

The Role of Open Spaces in Reducing the Vulnerability of Urban Tissues (Case Study: Region 17 of Tehran)

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Abstract: The earthquake as a natural disaster has been a while as concerns of officials and urban citizens. As the urban phenomenon is more than a collection of buildings, thus, immunization of urban areas against earthquake and reducing vulnerability especially in old tissues cannot be worn alone by retrofitting buildings to be resistant against earthquake. Urban open spaces can play an important role in reducing the vulnerability of urban tissues during disasters and crises. On the other hand, because of placement of region 17 in dense, worn and seismic tissue were considered for the study. Terrain based on library research, using the Delphi method, showed that in addition to low quality level of green and open spaces, the region is in bad situation, regarding the quantity level. In this paper, a brief review of the concepts of vulnerability, urban context, crisis management, and urban resiliency as a theoretical goal, investigated and in line with that, urban open spaces as the key to successful integration of recovery programs and the properties of urban figure and body that can increase its resiliency in the time of the incident, are discussed. Characteristics and indicators of urban open spaces such as access, densities, privacies, neighborhoods, walls, areas, facilities in the study area were evaluated and weighted and after identifying and analyzing the quo status and according to the results obtained from the theoretical and viewpoints, guidelines and criteria for the proposed scheduling were proposed which led to the kind of planning and organization of open spaces in such a way that these spaces provide needs of everyday people, and act as places for the relief operation and crisis management during disaster incidence.

Keywords: vulnerability, distressed areas, disaster management, earthquake, urban resiliency, urban open space

1. Introduction

It is in the light of providing comfort, security and safety that shapes and revolutions the human civilization. With Accidents and natural disasters result in loss of social, economic, physical damages and will disrupt or stop the process of daily living, social and economic activity, and in fact may affect the community [1]. The earthquake is one of the most serious natural disasters in modern times that have always been important and objectively visible. Earthquake is a natural disaster upon the magnitude of itself could create huge damages in a short time. Due to the rapid and uncontrolled urbanization in Tehran, urban and regional improper use planning, incorrect construction techniques, lack of infrastructures and services, environmental degradation, and the most important, urban geographical and geological location, the hazards of earthquakes have located at the highest level. In this study, it was believed that it would be possible to consider ways of planning and organizing open spaces, to highlight their role, both in everyday life and in times of crisis needs, with the aim of reducing vulnerability in urban context. With this belief, in the present article, it is attempted to investigate the role of open spaces to reduce damages of earthquake in the region seventeen in Tehran, using the capabilities and planning urbanization [1].

2. Statement of the problem

Earthquakes are a natural phenomenon in itself has no adverse results. What makes this event a disaster, is the lack of preventive methods of its effects and lack of

preparedness to deal with its consequences. Earthquakes, often has left devastating impact on human settlements, and has destroyed buildings and infrastructure and urban context and has forced wide social and economic effects on communities and cities. On the other hand, despite all the progress, that human has earned, unfortunately, due to insufficient knowledge and limited resources fail to prepare optimal controls to prevent natural disasters. However, one of the most important phenomena of the world today, is increase in urban areas and the increasingly and severe development of urban body, that is result of intensity of the process of urbanization and the use of facilities in such environment. In fact, urbanization represents the latest manifestation of human development in urban environments occupied and involved. These cities have physical bodies, each have placed an activity, all of them make urban space, and give their identity [1]. Urban areas are defined with centers of human population, human activities and structures and urban space have placed facilities and infrastructure with a variety of uses, including residential, office, services, health, recreation, etc within itself. All the above categories have dependent population that are severely affected in the event of an accident and lead to disrupt the lives and loss of life and great property in the urban areas. United Nations in 1992 in a document called "sustainable development of human settlements" has recommended to all countries that should consider reduction of earthquake risk in all human settlements planning processes. One of the most important factors in reducing earthquake losses is pre-readiness of a society to deal with the phenomenon of earthquake. Earthquake preparedness to deal with earthquake has various aspects that in Iran, so far only one aspect of it has been considered and it is retrofitting of structures against earthquake. While the reduction of urban vulnerability against earthquake cannot be sustained only through structural measures. As the physical aspect is only one aspect of

urban and the buildings are only parts of the structural elements. One of the urban areas that dealing with it can be helpful to solve the problems in this case, is urban open spaces and having different approach in relation to the planning and organization of these spaces. This article sought to investigate the role of urban green and open spaces to reduce the damages caused by the earthquake in region seventeen, Tehran as a case study by using the knowledge of urban planning and urban crisis management and to answer the following questions:

