ASSESSMENT SUSTAINABILITY OF OLD TISSUE CITY OF ZANJAN AGAINST THE EARTHQUAKE

1. **Valiollah, rabieifar**, PH.D student in Department of urbanism, Islamic Art University of Tabriz, and Teacher of elmi-karbordi Jaame University, Iran, (Corresponding author)
2. **Esmaeil, jabbari**, MSc department of Urban Management, Allameh Tabataba'i University, Iran
3. **Rahman, salehi**, MSc department of Geography and Urban Planning, University of Tehran, Iran
4. **Kamal, koohgard**, MSc Department of Geography and Urban Planning, University of olom and tahghighat of Tehran, Iran
5. **Saba, nabaei**, MSc Department of Urban Planning, Art University of Tehran, Iran
6. **Zhila, zolfaghari**, BSc student in Department of Physics ,University of Zanjan, Iran

ABSTRACT:

Studies show that in average per decade, Richter 7 earthquake that occurs with high power However, in cities of over 2.8 million units of homes is instable and are not resistant earthquake. The aim of the present paper, the measurement and analysis of the stability of the old zanjan sampling frame against earthquake by using at AHP is in a GIS environment. The research method is descriptive - analytical and kind of research is Functional and approach to be both quantitative and qualitative. Findings from the study show that 16.34 percent of the region's instability, 21.45% of the area has a mediocre stability and 62.21% of the faces with the stability conditions of an area are poor and unstable.

Key words: assessment, physical stability, earthquake, Zanjan

Introduction

The rapid development of the city, at recent decades, is affected various aspects of social, economic, cultural, political, and ... Human life. Raising sustainable development as the main slogan of the third millennium Due to urban effects on the biosphere range of different aspects of human life (Ghorokhlo and others, 2007: 157) .Characteristics of urban communities today, has cause instability humans and the environment (natural and built environment) (Mofidi and others, 2010: 15).

Studies show that in average per decade, Richter 7 earthquake that occurs with high power in the last three decades, more than 130 thousand inhabitants' people in this country lost their lives in the earthquake. While Iran its place 1 percent of the world's population but impact of these incidents, is 6% of all deaths worldwide. About 20 percent of the earthquakes that have occurred in the world during the past century are related to Iran and about 80 percent of fatalities caused by the earthquake of 6 countries including Iran. Most densely populated major urban centers are located at areas of high risk. 76% of the national average and major cities and rural areas are the zones with high seismic risk. The total about 68 thousand rural point of 2/3 million units are built of non-stable and non-durable materials. Cities of across the country for over 8/2 million residential units are -instable and are earthquake nonresistant.

The main objective of this study was to assess the physical stability of the old zanjan of Zanjan Against earthquake by using physical indicators and sustainability criteria in the study area.

Methodology

The research method in this study is a descriptive - analytic study and type of research is functional and approach that is both quantitative and qualitative. In general, statistics and information required have been collected in various methods. In the first by study and compiled from various sources (books, articles, theses, etc.) in the field of earthquake And sustainable urban development, theoretical research and the studies described in the previous section and interviews with scholars and experts, has been investigated to identify the sustained physical parameters of the earthquake. Finally, field studies of the scope and application of the detailed design, Understanding the characteristics of the physical and cognitive aspects of the to assess current problems in the context of physical indicators the

sustainability of the ancient city of Zanjan against earthquakes by using AHP method and EC Software has paid in the GIS environment in the region. The method of analysis was conducted in four stages and systematic hierarchical the following is provided as well as any in the analysis is expressed of the following methods;

1. Set criteria and sub criteria in determining the physical stability of the city;
2. 2. determination of preferred Coefficient (criterion) Physical stability in the city;
3. determination of the importance under criteria coefficient and analysis of physical Stability parameters;
4. Final analysis of the stability of the old tissue city of Zanjan frame against earthquakes;

Concepts and Theoretical

The concept of sustainability is really an attempt to achieve the best results in the natural and human environment will be unlimited for present and future (Firozbakht and others, 2012: 217). The idea of sustainability is often occur in lack of resources and the catastrophic events. When "Hans Karl von Karluiz" spoke for the first time about the "sustainability" at 1712, its main focus applied on the use prevent uncontrolled forest to get wood for the mining and industry (KUNDAK, 2008: 9). The main goal of sustainable development is creating a balance between the requirements of in economic, environmental and social. To achieve sustainable urbanization, cities need to develop social and economic structures without damage to the environment and a balance between population and natural resources. (Behmand & Rabieifar Others, 2012:30) Urban vulnerability than natural hazards such as earthquakes is result of function of human behavior. It describes the degree to which social and economic systems and physical assets in urban areas is sensitive or resistant to the effects of natural hazards (RASHED and WEEKS, 2002: 547). History of urban planning shows that safety is always a major concern for residents; although the concept of security has changed over time. (Shaw and Goda, 2004: 31). Many features, is warranted cities desirable - Architectural structures, population concentration, Places of assembly and interconnected infrastructure systems - They are also at high risk of floods, earthquakes, hurricanes and terrorist attacks casts (Godschalk, 2003: 136). Moore (2001) pointed out that the city as the most complex human creations are at risk, as well as the risk range from multiple vulnerability. As he pointed out the vulnerability of urban, everywhere infrastructure and building systems to telecommunications transport and energy supplies

lines in the covers. And reduce the vulnerability on the urban scale does not include only the strongest structures (Godschalk, 2003: 137).

Local physical stability of the events means is a place where the extreme natural event without suffering devastating losses, injuries, decreased productivity; Quality of life without a lot of help from outside the community is unable to resist (Mileti, 1999: 32-33). Urban robust, is sustainable networks of physical systems and human societies. Physical systems, is components built and natural environment of the city. They contain constructed roads, urban, buildings, infrastructure, communications, and energy facilities, as well as the city ¬ waterways, soils, topography, geology, and other natural systems. In general, physical systems urban the body's organs, bones, blood vessels, and muscles that acts. During a disaster, the physical system must be able to survive and operate under severe stress. If parts are damaged and they cannot be repaired, the loss will be increased and improved id decreased. Urban-resistant without the use of physical systems, in contrast, would be sensitive to harm disasters (Godschalk, 2003: 137). Sustainable land use pattern should be developed to ensure environmental protection and Disaster reduction planning can and should be integrated with the overall goal of environmental management are the same and sustainable development too. Vision of a sustainable future for social investment and lead people away from dangerous areas, Protect and preserve the environment and balance short-term needs and long-term goals (Erdogan and et al, 2009: 986 and 987).

