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Design Model for Temporary Shelter in Crisis Conditions with a Passive Defense Approach Supported by the William T. Fine Risk Assessment Technique (Case Study: Pādadshahr Neighborhood, Ahvaz)

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ARTICLE INFO **ABSTRACT**

Keywords:
Hazard, temporary shelter, crisis management, passive defense, William T. Fine

Natural and human caused hazards constitute serious threats to human habitats. In the event of such disasters, little may be done at the moment of occurrence, whereas by identifying them and paying attention to crisis management planning and passive defense the effects of damage and vulnerabilities can be reduced and minimized. Preventive crisis management methods cover the period before a crisis; in the event of a crisis cover response and confrontation; and after the crisis cover relief and recovery. Likewise, passive defense discussions are primarily before the occurrence of a crisis and involve preventive factors. In the present study, effort has been made through crisis management and passive defense approaches to identify the hazards present in the study area and to act in a preventive manner in the area, to derive guidelines and principles for the design model of temporary shelter in crisis conditions. The objective is how to achieve a design model for temporary shelter in crisis conditions with minimum of physical and human losses by the William T. Fine risk assessment technique, so that the strategies proposed, in the event of crisis, have the lowest level of risk exposure. To this end, the study area was investigated in terms of environmental, social, physical functional characteristics and also infrastructure and facilities, and finally the current state assessment was analysed through a SWOT table, and implementation strategies and policies were proposed, leading to alternative strategic options. After weighting the strategies, the optimized alternative was extracted and based on it the principles and guidelines for presenting the design model for temporary shelter under crisis conditions and with regard to minimizing losses and risk exposure have been achieved.

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1. Problem Statement

One of the most important issues that managers and citizens of large cities confront is the probability of suffering damage and harm from a specific hazard. In other words, risk-proneness of today's societies has become one of the concerns of urban managers. In city neighbourhoods as the smallest units of the city, many events occur such as natural disasters, man-made disasters and sabotage attacks. This matter calls for conscious planning and proper urban design in the direction of obtaining a desirable model to preserve the life and property of citizens, and minimize damage and injuries. One of the issues many cities around the world struggle with is crisis, which is accompanied by widespread physical and human damages or the conditions for such damage, requiring immediate action. Temporary shelter (or emergency accommodation) is one of the fundamental phases of crisis management after an event. Temporary accommodation can be defined as the set of activities including collecting and identifying people who have been affected or rendered homeless, transferring people to shelters, and creating safe and hygienic living conditions until their return to their original residence (Ahadnezhad et al. 2012) (Emami & Keshani 2012). In cities the issue of temporary shelter becomes even more significant; because in a crisis the scale of damage is much greater in urban areas than in rural ones. The city of Ahvaz, capital of Ahvaz County in Khuzestan Province, is the city under study in the present research, which, although blessed with the Karun River as a living entity, is located in the oil-rich southern region and the multiplicity of wells and oil/gas pipelines and also the passing fault line and other factors increase the probability of crisis in Ahvaz; hazards such as flood, earthquake, etc., which can themselves inflict irreparable damage on the city. This study aims, because of the hazardous nature of Ahvaz and the multiple natural events in this city, the absence of an efficient and standardized model for locating temporary-shelter sites after disasters, and the fact that such sites in Ahvaz remain unknown, to provide a model for planning and site-selection of spaces to provide temporary accommodation for disaster-affected people, in order to meet their primary needs after a disaster, which will begin immediately after the temporary emergency shelter phase.

2. Concepts

2.1 Hazard:

A hazard is a physical event, phenomenon or human activity that is potentially harmful. The types of such harms include human injury, financial loss, social and economic disruption, or environmental destruction; hazards fall into two general groups: natural or man-made (Ardalan et al. 2013) (Mansor Naeimi 2014). It is a potential threat to human life and their comfort and may be natural (such as earthquake, flood, drought etc.) or human-caused (such as war, industrial accidents etc.). The occurrence of such events in nature, so long as they remain remote from human habitats, imposes no direct destructive effect on humanity. But throughout history humans have faced these phenomena near or within their habitats, so that natural disasters often leave destructive impacts on human settlements and impose heavy casualties (Attar 2011). Cities, by virtue of their different structure from other human habitats, if the comprehensive principles needed for proper location are ignored, can become potential bio-hazardous points for urban disaster when accidents occur. Cities consist of built formations that each contain an activity and their sum construct the urban space and give it identity. Cities house functions and critical infrastructure of many kinds—residential, administrative, service, health etc.—and all of these contain populations that in the event of disasters are severely affected and disrupt the system of life and cause heavy human and financial losses. Lack of attention to correct location of cities and lack of planning to prevent uncontrolled growth has brought many problems and hazards for city safety. This growth has led to settlement on main flood channels, fault lines or in river/stream corridors (Mohammadi 2004).

