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Analyzing seismicity hazard in Boinzahra, Qazvin and Hamedan zones

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Abstract

Today analyzing seismicity hazard urban different areas is critical and inevitable due to develop and to expand cities in seismically active zones and naturally, the hazard because the earthquake is more in the bigger cities and the necessity to consider these hazards would be increased. Expanding the cities in Iran seismically active zones caused to be necessary to analyze earthquake hazard. Bouinzahra, Qazvin and Hamedan as cities in subject to earthquake hazard are perfect relevant instances. These important cities have been surrounded among active faults and it's possible always to happen a big earthquake on it. For probabilistic risk analysis for different levels of software EZF RISK that a program is incredibly strong in this field has been used. This study analyzes the seismic hazard of earthquake for these 3 cities considering this truth by Probabilistic and Deterministic analyzing method. The results showed the relative level of earthquake hazard is high in these cities and it's according to suggesting opinion of Iranian code of practice for seismic resistant design of buildings (2800).

Keywords Probabilistic analysis, Deterministic analysis, EZF RISK, ZMAP, Seismic Hazard of Bouinzahra, Qazvin and Hamedan zones.

1.Introduction

Iran is a seismic country in opinion of construction earth seismic and it is implied by happening different earthquake (Amberseys And Melville, 1982). Convergence between Iran and Arabia Saudi plate appeared on Iran crust shortly and in figure of fault and reverse and folding with speed 20 to 30 mili gram in a year (Berberi and et al 2001, Demetz et al). Jackson assumed the thickness of crust is 20 kilometers in Iran (Jackson, 1980). Bouinzahra and Qazvin are in a zone with relative seismic hazard and Hamedan is in a zone with high relative hazard [1]. In case of geography of Hamedan province and it's situation and divisions, poorarab divided Hamedan province to Asadabad and Bahar and Touyserkan and Razan and Famenin and Kabudarahang and Malayer and Nahavand and Hamedan [2]. The hazard of Bouinzahra, Qazvin and Hamedan site evaluated in this article by 2 Deterministic and Probabilistic methods and the maximum of horizontal acceleration for the earthquake base on the plan measured by to define seismicity source in the zone and to define the maximum of acceleration by a proper Attenuation relation that it's in fact input earned acceleration to analyze the structures statically and dynamically[3]. This study is a bout analyzing the hazard of Bouinzahra, Qazvin and Hamedan site by 2 Probabilistic and Deterministic methods. In Deterministic method by 5 Attenuation relations: Boore and et al, Koronel, Amercis, Katyama and Takashi and Doglos to analyze Bouinzahra zone Deterministicly and Abra and et al, Boore and et al, Gumbel and Bozorgnia [4], to analyze Qazvin and Hamedan zones probably were applied the ray of studying on Bouinzahra and Qazvin zones are in order 150 and 200 kilometers. Goutenberg defined richter for every source separately. The Probabilistic to happen an earthquake because to move the sources and combining liner and surface sources to achieve the given acceleration was exploited. Analyzing Probabilistic hazard (PSHA) related to Hamedan city is for a point with coordinates (48.568 & 34.743) in the center of Hamedan. First all of the faults in 200 kilometers rays to above coordinates are defined to do the project and then we make seismic sources around the site regarded to setting earthquake (1900 to 2015) and historical earthquake (before 1900) of the study limit [5]. Software ZMAP which is written base on Matlab program [6], is used to assign seismicity properties of every seismic sources. Also the above EZFRISK program which is a so powerful program have been used to analyze the Probabilistic hazard in different hazard levels. Finally, seismic hazard diagram, exceeded acceleration, uniform hazard spectra and to assign the acceleration ray for the site of the search will be compared to assigning the expandation of regulation 2800. Seismic hazard and

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engineering Probabilistic static are address's pre knowledge level.

2. Overview about the data and discussions.

Catalog earthquake in new era of USGS base [5], historical earthquake have effective role in responses from geophysics site [7], and International Institute of Earthquake Engineering and Seismology [8] and Iran seismicity historical book have been gotten [9-13] .
There are satisfied with final results because the volume of the analyzes are high. It could be referred to the studies regarding to the historical earthquake are so important and they will be so useable in researcher's searches. In continue, we will address to the active faults and to define the place of the zone earthquake.
The faults of Bouinzahra, Qazvin and Hamedan provinces.