Here it is important to make the urban safer against disasters. It is important to recognize the need to identify the structural issues that are caused by the earthquake. These issues in a broader perspective can be classified as follows:

1 - Safety jobs in residential areas;

2 - An aging population and children in the city;

3 - Social consciousness;

4 - Structures against earthquakes jobs for residents and residential areas;

5 - Anti-Earthquake Highway;

6 - Water lines and water tanks, anti-earthquake (Erdogan and et al, 2009: 986).

- Askab and others (1998) stated that reduced risk measures ranging from structural engineering and building code standards, land use planning and the acquisition of property includes (Godschalk, 2003: 136). According to Gadchak (2003) researchers are resistant to

natural disaster response systems have been studied, to conclude that these systems tend to be:

1 - Surplus to requirements, with some of the same components when one component fails, the whole system will not fail;

2 - Varied, with a number of different functional components in order to protect the system against various threats;

3 - Efficient with positive energy than the energy delivered by a dynamic system;

4 - Independent, with the ability to act independently without any external control;

5 - Strong with the strength to withstand attack or other external forces;

6 - Tied together with system components together so that they support each other;

7 - consistent with capacity and flexibility to change the learning experience;

8 - Partnership with the opportunity and motivation for participation;

In order to determine design parameters for -resistant building settlements against earthquake, this phenomenon in a broader sense of the priorities discussed at the urban scale. Development of sustainable settlements means the search for alternative development process with the following principles:

1 - Transfer of wealth from generation to generation, urban construction and environment;

2- Balance between settlements, including cities, villages and socio-economic aspects;

3 - Medical interaction, environment and buildings and their integrity;

- In the context of these ideas, the following principles for creating a disaster-resistant city is required:

1 - The city is a place where future generations can have a safe and secure lives;

2 - independent of the flow is less pressure on the environment;

3 Cities have green space and open space preserves;

4 - Protection of monuments;

5 - decentralization of urban functions and form a network;

6 - barrier-free urban design;

7 - Balance between suburban development and promotion of downtown areas;

8 - Comprehensive Zoning environmental protection;

9 - Construction of an industrial structure to comply with the ecological cycle (ecology);

10 - The city of environmental and ecological assets such as parks, forests and river uses (Erdogan and et al, 2009: 987).

Physical indicators of sustainability

Physical structure of the city, in the most full and that creates empty spaces the pattern is affected performance. In other words, the physical structure of the city and is defined how the body Skeleton key elements of the composition. These indicators include indicators constructed in such sectors, ranging from urban centers and indicators are normal.

To evaluate the physical structure of each of these parameters individually and in a neighborhood with other indicators should be reviewed to obtain the level of vulnerability.

A) Structural parameters

1 - The Structure: building both regular and irregular in shape and can be divided into symmetric and asymmetric that each specific vulnerability to earthquakes of various intensities shows (Hatami race and others, 2010: 4).

Table 1: Relationship between vulnerability of buildings and its shape in plan

Vulnerability			Variable	Indicator
Intensity IX	Intensity VIII	Intensity VII		
0/6	0/6	0/6	Symmetric	The plan of structure
1	0/86	0/73	Symmetric	

Source: (Center for Prevention, Crisis Management, Tehran, 2006: 23)

2 - Type of materials used according to regulations designed buildings against earthquakes; the structures are divided into four main groups

Each category of vulnerability to shows earthquake resistance of certain. Vulnerability of these four categories and each of them is described below:

- Durable, including steel, concrete, stone, brick and iron and steel
- Semi-durable: include brick, wood, stone, wood, concrete block, brick, stone, and brick all.
- Weak: all wood, clay and wood and mud.
- Fugacious, including tent, mat and is similar (Hatami race and others, 2010: 5).

3 - Structural System: The Structural system, the system is based on the construction and building codes in design of buildings against earthquake, this manufacturing system may be classified into seven groups according. Each of the seven groups, the intensity of the

earthquake will have different strengths. The following table shows the vulnerability of any system building shows different intensities against earthquakes.

Table 2: Relationship building systems against earthquake vulnerability

Vulnerability			Variable	Indicator
Intensity IX	Intensity VIII	Intensity VII		
0/25	0/125	0/125	Steel structure With bracing	Manufacturing Systems
0/5	0/27	0/25	Steel structure without bracing	
0/37	0/25	0/05	Reinforced concrete structures	
1	0/75	0/37	Buildings no Hank vertical and horizontal	
70/1	0/37	0/25	Building Horizontal coils without coil with vertical	
55/0	0/30	0/25	Building with vertical and horizontal coils	
0/70	0/50	0/30	Steel or concrete bearing walls on the sides of buildings and structures	

4 - Life of Structures: According to this index, how higher the life of the building, its vulnerability, even greater.

Regulations in the design of buildings against earthquakes, has an estimated useful life of the building for about 20 years. It should be noted that technological advances and increased use of quality building materials in new ways, the life of the building, is not the assessment criteria; It was built during the construction period is also important; Compilation of different words depending on the design of buildings against earthquakes, the seismic vulnerability of the building has changed life Is shown in the table below.

Table 3: The relationship between the life of the building and its vulnerability against earthquake

Vulnerability	Vulnerability Status	Building Life
More than 75 percent complete destruction	Very high	More than 50 years (decades before - 1952)
5 /. Less than 75 /.	High	26 to 50 years (between 1962 to 1987)
25 /. Less than 5 /.	Average	13 to 25 years (between the years 1987 to 2010)
Less than 25 /.	Low	Less than 13 years (between the years 1378 to 2007)

Source: authors, based on the against earthquake design codes

5 - Quality building and construction: Building as the final product of the process is the interaction of different groups, Influenced by a complex set of rules, services, materials, products and equipment that the build quality and performance depends on several factorsSuch as materials used in the construction of buildings, number of floors the building, year of construction, system construction, quality control and quality assurance, the insurance industry in this sector, education and public awareness, income, wealth levels countries and other items and the overall development of the country (Hatami Nejhad and others, 2010: 7). Finally, the quality of construction was the result of the interaction of these factors together, The of against different intensity of earthquake resistances shows in the table below.

