

Evaluation and Improvement of Urban Worn against Earthquakes (Case Study Neighborhood of Shiraz Zvalanvar)

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ABSTRACT

Natural disasters as the part of human life process are increasingly considerably and considered as a factor which harms humans and poses a major challenge toward achieving a sustainable development of human societies; however, some of the developed countries associated with progressions in the field of sciences and knowledge could not provide the appropriate control for preventing these natural disasters. Among these disasters, the destructive role of earthquake is so important in the human life as well the occurrence of an earthquake in a part of the world threatens the lives of thousands of people, damages most human-made installations and buildings and results into the physical damages as well as the financial ones. So the first step in dealing with this destructive phenomenon is to have knowledge about its causes and then suggest the options in order to deal with [overcome] for reducing the financial and physical losses. Shiraz as a metropolis in Iran had an increasing or a considerable growth during the recent decades which resulted into the non-standard buildings as most of them were the rural places and margin points. And considering the construction in the margin of this city caused the negligence of experts to the renovation and restoration of damaged and central textures of Shiraz for the reason that these textures are the main problems of urban management which it [problem] was considered as the most important concept by the urban experts of Iran during the recent year in particular the first half of 80 decades [after bam earthquake]. In this article, in order to study the experiences of Iran and the world, the theoretical points related to the importance of earthquake in the urban ancient and damaged textures were analyzed and finally, the indexes for determining the susceptibility of an ancient or damaged texture were defined. These indexes are the basis of our recognition to the considered are [Shiraz-Zulanvar area] and the level of its susceptibility [susceptibility of a texture] is based on each of them as well, by determining their effective coefficients, the whole susceptibility of different points was specified. This information is the basis of programming / planning to reduce the level or quantity of susceptibility and present the required suggestions.

KEYWORDS: earthquake, urban damaged textures, physical [framework] planning, susceptibility indexes, Zulanvar area

INTRODUCTION

Iran is one 10 susceptible countries in the world to [against] the natural disasters and based on the statistics of 40 registered natural disasters in the world, 31 of them occurred in Iran. In accordance with the seismicity, these [statistics] show that Iran is located in the path of seismic belt of Alp – Himalaya. In the global framework of Iran plateau, it was located in the junction point of Arabian and Indian plates. Iran is the permanent victims of earthquake and the occurrence of this event in some parts of Iran affected the life of people and the other things. About the seismic cities of Iran, there is always an uncomfortable prospect. According to the official figures and statistics during the past 30 years, more than 6 % of physical damages of fatalities in has been caused by the earthquake; almost we witness the earthquakes every day [with the power less than 4 Richter]; an earthquake each month [with the power of 4 Richter]; three earthquakes each year [with the power about 4 Richter] and a great earthquake every ten year [with the power of 7 Richter]. According to the statistics, 69 % of Iran's area is located on the active faults or their margins (Mahmoodzadeh, 2005). An earthquake is a natural phenomenon which does not have the undesirable results spontaneously but what causes the great damages in the excessive construction in the dangerous places and ignoring the renovation of ancient and damaged textures and also lack of information in order to deal with the consequences results from this natural event. In the conditions as the human innovations are being admired, using them [by the humans] is associated with haste and also lack of planning. In the framework of ancient organic urban textures, the climatic, geographical and cultural are emerged as well it makes clear and vivid the logic of life in them. But in spite of its ability for satisfying the psychological needs of its inhabitants, it faced the irreversible or irreparable damages against [to] the natural disasters, continuously. But what was the performance of our new cities? The fact is that the humans could not

