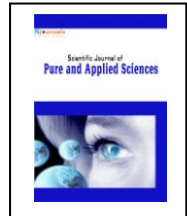


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**Original article**

## Earthquake vulnerability evaluation faizabad district of Kermanshah

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### ARTICLE INFO

### ABSTRACT

*Article history:*

Received 21 June 2014

Accepted 20 July 2014

Available online 25 July 2014

*Keywords:*

Earthquakes

Vulnerability

Risk

Crisis

This paper as example has been studied Faizabad district of Kermanshah and to reach its main purpose, which is reducing the damage caused by the earthquake on the Faizabad district is been provided and in subsidiary purposes part the research is tried identify factors influence in vulnerability earthquakes, pay to provide the factors required; All these factors have an impact on reducing earthquake vulnerability. This data using geological data, soil texture, getting satellite images and layering over Arc Gis software identified and for long term periods done predict using relation kernel PSHA also. In determining the level of environmental risk is to use software crisis. Finally, by recognizing the risk zone, solutions for Faizabad district offered.

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### 1. Theoretical foundations

Successfully today, in the world of earthquakes and other natural disasters much research has been done and good researches in Iran also received in fields of seismology, earthquake faults determination in the cities and Tehran and many scientific and academic institutions are active in this field. Comprehensive crisis management plan should be in main level of emergency after event and also in the short-term and long-term predictions in order reduce the negative effects catastrophic disaster will formulate (Thomas. E and ..., 1383, pp k) Doctor Fariborz Nateghi Elahi international institute of Earthquake Engineering and Seismology professor and chairman of Iranian Earthquake Engineering Association, many research and valuable books regarding earthquake has presented that present research benefited of result his work

and has paid to Vulnerability Assessment. Including a paper with discussing crisis management status in Iran in 2000, and in 2001 in an article to analysis earthquake in Tehran is paid; the cities vulnerability against earthquakes, earthquake crisis management mega cities and... is from other his researches. Serious studies in the our country after the earthquake Rudbar was started and after the earthquake Bam has been highlighted; Books and several papers such as crisis management, Mr. Mohammad Reza Tajik, prepared community by Mr. Shahram Alamdar, crisis management way of facing, Yazdanpanah Koramshahi (Behzadi, 2008, p7)

## **2. Earthquakes**

Sudden release of energy in a very short period of time, which is due to turbulence in the Earth's crust take place. Earthquakes may (tens, hundreds, or thousands of years) in a few seconds to release blocked energy (Gibson, 1997: 356).

## **3. Vulnerability**

City vulnerability against earthquake is a function of human behaviors that degree of surrender or capability resist economic, social and physical urban units against earthquakes indicates (Rashed and Weeks, 2003: 547).

## **4. Risk**

Susceptibility a society to a potential risk that it would threaten as Tehran regarding to earthquake potential risk has high. (Alamdari, 2005:18)

## **5. Crisis**

Any event that might peril or destroy property or human life crisis is considered. (Aslanzadeh, 1386, p 10)

## **6. Questions**

- What are the factors affecting the reduction of damage caused by earthquakes?
- Determine risky areas, what economic and social impacts for Faizabad district will be followed?

## **7. Introduction**

We live in a world where a city world is that its result is away from natural environment accepting unwanted unbalanced conditions which comes from uneven relations and urban space and city is a reflection of thinking organized in a cultural spatial region with its own rules. (Abrahamzadeh and Mojer Ardakani, 1988: 82) The city lasting effect history and still is evolving geographical and social unit. (Rahnamaii, 1988: 82) Issue appropriate use of urban lands same beginning of a new urbanity in the West is that became to one of the most important goals planning. Result this work set of concepts and methods and criteria and engineering techniques for the efficient use of urban land and to balance human relations and legitimacy as planning land use in word's urbanity is considered. (Mehdzadeh, Hashemzadeh Homayuni, 1981: 72) That with expansion dimension physical and problem urbanity as well as a gradual increase number cities in the world and continuation of environmental and economic Upload on their bed is made necessary by the need to pay more attention to their. Actually city is as a "resource development" requires management, dynamic in all its dimensions. (Shia, 2003: 73) Today earthquake risk covers at least 35 countries in worldwide and is factor failures of life and most of death. (Smith, Kate, 2003: 199) Iran country is in row 10 disaster-prone countries of world. Iran with the probability 31 natural disaster