Table 4: The relationship between product quality and the vulnerability of buildings against earthquakes

Vulnerability			Variable	Indicator
Intensity IX	Intensity VIII	Intensity VII		
0/6	0/6	0/6	good	Quality the building
0/8	0/8	0/8	Average	
1	1	1	bad	

B) Indicators of urban planning

Indicators of urban planning horizons are broader than the subject. These indicators do not only focus on buildings individually; But have attention a series of spaces surrounding the building and the overall state of the body is formed, Sustainability indicators on the body of an interlocking regime against earthquake impact, below are a few factors that have to be dealt with.

1 - Population density: Pressure on the population density of the body and its vulnerability in the face of an earthquake is inalienable. Pressure due to settlement or movement And the population in each location, based in front earthquake impact of the vulnerability. The problem here is that because this effects is defined of other factors associated with building sustainability And even Earth gender and geo corophologoicy condition. Not correctly revealed set, the numerical impact. However, the impact of these factors should be considered one of the factors that affect the physical stability of against earthquake and going the physical exhaustion of the town. The following table shows the relationship between vulnerability and population density. This amount is a relative thing, but we can say with our situation is pretty consistent; In Iran, construction system and building industry developments have not progressed enough Which impact of these factors on the physical stability cities make weak against earthquakes.

Table 5: Relationship of vulnerability and population density

Population density	Vulnerability
Equal to or less than 400 per hectare	Low Vulnerability
500 to 400 persons per hectare	Average Vulnerability
600 to 500 persons per hectare	High Vulnerability
Equal to or above 600 people per hectare	Very High Vulnerability

Source: (Fakhimi, 2007: 106)

2 - Communication network:

The first issue related to the communication network and access against earthquake, as they relate to the hierarchy which highest level on the scale of the city has access to substantial residential units (Azizi and Akbari, 2009: 27). The following table shows the relationship between vulnerability and shows the hierarchy of roads.

Table 6: Relationship between vulnerability and road hierarchy

Vulnerability	Wide, networked paths
Low Vulnerability	paths width More than 14 m.
Average Vulnerability	9 to less than 14 feet wide paths
High Vulnerability	3 to less than 9 meter wide paths
Very High Vulnerability	Less than 6 meters wide paths and dead ends

Source: (Fakhimi, 2007: 106)

3-Proximity between land uses: Among proximity of the user to evaluate the vulnerability of meaning for different placement and consistency and conflict between them. Any user-specified has performance and vulnerability to earthquakes and if that does not comply with the principles of proximity and incompatible uses are put together, will exacerbate vulnerability (Hatami Nejhad and others, 2010: 9). In order can be used to set the compatibility matrix (adjacency). Based on this matrix for each other's domain of influence in terms of a series of specifications Are compared such as: Dimensions of Earth, land slope, communications networks, associated applications, air quality - light - and sound .. Based on this matrix neighboring land can be one of the first state fully compatible 2. Fairly consistent.3 Relatively inconsistent 4. We'll be incompatible.

4-Geological situation: During the earthquake, the geological structure shows different resistance. Compatibility of each user the place where it is located, a matrix model based on utility and the status of geology and seismic hazard of the site is to be evaluated. These models have taken place based on geologic and seismic characteristics of the four sites, Site includes a very low risk (low probability of meeting the soil), low-risk sites (low risk of soil subsidence), hazardous sites (average subsidence and average of soil liquefaction potential and the site is located within 500 to 300 meters from the fault) and high-risk sites (high probability of meeting the soil and ground movement due to fault movement distance of less than 300 m from the main fault line and having high potential for liquefaction potential slip earth) to classify (Hatami Nejhad and others, 2010: 9).

4-Open spaces: In conjunction with the open spaces can be said which the main function of the open spaces, during earthquake, apart from one area to another And thus avoid the destructive forces operating focus is the development of a chain of events (Partovi, 1996: 353). For investigate the cause of open spaces and considered accessibility.

6_Building Density: High building density in addition to increasing casualties and loss of life and property, may block streets and roads And reduce the possibility of escape from dangerous situations and access to secure areas and the difficulty of blocking their poor survival (Ahad Nejad and others, 2008: 7).

7-Area of Components: Separation of land in the small size may fragmentation spaces that open and practically useful open spaces to escape and is reduced seek refuge in the relief operations and temporary accommodation... (Ahad Nejad and others, 2008: 5). In this regard, to be evaluated it is generally the vulnerability of different parts of the area following the earthquake.

Table 7: Components of the vulnerability in relation to the earthquake area

Vulnerability	Sq m of the fragment size
High	Less than 200 square meters
Average	250 to 500 Sq m
Low	More than 500 Sq m

Source: authors, based on various sources

8 - Grain size model: Whatever Grain size pattern is more regular (square or rectangle) and have fewer angles maze is closed, Less vulnerable to follow. In this respect, the different pattern of vulnerability Grain size is provided in the table below.

Table 8: Assessment of vulnerability of different models of Grain size during earthquake

Vulnerability	Grain size pattern
The less vulnerability is due to remain open and be more efficient in sheltering and temporary housing	Regularly. Square or rectangle
Probably more vulnerable due to their efficiency and reduce fragmentation of open spaces	Regular polygon (open and closed angles)
High vulnerability due to the impermeability textures and open spaces fragmentation	Irregular (mixed forms)

Source: authors, based on various sources

10 - Infrastructure and urban infrastructure: Secure network infrastructure, plays an important role in increasing the strength of the city against earthquake. Whatever length of the network infrastructure, the city is less; they will be less vulnerable of the damage. Locating facilities such as power plants should be careful in these centers are far from the residential areas. What is important in network infrastructure, the network plays an important role in the lives of the citizens and city life, as well as the effect that the absence of either of these networks vulnerable citizens will live on (Abdollâhi, 2002: fifty-nine).