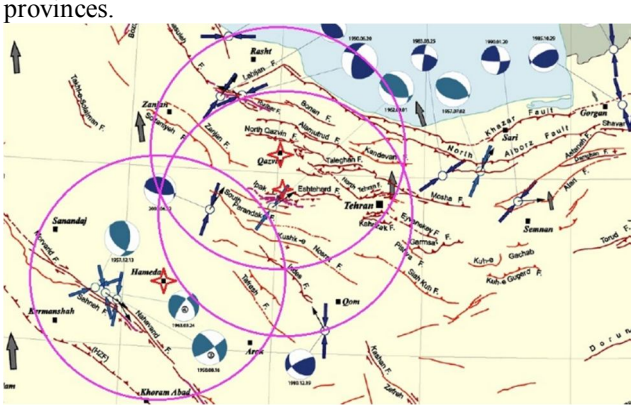

Figure 1. to define the place of the earthquake on the zone [7].

source will be achieved by meaning controlling earthquake. Then controlling earthquake of each seismic source achieve to the response by Attenuation equations by Cornell, Boore, Amberseys, Katyama and Takashi and Doglos [14]. The response of maximum of each equation will be earned for each seismic source. It will be as acceleration of plan of the zone. We address these equation in summery in this part.
Attenuation equation and assigning acceleration of each source (Cornell):

$$\ln(PHA) = 6.74 + 0.859M - 1.80Ln(R + 25) \quad (1)$$

Attenuation equation and assigning acceleration of each source (Boore):

$$Log\ PGA = -0.038 + 0.216(M_{mid} - 6) - 0.777.log(\sqrt{R^2 + 30.03}). \quad (2)$$

Which M is controlling earthquake and R is distance of center of seismic source in equation (1 & 2)
Attenuation equation and assigning acceleration of each source (Amberseys and et al):

$$\mathrm{Log(PGA)_h} = 2.522 - 0.142\mathrm{M_W} + (0.314\mathrm{M_W} - 3.184)\mathrm{Log}\sqrt{\mathrm{d^2} + 57.76} + 0.137\mathrm{s_s} + 0.050\mathrm{s_A} - 0.084\mathrm{F_N} + 0.062\mathrm{F_T} - 0.044\mathrm{F_O} \quad (3)$$

Which S_s and S_A are variables dependent to soil and F_N and F_O are variables dependent to fault mechanism M_W, d are in order moment magnitude and distance in this equation.
Attenuation equation and assigning acceleration of each source (Katayama and Takashi and et al (Japan 2000)):

$$\mathrm{Log(PGA)} = 0.446\mathrm{M_W} - 0.00350d - log(d + 0.012 \times 10^{0.446\mathrm{M_W}}) + 0.00665(\mathrm{h\text{-}20}) + \mathrm{S} \quad (4)$$

In which h, D, M_W and S are in order depth, distance and soil coefficient.

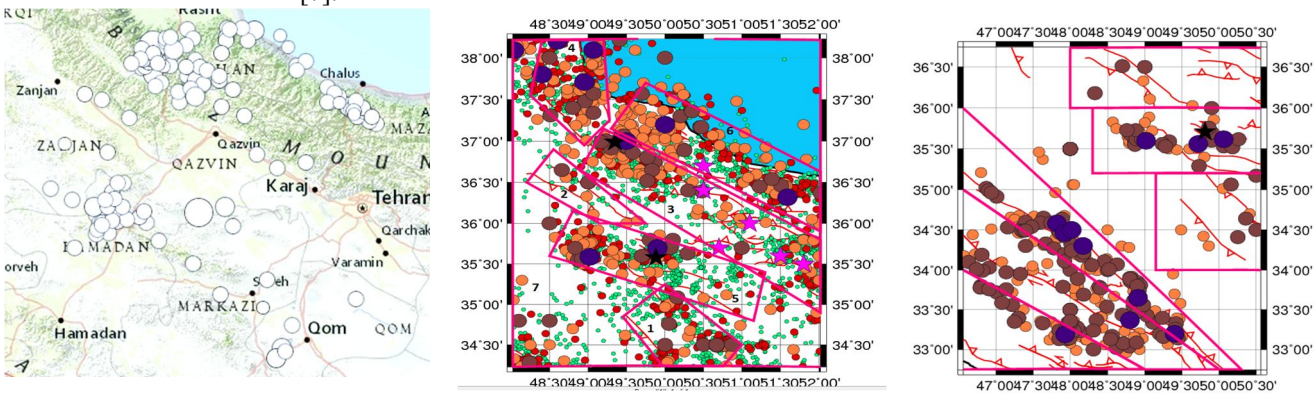

Figure 2. to define the place of Hamedan, Qazvin and Bouinzahra site earthquake.