- What are the urban open spaces and their communication networks role in reducing the damage caused by the earthquake?
- How is the role of urban open spaces in the area of seventeen, Tehran in relation to lessen the vulnerability?

3. Theoretical Framework

Immunization and security of urban areas cities against earthquake is of argument that has some thinking that below is the summary of them:

The first group- utmost importance for control has urban size in terms of building density, population and positioning the hazardous activities.

The second group- The most important issue for this group is resistant design of structures and physical elements of the urban.

The third group- It reviews the discussion about the proper distribution of the urban population in networks and decentralization of activities in one center and its distribution in different centers to reduce the vulnerability.

The fourth group- It seeks the factors and characteristics of urban texture such as the model, size of land segmentation, to be fill and emptied of each segmentation, and the proximity of buildings and roads, physical properties of ways, such as road width and

grade of its limitation, which are of vulnerability factors of urban context.

In this paper, by combining the third and fourth thoughts, the foundation for the current research has been made and the role of urban open spaces to reduce the vulnerability of urban have been investigated. As the designed range of projects has located in region of 17, Tehran and in distressed area, in this way, a glance at the views of experts on the concepts of vulnerability and crisis management, centers of relief has considered. Then, the concept of urban resiliency and the role of urban open spaces in reduction of urban vulnerability have been made. Assess the extent of damage and injuries to urban areas directly and indirectly is considered to adverse condition of their planning. Bad condition of structural elements and inappropriate uses of urban lands, inappropriate communications network of the city, compact urban tissues, high-density of urban areas, poor conditions and lack of city infrastructure and inadequate distribution of urban open spaces and so on have major role in the increase of earthquake damage to urban areas. Therefore, what change the earthquake phenomenon to a disaster, are improper urban planning and lack of safe urban spaces. In this article, the aim is to investigate the role of planning in reducing the vulnerability of old texture along with crisis management purposes. Therefore, the concept of urban resiliency has been analyzed and its relation to the recovery programs after the incident and urbanism have been described. Finally, the urban open spaces as common recovery programs and urbanism have been proposed and then its role in increasing urban resiliency and as a result reducing vulnerability of urban texture have been investigated.

4. The concept of open spaces and their role in reducing the vulnerability of urban tissues during earthquake

Urban green and open spaces

In the urban design literature, open space has a range of meanings. It includes green spaces (parks, green corridors, reserves, etc.) to public open space, private including streets, squares and private open spaces, such as gardens and courtyard [2]. Klasvn quoted from Perloff that "open spaces, are social areas within or adjacent to the urban and have public domain and are not occupied by buildings" [3]. Nashmyra in definition of open spaces says about limitation and non-limitation. "They made the open spaces with no buildings or their made spaces are less than one-twentieth of the whole". Recently, because of growing urban areas, other types of spaces due to having potential to support of urban life and improve the quality of life are considered as urban open spaces. For example, public and private lands, lands those are temporarily vacant, spaces and the car parks, road margins and edges, spaces between blocks [4]. In many developed countries, increase in urban open spaces is of effective factor for the urban sustainable development [5]. This is because the open spaces, in addition to providing light, air and urban breathe, over other elements have influence on in shaping and relationship between areas and different landscapes and urban projects implementation. In addition, in shaping landscapes and pleasant activities, spaces and comprehension of citizens about urban and development of recreation and tourism spaces are very useful. In addition, the green open spaces in critical situation have several functions including deployment of field hospital fundraiser, containment and crisis management, as well as temporary accommodation of people during earthquake and so on. As the number and size of open spaces is more the people's vulnerability because of earthquakes gets less [6]. Today, in most cities of Iran, especially in the metropolitan city, Tehran, due to uncontrolled construction, unplanned distribution of buildings in the city, on the day the open spaces in the city has decreased. In a way that the necessary balance between the built environments, building density and used open