In a general review and summary of the discussions in this paper, the two tables have been developed in the application of criteria and indicators of physical stability. (Table 10) is described the entire City sustainability criteria and indicators that are relevant in the context of anatomical structures. (Table 11) in the frame of selected criteria and indicators for the sustainable cities that will be examined in this study have been extracted (Table 10).

Table 10: Sustainability criteria and indicators of physical

Physical criteria and indicators for sustainable cities	
Urban block pattern	structure Forms
Facilities and urban infrastructure	Type of materials used
Pathways width	Structural System
Building Density	Structural Life
Quality Construction	Quality Manufacturing and construction
Building Structure	Population density
Types of building materials	Network communication
Gradient of urban land	neighboring Between land uses
Occupancy levels	Geological Survey
Life and dating buildings	Open spaces
Number of Building floors	Grain size pattern
Sources: (Hatami Nejad and others, 2010), (Center for Prevention, Crisis Management, Tehran, 2006), (2800 code design of buildings against earthquakes), (Hosseini, 2004), (Fakhimi, 2007), (Azizi and Akbari, 2009), (Partovi, 1996), (Ahad Nejad and others, 2008), (Abdullahi, 2002).	

In (Table 11), has been expressed the physical sustainability criteria and indicators selected cities, In fact standards and indicators had been selected for in this study based on criteria such as the time and place to discuss, in terms of scientific validity, Access to data and information in terms of performance, functionality and evaluated in this study. Then, in an assessment process were evaluated by using the analytic hierarchy process model and GIS analysis.

Table 11: Selection standards and indicators of sustainable physical

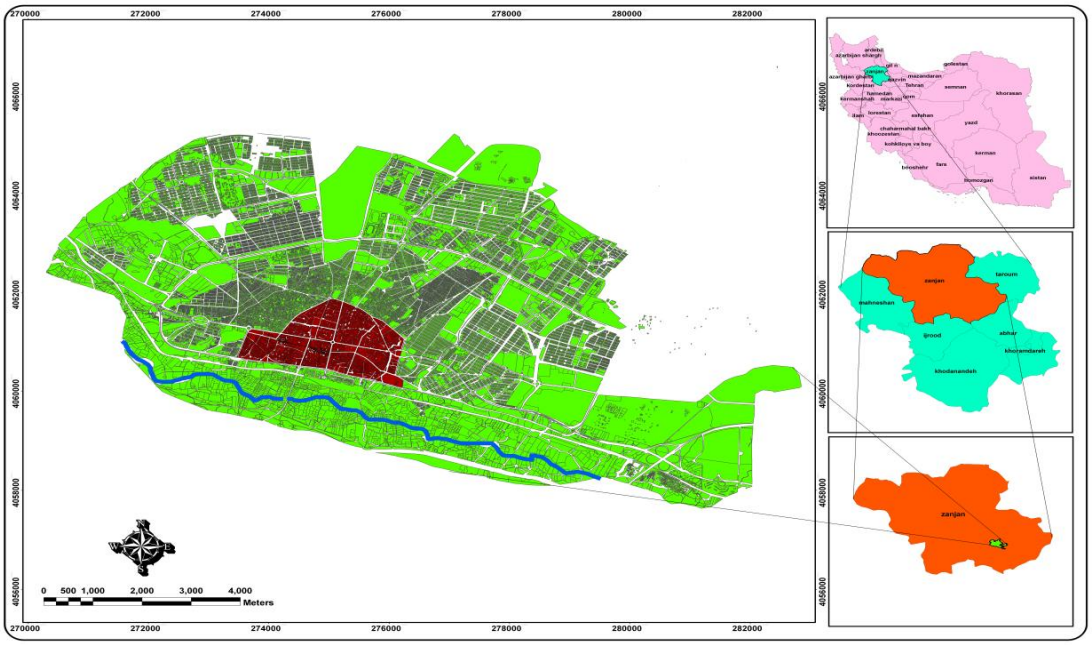
standards and indicators of physical city	
Compatible applications	Pathways width1
Occupancy levels	Building Density
Life and dating buildings	Quality Construction
Number of floors of the building	Building Structure
Separation of components (seed pieces)	Types of frontage materials
	Gradient of urban land

Source: authors

Recognition of the study area

Historical Recognition of the phenomenon, the foundation stone of the existing understanding and understanding of the situation makes it possible to estimate changes in subsequent events (Habibi, 2006). This city is today the center of the Zanjan province, traditionally, was important due to being in the trading way old Ray to Azerbaijan (Soboti, 1999: 82). Historical sampling at least 3200 years old is one of the oldest population centers in the region. And in Assyrian texts and documents as Andrea is mentioned from this area (Soboti, 2007). Date of birth Zanjan to appear Median time. Mostofi Hmdolalh in the book Nuzhat Alqolob its construction is attributed to Ardashir Babakian. Later it's called Zndygan, is the means does People of the Scripture. Then changed Zangan after the Arab invasion was known Zanjan. (Moradi, 2010: 90) These is a city in the eastern part of the Zanjan province and its located in the way Tehran - Tabriz, the average height of 1663 meters above sea level. Location city accordance with 48 degrees and 29 minutes east longitude and 36 degrees 40 minutes north latitude in between is located collection of the

heights of the North, North East, South and South-West (Hamadan. 74). The city has450,000 a population. Their language is Turkish (Azeri) and most of them are shia and Muslim.



Map 1: Location of study area

Analysis

In the present study, based on the analytic hierarchy process model (AHP), which stated, criteria and indicators for sustainability of the physical aspects of the city, with the advice and consultation with experts, then model the norms of the system. Evaluation of the physical stability is done in four stages in form of hierarchy.

1 - Determine the criteria and sub-criteria, in the physical stability

In the Analytical Hierarchy Process, are determined criteria and sub-criteria for the frame stability of the old zanjan of Zanjan. Each of the criteria has division based on the same factor (sub-criteria) in the region. The tables related the following criteria and criteria in the ancient skeletal zanjan of Zanjan are given below.