Natural Hazards:

Natural hazards are significant elements of human-nature interaction and must be taken into account both when humans use natural resources positively and when hazards and natural disasters occur (Gibson 1996). They are those hazards which are derived from natural phenomena and based on origin may be classified into three types:

1. Earth-based: such as earthquake, volcanic eruption, tsunami, etc.
2. Meteorological/climatic: such as flood, storm, drought, extreme cold or heat, landslide.
3. Biological origin: such as widespread epidemics e.g., SARS, influenza, cholera.

Man-made or Technological Hazards:

These are hazards caused by human error or intention, such as: fire, leak of hazardous materials, laboratory or industrial contamination, nuclear/radioactive activities, toxic waste, transport accidents, explosion, bombing, sabotage operations etc. (Ardalan et al. 2013).

2.2 Crisis Management:

Crisis:
An incident arising from natural or human events that imposes sudden hardship on a human community and requires emergency operations (Hosseini 2008). In other words, any sudden change resulting from unexpected events or of much greater intensity than usual that disrupts normal life and demands immediate action (Shakiba 2010). Crisis truly means a large special psycho-social pressure that breaks the regular life patterns and triggers social responses and brings about fatalities, threats, dangers and new needs (Goold 1990). According to another definition, a crisis is a rare severe event in the natural or built environment that disrupts normal human life and demands urgent decision-making (Huang 2000).
Crisis Management:

Today in management theory two extremes may be considered: on one side "management based on instant reaction"—in which planning or actions occur only just before or at the time of the event, or even experiment-and-error, whose results are far less than resource investment (Attar 2011). On the other side, "management based on goal and outcome"—in which desired objectives are defined and an operational plan and tools for achieving them are determined (Attar 2011). Crisis management is a process to prevent crisis or minimize its effects when it occurs so as to handle the worst-case conditions (Amiri 2010). According to Pearson & Claire, crisis management is a systematic effort by an organization together with its stakeholders to prevent crises or effectively manage them when they occur (Naroei 2015).

2.3 William T. Fine:

In this regard, a scientific and reliable method for decision-making about the necessity and justification of the costs (human/financial/meaningful) of hazard elimination and also the requirement for executing hazard-control programs as swiftly as possible is needed. One of the widely used methods in safety-specialist fields is the Fine technique, which is based on the calculation and evaluation of risk. This technique helps relevant officials to prioritize hazard-control programmes and determine urgency and planning needs in a fully transparent manner. The objective of applying this technique is to establish a method for the decision-making about the necessity and justification of the costs of hazard elimination and the requirement to implement hazard-control programmes as soon as possible. This method defines risk as a function of

hazard-occurrence probability, contact/exposure rate, and consequence level. The basis of the technique is computing risk score as:

Then there are tables assigning severity (A), exposure (B/E), probability (C/P) values, e.g.:

Severity of consequence (A):

Table 1:Risk Severity Description

Score	Risk Severity Description	Code
100	Multiple deaths – Irreparable environmental damage with long-term effects – High financial loss (over 15 billion IRR)	1
50	One death – Injury causing permanent disability to more than one person – Irreparable environmental damage with medium-term effects – Financial loss between 10 to 15 billion IRR	2
25	Injury causing permanent disability to one person – Irreparable environmental damage with short-term effects – Financial loss between 5 to 10 billion IRR – Impact on city reputation at provincial level – High consumption of resources and energy	3
15	Long-term injury without permanent disability – Repairable environmental damage with long-term effects – Financial loss between 500 million to 5 billion IRR	4
5	Temporary injury – Repairable environmental damage with short-term effects – Financial loss less than 500 million IRR	5
2	Minor injury requiring first aid (3 days or less) – Financial loss less than 100 million IRR	6
1	No further investigation needed – Negligible financial loss	7