1.2 Estimation of earthquake movement control

Different magnitudes will be earned fellow equations and it will be become normal by logical tree method. Controlling earthquake will be earned by Nowroozi, Amberseys and et al, Wels and et al and Solmas. The responses will be earned by applying distances variables on these equations which every one is for one type of fault (parallel, converse or all of the faults). To realize which equation is more careful. They are weighed and seismic

Attenuation and assigning acceleration of each source (Doglos 2003 global equation)

$$\mathrm{Log(PGA)_h} = -0.659 + 0.202\mathrm{M_S} - 0.0238d + 0.020\mathrm{s_A} + 0.029\mathrm{SS} \quad (5)$$

Above variables are similar to other equation's.
See deterministic seismic parameter obtained from the above equations in the following figure.

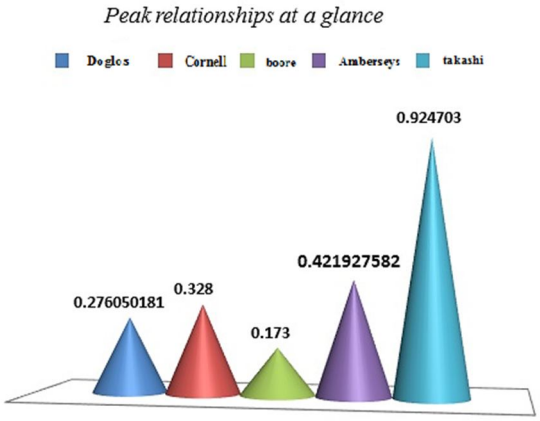

Figure 3. The responses of maximum Attenuation equation in assigning analyzing for Bouinzahra site (responses are base on gravity moment).

Such result was achieved by analyzing Bouinzahra zone in important role. The achieved results are exaggerated. Dogloss equation: In this equation, the magentude of equation is effective. Comparing the earned movement by above equations to regulation of Iran debt 6 could be resulted Kronal and Amberseys equations have more desirable results for Bouinzahra site.

3. Annalyzing Probabilistic hazard in Hamedan and Qazvin

Hamedan and Qazvin uniform hazard spectral diagram shows 5% damping for 475, 975 and 2475 years which it is applying for structures with high, medium and low importance. Although the structures should be designed for more returning era with increasing importance degree of them. For instance, diks and powerplants.

Annual exceeded accelerating diagram is shown separately by software EZF RISK in Hamedan and Qazvin site instead of each seismic sources. The left diagram shows annual exceeded accelerating probability diagram in Hamedan site instead of each seismic sources

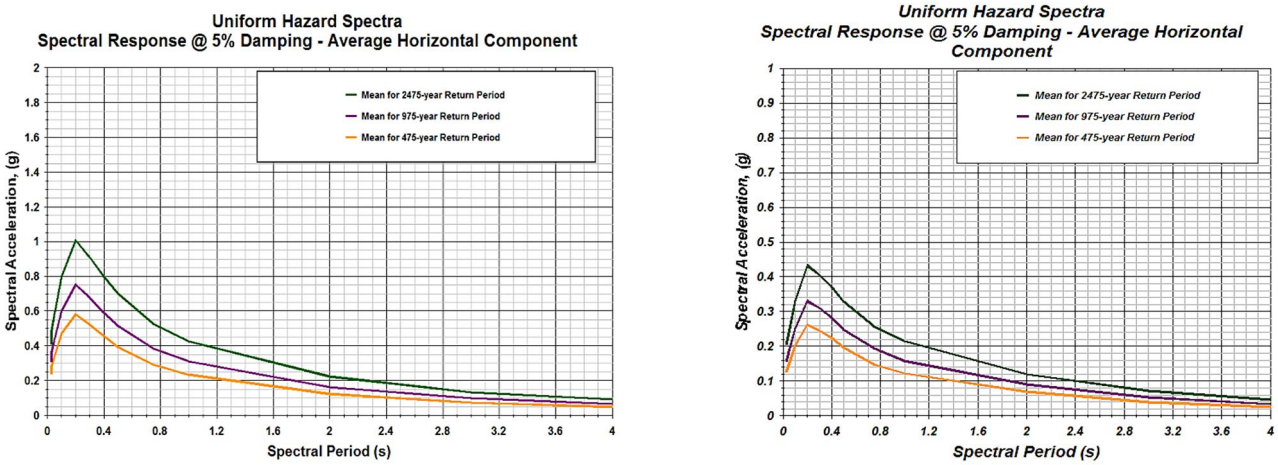

Figure 4. from right, Hamedan and Qazvin uniform hazard spectral diagram shows 5% damping for 475, 975 and 2475 years [15].