Table 12: Physical stability criteria Zyrmyarhay old zanjan sampling

Sustainability criteria Physical criteria secretary old fabric city zanjan	
The following criteria	The main criteria
20 m	Showing crossings
20-16	
16-12	
12-8	
8	
Compatible	Compatible land
Relatively consistent	
Apathetic	
Relatively incompatible	
Inconsistent	
0-80%	Building Density
120-80	
120-240	
400-240	
20-0%	Occupancy levels
20-40	
40-60	
60-80	
80-100	
New - under construction	Quality Construction
Maintainable - Refurbished	
Sabotage - ruined	
0-10 year	Old Building
10-13	
+30	
Brick - Iron and steel - concrete	Building Structure

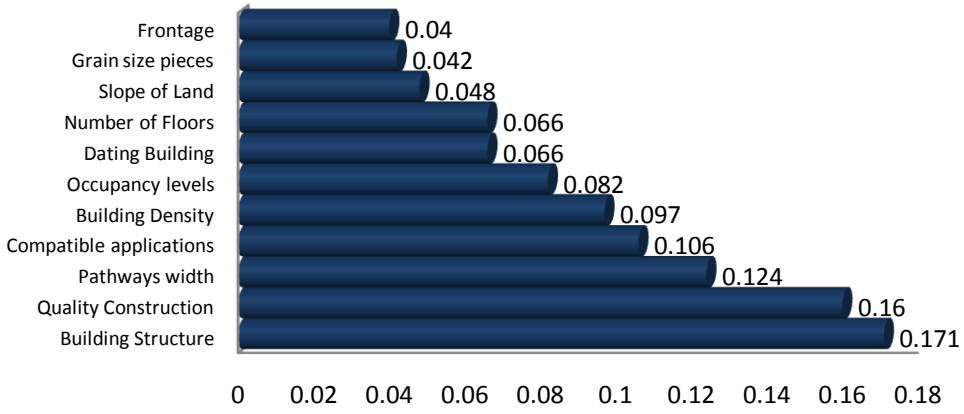
Brick and wood	
Mud	
1floor	Number of floors of the building
2 floor	
3floor	
4 floor	
+4 floor	
No view	Types of building materials
Stone and brick	
Glass	
Low 100 m	Grain size pieces
200-100	
400-200	
800-400	
+800	
+15%	Gradient of urban land
15-8%	
8-4%	
4-2%	
2-0%	

At this stage, the main criteria weighting method is used by binary comparison. Priority and importance of each criterion are rated relative to one another based on the target (the physical stability against earthquake). For the Weighting mentioned has been used of expert's opinions. Then based on EC software, the final score was determined for each of the criteria. According to review criteria for structure, quality construction and crossing wide, with scores respectively, 0.170, 0.160 and 0.124 are the most important criteria and Building materials with a score of 0.040 and a standard measure of At stability of the body are most least.

Table 13: The final score the city skeletal criteria

Criteria	Pathways width	Compatible applications	Building Density	Occupancy levels	Quality Construction	Dating Building	Building Structure	Number of Floors	Front age	Grain size pieces	Slope of Land	Final Score
Pathways width		2	2	2	0.5	2	0.5	2	3	2	2	0.124
Compatible applications			2	2	0.33	2	0.33	2	2	2	2	0.106
Building Density				1	0.5	2	0.5	2	3	3	3	0.097
Occupancy levels					0.33	1	0.33	2	3	3	2	0.082
Quality Construction						2	1	2	3	3	2	0.160
Dating Building							0.25	1	2	2	2	0.066
Building Structure								2	3	3	2	0.171
Number of Floors									2	2	2	0.066
Frontage										1	1	0.040
Grain size pieces											1	0.042
Slope of Land												0.048

Figure 1: The final score the city skeletal stability criteria



Adjustment index = 0.03

3 - Coefficient of Determination measures the stability analysis the city skeletal criteria: At this section, standards for any of the following criteria, weighted based on their degree of

stability is 1 to 9. The maps are based on the weight of each of the main criteria in terms of sustainability have been developed by using GIS.

Very high stability	High stability	Moderate stability	Low stability	Stability is very low	The following criteria	The main criteria
9	7	5	3	1		
❖					+20 m	Showing crossings
	❖				20-16	
		❖			16-12	
			❖		12-8	
				❖	8	
❖					Compatible	Compatible land
	❖				Relatively consistent	
		❖			Apathetic	
			❖		Relatively incompatible	
				❖	Inconsistent	
❖					0-80%	Building Density
	❖				120-80	
			❖		120-240	
				❖	400-240	
❖					20-0%	Occupancy levels
	❖				20-40	
		❖			40-60	
			❖		60-80	
				❖	80-100	
❖					New - under construction	Quality Construction
		❖			Maintainable - Refurbished	
				❖	Sabotage - ruined	
❖					0-10 year	Old Building
		❖			10-13	
				❖	+30	
❖					Brick - Iron and steel - concrete	Building Structure
	❖				Brick and wood	
			❖		Mud	
				❖	1floor	
❖					2 floor	Number of floors of the building
	❖				3floor	
		❖			4 floor	
			❖		+4 floor	
				❖	No view	
❖					Stone and brick	Types of building materials
		❖			Glass	
				❖	Low 100 m	
				❖	200-100	Grain size pieces
			❖		400-200	
		❖			800-400	
	❖				+800	
❖					+15%	
				❖	15-8%	Gradient of urban land
			❖		8-4%	
		❖			4-2%	
	❖				2-0%	
❖						

- Analysis of the stability of the old zanjan of Zanjan skeletal criteria against earthquakes

Skeletal criteria of components are studied at the context of the ancient of Zanjan. At this section due to the high volume of charts and maps avoid for each of the measures .only to explain the statistical distribution of their content

1) The skeletal stability the city terms of width Pathways:

One of the criteria has been studied for the stability of the skeletal zanjan the old of Zanjan, at earthquake is width Pathways. This Criteria At 5 groups, including Pathways width of 20 m, with nine score At very high level of stability, The second group of Pathways 20 to 16 meters, 7 weight with high stability, The third group of Pathways 12 to 16 m, with average durability with score of 5, The fourth group Pathways 12 to 8 meters, with a score of 3 a low stable And Fifth Pathways less than 8 meters with a weight of 1 to a very low level of stability is classified.