Exposure Level (B):

Exposure to hazards is determined based on the following time pattern:

Table 2:Description of Exposure and Frequency

Score	Description of Exposure and Frequency	Code
10	Continuously – Several times a day – Exposure more than 8 hours – Continuous pollutant release	1
6	Often – Several times a week – Exposure between 6 to 8 hours – High pollutant release	2
3	Occasionally – Several times a month – Exposure between 4 to 6 hours per day – Moderate pollutant release	3
2	Unusually – Several times a year – Exposure between 2 to 4 hours per day – Non-routine pollutant release	4
1	Rarely – Once every few years – Exposure between 1 to 2 hours per day – Low pollutant release	5
0.5	Slightly – Very rarely – Exposure less than 1 hour per day – Negligible pollutant release	6
0.2	No exposure, no occurrence frequency, and no pollutant release	7

Probability of Occurrence (C):

At this stage of risk assessment, the probability that the incident outcomes will fully occur is calculated based on the table below:

Table 3: Description of Probability of Occurrence

Score	Description of Probability of Occurrence	Code
10	Highly likely	1
6	50/50 chance – Possible	2
2	Could happen randomly – Less than 50% chance	3
0.5	Unlikely in next few years but possible	4
0.1	Practically impossible – Will never happen	5

Table 4 :Actions Based on Risk Levels

Risk Level	Actions	Rank
High	Immediate corrections required to control the risk	> 200
Middle	Urgent – Necessary attention should be given promptly	91 – 199
Low	Risk requires monitoring and control	< 90

2.4 Temporary Shelter:

Shelter is one of humanity's primary needs. Therefore, after any disaster with damage to permanent habitats—and as construction of housing for displaced persons requires significant time and cost—the issue of temporary shelter emerges. The first step in the discussion of temporary shelter is creating a refuge for people to be protected from weather conditions and to feel secure—this is what is usually called *emergency accommodation*. One of the most common approaches is the tent, which is quite suitable for the initial emergency stage. But since the rebuilding stage often takes many months or years for economic, technical and executional reasons, emergency shelter cannot function as a residence for several months or years. Temporary shelter therefore must provide a residence that better meets inhabitants' needs over a longer period – offering protection against extreme cold in winter or high-winds in seasonal changes. All methods of temporary shelter fall into three categories based on their management mode: camp (complex) form, dispersed form and hybrid form (Hany 2014).

2-5 Passive Defense:

One of the fundamental and essential tasks is to create uniformity and standardization in the definitions and key terms of passive defense, to establish a common understanding for the audience. Because as long as individuals and organizations have differences in understanding the meanings of words, achieving a shared understanding will be problematic (Jadidi, 2016).

Passive defense includes a set of measures that reduce the impact of potential threats without direct confrontation. Therefore, the actions categorized as passive defense mainly fall within preventive measures and actions to restore normal conditions. Naming this set of actions in a separate category, in addition to the

differentiation made for areas of action, highlights the special importance of passive defense measures in creating safety. This importance stems from deterrence and the relatively low cost compared to direct confrontation with threats. The definition of passive defense in the literature of this science is as follows: "A set of actions taken with a non-initiating approach to reduce the probability or minimize the effects of damage caused by threats is called passive defense." Thus, in a military battle, actions such as camouflage and concealment fall under passive defense measures (Mahmoodzadeh, 2013).

According to the vulnerability theory, in any given space there is a degree of vulnerability, while levels and ranges of safety within that space are not uniformly distributed. Defense, in fact, is a stable strategy for preparedness and coping with vulnerability patterns and is essentially a reaction to damage and threat; meaning a threat exists and a mechanism is needed to defend against it. Therefore, passive defense is a strategy of preparedness in emergency conditions or a deterrence strategy in facing human-made, natural, and technological hazards. Passive defense against dominant urban risk patterns is among the most important strategies for securing urban spaces for urban planners. Urban passive defense, also known as emergency preparedness or deterrence strategy, responds to citizens' needs for protection against urban natural and technological crises and encompasses various physical, ecological, and technological vulnerabilities. Defensive urban planning, incorporating safety and security principles in the adjacency of special land uses to reduce vulnerability to potential hazards, is one of the passive defense strategies, especially in hazard-prone cities. Overall, the set of non-armed actions that reduce the vulnerability of human resources, buildings, facilities, equipment, and the country's lifelines against hostile and destructive enemy operations or reduce risks arising from unnatural disasters is called passive defense (Cheshmeh et al., 2017).

