



Designing a creative city with using Passive Defense

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Abstract: Historic architecture and urbanization in Iran encompass the principles which have manifested in the traditions. Traditional urbanization and architecture has enjoyed a special place with an emphasis on sustainable features and creativity. Yet, the investigations in recent decades specify that architecture has sustained far from the reality due to uncontrolled growth of Yazd and exposure with various factors, whereby the challenges have appeared in traditional architecture and modern urbanization. The challenges include unbalanced expansion of cities and spatial discontinuity of city, poor urban density, problems of urban transport and increasing costs. In other words, in current age, some changes have been brought about in urbanization and architectural patterns due to exposure with various factors. Nowadays, cities have kept developing by a rapid speed, under which significance of public spaces has increased. The present research seeks to investigate fuzzy logic in passive defense in this context and propose a special approach for a more favorable design and development of it.

Key words: passive defense, fuzzy logic, urban design

Introduction

To achieve an ideal type in developmental perspective, a city requires attention by several expert groups including planners, urban planners, architects, sociologists, anthropologists and so forth on one hand and citizen participation on the other hand. Any city regardless of physical and ecological fabric and poor or rich vegetation and natural resources has essential potential and capacity to achieve sustainable development, and this comes to realize when a priority is given to a series of principles. Needing to cope with threats and crises has a long history to the extent of human life. Nowadays, threats keep widely increasing, so that growth of threats corresponding to the growth of facilities in the governments is not deemed to protect people's security. Countries' inattention to this has raised several problems including insecurity, violence and instability of governments. Wars and crises are frustrating issues that influence all the principles existing in a community. Victims of wars suffer from physical damage, economic loss and fear. This situation intensifies importance of duty of government and security agencies. The weapons which have been being used before industrial age at wars have been so simple, that there has existed a close relationship between technology and knowledge processes and the type of weapons that have been being invented at human communities to exploit from them at wars. In contemporary age, rapid advancement of military science and technology in the context of production of a variety of offensive weapons by developed countries has caused paying a particular attention to defense especially passive defense.

An effective action in improvement of passive defense lies of exploitation from institutional partnership that focuses on changes and institutional reforms which result in expansion of passive defense in country as well as sustainable development of passive defense. With regard to monitoring the process undergoing passive defense actions in the organizations and interaction with them, authorized organizations such as passive defense organization as well as security organizations play a potential role in expansion of

passive defense. In this study, suitable maps to localize shelters in several maps are provided that white to black color is allocated per pixel, which each pixel has bright to dark color per various criteria; the more pixel is darker, there will be more unfavorable place in sake of shelter for the specific criterion, consequently a unique map is considered for localization based on all the criteria. However various issues and dimensions contributing to passive defense have expanded in recent years, it seems that little attention has been paid to defense knowledge and considerations in urbanization and architecture design as the mediators in urban defense. Among various existing definitions, passive defense refers to the collection of actions that do not need employing armament, so that implementation of passive defense helps to avoid financial losses to military and non-military equipment and facilities and human losses and reduce the losses and damages. In this regard, defense architecture requirements elaborate scientific methods for developing passive defense in decision-making hierarchy. Passive defense actions include a series of sustainable architecture and design issues as follows:

Localization (optimal use of nature to defend), Dispersion (reducing visible and invisible risks in investment), Camouflage, concealment, deception (optimum utilization of nature and special construction materials and creation of construction form), disturbance in enemy's view (cyber warfare), facilities (flexibility of facilities against waves, impact and heat), urban design (how to use and strengthen the structural and non-structural urban elements to reduce damages due to explosion), design of interior architecture (stabilization of the elements inside architecture spaces to reduce vulnerability), fortifications (the possibility to build resistant structure against blast), the possibility for restoration (creating joints in construction and making effort in modularization of design to limit the damages due to blast and proliferate the restoration), design of emergency exits and entries (exists and entries must be designed in a way that people are not enclosed in the building after hit the bomb and explosives), multi-functional spaces (the possibility to use urban and architectural spaces in case of crisis), design of infrastructural networks (infrastructural networks must be designed in a way that rest of networks enable to transfer information in case of blocking a network due to blast). This article discusses the passive defense issues pertaining to resistant urban design and investigates the samples in underground spaces, history of the Vietnam War, process of establishment of tunnels, inverse engineering in construction of passive equipment and methods. In this study, a qualitative research method based on the information from urban maps has been used. However various dimensions and issues pertaining to passive defense have increased in recent years, it seems that little attention has been paid to the analysis of physical samples as the mediators in urban defense. Goji underground tunnel network which has been established during Vietnam war during the 1960s-1970s against French and American military invasion by Vietnam people during 19 years, is one of the most effective samples in adoption of defense and urbanization facilities pertaining to passive defense in the current age. This is in a way that engineering and urbanization dimensions of tunnels have remained unknown.

