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Reducing Earthquake Effects based on the Proposed Model of Physical Crisis Management (Case Study: Historical Texture of Yazd City)

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ABSTRACT

With the criteria and effective indicators in vulnerability and distinguishing the vulnerable spots at texture level, the study aims to develop a new model in Crisis Management to prevent and reduce the probable earthquake risks in the historical texture of Yazd. It is a descriptive-analytical method. Inferential statistics such as correlation coefficient and regression coefficient have been used for data analyses. For developing strategic planning, the network analysis model, route analysis and SWOT method are used. The network analysis model result show that physical index such as low passage width, building age, demolition, quality of building, building density, separation area, type of materials, number of floors, with the value of 0.22 has the maximum role in vulnerability of the texture during the earthquake. In this regard, to develop solution for reducing the historical texture vulnerability of Yazd is based on the Crisis Management model. Before the occurrence of earthquake the phase will have a feedback that along with awareness to the citizens regarding earthquake, the zones with high vulnerability and individual blocks with complete information have been identified. A comprehensive database about the development of comprehensive planning for the prevention stage; and after the implementing the measures their feedback are tested in number of samples. This stage help to identify the historical texture, organizing and physical texture problems that has not been referred before in any earthquake Crisis Management models.

Keywords: physical crisis management, crisis management model, feedback, historical texture, Yazd City

INTRODUCTION

With the expansion of cities and urbanization and the gradual increase in the number of cities in the world (especially in developing countries, like Iran), the urban development with high population density has increased environmental load (Sadeghi et al., 2012: 63). The need for social life, need for housing and migration from rural to urban have led to this growth and development, especially in metropolis (Saeidnia, 1998: 21). Also, the number of inhabitants in urban area around the world has dramatically increased and it is expected that in the next two decades this increase will be influenced by globalization. This process of population density in many cities; regardless of potential natural disasters on the earth surface such as earthquakes, landslides, etc., is increasing day-to-day (Adedayo et al., 2011: 3). The most important is the crisis in urban settlements, especially the old and worn-out textures which are densely populated areas facing maximum danger

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(Ghanavati et al., 2009: 7). Accordingly, due to the unexpected nature of natural crisis and the need for proper decision making and rapid operation; a new theoretical branch of science has been developed as crisis management (Sadeghi et al., 2012: 63). The science of crisis management addresses the crisis components when an eco-complex is exposed to natural and human hazard with a comprehensive view and emphasizing on the prevention and reduction of risk and damage (Majd et al., 2015: 37). Every year large group of people on earth are affected by floods, storms, landslides, tornadoes, earthquakes and fire hazards (Nekooei Moghaddam et al., 2016: 1). Meanwhile, earthquake is considered to be the deadliest natural hazard on the earth (Santos-Reyes et al., 2014: 662). Earthquake as repeatable phenomenon existing throughout history and will be in the future (Shia, 2010: 3).

Recent earthquake experience in Iran like the earthquake in Bam shows that cities with historical texture due to the instability of structure made with straw and mud or mud and brick had devastating financial damages and human casualties. On the other hand, due to narrow passages in the historical texture, the rescue and relief operation team faced major access problem to the area with increased casualties compared to other parts of the city (Mahmoudzadeh et al., 2011: 16-17). From the earthquake experience it can be concluded that the rate of human casualties and physical damages in the historical and worn-out texture are more than the urban texture. Hence, the historical texture, in addition to the difficulties for the inhabitant living; has led to increase vulnerability in case of unexpected earthquake. The characteristics of these textures are the building instability and a set of physical movement, environmental, economic and management failures (Mahmoudzadeh et al., 2011: 16-17). Since, a large part of earthquake damages can be due to not following the principles and criteria of urban planning, which is because of the lack of attention to physical damages due to the lack of proper estimation of the vulnerability of cities caused by earthquake. Therefore, to reduce the risk and control the disaster; there is a need to standardize the building materials, increase the coefficient of confidence, safety in construction and renovation of the deteriorated texture. To reduce the risk of natural disasters, especially earthquakes the following to be considered in the agenda this includes; stability, durability, optimal Crisis Management, and rescue and relief accessibility (Shams et al., 2011: 42). Yazd is one of the cities which have worn-out and historical valuable texture and it is always exposed to natural and human hazards. The historical texture of Yazd consists of two phases: the first phase is unevenly distributed as patches in the other phases of the city; and continuous phase with an area of 519 hectares that is considered as untouched historical texture of the country and forms the central core of Yazd city as the case study area. The population of this part of the city is 42851 individual and its net density is 22 people per hectare and its gross density is 63 people per hectare and the existing number of residential building is 20343 with different classes. At present, the historical texture of Yazd city faces many problems which includes, negative population growth, low social status, ruined and abandoned spaces, inappropriate access, and the down fall of its economic centers. The initial form of the city because of its deployment position and defensive necessities was a castle that later gradually developed as (Sharistan) residential area at the southern edge of the castle (Kohndzh) (Aramnshahr Consultant Engineers, 2011: 1). As a result, the aim of the research is to investigate the natural and human crisis in the historical texture of Yazd city and to develop a Crisis Management model to reduce the physical damages to the historical texture of Yazd city.

Purpose of Research

To present the physical crisis management model with an approach to reduce the historical texture vulnerability of Yazd city in the effect of earthquake.

