

Role of urban planning in decreasing damages & losses of natural disasters (e.g. earthquake)

Case study: Tehran Two Zone

H.R. Joodaki¹

¹ Islamic Azad University, Islamshahr Branch

Abstract

Development of cities and urbanizing as well as gradual increased number of great cities or metropolitans in the world, especially in under developing countries including Iran, on one hand, and growth of cities, population concentration and centralization as well as increased environmental and economical loadings on their beddings, on the other hand, all have been causing us to accept various roles and functions seen for the urban planning. One of the most paid attention issues to which most of the metropolitans of the world are faced is the issue of natural disasters. Given to the unexpectedness feature of most natural disasters there are required many actions and preparations before, during and after crisis happenings to decrease the damages, losses and vulnerability concerning such events. This issue is interrelated with urban planning concepts, urban management and geography, in special. By applying the urban planning criteria and principles, urban land use, transportation networks, urban substructure and urban textures we can decrease the effects and consequents resulted from the natural disasters so much effectively. The geographical range of Iran in the matters of probable happening of such events especially earthquake, is considered among the most vulnerable regions of the earth that every year this country has been experiencing many of such natural disasters causing many damages (e.g. death, injury and financial) and the urban extensions have been touching such unpleasant natural disasters happenings. It seems that carrying out specific planning for immunizing the urban spaces and environments more much better is completely necessary. The cities due to population concentration and centralized economical investments characteristics are very susceptible to be damages dangerously and these environments from their establishment till now have been considered for some specific form and structure for growth and development and by passing time, they have been developed. The urban planning knowledge relying on geographical data by defining and developing its specific measurements and concepts using this data could be highly useful to carry out the managerial principles required to decrease the vulnerabilities of the cities against natural disasters.

Key words: *natural disaster- earthquake- urban growth –urban planning-disasters managment*

Introduction

The city growth has been causing that the cities are constructed on the main lines of fault(s) and or in the rivers' coasts and streams. There are no limits and restrictions for disasters. Perhaps, happening of a natural disaster, e.g. earthquake outside the city's domain shall be characterized with many other destructive consequences, probably. We should remember that, some aspects of these losses are due to interference and maybe aggression of human beings to the rivers and streams' coast for irregular and not programmed use of urban lands and clearly when rivers overflow and or in showery seasons, those rivers and streams will destructing all buildings and constructions in direction of floods; this is the same with earthquake.

Regarding Iran geographical location in relevant to the natural disasters which has been always affecting by and experiencing many consequences and losses, and vulnerability feature of many cities of this country against such natural disasters.

Development of Tehran city low quality structure and absence of suitable disaster management make that damage, losses and vulnerability front future earthquakes.

Tehran zone two lie on the many faults include north Tehran fault that can create earthquake with 7/2 R and population, building accumulation in this zone are important losses Tehran zones.

Discussion

Earthquake as a phenomenon is considered among the natural disasters happening in most of regions and parts of the world. During the years 1900 to 1990, about 1,100 deadly cases in 75 countries of the world were reported and more than 80% of the resulted mortality rates have been reported for six countries. Iran with mortality rate of 120,000 is included in this list of six countries with high mortality rates. Furthermore, during 1982-1991, Iran has experienced the highest number of earthquakes. In most of the world's countries especially the under developing countries, the increasingly process of urbanization in cities is rapidly proceeding and it is itself as a potential factor for occurrence of many damages while happening of natural disasters, more dramatically.

Rapid and unorganized development of margins without urban protections, more increasingly densities of population in high-density zones, unstudied and irregular high-rise constructions in relationship to the comprehensive plans, irregular and unstructured civil gas piping networks, paying insufficient attentions and awareness towards the accidents happening probability in the matters of developing and establishing population centers, not observing the preliminaries in safety cautions in constructing the urban structures and buildings as well as unplanned and unorganized constructional projects in this regard, all have been leading us to forecast very heavy losses as a result of such natural disasters. Other factors involved in earthquake phenomenon are: overpopulated urban locations (e.g. schools, factories and hospitals), broken dams and probable floods, explosion in gas piping networks, fires and etc. [8]

Tehran city lie on the 6 main faults and 60 other faults that includes: south and north Rey fault. This fault lie in the north Tehran plain and on the north near the ghaz hill and Qale Noo village. In figure 1 distribution map of Tehran faults are given.