Resistant urban design

However, the literature pertaining to urban design is a relatively new issue, an extensive series of elements associated to key concepts about quality of urban design with an emphasis on security and safety indicates that formulation of a theoretical framework is required to organize a wide series. With regard to model for sustainable design, quality of urban design can be considered as the outputs of three components including functional quality, aesthetic-empirical quality and environmental quality. Functional component of quality of urban design encompasses providing security in movement and easy access to attractive urban centers on one hand, and encompasses the functions such as spending leisure time, various ceremonies, eating, having conversation, and meeting friends on the other hand. Accordingly, the component 'aesthetic-empirical quality of urban design' deals with individuals' percepts and environmental preferences versus urban spaces. Ultimately, the component 'environmental quality of urban design' encompasses the issues such as regulating the climate in urban microspaces (sun, airflow, etc.) and concerning about environmental sustainability and deals with the quality based on ecology of urban environment and how to use natural resources including ground and water pertaining to urban patterns. In this regard, security and safety issues are considered in this study. In general, safety is called to the man's physical health and avoidance of the threats that can endanger the man's physical and mental health.

Table 1. Division of urban security

Functional component	<ul style="list-style-type: none"> -quality of behavior settlements(adjustment of activity, time and space) -quality of adjustment of urban form with information network, roadway, accessories -quality of safety of environment for activities -quality of security of environment for activities
aesthetic-empirical quality	<ul style="list-style-type: none"> -quality of spatial environment including materials, physical organization, mass-space, Structure Patterns, permutation , Null map and so forth -quality of sensory-perceptual environment including analysis of urban façade -quality of subjective perceptual environment including quality of subjective façade, vitality and so forth
environmental quality	<ul style="list-style-type: none"> -quality of climate at urban microspaces -quality of sounds, taste and smell -quality of sustainable urban design -efficiency of natural resource consumption -balance in ecosystems -diminish pollutions

Yet, security has had more likely a subjective aspect, under which it can say that sense of stability implies the rights and duties that any man has about others and his surrounding environment as well as trust on maintenance and implementation of those rights and duties. Division of urban security is possible from different aspects, including individual, social and spiritual security and so forth, yet little attention has been paid to urban security.

Urban passive defense

The indicators which are used as the key concepts in passive defense actions to cope with threats include: decrease of urban vulnerability, stability in design, creation of defense deterrence, integration of crisis management issues with urban design, the possibility to continue necessary functions. Yet, historic investigation indicates that the contributing factors such as natural environment ability, religious beliefs, defense , military and security factors, economic , business , and political issues have potential roles in the process of formation of cities and human settlements. For instance, after Islam, most urban areas had a spatial hierarchy such as Arg(Kohan Dezh) including government palace, Sharestan or the city. Yet, in contemporary age, defense was assigned to the armies. During cold war and regional wars such as imposed war and bombing of cities, the necessity of protection from non-military forces was intensified, and gradually features in using non-military factors as the defense from urbanization and architectural designs kept extending. Hence, the passive defense actions in line with urban design and reduction of losses due to military attacks include: Decentralization and dispersion of buildings and facilities in urban areas, retrofitting of critical facilities, camouflage, concealment and deception pertaining to facilities and urban centers, establishment of shelters at important urban centers in a multipurpose way, alarm system, warning device at the least possible time to reduce damages due to military attacks.