RESEARCH METHODOLOGY

Based on the components under study, the research is qualitative and quantitative and is a descriptive-analytical method. This is a theoretical research and the required information is collected from library resources by means of measuring tools such as receipts, tables, cards; and the data achieved is analyzed and resulted from deductive and inductive reasoning, allegory, thinking and logical. The statistical population of this research is the qualitative part. The research requires specialized resources that can be documented through library, university research document center, research center, earthquake related organization and crisis management; websites and specialized publications. Due to the wide area of historical texture of Yazd city approximately 519 hectares and 20343 structures were calculated as the statistical population of the sample volume based on sampling using Cochran's formula. The sampling method is based on the Cochran method (the sample size of 127 for the experts that the final sample size is selected by Cochran's method). The statistical population in the quantitative part of the physical components of the historical texture of Yazd city

includes the number of historical monuments, number of floors, type of materials, building age, capacity and the width of the passageway. Field survey (questionnaire) has been conducted to investigate and analyze the level of vulnerability.

THEORETICAL BASIS OF RESEARCH

The crisis management literature, as the domain of study and research in the field of strategic management and control is full of models, theories, patterns, mechanism and methods that teaches the crisis manager the following: that how to predict the disaster? How to prevent from crisis hazards? And prepare themselves from counteract and if they occur how to confront form it (Gholipour, 2004: 54). As a result, crisis management is difficult due to the diversity, complex, vague and multi-dimensional disaster. Therefore, various scholars have designed and developed models. These models help for simplicity of complex issues.

In some models, such as Mitroff and Pearson model both in diagnosis stages are considered as the fundamental stages in the pre-crisis stage and learning stage that has been neglected in most of the crisis management (Saeidi, 2005: 26). Based on Lachat model, the crisis management process begins with the expectation of the crisis or its prediction and ends with the rehabilitation of the crisis and damaged system (Tajik, 2000: 201).

The proposed Finck Mobin model suggests that comprehensive community investigation has been done for crisis situation; an investigation that will guide the organization to identify the events that stimulated the disaster. After identifying these cases a practical program is prepared. This program includes explanation of the situation of crisis and expression of desired result (Penrose, 2000: 69).

The models presented so far shows the relationship between different phases of accident management process. From the study of the models it can be concluded that most of them are around the four main phase of crisis management that includes; prevention, reduction, response and recovery. Such models are not designed to cover all aspects of the accident management and have limitation.

It can be concluded that different model have proposed an approach for crisis management, so that their role in the past crisis is clearly evident. However, attention to each model to a particular field has prevented the attention to all other factors affecting management. Also, in most models presented, the feedback status as a lost loop has been forgotten and fewer models have been considered for the crisis hazard issues. Therefore, this research attempts to improve the existing models, landscaping, mission, goal and strategies has been considered; and with effective investigation determine the dimension and effective criteria in the comprehensive crisis management.

In each hazard, natural and human factors are effective; and natural factors are effective in the vulnerability areas where settlements in terms of natural base and are adjacent to the hazardous elements such as faults, mudslides and roughness. The effective human factors include; increased earthquake damages, urban population increase, inappropriate housing, unbalanced economic and social conditions, and suburbanization. Therefore, these components have been well implemented in the development of a new crisis management model in the historical texture of Yazd city.

If we take into consideration that the investigation of damages and injuries caused by earthquake in cities indicates that the caused damages directly or indirectly is related to the unfavorable planning and urban design conditions, the following distribution of inappropriate physical element and urban land use, inefficient communication network, compact urban texture, high urban densities, inadequate condition for the establishment of urban infrastructure and lack of open urban space have a particular role in increasing the magnitude of damage to cities against earthquake. This above mentioned cases has been considered in the development of a new model of crisis management.

INVESTIGATING FEATURES OF THE HISTORICAL TEXTURE OF YAZD CITY

The historical texture of Yazd is the world's first raw clay city and the second city with historical texture after Venice of Italy. Till date, it is the untouched historical texture of the country with registered number 15000 in the National inventory record. Yazd city has a special place among the historical cities of Iran. The population of the historical texture as per the last census data of Iran is 43851 people which form the 10 percent of the total city population. Recognition of the historical texture has been done based on physical division (quarter). The historical texture of Yazd has nine quarters consist of; Sheikhdad, Dolatabad, Mosalla pit, Fahadan, Green dome, Gazargah, six wind-catchers, Zoroastrians, Poshte bagh (Sarai et al., 2013: 6-7).