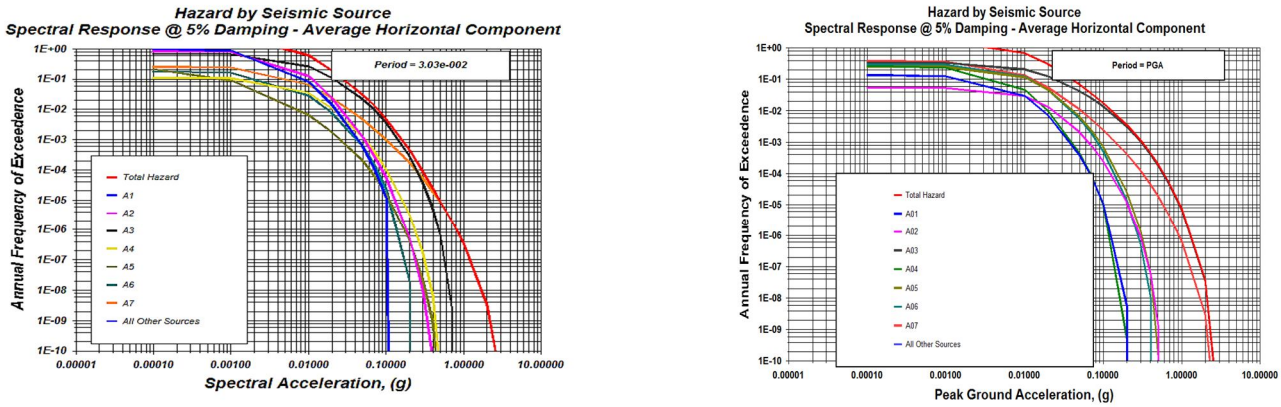

Figure 5. Hazard by seismic source specral response @ 5% damping in Hamedan and Qazvin site instead of each seismic sources in general and individually [15].

different approaches: Cornell equation: Distance plays embossed role to achieve earth movement. Boore equation: Both distance and magnitude have equal role. But achieved results are weak. Amberseys equation: results are desirable. Takashi equation: magnitude plays a more in general and individual (A_1 to A_7 sources).

The right diagram shows annual exceeded accelerating probability in Qazvin site instead of each seismic sources in general and individually (A_1 to A_7 sources, Figure 5).

The right diagram states activity rate of seismic sources in Hamedan site base on moment magnitude (sources A_1 to A_7). See the Figure 6.
Regard to analyze Probabilistic seismic hazard in Hamedan site, 3 Attenuation equation's Mr Abra and et al, Mr Boore and et al and Mr Gumbel- Bozorgnia is used. It could be compared 3 Attenuation equations and average weighting for average horizontal seismic for the effective sources for damping 0.5. for example the response of Boore and et al equation are presented in the distances. Diagrams of sourced A1, A3 & A7 (Figure 7). The following figure are expanding acceleration for Hamedan zone instead of different level of hazard in 975 and 2475 years (Figure 8 & 9).