Underground urban spaces

In general, concerning retrofitted urban design which deals with humans, public spaces and improvement of quality, underground space refers to the urban and public space which is designed and built in lower ground levels. In this regard, such spaces must be included described qualities of urban spaces including identity and legibility, safety and security, efficiency and diversity, pedestrian orientation, easy access, sustainability and vitality, integration and continuity, quality of public realm, visual proportions, human scale, rich sense of justice. This is in a way that the spaces such as caves, tunnels and underpasses of the roadway lack such features. In recent years, huge attempts have been made in line with documentation and investigation of underground spaces and multipurpose urban functions from perspective of passive

defense, which it can refer to role of underground spaces in sustainability of cities via comparison of existing urbanization models in passive defense perspective.

Accordingly, underground spaces are categorized in functional (residential, non-residential, infrastructural, military), geometrical (type of space, rate of openings, linkage with the surface, depth, dimensions and scale of project), origin (natural, mineral, reuse after end of a previous use), features of site (geographic, climate, land use) and features of project (zone of project, design, construction and age) (Carmody, 2009, pp. 29-33). Underground settlements in Bagnot County in china and hill settlements in Masuleh can be analyzed in this category. On the other hand, underground urban spaces can be classified to four groups (Golany, Ojima, 1996, , pp. 28-33). A-Earth-shattered Habitat: this settlement has been built in United States on the ground surface, yet it is protected via a layer of soil to the extent of half a meter in thickness. This method is a response to high consumption of energy for cooling and heating especially in adverse climates.

B- Semi Belowground: this refers to an underground settlement that its one part is below ground and another part is above the ground. This settlement is the most common form of settlement used in villages in China, Japan and other historic places around the world. The samples for these spaces include the settlements in North China, Southern Tunisia and Eskimo cottages. C- Subsurface house: These settlements have low depth at the middle of the ceiling to the ground surface, being used by people in Bula region in the long lost past. D- Below ground: Such spaces have been the most common forms in underground cities. Depth of these spaces has been suitable, under which the underground space has been being used as a 'cut and use' method, in which there is no need to construction materials. E-Geo-Space: this is used as a topic for underground space that is being used by the Japanese people in design of their spaces. The space has been set at the depth of ground, having a variety of applications such as underground shopping centers. Currently, passive defense is required to reduce the vulnerability in infrastructures required for people so as to provide the conditions for more security. Such actions have been fulfilled in most of countries around the world. Therefore, passive defense is an unavoidable necessity against threats by enemies. Passive defense has been regarded as the important responsibility, thus this is more important than the military readiness.

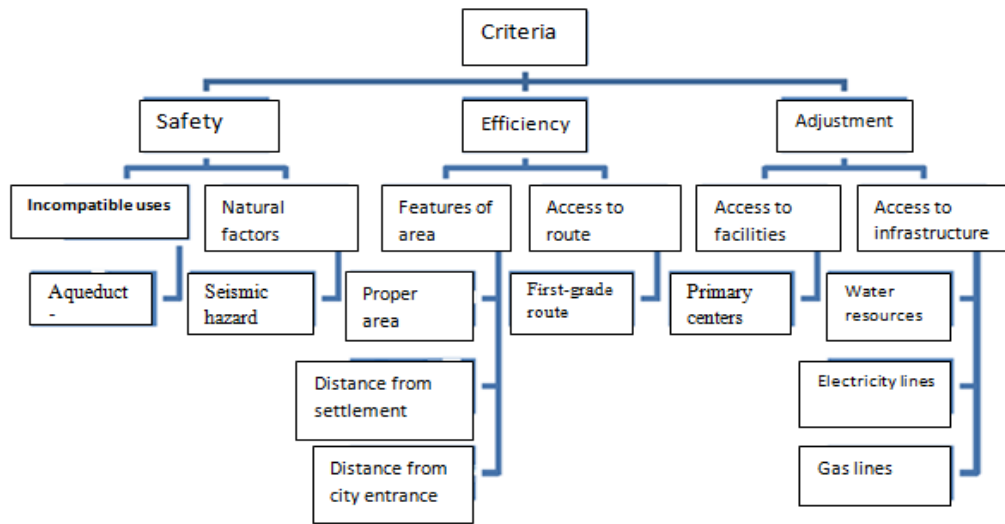


Figure 1. overview of the standards pertaining to each of criteria concerning localization

Concurrent with development and growth of cities, public spaces will be more important and urban elements which occupy these spaces will be drawn into attention by designers, planners and people. Since the modern approaches of design have faced success, participatory design has been assumed as a means for development of urban furniture. In this section, overview of the used criteria and standards pertaining to each of criteria concerning localization has been considered.