Table 15: Statistical distribution in terms of physical stability within a passageway

Showing crossings	The stability	Weighted Score	Area in acres	Percent
20 m	Very high stability	1	30.74	40.58
16-20	High stability	3	5.32	7.02
16-12	Moderate stability	5	6.89	9.10
12-8	Low stability	7	14.99	19.79
8	Stability is very low	9	17.80	23.50

2) The skeletal stability the city terms of Adjustment applications:

Compatibility criteria in five categories based on applications in the context of a residential neighborhood located in the ancient city of Zanjan. Applications that are highly

incompatible certainly will the most damage to each other in earthquake so the applications that are more consistent faces with a more stable. Incompatible User (refueling stations, ammunition storage, industrial units and hospitals) with a score of 1,which has a very low resistance. relatively inconsistent User (administrative buildings - security, the average manufacturing plant, facilities, water, electricity and gas, public parking) weight of 3, Indifferent User (universities and clinics) rating of 5, relatively consistent User (banks and high school) Rating 7, And ultimately user friendly (parks and gardens, horticulture, and barren land, nursery, primary and secondary, shops, etc) has been awarded the highest rating 9 are stable too.

Table 16: Statistical distribution of the physical stability of the compatibility of land

User friendly	The stability	Weighted Score	Area in acres	Percent
Compatible	Very high stability	1	3.01	1.39
Relatively consistent	High stability	3	16.31	7.54
Apathetic	Moderate stability	5	3.54	1.64
Relatively incompatible	Low stability	7	2.83	1.31
Inconsistent	Stability is very low	9	190.63	88.13

3) The physical stability in terms of the occupation:

Occupancy level is divided in five classes. First-class is occupation level (20-0 percent), second grade is (40 to 20 percent) and third grade is (60-40 percent), fourth grade is (80 to 60 percent) and fifth grade is (100 to 80 percent). Their rate for first-class score of 9 with very high stability, Class II rating 7 with high stability, And the third class 5 rating, with

average stability And Class IV and V, respectively, weighs 3 and 1 with a low and very low stability.

Table 17: Statistical distribution of the density of the physical stability of a building

Building Density	The stability	Weighted Score	Area in acres	Percent
0-80 %	Very high stability	9	148.44	68.62
80-10 %	High stability	7	33.63	15.55
120-240 %	Moderate stability	3	28.85	13.34
240-400 %	Low stability	1	5.40	2.49

4) The physical stability of in terms of quality of construction:

One of the important criteria in evaluating the seismic stability of skeletal zanjan ancient Zanjan. These criteria in three groups, new - under construction, substantial maintenance - repair and destruction - are classified, New buildings - has been under construction 9 points that are very stability of and reliable building maintenance - repair rating 5, destructive - ruined Score 1 was given too little stability.

Table 18: Statistical distribution of the physical stability of the occupation

Occupancy levels	The stability	Weighted Score	Area in acres	Percent
0-20 %	Very high stability	9	37.06	17.13
20-40	High stability	7	25.36	11.73
40-60	Moderate stability	5	53.03	24.52
60-80	Low stability	3	64.59	29.86
80-100	Stability is very low	1	36.27	16.77

5) The physical stability of the old building:

These criteria was classification include the 3 groups (10 -0), and (30 -10 years), and (30 + years). First group nine points which high stability of, the second group, with a weight of of 5, the average stability and a third group with a score of 1 is very low stability ,Weights that are assigned to them.

Table 19: Statistical distribution of physical stability in terms of building quality

Quality Construction	The stability	Weighted Score	Area in acres	Percent
New - under construction	Very high stability	9	17.23	7.97
Maintainable - Refurbished	Moderate stability	5	148.55	68.67
Sabotage - ruined	Stability is very low	1	26.48	12.24

6) The physical stability of city in terms of building structure:

Criteria building structure, is another important criteria in evaluating the seismic stability of skeletal zanjan of ancient Zanjan city. Building structure is classified in three groups. Class 1 rated mud with little stability, Second floor, brick and wood, with low resistance with weight 3, Third floor (brick and iron structure - metal) with a score of 7 is very stable and the fourth floor (concrete structure) with nine rating on the strength of their high stability, have been weighted.

Table 20: Statistical distribution of the physical stability of the old building

Old Building	The stability	Weighted Score	Area in acres	Percent
0-10 years	Very high stability	9	21.29	9.84
30 -10 years	Moderate stability	5	89.80	41.51
30 + years	Stability is very low	1	60.02	27.74

7) The physical stability city in terms number of floors,:

Number of floors criteria of the building in 5 groups, including a class with a score of 1, which has a very low resistance, 2 floors with a score of 3, 3rd floor, with a score of 5, 4 floors rating 7 And the last group of fourfloor building belonging to nine rating and are very stable.

Table 21: Distribution of stability in terms of the physical building structure

Building Structure	The stability	Weighted Score	Area in acres	Percent
Mud	Stability is very low	1	1.13	0.52
Brick and wood	Low stability	3	58.67	27.12
Brick and iron - Metal	High stability	7	100.03	46.24
Concrete	Very high stability	9	2.12	0.98

8) The physical stability city in terms of type of building materials:

Mentioned Criteria in three groups: the first group of buildings with glass facades have to be included that rating one which has lowest in terms of sustainability its own weight. Facade stone and brick, with a score of 5 with moderate stability and thatch building's Facade and no posing, weight 9 is given in terms of sustainability has the highest weight.

Table 22: Statistical distribution of the physical stability of the number of floors of the building

Number of Floors	The stability	Weighted Score	Area in acres	Percent
1 floors	Very high stability	9	1.16	0.62

2 floors	High stability	7	3.35	1.78
3 floors	Moderate stability	5	7.50	3.99
4 floors	Low stability	3	47.98	25.56
5 floors	Stability is very low	1	127.74	68.05

9) The physical stability city in terms of separate parts system:

Separate system Criteria or components of the seed pieces are divided in five categories. First floor pieces (less than 100 m) with a1 score, which is much less stable. Second categories pieces (200 -100 m), with a score of 3, And Class the third pieces (400-200 m), rating fifth, fourth floor pieces (800 -400 m), rating seventh and fifth floor (800 + m) with nine rating is very stable.