Other faults are north Tehran, Masha, kahrizak and parchin faults. If earthquake of Rey fault occurring, around 500/000 building (%55) losses, 400/000 people died and 4/600/000 people wounded. In table 1 losses building of each faults are given.

Survey and analysis general situation of zone two against earthquake.

1- survey the kind and position of zone faults.

A view of earthquake show this zone lie on the Alborz geology and many of faults in zone have more vibration ability. Among them is Tehran north fault in Alborz mountain at length of 35 km from kan in west to Lashgarak in east. In west Lashgarak this fault enter to a complicated geology region and connect to Masha fault. Other faults is Nyavaran fault that estimate length of between 13 till 18 km and from sadatabad and Frazhad untill north

Aqdasye. As, in this zone lies Davodye and Bbagh Fayz faults that have length of 2 till 10 km.

In zone two, Hesark, Frahzad, Drake, Ponak, West town, Sadye, Jandarmery town and Ggisha from two side of fault line there is possible very hard destroy. The primary earthquake survey in zone show that sadatabad, Shemiran, Ponak, Tarasht height and Tajrish- Nyavaran subside are very read for earthquake. In many region like Darake river and Ponak valley sedimentary soil have not good accumulation and building is very hazardous for people in the region [7]. In figure 2 map classification of earthquake danger in zone two

2- Losses building estimate in zone two:

Zone tow with around 4956090 square metre and population about 566392 people is very important zone in Tehran. Residential uses that have more surface in zone (16599611) square meter- 33%). Other uses relation with residential uses and permeation with other uses.

Residentials set and districts are no create with layout (except west town) that destroy half of building with north fault action (51/5%). Administrative uses (22%) commercial uses (10%) and educational (9%) are other main uses that damage and losses of earthquake. In table 2 comparison between main uses in zone tow are given.

Zone two with 20% highway of Tehran is a relationship bride between western- eastern and north- southern.

At first damages of bridges because of disagreement and second difficult to pass in street by reason building collapse and damage many of vital artery like water, Gas and electricity. Metro network closed by reason destroy building and closed arrival, depart origins. In table 3 scales of losses general building and installation are given.

There are 8 thanks of water that they are 20 years old and built from concrete without designing against earthquake force. There are 3 thank of water in north zone in Nyavaran fault, there is a concrete pipe of water that pass from Bagh Fayz fault that totally destroyed because of break off this fault.

There are two electricity transfer with 63/2kw in zone. Transfer lines are on two faults: Tehran fault and Nyavaran fault.

Main pipe gas transfer (124 inch) in north of zone is on the Nyavaran fault and other gas line is in Davod ye bagh Feys faults. Action of faults and slip by reason of zone slope can create hard losses to the pipe and fire [9].

A. Safety of habitants Role

1. Urban land uses

Some uses play even more sensitive role in earthquake's losses for reasons of overpopulation and dangers for their neighboring regions such as schools, factories, hospitals, fuel and water storage tanks and so forth. It is highly necessary to pay attention in site finding for such uses.

Dwelling is regarded as one of the most important uses in zone. Firstly, it should be tried to design suitable and a seismic buildings and use appropriate materials. Secondly, given to seismic zoning and danger drawings drawn for residential uses it should be tried to avoid residential uses on the faults location and escarpment, weak, sandy and alluvium lands. Dwelling must be away from dangerous uses such as industrial factories. The residential zones must be established neighboring outdoor and green spaces [3].

Strengthening of residential structure (Ateye sazan, Hormozan and Mahestan residential set) that is propounded from diminution, size and height and commercial uses (Iran zamin, Golestan, Bostan and Yadman center), educational centre like university, center for weak people,

Protection and strengthening green spaces and parks in heart of residential space and region with more traffic. Pardisan forestry park, West town parks and Chamran axis spaces, west of zone is unique characteristic of this zone.

Forestry and recreation area like Darkeh, Farahzad and Tarasht until south Alborz is the best facility and use of land for decreasing damage of earthquake.

2. Urban densities

High population and construction densities in a city mean more mortalities and losses while happening earthquake because when constructions are collapsed more people will die. Also, because of closed ways when earthquakes happen, discharging buildings in overpopulated zones when fires and flood, indeed, access to safety locations would be faced to many obstacles more critically. High construction densities imply that there will be smaller empty spaces for contemporary settling the damaged persons.