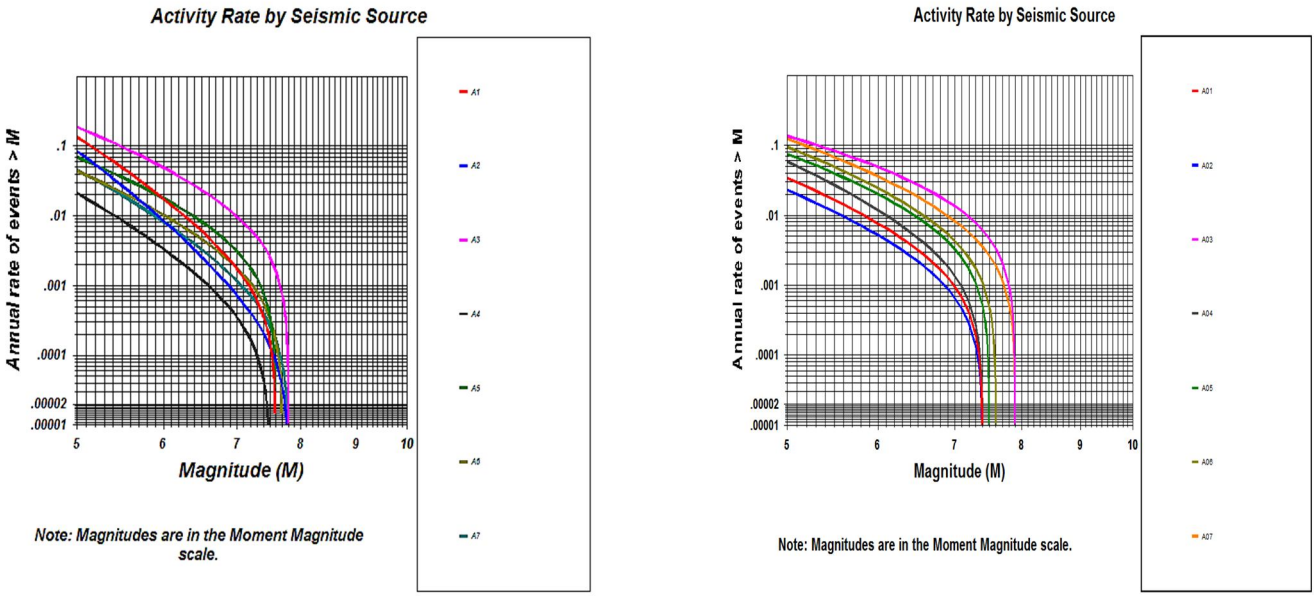

Figure 6. activity rate of seismic sources in Hamedan in the left diagram and activity rate of seismic sources in Qazvin site in the right diagram.

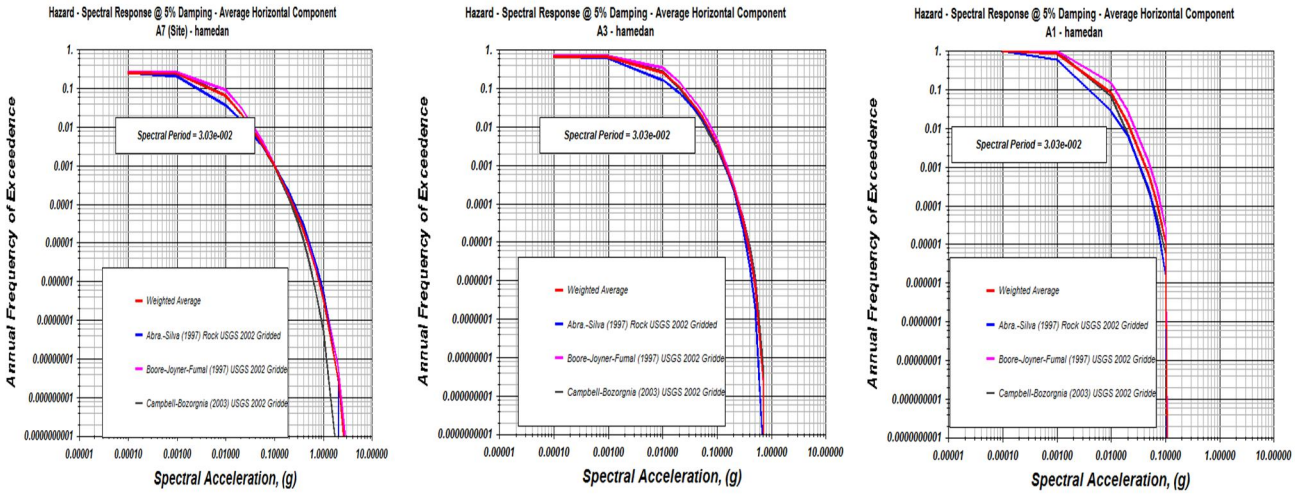

Figure 7. Analyzing probability seismic hazard in Hamedan site on Abra and et al, Boore and et al and Gumbel- Bozorgnia's 3 Attenuation equations.