Table 23: Statistical distribution in terms of physical durability of building materials

Building of view	The stability	Weighted Score	Area in acres	Percent
Thatch and without posing	Very high stability	9	110.10	64.35
Stone and brick	Moderate stability	5	57.69	33.72
Glass	Stability is very low	1	3.32	1.94

10) The physical stability city in terms of slope of the land:

Another criterion for assessing the sustainability of old zanjan city of Zanjan frame used in earthquake zone is the slope of the land. These Criteria in four categories, gradient (8 -6 percent) rating 3, the slope (6 -4%) by weight 5, the slope (4 -2 percent), with a slope rating of 7 and (2 -0 percent) with a score of 9 out highest weight in terms of their sustainability.

Table 24: Statistical distribution of the physical stability of the separate parts

Separation of Components	The stability	Weighted Score	Area in acres	Percent
Low 100 m	Very high stability	1	33.07	16.96
200-100	High stability	3	31.72	16.28
400-200	Moderate stability	5	63.71	32.69
800-400	Low stability	7	46.92	24.07
+800	Stability is very low	9	19.50	10.00

11- Another criteria for assessing the physical stability of the old zanjan sampling was used in the earthquake area is steep terrain. . The criteria in the form of 4 floors, steep slopes (8 - 6 percent) rated 3, the slope (6 -4%) by weight 5, the slope (4 -2 percent), with a slope rating of 7 and (2 -0%) with scores 9 has the highest weight in terms of their sustainability.

Table 25: Statistical distribution of the physical stability of the slope of the land

Residential land slope	The stability	Weighted Score	Area in acres	Percent
8-6%	Low stability	3	1.499	0.53
6-4%	Moderate stability	5	5.458	1.92

4-2%	High stability	7	33.928	11.94
2-0%	Very high stability	9	243.313	85.61

3 - The final analysis of the stability of the physical zanjan the old city of Zanjan in the earthquake:

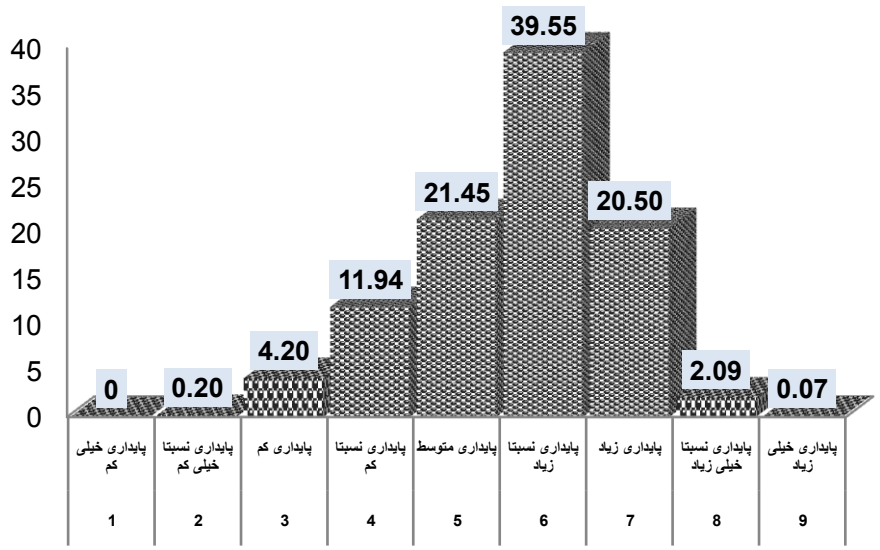
Up to this point, all the required maps were analyzed criteria and weighting to each element maps based on standards, given a system perspective, overall look and composition to determine the physical stability of the old zanjan city of Zanjan against earthquake that's not Only one measure or an index, but the different indicators are analyzed together. As well as the criteria used to determine the stability was not equal importance and maybe even a Measure be more crucial role than the other. Accordingly, from scores for each of the obtained criteria was used in the second stage of analysis. In fact, in this process of analysis, city physical layer criteria (standards) the combination together with the use of EXT_AHP software in GIS environment Apply the final score for each criterion, finally the physical stability of the old zanjan was extracted in earthquake at zanjan.

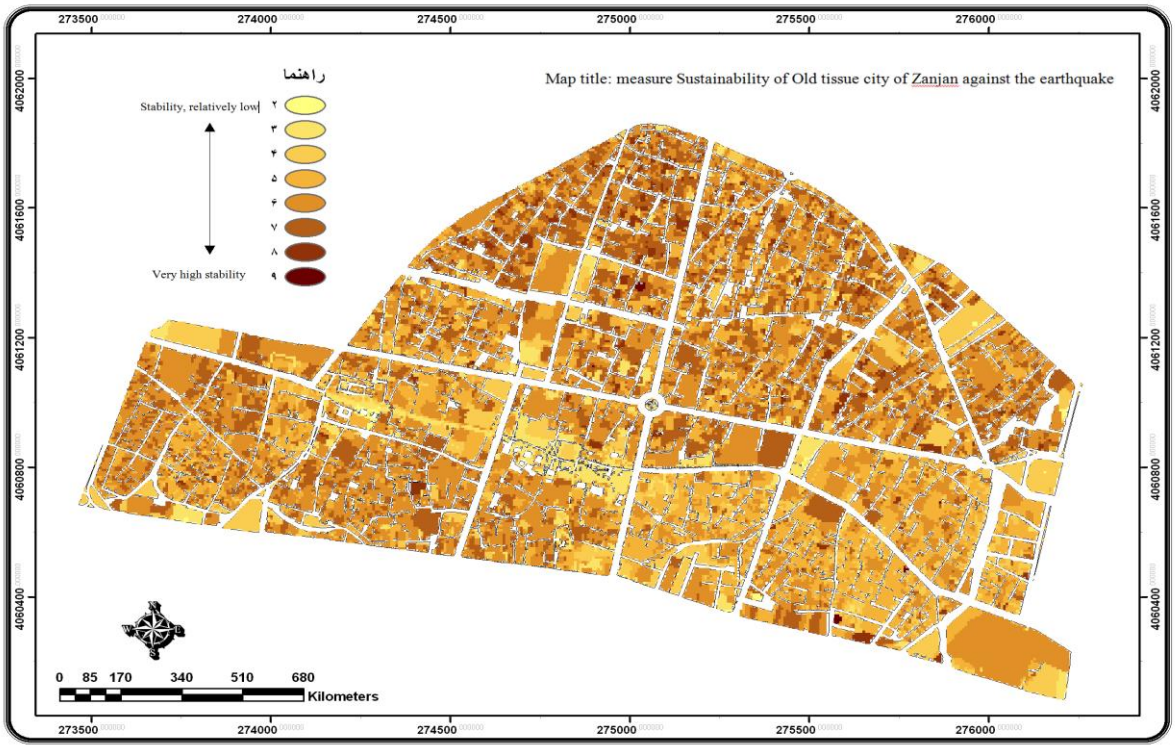
For able to sustain the level of precision and depth indicated on the final map is classified into nine distinct categories. First floor zones from the region, which are defined by rating 1 and its stability is very low. According to the investigation, none of the old zanjan city of Zanjan is not in these categories. The second floor includes zones with relatively low persistence and determinations are second rating. They represent 0.20 percent from the area. The third categories, with a score of 3 or less stable that make up 4.20% of the area. Fourth floor, are marked with relatively low stable weight 4. In this category, 11.94 percent are located in the zones. The fifth category includes classes with average stability that is weight 5. Sixth floor, with a rating of 6 has a high stability which forms 39.55% of area. Seventh floor, with high stability and rating 7-this area accounts only 20.50 percent. Floor, eighth and ninth, respectively, with scores of 8 and 9 have been identified the relatively high stability and high stability, 2.09 and 0.07 that they are in the zone. The statistical distribution, percentage and map the physical stability of the old zanjan city of Zanjan has been following.