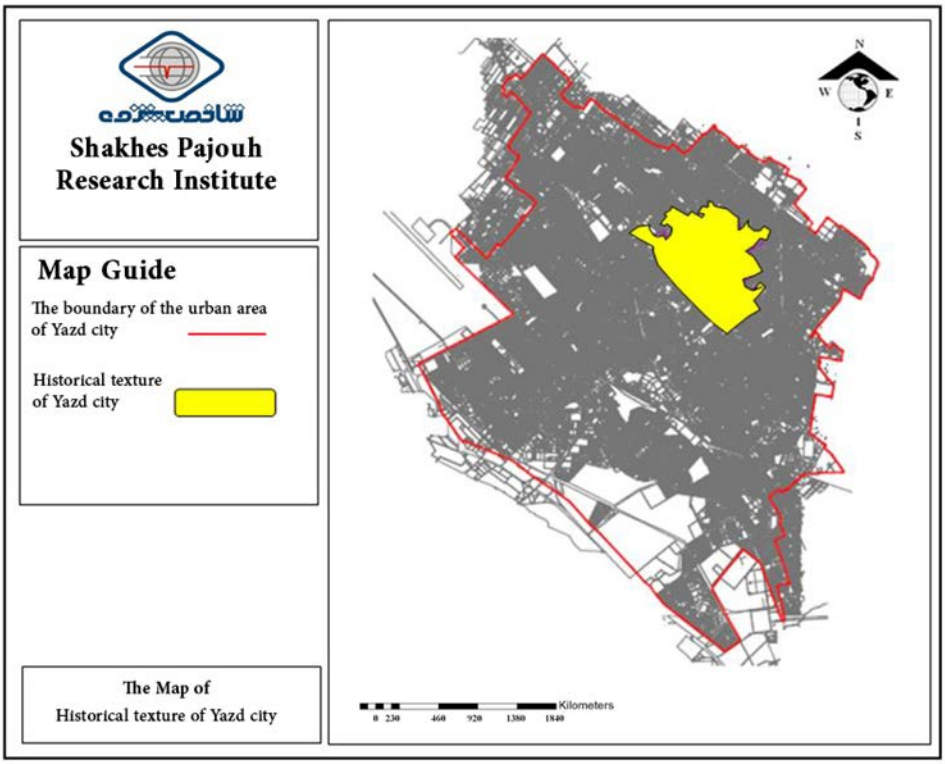

Figure 1. Historical texture of Yazd city
Source: Iranian Statistic Center, 2011

The historical texture of Yazd with an area of 751 sq. m. and protected area of 5000 hectares and more than 6500 ancient space is in fact the most extensive and principled historical texture of Iran. It has 77 neighborhood in the form of nine divisions accommodated the neighborhood of Yazd. While, analyzing and investigating the historical texture of Yazd and other similar cities that have hot and dry climate it is important to note that the climate factor has a fundamental role in rationalizing their texture and architectural composition of these areas (Moeyadfar & Taghvaei, 2014: 86).

The physical historical texture of Yazd is a vast and complex phenomenon. This texture has been created from various sub-system such as grains, blocks, super-blocks, sections and land use of the texture land and their internal and external relationship that in the fabrication condition of texture system of the physical historical city of Yazd and its sub-system follows a hierarchical system (Behzadfar et al., 2011: 86). Establishment of the half of the city signage in the historical texture of Yazd indicates that the historical texture and elements present as the root of identity and defining principle of city have special place for the city resident. On the other hand, the new urban fabrics built in the recent decades were not able to create the identity and structure the minds of the citizens of Yazd (Pourjafar et al., 2011: 15).

Qualitative Features of Residential Units in the Historical Texture of Yazd City

The quality of resident according to the effect that it has on health, safety and suitable environmental condition has direct relationship with affordability and income. This index includes factors such as type of material, quality and age of the structure, structural technology approach.

Type of building material

One of the main elements in housing construction is the utility of material that has an important impact on the quality of durability. To construct the residential unit; select the material with regard to climatic condition, status of production of material and architectural style are very important. The type of construction material used in the building of Yazd differs from metal structure to straw and mud.

Table 1. Comparison of the type of material employed in the historical texture of Yazd city

Material	Straw and mud		Brick and Iron		Brick and Block Joist		Composition and other		Total	
Year	No.	%	No.	%	No.	%	No.	%	No.	%
1966	10549	89.1	1029	8.7	81	0.76	179	1.44	11838	100
2006	6003	53.56	4660	41.6	101	0.9	436	3.9	11200	100

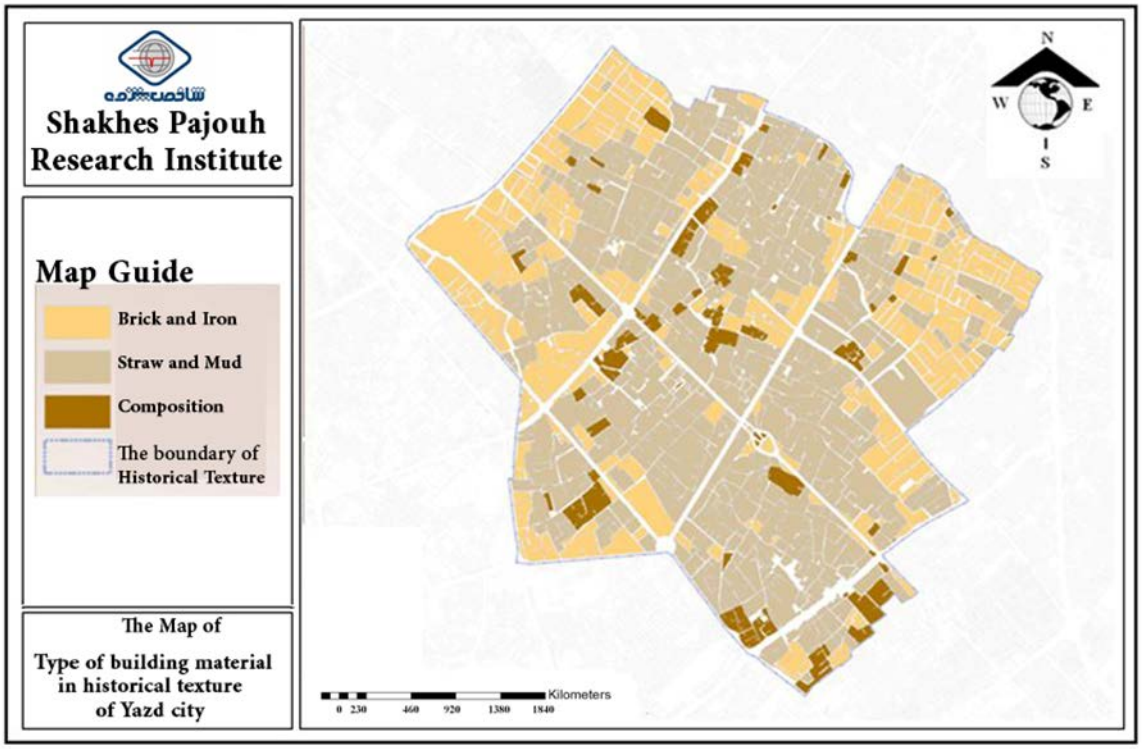

Figure 2. Type of building material in historical texture of Yazd city
Source: Armanshahr Consultant Engineering, 2011

In the historical texture of 1966 around 89.1% of the residential units were made of straw and mud material; and in 2011 it has decreased to 48.3%. Also, the unit built with iron and bricks from 8.7% increased to 15.6% (**Table 1**) (**Figure 2**).