space during crises do not exist. Decreasing trend of green, open and sport spaces in Tehran might be traced mainly during the last forty years. As mentioned, green and open spaces in the process of rapid urbanization, have affected and given the increasing population density, per capita open space per person has decreased. This problem is arisen due to the ignorance of the effects of urban open spaces in urban areas with poor infrastructure and lack of attention to strengthening the existing urban spaces. On the other hand, the quality and quantity of these spaces are not acceptable.

5. The role of open spaces in reducing vulnerability

Singer, 1952 and Lynch, 1958, both argued that the open spaces (urban open spaces that scattered between built spaces) are more resilience than the congested areas. Lynch, 1958, in addition to resiliency, believed that there are many other features that can make a form more resistant than others can [7]. More features in the transport network, services and utilities, and infrastructure cause the urban to do better in earthquakes and emergencies [8]. Issues related to disaster management and urban open spaces need not always met by creating new spaces in the suburbs. These new spaces not only are separated from old feeling of people connection, but the time and use of resources will be more. Therefore, it is better to use of urban open spaces or region in such a way that provide these spaces in a way to drain the site during an earthquake or other natural disasters to be compatible. These spaces should be able to connect with people and to offer numerous activities to people to be sufficiently resilience.

6. Urban resiliency

The best way to understand a system is embarrassing and disturbing it [9]. Theories of recovery of urban planning and normative urban design theories have common positive points to ensure the safety and health of urban communities. In any case, the need for shelter

and resuscitation in an emergency such as earthquakes, are sometimes at odds with the needs of the urban. The concept of "urban resiliency", offers style of programming that is in full compliance with urban everyday requirements [10].

7. Urban resiliency and open spaces

Holling and Walker have developed a model of urban resiliency that offer a full understanding of the structure and function of a system and its disorders over time. This issue will allow that for design resiliency and manage accordingly. Walker, 2004 believed that urban areas have complex systems and communities as integral members of these systems, and have important role in the adaptive response. Along with the recovery plans of urban for coping with the chaos, urban designers move toward urban designing that promote the adaptation. In fact, both experimental unconsciously are moving towards each other. Since the earthquake may never happen, a reluctance to retrofit urban areas to prepare for recovery needs exist. Especially if this will, need a great expense [11]. However, if urban design and urban policy of recovery programs be along with focusing on urban resiliency; continuously and growing retrofitting during daily process automatically creates opportunities to facilitate recovery in the event of an earthquake. The key to successful integration of recovery theories of planning and urbanism is in a changing mentality towards urban open spaces. "The common denominator of recovery plans and urban development is urban open spaces network». Streets, parks and abandoned open spaces that are parts of the everyday life of the urban are considered as the "Second urban" at the time of recovery after the earthquake, and will be life giving. Network of urban open spaces have important and inherent role and influence on urban resiliency concept, the capacity that will make the urban to adapt to turbulent conditions. Designing a network of open spaces not only improve the quality of everyday urban life both also has considerable influence as a potential in emergencies like

earthquake, to prepare safety for people and urban recovery.