Table 26: Statistical distribution of old zanjan sampling frame stability against earthquake

The stability	Weighted Score	Area in acres	Percent
Stability is very low	1	0	0
Stability, relatively low	2	0.399	0.20
Low stability	3	8.351	4.20
Relatively low stability	4	23.748	11.94
Moderate stability	5	42.680	21.45
The relatively high stability	6	78.685	39.55
High stability	7	40.773	20.50
Relatively high stability	8	4.155	2.09
Very high stability	9	0.139	0.07

Figure 2: Percentage of ancient zanjan sampling frame stability against earthquake





Map 2: The Ancient zanjan sampling frame stability against earthquake

Summary and conclusions

Urban development in recent decades of social, economic, cultural, political, and ... is affected Human life. In fact, the characteristics of urban communities are causing instability environment and human now. Studies show that in average per decade, 7Richter earthquake that occurs with high power However, in cities of over 8/2 million units in non-volatile and are not resistant in earthquake.

According to studies conducted, frame criteria, quality construction and width crossing points, respectively, 0.170, 0.160 and 0.124 are the most important criteria And criteria for building materials with a score of 0.040 is The least criteria are the physical stability. The sustainability criteria such as the sampling frame construction, quality construction, occupancy levels and building materials are in a bad condition that can seriously shake the stability of the fabric of the old city of Zanjan. The results indicate the stability criteria the dire situation in the earthquake-old skeletal zanjan in this area and represents 16.34% of the total area of unstable 21.45percent of the area is mediocre stability and 62.21% area face completely stability. This situation represents the study area is poor and unstable.

Resources:

1) AhdnzhadMohsen; Meshkini, A. and Batool Nouri (2008). Assess the vulnerability of informal settlements, and margins against earthquake using GIS: A case study: the informal settlements of Islamabad. Municipal GIS Conference North University, Amol.

2) Partovi, Parvin, 1996, reviews of obstacles, constraints and contrasts the implementation of measures to reduce vulnerability to earthquakes.Proceedings of the Second International Conference on Seismology and Earthquake Engineering, International Institute of Seismology and Earthquake Engineering, Tehran.

3) Soboti, Hooman, 2007, Introduction to the historical center - a cultural and tourism sampling, Proceedings of the Conference elected urban issues of Zanjan, Zanjan Islamic Azad University Press

4) Sobouti, Hoshang, 1999, Zanjan history, Fourth Printing, Publishing Zangan, Zanjan

5) Hatami Nejad, Hossein, FathiHamid and eshgabat, Farid (2010). Assess the seismic vulnerability of the City sample: District 10 of Tehran Municipality. Journal of Human Geography, No. 68, summer, pp. 1-20.

6) Habibi, Seyed Mohsen, 2006, from flux to city, the sixth edition, Tehran University Press, Tehran

7) Hosseini, Maziar (2004). Challenges and strategies for risk management in Tehran. Tehran: the Tehran Disaster Management Organization.

8) Abdollahi, Majid (2002). Crisis management in urban areas: flood and earthquake. Tehran: Publication of the country's municipalities.

9) Azizi, Mohammad Mehdi and AkbariReza (2009). Planning considerations in assessing the vulnerability of urban earthquake: A Case Study in Tehran FARAHZAD. Fine Art Magazine, No. 34, Summer, pp. 36-25. 10) Fakhimi, Nasim (2007).creat SDD for an earthquake disaster management.doctor Mohammad Hossein Sharif-Zadegan to help senior thesis field of urban and regional planning, martyr Beheshti University, Tehran.

11) Fyrvzbkht, Ali, Parhizgar, and Rabie Far Valiolah., (2012), Strategies for Environmental Structure of Urban Sustainable Development Approach (Case Study: Karaj), the study of human geography, number 80, pp. 239 - 213th

12) Qorokhlo, Mehdi. and Hashemi, H., 2007, Urban Sustainability Indicators, No. VIII, Journal of Geography and Regional Development

13) Moradi, Hafez, in 2010, the physical structure of management roles in transforming the city council (Zanjan City Case Study), Master's thesis, University of zanjan

14) Shemirani Mofidi, Seyed Mojtaba and Eftekhari Moghadam, Ali., 2010, Urban Sustainability, vision and principles and its implementation in developing countries, Issue 12, Year VI, International Journal of Manufacturing Research