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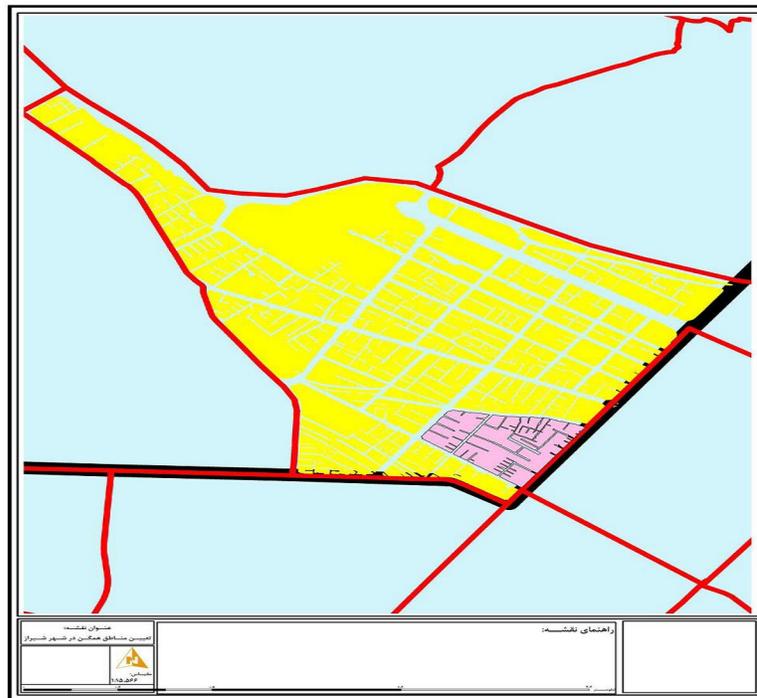
find the appropriate solution in order to overcome these natural disasters in spite of the scientific developments. Therefore, some changes resulted into an disorganization in humans' life such as;

- Urbanism development and the dominance of related patterns,
- The increasingly development of residential, industrial and the other structures,
- The preference of machine life system.

Due to these issues, the effort of theoreticians was toward finding a way to escape from this disorganization and defining a health city and stable development. Discovering the reasons of events, estimating the time of their occurrence and how to overcome them by resorting to knowledge and information were the aims of humans.

RESEARCH DOMAIN

The case study of this article is Shiraz [district no.:1 - Zulanvar area]. Shiraz, capital of Fars, is located in a vast region with an area about 4334 square kilometers. Shiraz is the historical and cultural center of Iran. The intensity of industrial, economic, productive and medical activities and its attractions resulted into the acceptance of immigrants from the neighboring provinces, cities and villages. And the increasingly intensity of populations increased exponentially the vulnerability of this city to the earthquakes as well considering this issue is unavoidable. District area [Number 1] in Shiraz constitutes the north side and the center of Shiraz. And in practice, it is the core of commercial, administrative, health, educational, cultural and military activities and also it is a determinant subsystem in the collection of systems in Shiraz. Accordingly, it has a compressive and consistent texture as well it has a defined physical identity in the whole region. This region is one of the relative ancient areas in Shiraz and it was located in district no.:1. This area is between the main paths of Enqelab-e-Eslami [Islamic Revolution] – Shurideh Shirazi and the secondary paths of Zulanvar – Western Moshir. The main internal pathway [Takhti] with a width of 12 meters in a North - South side, divided this area into two parts. In general, Zulanvar in terms of access or connection with the other neighboring parts has a relatively good situation. The current area of this region is 6/19 hectares as well a population of 1960 individuals [based on the census of renovation department of this are] lives in this place. Of which 1,013 are male and 947 are female. The buildings of this area are ancient with a fine-grained texture. The texture of this area is organic. In the new buildings, the width of lane to the wall [walled lane width] had not been observed which certainly blocks the paths and streets after the earthquake. And also, there are not any especial relief centers.



Map 1 - Geographical location of the study area

METHOD

To perform this study, by considering the related issue, the Consistent and correlation approach was used [

HafezNia, 2007]. This study was done as an analytical-observational investigation. In general, three factors of this paper were presented as follows:

- Earthquake
- damaged and ancient textures
- Physical structure

Then, according to the case study, the situation of buildings, roads, utilities and equipment were selected [by the field and library methods] and based on the vulnerability factors of physical texture, different groupings were done based on the amount of physical vulnerability and they will be specified as indexes or indicators. Then, by combining these indicators with each other, a model will be obtained. And for each of the pathways as the indicators for determining the texture, the amount or level of whole vulnerability is identified. And a map will be provided for each of these indicators. As a result, in order to provide or prepare the map of physical vulnerability, the maps will coincide [overlap] with each other. According to these issues, and studying the reasons and the quantities of physical damages due to earthquake, some suggestions to improve the situation of ancient buildings were presented.