Zone two is dispute of great building and great, heavily residential set and many uses with more population accumulation. Residential set and many uses with more population accumulation. Accumulation control is the best tool for planner that decreasing damages of earthquake, Geotechnical study in trembling earthquake waves is a factor for classes limitation in the field of building accumulation.

In zone two focus is more on the middle and south of zone with attention to especial region (Darakeh and Frazhad) and north mountain there are land with out use that possible space distribution of population and residential in future [2].

3. Urban installation and substructures

Regarding significant role of water in life of citizens, many effective preventive and protecting actions must be put into exercise against earthquake's dangers such as planning for irrigation storage system in cities and considering the population, industries beside water storages and resources, site finding and erecting storage tanks in safety regions with rapid reparability, use of surface, underground and new water resources to be substituted with when the above resources are damaged. Another action is to reinforce and strengthen all water storage system structure, pumping stations, water storage tanks and control of the city water piping network via a central system such that if some part of network is damaged, other parts of network could be protected against damages. The other role seen for water resources is to firefight fires occurred when any earthquake happens. For instance, any leak out of civil gas piping network could be changed to dangerous and damaging fires. Hence, it seriously must be attempted to protect civil gas storage tanks and make necessary actions relevantly, such as blocking all storage tanks, strengthening and reinforcing civil gas equipments, using a central control system and all necessary apparatuses namely, gas blockage switches, firefighting equipment and so forth [1].

Totally there are three fire stations and one assisting station in zone tow. In this case when occur earthquake they con not to halter fire. So, with population and area standards (population, for 50000 people and each 5 km one station) we need 11 fire stations and 10 stations (area).

B. Role of triggering and facilitating actions in disaster management

1. City transportation network

If zone transportation network is damaged it surely shall increase the mortality rates of earthquake in zone. Any effective transportation network will provide the possibility to escape from and access to safety areas; and also, rescue vehicles can be driven easily. Therefore, the zone transportation network must comply with the hierarchic conditions for intracity passages, (e.g. grade I and II artery and local) and have standard width, they must be away far enough from the faults and have the minimum dead-end valleys and traffic knots.

The transportation network installations such as bridges (Nas and Jallal all Ahmad bridges) must have required strength against earthquake. The relationship between uses and rapid access to main and necessary uses can be possible via an effective transportation network. The transportation network distribution and establishing multi-purpose systems featuring of high potentiality to be used as substitute for damaged ones in emergency cases is among other preparations in the filed of transportation network [5].

In table (4), the specifications of rapid passages required in decreasing the losses and damages concerning to the earthquake susceptible cities are given. Designing open space and free plots of land for emergency uses (shelter and assisting) create belt in north zone and off load, escape emergency way in the zone.

2. Urban structure and form

In general, it can be said that multi-center structure is more resistant against earthquake compared to mono-center structure, and therefore, we can expect damages in smaller volumes. Since, open forms show more flexibility rather than the compressed spaces. Furthermore, in open forms in addition to decreased urban densities, we have more facilities are among other specifications and advantages. Many uses zone two are liner and independent from other. The best way for relation ship between uses and other city structure is use of access network. Sattarkhan axis because of traffic reason can create a suitable structure in the zone. [7]

3. City texture

Any type of city texture when any earthquake happens is characterized to possess its specific resistance against it, accordingly. Any regular and continuous texture in smooth lands having blocks with one or two regular constructions will result in decrease of earthquake's damages; and this texture with organized roads networks, short lengths and checkered subsidiary valleys due to access number will all prevent the texture to be paralyzed. Irregular and continuous texture in smooth lands regions or foothills have lower efficiency in the matters of vulnerability and are known to bring more damages if earthquake happens. So, because of element inflection especially in residential zone two there is possible for change. This change in the residential pattern and finally crate change whole of the zone. [4].

Conclusion

Urban planning is desired as a means that plays a very effective role in decreasing the earthquake's damages and losses. Among the different levels of physical planning, the most effective level for decreasing the vulnerability rate of cities against earthquake is the middle level or urban planning and the existing concepts in urban planning namely: city structure, city form, urban lands use, city installations and substructures (e.g. water, electricity, gas, telephone, city road transportation networks and etc.) all can play a significant and critical role in decreasing the vulnerability rate of cities against earthquake.