Average life of the structure

One of the indicators in assessment and evaluation of the quality of structure is the building age and the completion date, which indicates the percentage of the existing building able to reside in and how much percentage because of the expiry of the useful life of the building has existed from the capital category.

In the historical texture of Yazd city 9.4% of the buildings have served less than five years, 11.6% of the building with a life span service of five to nine years, 15.2% of the building with a life span service of 10 to 29 years, 26.2% are 30 to 59 years old and 37.6% have served more than 60 years. In the neighborhood of the historical texture the services of the buildings differ (Aramnshahr Consultant Engineers, 2011) (**Figure 3**).

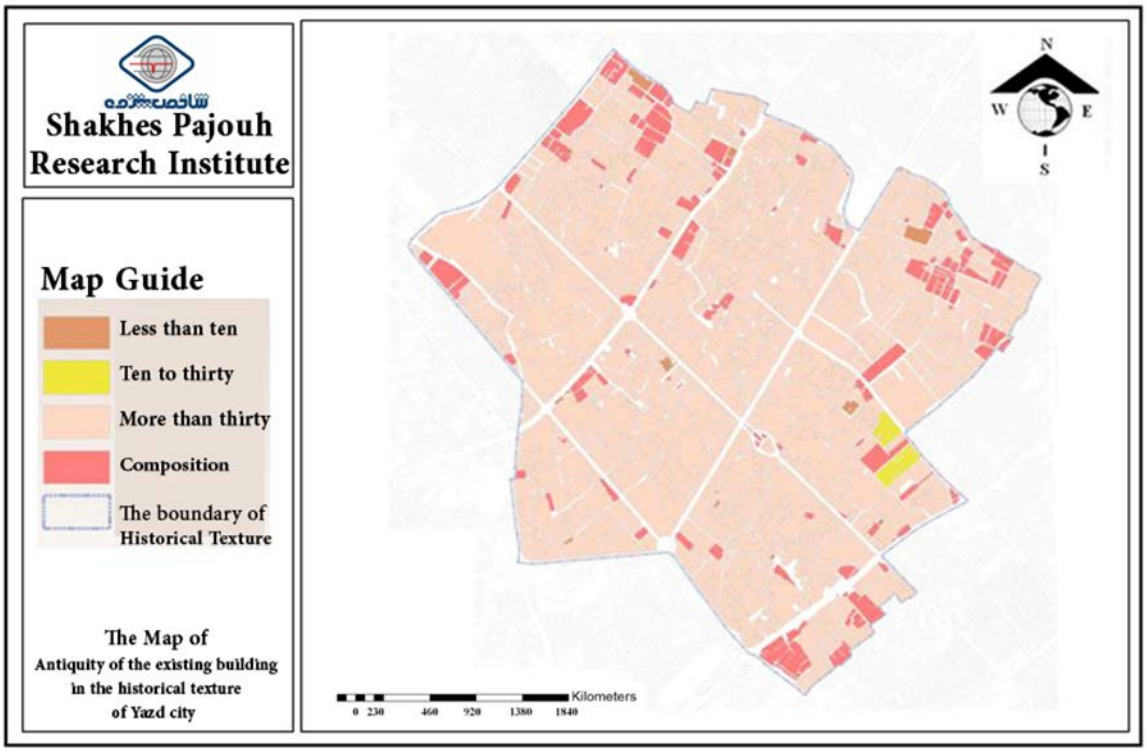

Figure 3. Antiquity of the existing building in the historical texture of Yazd city
Source: Armanshahr Consultant Engineer, 2011

Quality of the building

One of the criteria used to study the housing condition is the quality of the building. Buildings are qualitatively categorized to new, refurbished, destructive and valuable. In the historical texture of Yazd city, the total available residential units 2.6% are valuable, 48.8% restored, 34.1% new construction and 14.5% destroyed and ruined. Among the neighborhood of the historical texture the green dome (Gobatesabz) neighborhood had the maximum progress in modernizing and restoring. In this neighborhood, 43.1% of the building have been renovated and refurbished. The highest percent of valuable building (9.7%) are in the Gazargah neighborhood, the maximum repairing building (59%) are in the six wind-catcher neighborhood, the maximum amount of destroyed building (15.4%) was in Green dome (Gombaht sabz) neighborhood and the most ruined building (12%) was in the six wind-catcher neighborhood.

Prioritizing Important Factors Influencing the Intensity of Historical Texture Vulnerability of Yazd City during the Occurrence of Earthquake using ANP Model

The main aim of the research is to identify the effective indexes in the historical texture vulnerability of Yazd during the occurrence of earthquake. In relation to the historical texture vulnerability the different criteria and indicators have been considered. By establishing inter-group and external group communication between elements and indicators, the effects of each element in the vulnerability of the historical texture of the city are determined (**Figure 4**).