THE MAIN DISCUSSION

Shiraz in terms of the inclusive plan of Shiraz, form and shape of buildings and the residential areas are divided into four categories:

- The old part of this city with high density of buildings and population [40% of residential areas and 41% of population] and the average age of buildings constructed in 1934 [only 18% of the buildings have been built after 1961].
- The second region represents the beginning of town's development with broad alleys and new houses with enough space, rich residents and the development toward the West and North.
- Contains the second stage of city-development toward the West, South, North and North East, but each region has specific features. In the West and North West side, the development is more like the first category [from west to the south]. Its residents are middle-class [the average date of its construction is about 1958].
- The existence of villages as their life depends on the the urban life like Ghasroldasht, Abyverdy, Chugia, Keshan, DehKoreh, Saadi, etc.

In the central core of Shiraz, the economic and social situation of this area and the neighboring parts as well as the quality of their constructions is completely obvious and clear. By considering the service problems to these communities and lack of green spaces and their high density, destructing these communities and their renewal is the only fate for them. Shiraz with 1053025 populations [in the formal census of people and housings in 1996] is the fifth largest city in Iran after Tehran, Mashhad, Isfahan and Tabriz. And also this city has a high population growth during four decades [1956 to 1996]. Studying the population changes show that during these four decades, the population has increased from 170,659 to 1,053,025. In other words, the city's population is increased 6.7 times. According to the census, there were only five cities in Iran [with a population about 10,000,000 million individuals] in 1996. Shiraz was one of the five largest cities in Iran with having a population 10,000,000 million individuals in 1996. So, this issue can reflect the role and importance of this city in the national and regional levels. In other words, Shiraz is one of the major cities of Iran [in south of Iran] [the counselor of house and city, 2010].

BUILDING'S DENSITY

The density of building is the percentage of land's area which is being used for construction, vertically. Based on the available rules, 60% of the land's surface was allocated to construction or building. 120% density refers a two-story building as 60% of land will be the infrastructure of each story. Building's density has played a decisive role in these studies. Assuming the height of each floor [3 meter], it is possible to estimate the height of a building. And it is so important in order to get the ratio of sidewall height to the width of lane or pathway. And the more stories, the more residents will be. And the building will be more important. The segmentation which was shown on Map No. 3-4 is as follows:

- Group I; buildings that have a density between 0 to 149 percent are rated 1.
- Group II: buildings that have a density between 150 to 199 percent are rated 2.
- Group III: buildings that have a density between 200 to 249 are rated 3.
- Group IV: buildings that have a density more than 250% density are rated 4.



Map 2 - Status of roads' construction based on the constructional density of texture

QUALITY OF BUILDINGS

Based on the related studies in this area for specifying the morphological species, first the quality of buildings were classified in three groups as follows; and then their map was prepared:

- Lasting monuments
- Buildings that can be rebuilt
- Buildings that can be destroyed



Map 3: Quality of lanes based on the neighboring buildings

STUDY THE FUNCTIONAL STRUCTURES OF BUILDINGS

In the studies of city structure, the main structural elements which constitute the main framework of the city occupy a small part of the city. Although the residential areas have not a key role in the city, mentally, they have a main role in disturbing the structural elements of city and forming the framework of metropolis. Table 1 shows the rules and regulations relating to the separation of land and buildings' construction in the particular residential areas and commercial – residential complexes.

Table 1: rules and regulations relating to the separation of land and buildings' construction in the particular residential areas and commercial – residential complexes

Maximum residential occupancy (percent)	Maximum residential occupancy (percent)	Maximum residential occupancy (percent)	Maximum Elevation	Minimum length	The minimum width	Minimum separation of land	Number of categories
240	60	50	30, 35	30	16	600	5, 6
280	50	40	30, 35.5	35	18	800	7, 8

Source: the engineers of Home and City Counselor

It should be noted that the suggestions for revising its inclusive plan were displayed in Map No.6-4.