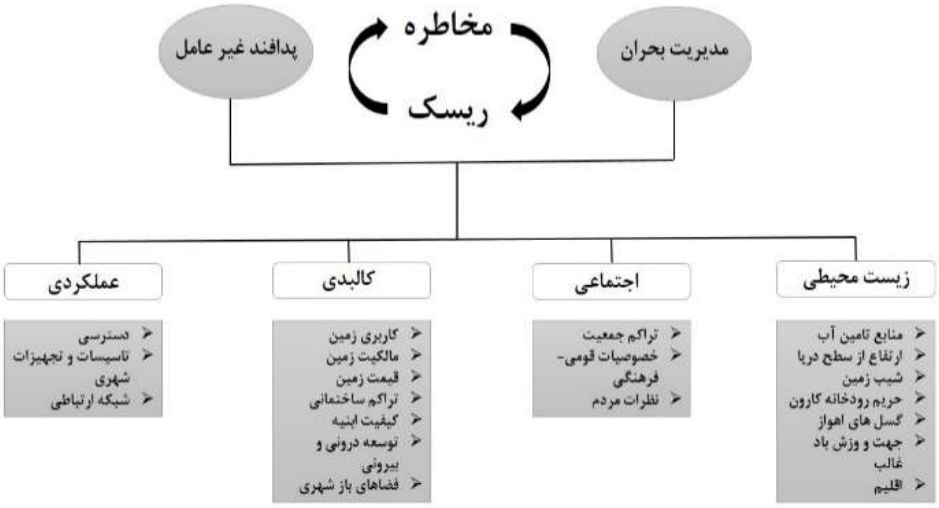

Figure 1 : Conceptual model of theoretical foundations

3- Research Methodology

Research is a dynamic process conducted to solve problems or achieve solutions. Some define research as the interaction of science with worldly phenomena, while others see it as the reciprocal action of science and phenomena. Other definitions involve different interpretations of the two elements—science and phenomena—thus research can be described as:
A systematic and scientific investigation of worldly phenomena with theoretical background and credibility, aimed at answering one or more questions or solving one or more problems (Attar, 2011).

The present study aims to provide a temporary shelter design model under crisis conditions with a passive defense approach using the William Fine evaluation technique. The mentioned model is carried out in the case study (Padadshahr neighborhood of Ahvaz) through two main stages:

- Identification of suitable locations for temporary shelter after a crisis within the study area
- Ranking and prioritizing crises and locations selected in the first stage for temporary shelter of affected individuals