“Flexibility of city form”, “adjacency and consistency of uses with each other”, “appropriate distribution of urban densities”, “having effective transportation network, “having hierarchy” and “having reliable, resistant and repairable substructure installations and city substructures” are among important factors involved in urban planning that could decrease the consequences and damages resulted of earthquake at very high rates.

The urban levels should also be equipped with different facilities, including relief, rescue and firefighting equipments so as to make the necessary actions in order to fundamentally and tangibly decrease the affects and consequences of earthquake on city and the habitants as much as possible.

For decreasing damages and losses of earthquakes in two zone we must consider such as:

- Building in earth quake centre prohibited and prevent from development of losses zone especially toward north of zone.
- Create limitation in building for decreasing building and population accumulation in zone.
- Planning, designing, green space, open space and forestry protection in south east region.
- Designing a suitable water, electricity, gas system and carryout that with security and use suitable material for automatic brake off.

References

- [1] Abdollahi, M, 2001. *Disaster Management in City Areas*, The State City and Villages Municipalities Organization, p.59.
- [2] Ahmadi, H, 1997. *Role of Urban Planning in Decreasing city's Vulnerability*, Dwelling, p.66.
- [3] Bahrani, H, 2005, land use planning in seismical regions, center for study Iran physical disasters, p.24.
- [4] Mohammadi, M, 1993. *Evaluation of City Texture in Dwelling's Vulnerability in Natural Accidents*, A Collection of Papers on Seminar on Dwelling Development Policies in Iran, pp.211-219,.
- [5]] Modarres, M, 2002. *Application of Network Theory in Urban Transportation to Minimize Earthquake Damage*, Journal of the Opening Research Society, pp.1308-1316,.
- [6] Nader Zadeh, A. 2004, Journal of Urban Development and Rehabilitation, v18, p37.
- [7] Nateqelahi, F. 2007, urban region planning in seismical areas for losses of damages, third international earthquake engineering pp 51-76.
- [8] Zomorrodian, J, 2007. *Application of Natural Geography in City and Rural Planning*, Payam-e Noor, p.40.

Table 1: losses building of each faults

Percent	Number of losses building	Faults name
41/3	26980	Rey
45/7	29862	North Tehran
11/1	7248	Masha
51/5	33617	Floating model

Table 2: comparison between main uses in zone two

Uses suitable with residential 71%	Class	Percent	Number	Uses
	1	23	13	Administrative
	3	18	10	Green space
	2	21	11	University
Uses unsuitable with residential 29%	5	9	5	Educational
	4	10	6	Industrial
	4	10	6	Commercial
	5	9	5	Medical
	-	100	56	Total

Table 3: scale of losses general building and installations zone two

University	High school	Guidance school	Primary school	Hospital	Fire station	Traffic department	Police	Administrative	Details
39%	37%	36%	35%	29%	38%	35%	28%	25%	North Tehran fault

Table 4: Specifications of rapid passages required in decreasing the losses and damages concerning to the earthquake susceptible cities in zone two

Zone physical divisions	Zone passages	Usable spaces while and after earthquake (settling & treatment)
residential unit of 9 households	Sidewalk of 2.5 meters width Street of 6-9 meters width	Parking (rapid sidewalk access)
neighbor unit of 200-600 households	Sidewalk of 2.5 meters width Street of 6-9 meters width	Child play land, sporting land and mosque (rapid sidewalk access)
district of 700-1250 households	Street of 9-15 meters width	District park, primary school and mosques (intradistrict street access)
ward of 1800-3000 households	Street of 15-18 meters width, accumulator grade II	Park, health center, middle schools (round district street access)
area of 3000-5000 households	Street of 21-24 meters width, accumulator and distributor grade I	Area park, high school, clinic (accumulator grade II street access)
zone of 13500-18000 households	Street of 30-45 meters width, artery grade II	Zone park, sports stadium, hospital, technical high schools (rapid artery access grade II)
City of more than 18000 households	Street of 50-76 meters width, artery grade I	City park, sports complexes, universities, airports (rapid artery access grade I)