from more than 40 kinds of natural disasters in recorded in the world faced, for this reason, the study and recognizing urban disaster and risks in the country is essential.

Earthquake experts believe that Iran is the world's most talented earthquake-prone countries; so that areas with low risk, is very low and a large part of country form with much damage zones. (Ashtiani and et. 1993: 7) 70% of Iran is located on earthquake risk. By positioning Iran over the Alpine-Himalayan belt, Iran during the past centuries has experienced 130 earthquake magnitudes 3.5 Richter. (Ghafouri and Ashtiani, 1999:4) According to Director General of Studies and Coordinating Minister of State at (80 year) 86% of the urban population of the country is located on earthquake faults. While natural disasters in particular earthquake due to the instability of urban spaces against disasters such as earthquakes and unprepared people in the short time can be seen diversity physical damage. Physical damage caused by life, financial and performance damage and the resulting socio-economic damage and failure of urban systems. Considering the vulnerability of cities in the against earthquake and appearance its harmful effects on the physical landscape and urban land, this research aims is understand the factors affecting at reduction of vulnerability to changes in the physical tissue and as well as reform Locating land in reducing the damage caused by the earthquake. So at this about has been studied the central part of the city of Kermanshah.

## 8. The studied area

The city of Kermanshah is located between 34 degrees and 19 minutes northern latitude and 47 degrees and 7 minutes eastern longitude of Greenwich meridian. Height of the city from sea level is 1322 m. Kermanshah is located in the central part and is limited from north to Miyan Darband Rural District, from south to Dorud and Faraman and Qarah Su Rural District, from East to Mahidasht District and Baladarband District and from West to Bisotun District. (Statistical Year Book 1385) In 1390, the city's population of over 851,405 people. In Aban 1390 in Kermanshah Family size was 4 people. (Statistics part State Government Office, 1390) Faizabad is one of the oldest neighborhoods samples that have formed around the historic center of the city and its history goes back more than a hundred years ago. Faizabad district with an area of about thirty-three acres is located in the northeast of the central tissue and is limited of north to Silo and Amiri Streets, from south to Nawab Street, from East to Jalili Street and from West to Modares Street.



Fig. 1. The studied area.

## 9. Data collection approach and analysis of data

Desired method in urban vulnerability analysis is general survey and comprehensive elements urban vulnerability and disaster impact on existing entire systems a city. Vulnerability analysis is meant to examining the status of their in event is a risk factor. Therefore, in vulnerability analysis a city against earthquake can be studied the following cases:

1. Studies of the natural environment
2. Study History of seismicity zone
3. Classification Infrastructure( including buildings, structures, facilities)
4. Social studies (identification the urban population distribution and population density, age structure and...)
5. Economic studies (based on the natural environment and infrastructure Studies- Nateghi Elahi, 1981:2 )

A method used in most probabilistic analysis of seismic risk taking (PSHA) by Cornell (1968) has been defined. There are four basic steps to measure PSHA:

Step 1 is to define the seismic fountains.

Step 2 Determine the recurrence property fountains is where every fountain with a probability distribution of earthquake or recurrence relationship can be described.

Step 3 is to estimate the impact of an earthquake is similar to determined way, with this difference that in the probabilistic analysis, the range of sizes earthquake considered is required a group of diagrams attenuation or ground motion, Each of which are concerned to a ground motion parameters such as maximum peak acceleration and distance of an earthquake with given size.