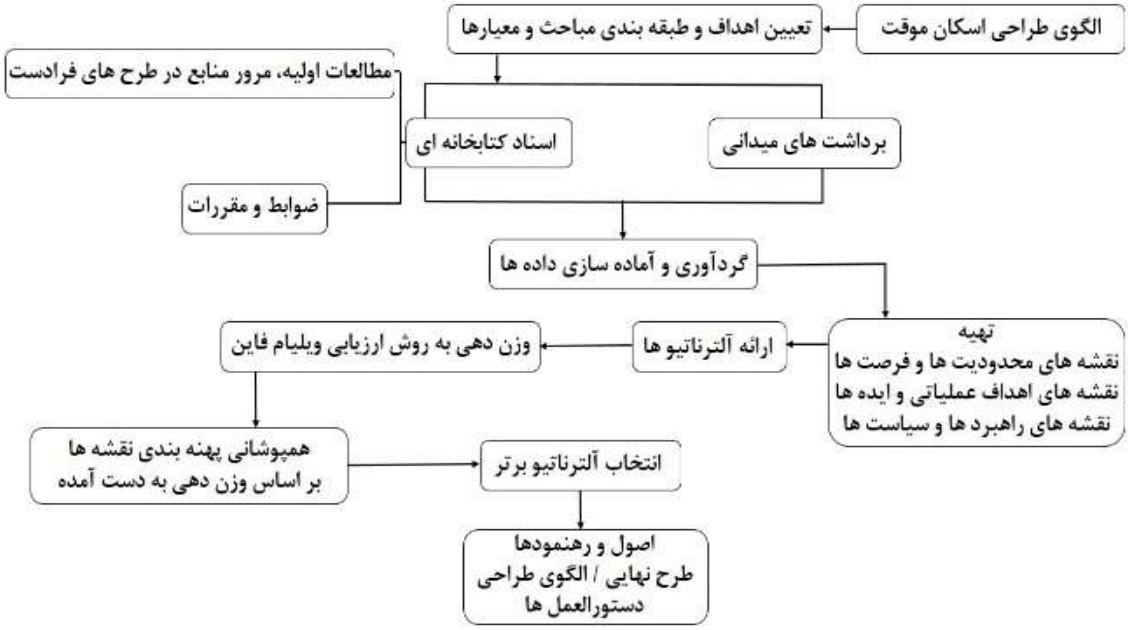

Figure 2 : Research process and methodology

4- Recognition and Findings

The study area, which the research factors such as design, evaluation, etc., are based on and where the main plan will be implemented, in this study is Padadshahr neighborhood, one of the districts of the metropolis of Ahvaz, selected as the direct intervention area.

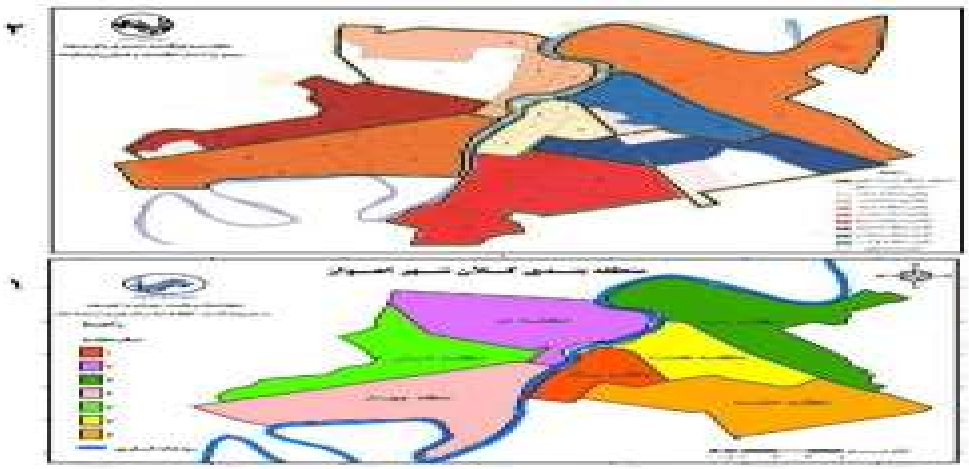

Figure 3: Location of the direct intervention area

4-1 Climate Conditions

Ahvaz has a hot and humid climate characterized by high temperatures, high surface evaporation rates, low precipitation, saline soil, sparse and scattered vegetation, short and humid winters, and high humidity most of the year.

4-2 Fault and Seismic Conditions

Considering the location of faults in Ahvaz city and the study area, the Ahvaz fault runs west to east through the city, and the Mosalla fault is immediately adjacent to the area of interest and holds special importance.