8. Study area

A general understanding of region seventeen, Tehran

The results of the General Census of Population and Housing, 2006, Iranian statistics center, this region has over 256,022 people, with a negative growth trend (decreasing). The region covers an area of 794.3 acres and occupies 1.1% of the total land area of Tehran near six different areas of Tehran (9, 10, 11, 16, 18, 19). This region from north to ends to Qazvin Avenue, from east to Nawab highway, from west to highway Ayatollah Saeedi and from south to west Nawab highway and along is limited to Zamzam Avenue. This area has the highest proportion of distressed and dense areas in the twenty-two districts of Tehran. Geographically, this region has a favorable disposition towards the city of Tehran. The region's proximity to downtown, its proximity to job and employment centers in west of Tehran, presence of four major communications axis around it including Qazvin street on the north, Nawab highway in the east, Ayatollah Saeedi highway in west, Zamzam Avenue and highway of Javaneh in south and establishment and function of three trans-regional market (including furniture market of Yaftabad, bags and shoes of Amin al-Mulk and aluminum industries of Qale morghi) are of advantages of the region compared to neighboring regions. Despite the above advantages, this area could not earn its real position in Tehran and among

its regions and still is considered as a backward and marginal region. The area directly affected by two faults, namely, South Ray fault in 20 km long and north Ray fault that is located in the south of Tehran (Fig. 1).

9. Materials and Methods

In this paper, the methodology was in two forms. Due to the nature of geography, that investigated the interrelationships and interaction of human and environment in a spatial context and concept of urban as a geographical phenomenon that created manifestation of human thinking, spatial data and required documents were provided by library procedure. The field study was considered as another part of the study. The research methodology and data collection was based on two premises of library document collection and field study and consequently by Delphi method various criteria were weighted.

The study population consisted of 30 persons. These persons besides being expertise in urban planning were familiar with the city of Tehran, and the region of Seventeen. Based on the theoretical framework discussed in this study, the questionnaire comprises of urban criteria separately for each of the sub-goals and fits with the theme of Urban and seismicity of the region was compiled. Then assessed by the five-choice Likert scale "very good, good, moderate, bad and very bad" and a score of five to one were set and data was evaluated according to familiar people with the area.

