with a lot of energy. Due to this lack of long-term fault activity, the city is in great danger lurking. These faults may be coming to the movement, earthquake with a magnitude of 9/6 to 1/7 which are in place due to surface faulting near to the city of Qazvin, enormous human and financial losses will follow. This is also true in the case Abyek.

5. In this study, as given in Table 1, it has the potential of relatively "high seismicity.

Value B = 1.4 for the entire study area due to the occurrence of large earthquakes in the past century earthquakes Boin Zahra and Roudbar-Manjil showing high levels of seismicity. [7] method, which is used to support the use of historical earthquakes in the range of studied, return period earthquakes that, would be quite realistic. Taking courses without the occurrence of earthquakes, as mentioned earlier, among the advantages of the method should be [7] for example, a return period of earthquakes with magnitude 7.0 regardless of historical earthquakes 6/65 years and considering them, 8/395 years and this showed the effects of historical earthquakes. In addition, the focal depth of earthquakes and focal depth distribution should be noted that most of earthquakes have been occurred at depths less than 60 km. It should be noted that the depth of the earthquakes in the stations are considered valid in terms of accuracy that has been reported. Despite this, because researchers and users from deep earthquakes, with different patterns of shell area and number of layers taken into account, different depths of the earthquakes have been reported and this choice also discussed the results of this research will undoubtedly impacts.

REFERENCES