Step 4 Determine the risk at the site, which is basically of method used in reaching a determine risk differently. In this case, the effect of all earthquakes occurred in different sizes in different places, and fountains in a curve the form of unit have become, which shows probability of exceeding different levels of ground motion (such as the maximum peak acceleration) at the site during the specified time interval. One of the most recent developments in PSHA has been seismic fountain modeling. In the present study, a computer program CRISIS has been applied for seismic risk taking analysis. Of this software is used to determine land risk taking after that in environment Arc Gis was prepared of natural various layers including height layer, slope and faults and soil texture. In a seismic fountain, possible earthquake and the maximum magnitude, are generally considered as unchanging. In general in this study is used of combination of a library of methods, descriptive, data collection organizations, Internet, study documents and data analysis use of the software.

## 10. Research findings

Kermanshah, is located influence a group of major earthquakes such earthquake in 1932 with magnitude 5, earthquake in 1957 with magnitude 6.5 (four earthquakes with magnitude 5.0, 5.5, 5.7, 6.5 in 1958), earthquake in 1963 with magnitude 5.5 and two earthquake (5.0 and 5.2) in 2002. Kermanshah located in the wrinkled belt - driven Zagros. Wrinkled belt - driven Zagros has been drawn of easternmost part Turkey to Gulf of Oman. At first glance, this belt is a set of broad longitudinal folds shows that influence over sediments of Phanerozoic the northeastern margin of the Arabic plate. (Stocklin, 1974, Berberian and King, 1981) Kermanshah city in the northern is part of the Sanandaj - Sirjan zone. This section is divided into two parts:

- Bisotun limestone in the north
- Radiolarites Kermanshah in the south

In addition, the city of close by important seismic fault such as the young faults present era are surrounded in which close range than it is located. Kermanshah city is located in folded belt - driven Zagros at less than 50 kilometers south of young fault of present era.

Table 1 shows comprehensive characteristics of Kermanshah faults.

Two fault segment that has the greatest impact on the city of Kermanshah. The fault segment Sahneh and Morvarid. Among others fault that may affect seismic Kermanshah, is fault south of Kermanshah. The fault in the southern part of Kermanshah in near the White Mountains is located that Of course its activities a manner that does not cause harm of city and its magnitude is very low. (Crisis Management of Kermanshah, 2009)

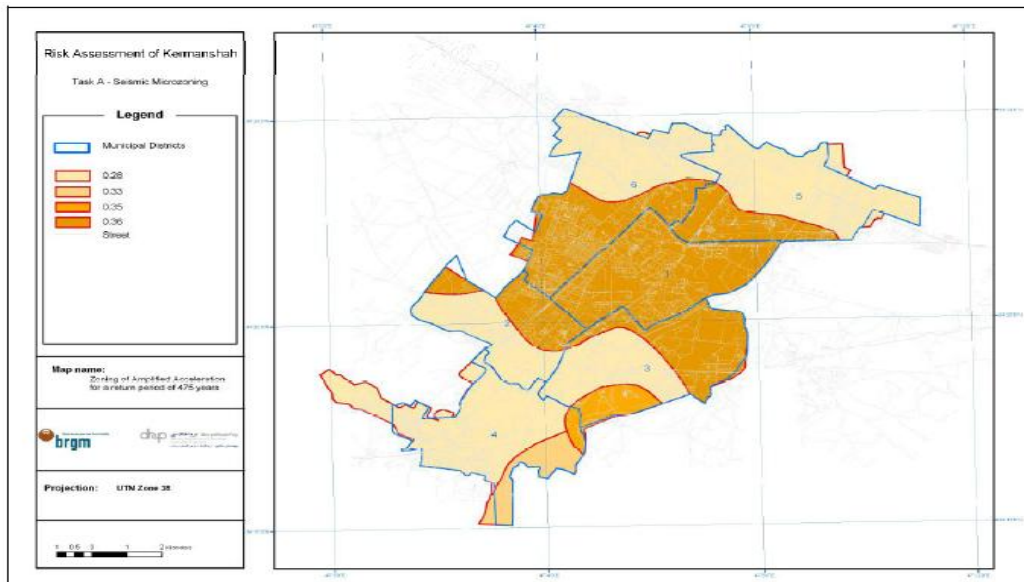
**Table 1**

comprehensive characteristics faults of Kermanshah.