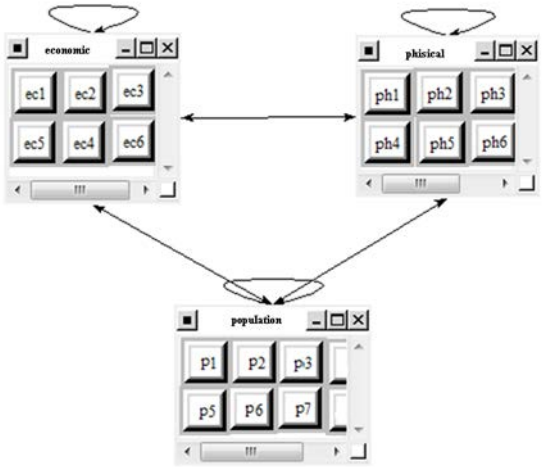

Figure 4. Relationship between vulnerability clusters of the historical texture

Table 2. Couple comparison matrix and cluster weights

Title	Population	Economic	Physical	Relative weight	Total weight
Population	1	1.38	3	0.637	0.117
Economic	2.64	1	1.21	0.704	0.103
Physical	3.46	3.41	1	0.848	0.231

Table 3. Incompatible rate of the ANP model

Indicator	Population	Economic	Physical	Average rate of incompatibility
Incompatible rate	0.032541	0.051241	0.012547	0.03210

Table 4. Final weight of indexes under study of the historical texture vulnerability of Yazd city during the occurrence of earthquake

Research index	Common weight	Cluster weight	Final weight
Population	0.633	0.117	0.0740
Economic	0.405	0.103	0.0417
Physical	0.956	0.231	0.2208

In this research, the criteria are in three clusters such as; demographic, economic and physical, that each contains a number of influential elements. In addition to the inter-group communication there is a correlation between clusters (**Table 2**).

Pair comparison and matrices related to all the criteria and clusters are determined using priority scale distinguished between 1 through 9 numbers. For all criteria and options a paired comparison is carried out. In **Table 2**, the results of paired comparison shows the Analytical Network Process model for the vulnerability of historical texture of Yazd city during the occurrence of earthquake and the effective components in the field of crisis management. As shown, the incompatibility rate of judgement is 0.03210. In this method, the amount of incompatibility should not be greater than 1. This amount of error with considering the number of judgement and error made by the survey is acceptable (**Table 3**).

The result of Analytical Network model shows that the physical indices includes less width of passageway, building age, demolition, building quality, building density, separated area, type of material, number of floors, with the value of 0.220 have the maximum role in vulnerability of historical texture of Yazd city during the occurrence of earthquake. Demographic indicator such as population density, household density in the residential units, high number of children, elderly people and women, play a major role in the historical texture vulnerability of Yazd city during the occurrence of earthquake. Meanwhile, the population density is one of the effective factors for vulnerability. The greater the population density during earthquake the possibility for relief team are limited because of increased population causes traffic and slowing down the access to the crisis area (**Table 4**).

Table 5. Strength, weakness, opportunities and threats of the historical texture of Yazd city with crisis management approach

SWOT Matrix	Strength (S)	Weakness (W)
Internal	X_1: Existence of central courtyard in most residential buildings of the historical texture X_2: Granting banking facilities for the modernization and renovation of historical texture X_7: High percentage of one-story buildings in historical texture X_{12}: Mild slope of historical texture lands X_{14}: The spatial status and role of historical texture in attracting tourist as a factor to increase the incentives of officials and practitioners to focus on the management of earthquake crisis X_{21}: Initiating early learning and introducing to earthquake crisis management in offices and schools. X_{26}: Municipality's determination to participate in the renovation of neighborhoods in the historical fabric of the city.	X_3: Unavailability of relief vehicles to the interior parts of the historical sites during earthquake crisis with the existence of 131 hectares with undesired access in the area X_{16}: Existing 19753 m2 of shelter in the pathway of historical fabric site. X_{23}: No accessibility to 65% of the existing parts in historical texture to the cavalry X_{20}:The quality of durability of the existing building is 70% in the historical fabric X_{25}: High age of building (more than 62% of the buildings are more than 30 years old X_{28}: The probability of historical fabric vulnerability is due to its closeness to the northern fault of Yazd X_{30}: Lack of studies in crisis management in the historical texture during the occurrence of earthquake X_{31}: Existence of heterogeneity in the age pyramid of the population and the existence of the elderly in the historical texture X_{32}: Lack of adequate capacity for access to emergency vehicles in the condition of earthquake in the entire historical texture X_{33}: Structure of texture and reduction of plots X_{34}: Lack of static approach to earthquake crisis management at macro management X_{35}: Low efficiency for firefighting facilities in the city of historical texture X_8: Existing of overwhelming traffic attraction at trans-regional scale especially in Imam and Qayyam Street X_9: High vulnerability of communication route from historical fabric to hospitals and medical centers of the city X_{10}: Failure to provide timely fire extinguishers services due to inappropriate access to the site X_{36}: Existence of traffic junctions in historical texture such as traffic junction of the Shahada crossroad; the crossroad of Besat and Imam Reza Square X_{37}: More than 50% of the residential units are made of straw and mud in the historical site of the city
Exterior	**Opportunities (O)**	**Threats (T)**
	X_5: Establishing municipality of the historical district as the sub-division municipality of the center, like the municipality of other region X_{11}: Development thought of Iran city and emphasize on the organization of historical texture of the city X_{15}: Proposal to register globally the historical fabric of Yazd city and special attention to this fabric in design development X_{17}: Existence of master plan for preserving the historical texture of Yazd city X_{18}: Existence of the rescue and relief facilities such as Red Crescent at city level	X_4: Lack of micro-macro policy in the field of crisis management in Iran and Yazd city X_6: Lack of adequate budget for management in the event of an earthquake X_{13}: Inappropriate deployment unskilled dispersion of service centers in event of an crisis X_{19}: Failure to identify the accident area during the occurrence of crisis management in city and historical texture X_{22}: Extra-legal structures of power and possibilities of increased crime and offenses during earthquake X_{24}: The dispersion of sand dunes around Yazd city and strong winds and storms with fine sand grains (as an stimulating factor) X_{27}: Lack of failure and stability of buildings; lack of change in the criteria and its role in increasing more worn-out building existing in the historical texture.