The study area, although has a damaged or ancient texture, it has the adequate potentials in order to change into an area with the appropriate performance if there are spatial and physical organizations. Most buildings in this area are residential complexes but the other functions or uses have few levels. The services within a texture consist of a school, a sports stadium, and commercial stores that often have a domain of a meta-regional effect. All available services in this area are related to the paths of roadway and they require parking. In map no.: 6-4, the functions of neighboring buildings are clear and vivid. Zulanvar is located within the especial residential place and residential – commercial complex.

STUDYING THE NETWORK OF LANES AND ITS PHYSICAL STRUCTURE

The structure of network in the region is generally radial and linear which shapes the framework / foundation of physical development by several axes such axis of West - East and North - South perpendicular to each other. The dimensions of the lanes of this area were selected and specified for study as well in table 2, the accurate specifications were presented and the final maps were drawn.

Table 2 - Physical properties of pathways or lanes

Height of wall	Width	Length	Name of Passageway	Row
5.25	2.80	23.50	Enghlab 8	1
7.40	6.00	104.00	Enghlab 6	2
5.80	6.00	95.00	Mahdiyeh 1/1	3
6.25	6.00	154.00	Mahdiyeh 1/1	4
6.00	2.00	20.00	Zoalanvar1/4	5
7.30	4.00	92.00	Zoalanvar4	6
5.00	1.80	10.00	Zoalanvar2/6	7
7.80	3.00	22.00	Zoalanvar7/6	8
6.60	4.00	84.00	Zoalanvar6	9
7.50	4.80	35.00	Zoalanvar5/6	10
6.00	3.00	46.00	Zoalanvar3/6	11
7.10	3.20	80.00	Zoalanvar1/6	12
7.00	3.00	30.00	Zoalanvar2/10	13
6.00	3.60	14.00	Zoalanvar1/10	14
7.50	4.00	38.00	Zoalanvar1/2	15
8.00	4.70	97.60	Zoalanvar12	16
6.90	12.00	297.00	Zoalanvar1/2	17
6.75	6.50	37.00	Zoalanvar9/7	18
6.50	3.80	52.00	Zoalanvar5/7	19

6.10	4.50	115.00	Moshiregharbi 1/7	20
6.00	3.80	41.00	Zoalanvar3/7	21
7.50	4.00	19.30	Moshiregharbi 1/3	22
5.70	3.80	40.00	Moshiregharbi 1/7	23
6.60	4.00	40.00	Moshiregharbi 5/1	24
6.00	6.00	40.00	Moshiregharbi 3/1	25
6.30	4.00	40.00	Moshiregharbi 1/1	26
7.00	4.00	38.70	Moshiregharbi 2	27
7.00	3.60	37.40	Moshiregharbi 4	28
5.66	3.60	36.00	Moshiregharbi 6	29
5.00	8.00	112.00	Enghelab 12	30
7.10	8.00	117.00	Moshiregharbi 1	31
7.10	4.40	40.00	Moshiregharbi 9/1	32
7.50	6.50	65.50	Moshiregharbi 5	33
4.00	6.60	30.00	Enghelab j/1	34
5.10	4.00	58.00	Moshiregharbi 5	35
8.30	7.30	47.00	Enghelab B/1	36
6.75	4.00	25.00	Enghelab 10	37
8.00	5.50	8.50	Enghelab B/6	38
4.50	4.70	6.20	Enghelab A/1	39
7.00	6.00	100.00	Shoride 11	40
7.20	4.00	50.00	Zoalanva/2	41
7.80	6.00	95.00	Shoride 13	42
6.50	3.10	42.00	Zoalanva8	43
6.40	6.00	80.00	Shoride 15	44
5.60	4.00	30.00	Zoalanva16	45
6.75	3.00	108.00	Zoalanva16	46
6.50	6.00	65.50	Karim 4	47
5.80	5.30	114.00	Mahdiyeh 2	48
5.25	5.50	40.00	Mahdiyeh 1	49
6.00	8.00	295.00	Moshiregharbi 4/7	50
6.00	8.00	51.00	Ghavami 1	51
5.74	12.00	164.00	Mahdiyeh1/1	52
6.20	6.00	50.00	Zoalanva7/7	53
6.00	4.00	43.00	Zoalanva1/7	54
6.00	7.00	64.00	Moshiregharbi 6/7	55