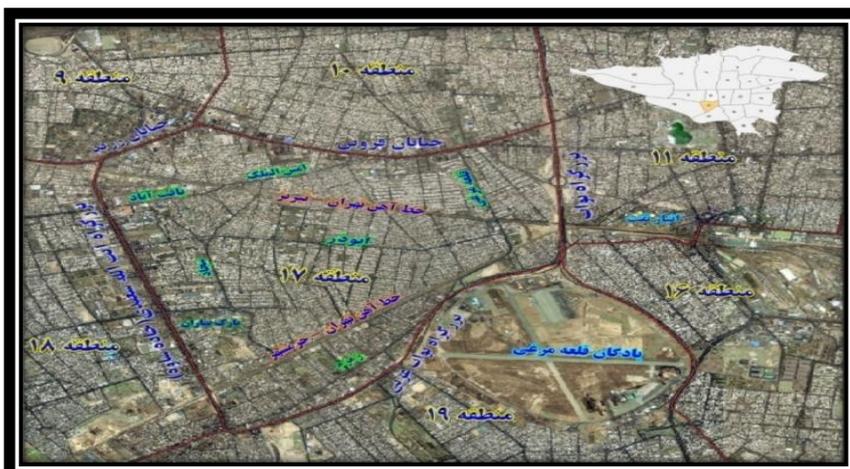


Fig1. Location of region 17 in Tehran

Very bad (1)		Bad (2)		moderate (3)		good (4)		Very good (5)		Urban planning criteria related to reducing vulnerability
%	no.	%	no.	%	no.	%	no.	%	no.	
30	9	43.3	13	16.6	5	10	3	-	-	Approaching the concept of flexibility
13.3	4	40	12	33.3	10	10	3	3.3	1	Ease of entry and exit in urban open spaces
16.6	5	26.6	8	46.6	14	6.6	2	3.3	1	Proximity to residential areas (incentives to encourage victims to return to everyday life)
26.6	8	30	9	26.6	8	10	3	6.6	2	Consistent with existing plans or proposed in detailed plan
23.3	7	26.6	8	30	9	13.3	4	6.6	2	Use of vacant land and without compactness between the blocks
13.3	4	33.3	10	40	12	10	3	3.3	1	The use of worn textures of grade 3 and 2 in the development of open spaces
	6		14	26.6	8	13.3	4	-	-	Having a good communication network and close to the main road network
6.6	2	43.3	13		11		2	6.6	2	Ease of access and proximity to local open spaces (primitive spaces of collector)
10	3	26.6	8	23.3	7	40	12	-	-	Proximity to urban services and facilities such as equipment, schools, mosques, subways, hospitals, and fire stations, . . .
20	6	30	9	16.6	5	26.6	8	6.6	2	Away from railway route to safety and noise reduction
46.6	14	26.6	8	16.6	5	10	3	-	-	Having the visual axis orientation and legibility of the open spaces
16.6	5	43.3	13	10	3	23.3	7	6.6	2	Proportional relationship between the plaza and surrounding buildings
16.6	5	53.3	16	23.3	7	6.6	2	-	-	Respect for a hierarchy in selecting local open spaces
6.6	2	13.3	4	33.3	10	43.3	13	3.3	1	Having multiple inputs

26.6	8	33.3	10	30	9	6.6	2	3.3	1	Compliance with legal limits faults, power transmission towers, etc.
36.6	11	50	15	10	3	3.3	1	-	-	Temporary accommodation available in open spaces

Table 1. Results of Urban planning criteria related to reducing vulnerability

10. Results

Response of town experts to questions about “the role of open and green spaces of region Seventeen, Tehran to reduce earthquake damage” showed that the proximity to urban services and facilities, such as facilities and equipment, municipal, and local services, with 12 cases (40%) and the having several input with 13 cases (43.3%) were of positive points of the region. In addition, proximity to residential areas, with 14 cases (46.6%) and use of worn tissues of grade three and 2 in the creation of open spaces with 12 (40%), presented the moderate situation of the region. Approaching the concept of resiliency, with 13 cases (43.3%), ease of entry and exit into open spaces in urban, with 12 cases (40%), having a proper network of communication and proximity to main street network with 14 cases (46.6%), ease of access and proximity to local open spaces by 13 (43.3%), the proper relationship between the plaza and surrounding buildings by 13 (43.3%), compliance with local hierarchies in selected open spaces with 16 cases (53.3%), compliance with legal limits faults, power transmission towers, etc., with 10 cases (33.3%), consistent with existing and proposed projects in the detailed design, and use of vacant lands and useless between the blocks, and to be away from the railway for safety and noise reduction, indicated undesired situation of the region. In addition, having a visual axis of orientation and legibility of the open spaces with 22 cases (73.3%), and the possibility of temporary accommodation in

open spaces, with 26 (86.6%) indicated the adverse situation of the region (Table.1).

11. Recommendation

Development of urban open and green spaces

In region seventeen, should also maintain open and green spaces, and further develop the green and open spaces in residential neighborhoods. In addition, in the creation of green and open spaces, it is necessary to consider the seismicity. Easy access, comfortable and quiet spaces of relaxation and recreational facilities and structures, simple and small buildings, urban and local independent installations and grass and small trees should always be considered.

Optimization of communication networks

To improve and to optimize the urban communication, one of the essential activities is existing network analysis to identify the network vulnerabilities that is an important topic. The following factors can decrease the vulnerability:

- Distance between different land uses in the city should be less.
- The relationship between public lands through appropriate channels by land use should be established.
- Network should hierarchy eligible.
- Network should have better control capability.
- The percentage of nodes in the network traffic should be low.
- The number of deadlocks in the network should be less.
- The network should have short length, adequate speed and higher safety.
- Networks should provide escape and evacuation possibility.

- Important uses should connect to each other by quick access.

- Communication centers should not be concentrated in one area. It should also develop a multi-purpose systems, each of these systems can be replaced with damaged system in emergency. Principles such as the hierarchy of communications networks, wide and direct routes, low limitation, resiliency, and presence of different options available of open design is effective in reducing earthquake vulnerability. To increase safety, it is necessary to provide the green strip along with main routes, between the sidewalk and roadway route.