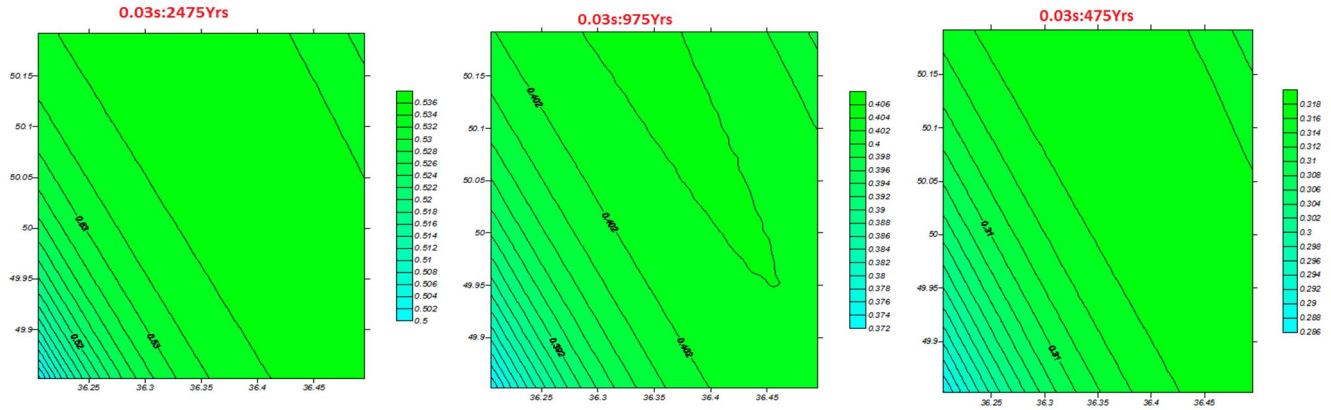

Figure 8. Zoning acceleration for Hamedan zone

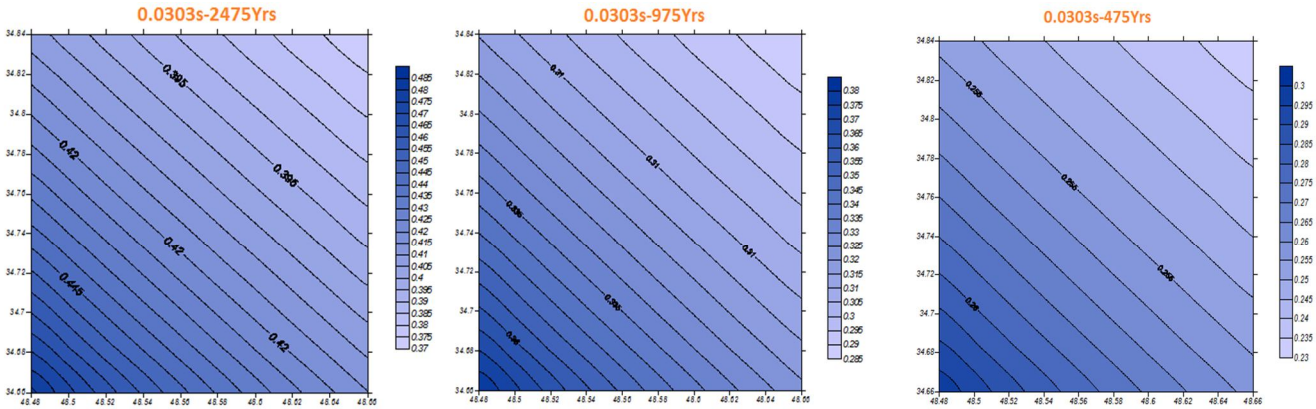

Figure 9. Zoning acceleration for Qazvin zone.

4.Conclusion

In Hamedan site

- Maximum acceleration rates instead of level of hazard 1 (happening event 10 percent in 50 years) is 0.3 G according to above evaluations which it's accord to the gotten rate in regulation 2800 in Hamedan that it is 0.3 and it is gotten by the regulation is referable.
- According rates in hazard level 2 (probability 2 percent in 50 years of the structure life) can take 1.5 times to the acceleration rates in hazard level 1 that it is right in this project.

In Bouinzahra site

- In regard to the evaluations, the maximum acceleration rates is 0.37 G from lining number 1 and surface number 2 instead of level of hazard 1 by possibility method.
- In regard to the studies in this project, it could be found Bouinzahra city is in subject to financial and vital damages resulted to earthquake and crisis management and necessary readiness will be required to decrease damages in this area.
- Hazard curves, source of Epic fault is selected as the most probability source (that the earthquake with 7.0 Richter in Bouinzahra in 1962 was for this fault).

In Qazvin site

- The maximum acceleration rates is 32.0 g instead of hazard level 1 (happening probability 10 percent during 50 years) according to above evaluations, that it is according to the given rate in regulation 2800 in Qazvin city, means it is 0.35 g and the given rates by the regulation in this matter are referable.
- According to regulation 2800, bed rock acceleration rates in hazard level 2 (possibility 2 percent during 50 years the structure life) could be taken 1.5 times of acceleration rates in hazard level 1 that it is right to this project partly.

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