Fault	Faulting length (km)	Seismic layer thickness (km)	Fault slope	Area of a Region is broken in terms of relationship Wales and Cooper Smith	The maximum probable earthquake	Slip rate (mm per year)	Maximum approximate distance to city	Least approximate distance to city
Dorud	120	15	80-70	1864.41	7.3	5	170	147
Nahavand	85	15	90	1275.00	7.1	5	142	80
Sahneh	155	15	90	2325.00	7.4	5	100	30
Rezin	50	10	45	707.11	6.9	3	40	24
Morvarid	160	15	90	2400.00	7.4	5	190	50
East Dorud	120	15	90	1800.00	7.3	5	319	205
Piransahr	102	15	90	1530.00	7.2	5	310	212

References: Crisis Management of Kermanshah: 2009: 38

Earthquake risk in urban areas is a combination of local seismicity (the probability of occurrence of large-scale earthquakes in the area) along with consideration of endless number of buildings with low resistance and settlements with high vulnerability. In here risk in terms of the number of constructional units that may be in the form of an earthquake with a probability of occurrence of 10% at 50 years( with approximate return period of 500 years ) to be demolished, have been calculated (Figure 1). The evaluation of losses, represents the average total risk in an interval. Existing pattern for the calculation of losses, including long-term intervals (a century or more) along with minimal losses and sometimes with heavy losses (Coburn and Spence 2010:13-15)



**Fig. 2.** zoning map magnification acceleration for a return period of 475 years.

References: Crisis Management of Kermanshah: 2009: 38

As it was shown in the map, the central section of city (the region one) is located in the most speedy region (the maximized speed) 0.35. (The classification of the speediest regions are respectively: a- 0.28, b- 0.33, c- 0.35, d- 0.36).

One of the natural dangers is the fluency of earthquake, which depends upon two factors: the identity of vibration (seriousness and time) the damage of bed depends upon the fluency. According to geotechnical studies, it includes SPT, the broad cast of bite, the limit of Aterberg as well as the relative damage of repository comparing to the fluency base on the seriousness of earthquake which is measured by the geological age, the repository environment, and the possibility of fluency in every region.

As whole, this city is not end angered by the fluency. For the surface fraction of earthquake, it can be said that the fraction results from moving the crusts in the deep levels that while they come to the surface causes the long fractions in a region, which is called the zoon of fraction. The canonical depth of earthquake should be less than 15 to 50 km in the surface fractions. The least magnitude of earthquake can produce the surface fractions usually about 5 or more. The stronger earthquakes have more breaking potential in the surface; therefore the lack of active fractions causes not to see the broken fractions in Kermanshah map.

### 11. The analysis of economical – social damages

The features of economical – social damages relate to the social, economical structure of city, it is in this way that we can examine the damages of earthquake in Feiz Abad Street in Kermanshah.

These features include: the damage age of crowd, the density of crowd, the density of industrial centers by which every item is classified in to the table.

### 12. To assign the features of body damage

These features relate to the physical elements in the city, therefore the number of inhabited buildings, the materials are very important in Feiz Abad Street. The other features include: the feature of density of building, the materials of building, the lack of hygiene centers, the lack of free, green environment. All of items are presented in table 13.

**Table 2**

The present application in Faiz Abad.