Analysis

Fuzzy overlapping method using fuzzy logic regression model

In this step, preparation of layers and fuzzy maps pertaining to each parameter is considered. At each of fuzzy maps, value of each place unit ranges from 0 to 1, i.e. the more the value is close to 1, it indicates the associated place to settle shelter from perspective of aforementioned factor. To achieve this, it requires explaining membership functions corresponding to the nature of each factor. With regard to the studies on how the effect of these factors can be on the considered localization, just one fuzzy membership function has been considered and explained in following.

Preparation of fuzzy factor maps using piecewise linear membership functions

identification and preparation of all the criteria and factors affecting localization of databases, it requires preparing the factor maps at each of layers. Preparation of factor maps includes two steps of processing and weighting the information layers. In this step, each of sub-criteria is weighed based on the relative effect in determining the position of shelters. In each fuzzy factor map, value of each existing class and local unit ranges from 0 to 1. To prepare a fuzzy factor map, some instructions were entered and performed in software GIS via Raster Calculator tool by describing linear membership functions regarding the proposed criteria and measures and positive or negative effect of each parameter. Fuzzy membership functions have been used for the considered factors that the degree of proportion of various places gradually changes via the distance from them. With regard to the explanation for such functions using experts' view, the values of membership functions were obtained in borders and linear functions were formed. Ultimately, the output from each step is a Raster layer that the values ranging from 0 to 1 have been considered for each information layer based on the described criteria. Borders of functions for the considered sub-criteria have been represented in table 2. After determining effective parameters in localization of this use, information layers were prepared, whereby fuzzy factor maps were provided based on the described standards. In Raster map from the integration operations, value of each pixel indicates favorability of that place to establish the shelter. Five criteria and layers including seismic hazard maps, aqueducts layers, position layer, primary centers layer and first-grade route layer have been considered in localization of regional shelters regarding nature of the localization in a large scale. Proximity to water resources, power lines and gas lines has been regarded as a criterion for localization of shelter at regional level. The results from localization analysis of urban shelters indicate that there is no place as a shelter in this scale in the existing status. Hence, the selected places are considered as the proposed places to build shelter in form of passive defense planning. These proposed places have the area about 424333 m⁴, yet this area cannot meet the need of population of 216252 regarding 31 per square foot in the shelter at the regional scale.

Table 2. Borders of functions for the considered sub-criteria

Sub-criteria	Determined numerical border and positive to negative function in fuzzy membership functions					
	Degree of band importance		Degree of average importance		Degree of good importance	
primary centers	-	$x \geq 700$	$+\langle x \langle -$	$500 < x < 700$	+	$x \leq 500$
first-grade route	-	$x \geq 300$	$+\langle x \langle -$	$200 < x < 300$	+	$x \leq 200$
position	-	$x > 2000$			+	$x \leq 2000$
aqueducts	+	$x \geq 200$	$-\langle x \langle +$	$100 < x < 200$	-	$x \leq 100$
seismic hazard	seismic hazard map obtained through model					

Conclusion

Development of existing elements in urban spaces is a suitable infrastructure for participatory design. People's participation in design of urban furniture can be a solution to revitalize desolate areas. The process of

participatory design enhances the social interaction and reduces vandalism and urban alienation. This design approach guarantees that end product meets the people's needs based on their common values. People, designers and decision makers propose their ideas for design based on their knowledge and experiences. Concerning process of participatory design, the roles assigned to each of members change for which it requires dividing powers, authorities and knowledge. Development of urban furniture through a participatory design approach is a suitable opportunity to improve quality of public spaces.

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