- Development of public education

Iran is of most prolific areas of earthquakes in the world, but it has not even really been paying attention, education and public awareness. It is obvious that people who are faced with an earthquake, if have knowledge of basic shelter, relief and medical services and primitive commissioning and use of public open and green spaces, street systems, coordination with auxiliary forces, temporary accommodation and so on, could faster and better keep their lives in comparison to government forces.

Proposed criteria associated with open spaces and reducing vulnerability

Appropriate quantity and quality of open spaces, help to recreational and social needs of individuals and socials and provide wide range of passive and active entertainment to serve the diverse needs of the community.

If want to design urban open spaces in act to reduce vulnerability to urban texture it must consider the following criteria to make more quality:

- These spaces should be easily accessible and geographical positioning to potential users. The proposed site for such purposes, should be as well locating toward a public open space, with convenient access to users. So that, the demand for such activities should be existed in the region.
- Preservation of natural and cultural features including the existing trees on the site

- The combinations of significant natural and cultural features in the open spaces and if necessary, create a focus or vision to support these concepts.
- Providing and maintaining the drainage of flood, water quality, streams, and around streams
- Ensuring compatible land uses with open spaces.
- Nature and landscape of open space should be match and accordance with the known area and landscape and nature surrounding open space.
- Open spaces for future purposes should be suitable.
- Recommendations for design and aesthetics should not have adverse effect on the environment. To ensure that urban development do not effect on landscapes and sensory qualities of the environment.
- Selecting a space as an open space has no adverse effect on plant communities.
- Noise should not have negative effect on surrounding residential areas and should not lead to reduce safety of surrounding residential texture.
- Open spaces should provide opportunities for easier social interaction.
- Public access to adjacent open space should be sufficient. Pedestrian access into public spaces should be convenient and safe. This access should include all user groups; increased trails should be considered as a valuable element of designing.
- Entering a public space, if possible, should induce feeling of inviting through having multiple entry points and providing visual access and free of physical obstacles on the sidewalk or adjacent structures to citizens.
- Public spaces should be designed in such a way that it requires minimum maintenance.

- Public spaces should prepare opportunities for public art, making statues for promotion of cultural activities.
- Open spaces should be limited by boundaries to avoid the risks. In order to create boundaries, walls around public spaces should not be designed as it creates an insecure environment and will destroy the relation between the space and nearby buildings. The most importantly, it will be difficult to access in times of crisis. It is better to limit the open spaces by lattices, which are designed architectural, or by plants or can isolate this space just by changing the color of the paved floor.
- Public spaces should provide other facilities such as drinking water, the position of bikes, Pergola, recycle bin and so for passersby. Landscape elements and short walls, stairs and different levels in these spaces can be used as a form of benches. Consciously designed to reduce costs, (resiliency and simplicity).
- For safety and security reasons, these areas should have adequate lighting and visual and physical visions should be existed in surrounding streets and buildings.
- Explore opportunities to incorporate various forms of water and other landscape structures in this space that can focus on the design of public spaces with plants as an optimal visual quality and sincere in designing.
- The use of design elements such as columns of plants can be used for emphasis on designing.
- Use of a variety of seasonal plants, deciduous and evergreen makes possible the creation of interesting visually and beautiful views over the years.
- In the design of public spaces, important factors of weather should not

be ignored. Degree of penetration of sunlight to public spaces plays an important role in the design of these spaces. Public spaces designing should be designed in such a way that in cold seasons benefit the heat of sunlight and warm seasons have shadows to protect itself from sun light.

- The amount of acquiring light and shade it should be used varied features and styles in urban design such as size of urban open spaces, height changes, confined spaces created by the mass of buildings, trees or other forms in these spaces. Besides the factor of sunlight, lack of wind and water, as well, enjoying the sunlight is important.
- When people and residents decide to walk or do other activities in a public space, waiting to breathe healthy air in it. The air quality is very effective in increasing importance of urban spaces. During rainfall, plants filter the air. Good air circulation around buildings and urban spaces can disperse air pollution [12-14].

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