According to the research findings, any planning towards crisis management in the historical texture of Yazd city; emphasize should be made on physical components. Observing the standards for the physical components will help to strengthen the structures in the fabric and in case of earthquake; the components of demographic and economic dimension will be less damaged. Therefore, in developing the final model of crisis management; the physical dimension of crisis management cycle should have a significant role.

Development Strategic Planning (SWOT) to Reduce the Vulnerability of the Historical Texture of Yazd during the Occurrence of Earthquake

The first step in analyzing the strategic planning for the reduction of vulnerability of the historical texture of Yazd city during the occurrence of earthquake is to identify the dimension and effective variables in increasing the severity and extent of the earthquake disaster. Therefore, initially it is essential to identify the strength, weakness, opportunities and threats of the historical texture condition in terms of failure and problems (**Table 5**).

According to the results obtained from the research data and its analysis; each of the variables of the historical texture vulnerability of Yazd city during the occurrence of earthquake, the standardized from 1 to 10 for the amount of data was done. Then, the strength, weaknesses, opportunities and threats of the physical crisis management of the historical texture was identified from 37 variables. Finally, the average coefficient of each SWOT components was calculated in the historical texture. Based on the study conducted in relation

Table 6. Standardization of variables coefficient (from 1-10) in SWOT model in the historical texture of Yazd city

	Strength (S)		Weakness (W)		Opportunities (O)		Threat (T)	
	Variables	**Average coefficient**	**Variables**	**Average coefficient**	**Variables**	**Average coefficient**	**Variables**	**Average coefficient**
Status of historical texture of Yazd city	(X_1); (X_2); (X_7); (X_{12}); (X_{14}); (X_{21}); (X_{26})	7.13	(X_3); (X_{16}); (X_{23}); (X_{25}); (X_{20}); (X_{28}); (X_8); (X_9); (X_{10}); (X_{31}); (X_{30}); (X_{32}); (X_{33}); (X_{34}); (X_{35}); (X_{36}); (X_{37})	9.41	(X_5); (X_{11}); (X_{15}); (X_{17}); (X_{18})	6.54	(X_4); (X_6); (X_{19}); (X_{22}); (X_{13}); (X_{24}); (X_{27}); (X_{29})	8.36

Table 7. Calculating the percentage of strength, weakness, opportunities and threat and determining the strategies for the historical texture of Yazd city

Title	**SWOT**									**Strategy**
	S	**W**	**O**	**T**	**Internal S/W**	**External O/T**	**Positive S/O**	**Negative W/T**	**SWOT**	
Historical texture of Yazd	18.9	45.9	13.5	21.6	64.8	35.1	32.4	67.5	83.4	**Second**

to the planning process to reduce the vulnerability of the historical texture; weakness and threats with 9.41 and 8.36 coefficient had the highest amount; and strength and opportunities with 7.13 and 6.54 coefficient had the lowest amount (**Table 6**).

After the internal factors (strength and weaknesses) and external factors (opportunities and threat) and coefficient of each determined in the historical texture; the percentage of each of these four factors is presented in **Table 7**. In the SWOT column, the percentage of variables input to the model has been shown. Later, it is distinguished how much percentage is attributed to strength, weakness, opportunities and threat. Finally, based on the calculated percentage the required type of strategy to reduce the historical texture vulnerability during the occurrence of earthquake is presented.

According to **Table 7**, the historical texture of Yazd city has numerous disadvantages (that is 45.9%). This means that with the present planning process more emphasize should be given for strengthening the existing buildings; creating suitable accessibility for timely provision of services during critical situation; allocating parts of the historical texture to open spaces for accommodation and emergency evacuation in critical situation. The strength is significant too and can rely on the strength and opportunities to weaken the weaknesses and threats. Therefore, according to the results of **Table 7**, strategies are presented to achieve the reduction of the vulnerability in the historical texture of Yazd city.

For planning and to reduce the vulnerability as per the results of **Table 7**, the overcoming strategies are used because it takes into consideration its logic, so that the negative internal factor (weaknesses) are minimized or completely disable (**Figure 5**).

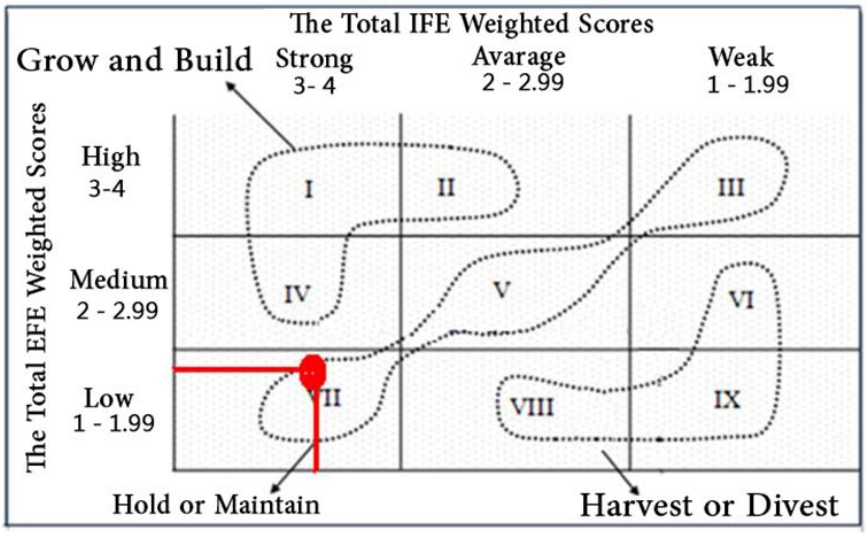

Figure 5. Strategic Matrix and priorities for application to reduce the vulnerability in the historical texture of Yazd city

The results of SWOT analysis show that, in addition to the use of strategies to overcome the weaknesses by employing strength; also use of competitive strategy with respect to final score at the home number 7; because planning is based on a specific and local crisis management in each region, due to the extension and dimension of its vulnerability can provide grounds for historical texture during the occurrence of crisis (**Figure 5**).