Row	The kind of application	Number of crowd 7540		
		Squire	capitation	Percentage
1	In habitual	131333.8	17.418	40.01
2	commercial	29623.339	3.92	9.02
3	In Structional	4644.072	0.61	1.41
4	In the region of market	16647.412	2.2	5.07
5	Office	2472.489	0.327	0.75
6	Cultural	5074.333	0.672	1.55
7	Sport	840.98	0.11	0.26
8	Religious	4013.2598	0.532	1.22
9	Green area	709.7664	0.094	0.22
10	Hygiene and treatment	2816.504	0.373	0.86
11	Equipment	69.4255	0.01	0.02
12	Industries	9108.061	1.207	2.77
13	Transportation and stock	1016.365	0.134	0.31
14	Parking	8583.185	1.138	2.62
15	Karaj	18208.422	2.41	5.55
16	Empty land	31391.286	4.16	9.56
17	Passenger by	61712.635	8.18	18.8
Whole		328265.33	43.495	100

<b>Table 3</b>						
The features of damage.						
The features of damage			Squire	Number and density	percent age	
The features of social – economical damages centers	The damageable age	Whole crowd of Feiz Abad		7540		
		The damageable		3053		
		Comparison of damageable crowd to whole of it			40.49	
	The density of crowd	The pure density		279		
		The non pure density		300		
	The density of industrial centers	The operational squire for production	39747.75			22.92
		Comparison of industrial centers to the productive ones				
The features of body damage	The density Materials for buildings	The operational squire in building	131333.8			
		The number of bildings		236		
		The pure density of inhabitants		574		
		The non pure density of inhabitants		279		
	Materials for buildings	The buildings with continuous, seem – continuous materials	24292.8			
		The in continuous buildings	6714.47			
		Comparison of continuous and non continuous				27.63
	The lack of hygiene centers	Squire Fez Abad	328265.33			
		The region of hygiene and treatment	2816.5			
		Comparison of hence to whole region				0.86
	The lack of free, green environment	The abandoned area	2612.79			
		The green area	709.76			
		The arid area	28778.49			
The agricultural area		0				

Source: writer, 2013.

### 13. The analysis of damageable fezi abad region against earthquake

#### 13.1. The studies are focused in two fields



1) The first studies about events, the dangerous causes as the damageable facts, by which the experts try to predict time and place of events in order to provide the technologies to make human's structures capable in front of dangerous natural events.

2) The other section is base on the dangerous situations of regions in which events take place. The damageable inhabitants are different due to the level of life, the social, economical conditions. Therefore, the damageable situations are not results of dangers; instead, they are political, social, economical conditions in the final level. According to the suggested model ( $K_t = A_1K_1 + \dots + A_{10}K_{10}$ ) the least amount of damageable condition is 63.3 and the most is 316.5. it is changeable between 63 to 223.8.

It is necessary to say that none of them are not limited to zero to 63, therefore, the damageable condition won't lead to maximum level meaning 316.5, because there is no section to take degree 5 among the variables,

The variables respectively show the fluency K1, the geometrical factor K2, the most, horizontal speed K3, the structure age of crowd K4, the density of crowd K5, the density of industrial centers K6, the density of buildings K7, the building materials K8, the lack of hygiene centers k9, and the lack of free, green area K10.

Therefore, after accepting the least damageable condition comparing to 63.3, the most would be 223.8 and the most damageable condition is 160.5. ( $223.5 - 63.3 = 160.5$ ). While the damageable condition is classified into the little, middle and the most, we have.

The little damageable condition is equal to %39 and the most damageable

$$(19.5 * \%39) + 63.3 = 125.8$$

The middle damageable condition is equal to 39 to 59.4 percent age, and the most damageable condition

$$(160.5 * \%59.4) + 63.3 = 158.6$$

The considerable, damageable condition is equal to 59.7 to 74.6 percentage of the most damageable condition

$$(16.5 * \%74.6) + 63.3 = 183$$

The most damageable condition is equal to 74.6 to 100 percentage of the most damageable condition

$$160.5 + 63.3 = 223.8$$

Because was will:

The low damageable condition = Leas than or equal 125.8

The average damageable condition = 125.8 – 158.6

The significant damageable condition = 158.6-183

The most damageable condition = higher than 183

$$K_t = 4.6 K_1 + 5.4 K_2 + 6.4 K_3 + 6.4 K_4 + 7.5 K_5 + 5.4 K_6 + 7.4 K_7 + 8.4 K_8 + 5.9 K_9 + 5.9 K_{10}$$

$$K_t = 4.6(1) + 5.4(5) + 6.4(4) + 6.4(5) + 7.5(5) + 5.4(2) + 7.4(2) + 8.4(5) + 5.9(1) + 5.9(4) = 224$$

Therefore, the destroyed region of Feyz Abad cannot be taken as the destroyed region comparing to other regions which are more damageable (It has take the mast correlations comparing with other regions), it has unsuitable condition. As matter of fact, the high density of crowd, the high number of damageable crowd, the in accessibility to the free environment, the high age of buildings, the unsuitable materials are whole and whole the features of this region.

Evolution

The goal of civic planning is to predict the events, to recognize the dangerous processes, to secure the environment, in order to improve the city. As whole, the civic planning of natural dangers, the planning to decrease the effects on the human society are the different tools of planers. In fact, the civic planning is based on these politics, as well as the social, economical, regional conditions to improve the physical, social environment; the main role of it is to secure the societies against the natural dangers.

Regarding the issues which relate to the fractions, the fractions, the/ possibility of earthquake is very high in the city, it is as great as due to the gathered data of management of crisis. If it happens, we face the most destruction in the old region which Feiz Abad is belonged to, it should be considered that Feiz Abad has the most applicable in habitants.

The economical body of central section and Feiz Abad region were belonged to the commercial region, it has the main effect on the body and the pictorial perspectives, which the most sections are the



little offices which are located in the local market. It is necessary to say that the financial sources should be injected in the city if the earthquake happens and there will be a great amount of unemployed people which should be planned on them.

The unequal civic management is the reflection of unequal, social, economical, physical conditions (Hatami Nejad, 1387: 596). Therefore, the crisis spots are according to the inhabited places by the poor people of society due to the body. The pictorial manifestation of earthquake effects is the destruction of body.

The building materials are only 21.87 percentages of Feiz Abad buildings which are made of Sement and the iron Skeletons. Therefore, it is about 78.15 percentages of buildings which have the most damageable conditions.

If the earthquake happens, it is not possible to access this region because of non-operational net, the little width, the little penetration. Therefore, the hurt people will increase if an earthquake happens in this region. Furthermore, it has the economical, financial damages too.

One of the causes that influences on the old region of Feiz Abad is the feature of taking the immigrated people in Kermanshah because of the social, economical causes. This region attracts the poor people who take the most economical problems in the crisis. Furthermore, there is inconvenient application in it.

The issues of management are the main bases of operational management of crisis, because we can take the good planning. The main problem of inconveniency among the organs is between those who make decision and those who operate them. The lack of planning among the organs, the lack of supervision on the people's instruction about the earthquake should be considered in the old regions as well as the unemployed people in these regions.

Some of affective factors of management in the emergency condition in the state organs are: to prevent the events, to align the forces in the emergency conditions, to follow the plans, to recognize the roles (New Lianito, Sinodin, 2001: 2665).

Therefore, there are some suggestions:

- To produce the suitable density of crowd according to the capacity in order to decrease the effects of earthquake.
- To consider the fair principles in the density of crowd, the density of buildings.
- To develop the instruction level among the inhabitants to face the earthquake especially the damageable (teens and children) and employed persons.
- To make capable inhabitants in the old regions (to employ, to save, to produce the facilities).
- To assign the principles to make the convenient lands to change the dangerous application in the dangerous regions.
- To use the experts in the prepared programs, in order to use the good civic programs.
- To build the service centers to manage the crisis while earthquake happens.

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