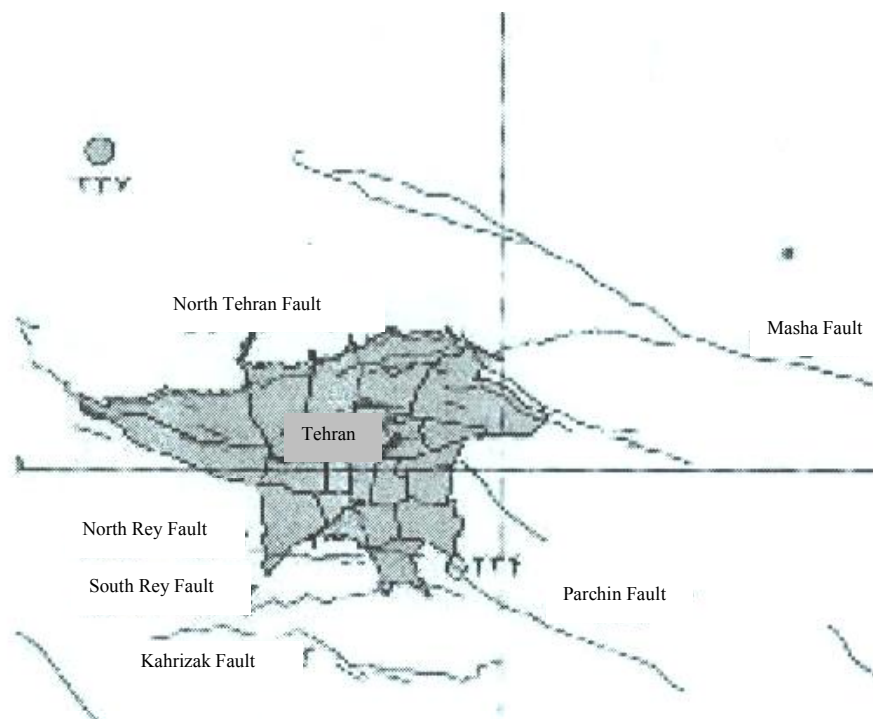


Figure 1: distribution map of Tehran faults

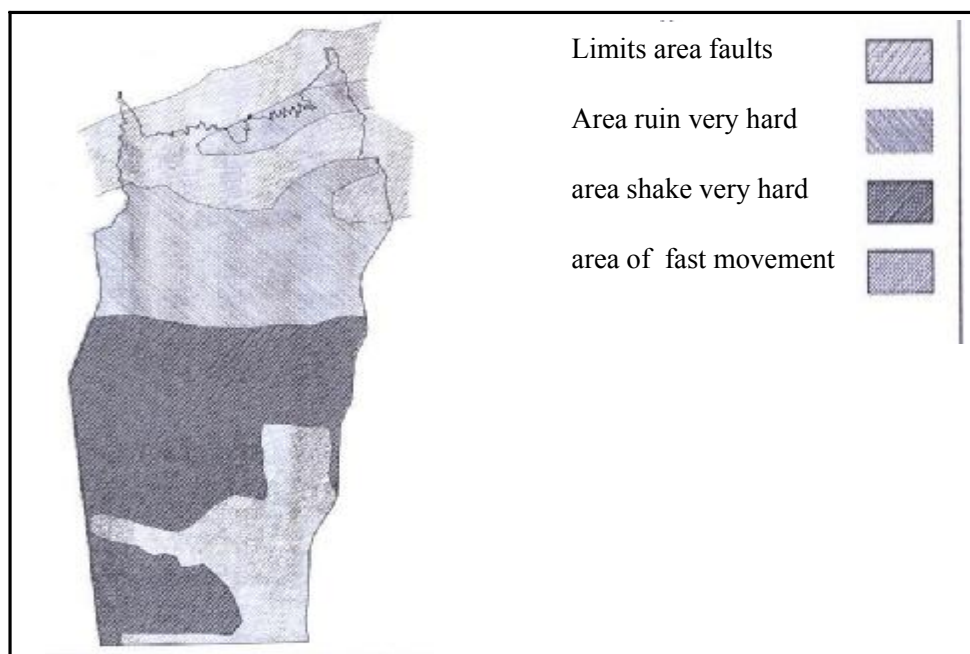


Figure 2: Map classification of earthquake danger in zone two