PROVIDE PHYSICAL CRISIS MANAGEMENT MODEL DURING EARTHQUAKE

In most of the presented models, some components have been investigated in which some effective factors are forgotten. In most examined models all the three aspects of risk assessment, risk management and operation management have been considered in the model. But, based on this study, some of the sub-components of these three issues have been neglected. Lachak model and reaction models against the pro-active model are single dimension models; that only focuses on the dimension (criteria and indices) of operational management. These models can be used to review the management process. The process models include a logical order and successive stages; that imperfect execution or neglecting each of the stages will put the whole process into difficulties and as a barrier to achieve the ultimate goal that is to improve performance. Other type of single-dimension model is the Little John model which focuses on risk management. Other single-dimension models are the crisis cube model, Scott-D. Johnson model and Bruce Hagman model which considers the risk management. The formation of these models is rooted in the identification of effective factor in vulnerability. The present topic is one of the most important parts of management. The perception and analysis of this part plays an important role in risk reduction and crisis management.

Another two-dimensional type includes themes of risk management and operational management is the Miterf model. This model is called as the functional management model; because without referring to risk assessment it only focuses on the process and how to manage it. In other words, no importance is given to the performance result as the final loop of the model and the risk assessment section that determines these results. For example, Mitraf model was launched in 2000, the operational dimension was considered; and presented its structure in the framework of risk management. The specific feature of this model is that, it is a pre-active model and gives importance to the learning element.

The McConky model pays attention to risk management and is referred to as an empowering outcome. In this model, the only missing link among the three main components of the study is the risk assessment process which is included in this classification. Finally, another type of crisis management model, which is called as criteria (ideal), includes three dimensional models. These models which includes all the three elements; such as risk assessment, risk management and operation management are known as comprehensive crisis management model. The two stages of crisis management model with the research factors like prevention,