Map 4 : Status of texture based on the ratio of length to width of lane



Map 5 – texture situation no.: ... based on the ratio of lane width to the height of the sidewall

STUDYING POPULATION, POPULATION DENSITY AND RECOGNITION OF ITS DISTRIBUTION IN THE CONSIDERED AREA

The department of renovation services in Zulanvar decided to count all residential blocks by separating the families in these blocks during 2012. It must be mentioned that for accomplishing the economical and social studies, the field method was used for selecting and specifying the number of families as well there are some problems in getting the whole information of all families such as the number of rental buildings, lack of cooperation between some residents, emptiness of some residential blocks, etc. Then the different economical and social-economical factors were studied [by using the field methods and results]. According to the grouping[s] in the map of population density and this main principle "the more number of individuals, the more losses and vulnerability will be", therefore, for measuring the lane's network, first the average of population density of each lane will be considered and then, based on the above mentioned principle, the groups and ranks / rates were presented as follows:

- Group I: population density less than 250 persons per hectare, which is rated 1.
- Group II: population density between 251 to 500 persons per hectare, which is rated 2.
- Group III: population density of 500 persons per hectare, which is rated 3.



Map 6 - Status of texture based on the population density of passages

DETERMINING THE COEFFICIENTS OF INDICATORS

In order to study the vulnerability of texture, it is possible to study the individual indicators of each lane for specifying the deficiencies. But for studying the lanes, comparing them with each other, analyzing them and determining the priorities, we should combine these factors with each other and define the vulnerability of each lane by a number. First, a form was provide and then by considering the library studies and the viewpoints of experts of urban domains and the earthquake, a coefficient was allocated to each of these indexes in order to specify their priority. And secondly, we try to determine the whole vulnerability to the texture. Based on table 3, the determination of vulnerability indicators [as well the view of experts has been asked about the importance of indicators] are:

Table 3 – the importance of vulnerability indicators

3	2	1	Factors influencing the physical vulnerability	INDEX
	*		The population density	A ₁
	*		Building density	A ₂
*			Structural load bearing system	A ₃
		*	Ratio of length to width of the Passageway	A ₄
	*		Width ratio of the wall Passageway	A ₅
*			Building Quality	A ₆
*			Importance of Passageway	A ₇
	*		Outdoor neighborhood	A ₈

After reviewing the results, the coefficient of indicators were obtained. The coefficients [Tables 2-5] are:

Table4–significance coefficient of indicators

Index	Factors influencing the physical vulnerability	Index Factor
2	The population density	B ₁
2	Building density	B ₂
3	Structural load bearing system	B ₃
1	Ratio of length to width of the Passageway	B ₄
2	Width ratio of the wall Passageway	B ₅
3	Building Quality	B ₆
3	Importance of Passageway	B ₇
2	Outdoor neighborhood	B ₈

Before considering the significance coefficient of each proposed indicators, the situation of vulnerability was studied. Based on the whole vulnerability, the lanes, streets and finally the physical structure of this area were divided into groups and then their maps were drawn.



Map 7 - position of texture vulnerability without considering the significance coefficient of parameters

CONCLUSIONS

One of the cases to reduce the damage caused by earthquakes in the cities is urban planning for organizing [physical organization] the damaged and ancient urban textures and the results of this planning are;

- Protecting the city from the destructive damages,
- Protecting the identity of city,
- Saving the humans' life and
- Preventing the financial damages.

These kinds of buildings are constantly exposed to earthquakes due to these reasons;

- The age of buildings,
- Weakness of residents [in the financial ability] in order to reinforce the buildings,
- The bad structure of lanes and etc.

In this paper, each lane was considered as an index for determining the neighboring texture and based on the indexes of vulnerability, it was studied. By assuming the occurrence of earthquakes, the quantity / level of

vulnerability of lanes and its effective factors were specified and then the administrative suggestions in terms of the available situation in order to extend and changes the lanes and renovate or reinforce the ancient buildings were presented until the vulnerability of texture and also the time of assistance during an earthquake for preventing the physical losses reduce.

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