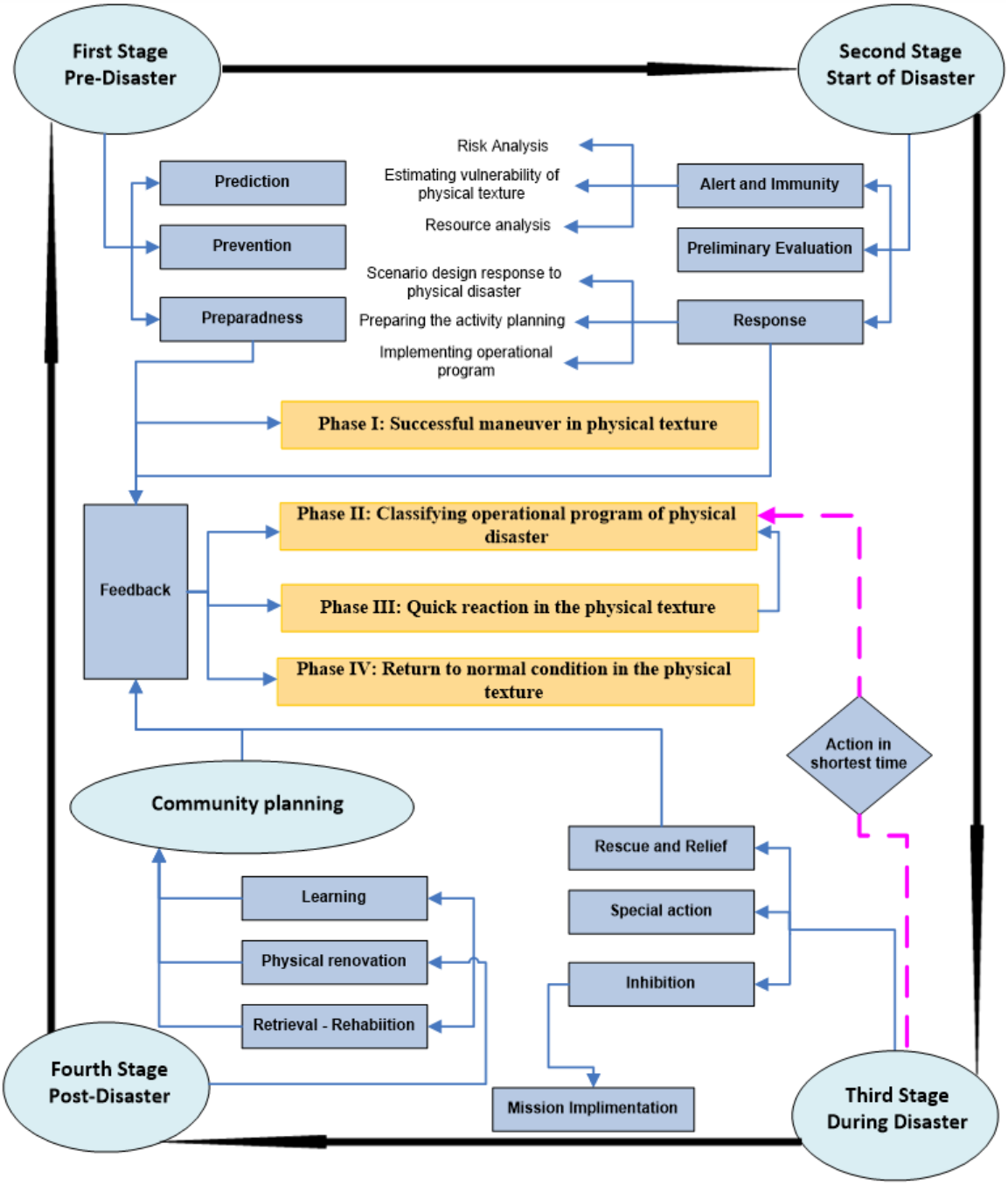

Figure 6. Presenting physical crisis management model during earthquake

response and re-construction is a process and operational model; but in the first stage of the process, is the recognition of risk with an emphasize on assessment is a multi-dimensional model and finally, the study of dimension of risk management (risk area, risk identification, estimation and its reduction).

The overall purpose of the two part model is to do the future planning measures to reduce the damage. This model believes that the assessment of vulnerability alone cannot reduce the natural hazard; but in the first stage requires a missionary action. The mentioned model with a study of components such as prediction, prevention, risk management, confrontation and reconstruction in the first part, monitoring and modification of program, risk control, risk assessment and its analysis in the second stage attempts to provide a comprehensive model.

The four layer model initially introduced as a four-step model that continuously tries to aggregate the comprehensive crisis management components. The model, attempts to present a suitable model by examining the reduction of effective and preparedness in the field of operational management, analysis and control of risk in the field of risk management; and finally risk analysis, vulnerability estimation and resource assessment in the field of risk analysis. The advantage of this model is to balance between preparedness and flexibility for appropriate response to the specific needs of the accident and finally reaching the reconstruction stage.

With these explanation, the cyclical model is a process-operational model that by examining some of the components such as resource management in the field of risk assessment and identification of risk in the risk management sector, a three dimensional model can be considered. Among all the mentioned models in this research, only the cyclical model can thoroughly examine the components. Most of the components considered in the research except risk and its monitoring field of risk management is also covered. The cyclical model for the management of earthquake crisis a cycle has been presented; that is one of the most complete cycles in which the management and executive measures during crisis are considered. In this cycle, there are several stages and sub-stages. In addition, according to the type of crisis the priorities of this stage has changed; and in some cases few of these stages does not exists. In making this model, the combination of logical, integrated and causal are used. However, some scholars see crisis management as one-dimensional. Even in some two-dimensional models, one dimension is overlooked. While the typology presented in this study shows that according to the ideal type, the comprehensive model should include all the three elements.

CONCLUSION

This research develops criteria and effective indicators for vulnerability and identifying the vulnerable points at the texture surfaces; as well examine the crisis management models, to look for developing a new model in crisis management for prevention and reducing the potential earthquake hazard in the historical texture of Yazd city. Based on the studied components, the type of research is qualitative and quantitative and it is a descriptive – analytical method. This research requires surveying and field study and questionnaire has been used as a research tool. Data analysis tools are the inferential statistics method; correlation coefficients and regression are also used. To analyze the data, network analysis and route analysis model are used and SWOT model are used to formulate the strategic planning.

The result obtained by analytical network model show that the physical indices such as low width of passage, building age, deconstruction, quality of building, building density, separation area, type of materials, number of floors with the value of 0.220 has the maximum role in the vulnerability of the historical texture of Yazd city during the occurrence of earthquake.

Based on the results of route analysis, the physical criteria of not following the provision of 2800 Code, the presence of Dead-End, low width passageway, high construction density have the highest impact on vulnerability of the historical texture during the occurrence of earthquake and neighborhood user has the lowest impact. Based on the study done in relation to planning process to reduce the vulnerability of the historical texture of Yazd city; the weakness and threats with coefficient of 9.41 and 8.36 had the highest amount and strength and opportunities with coefficients of 7.13 and 6.54 had the lowest amount. According to this information, the historical fabric has numerous weaknesses (45.9%). This means that with the present planning process more emphasize must be given for strengthening the existing buildings, providing adequate accessibility for timely services in critical situation, allocating part of historical fabric to open spaces for emergency accommodation and evacuation. But, there are attracting strength points and with the use of these strength and opportunities can reduce the weakness and threats. One of the most important approaches to reduce vulnerability of the historical fabric of Yazd city is to use the crisis management model.

In summary, different models have been presented for crisis management; each has strength and weakness. But, since the crisis dimension in the city's historical texture is different than the entire city therefore, the crisis management should be related to extent and according to its vision, mission, macro goal and strategies must explain the level of performance and dimension; and design the indicators and choose a model. Thus, each organization and department operates by considering the available resources at different levels at different areas of crisis management; and with regard to the vulnerability factors such as economic, social and physical attempts to reduce the consequences of the earthquake crisis in the historical texture.

In the crisis management model; in the first stage before the occurrence of earthquake in the historical texture of Yazd, the stages will have feedback, it means that; in this step comprehensive measures are taken

to inform the citizens about the earthquake crisis. Simultaneously, with this step, the highly vulnerable zones, individual plots with complex information such as building quality, building age, number of floors, type of materials, access to route network, etc., are identified; and creates a comprehensive database about the development of comprehensive organizing program. After implementation of the proceedings the feedback in multiple sample are tested. This stage help to identify the historical texture, organizing problems and physical problems, that have not been referred before in any of the earthquake crisis management models.

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