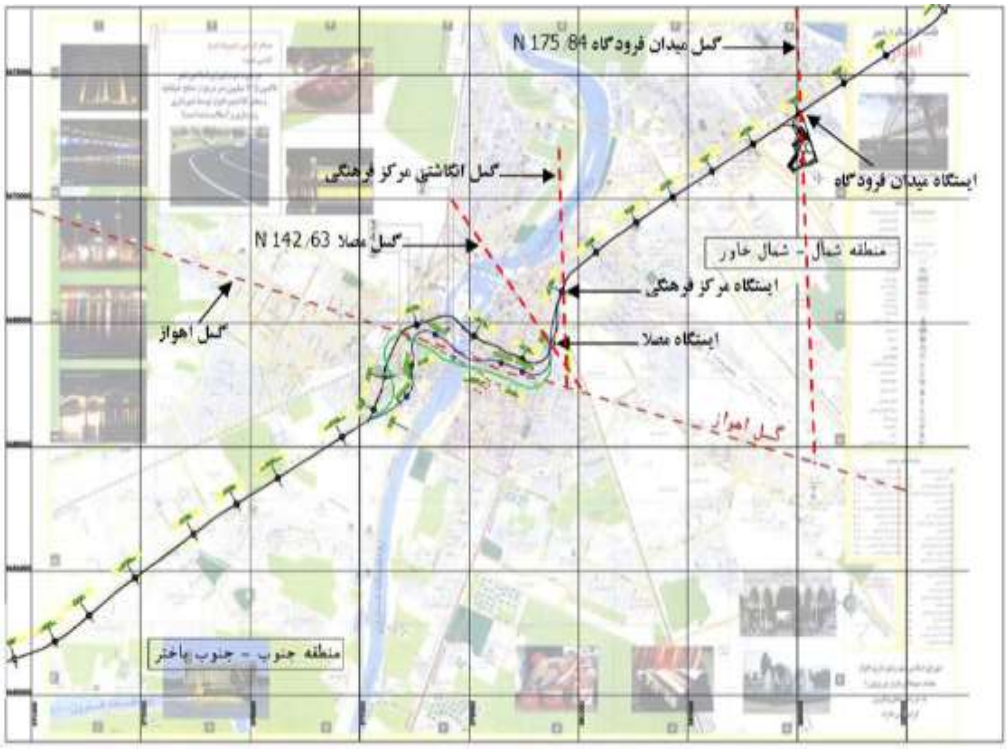

Figure 4 : Fault locations in Ahvaz city

Mosalla Fault

The Mosalla station is located on Ayatollah Behbahani highway, south of Mosalla and north of Abadan intersection. Initial geotechnical studies revealed heterogeneities in the thickness and continuity of subsurface layers of the Aghajari formation, indicating the presence of a significant fault. Excavation revealed a notable fault with an N142 strike and a dip of 63 degrees toward the east to northeast. The measured vertical displacement is approximately 1.5 meters. Coordinates for this fault sampling location are Y=3467610, X=280475, and it can be classified as one of the main linear fault structures (Azhdari & Paydar, 2014).

4-3 Land Price Structure

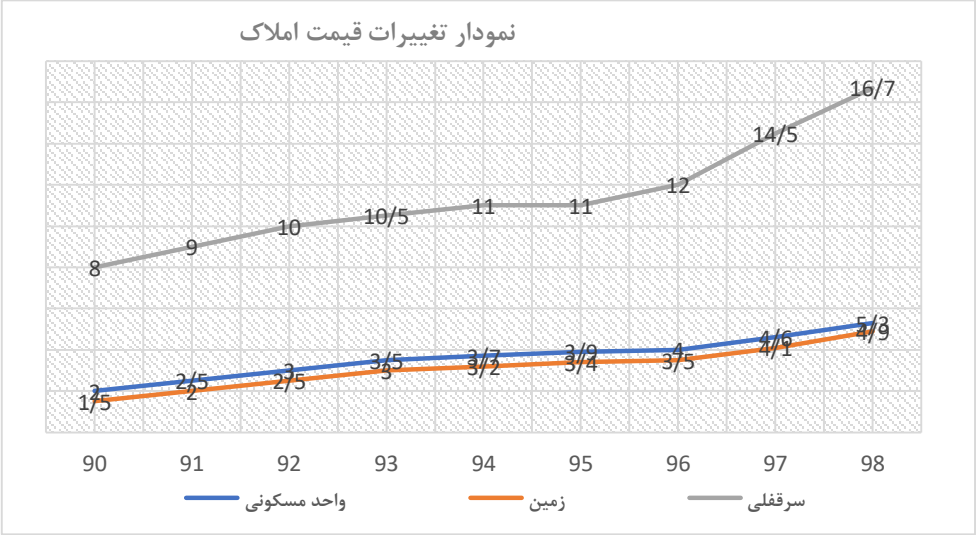

Figure 5 : Property price changes from 2011 to 2019

Price slopes for residential units, land, and leaseholds showed significant growth from 2011 to 2014, followed by a recession cycle from 2014 to 2017, and an upward trend starting in early 2018. It is noted that land and building prices in Iran do not follow global cycles; after a boom period, prices do not decrease during recessions but rather stabilize until the next boom cycle begins.

4-4 Land Use

The study area is predominantly residential, alongside commercial, educational, religious, administrative, service, cultural, higher education, parks and green spaces, sports, and medical uses. Documentation is shown in the map below.

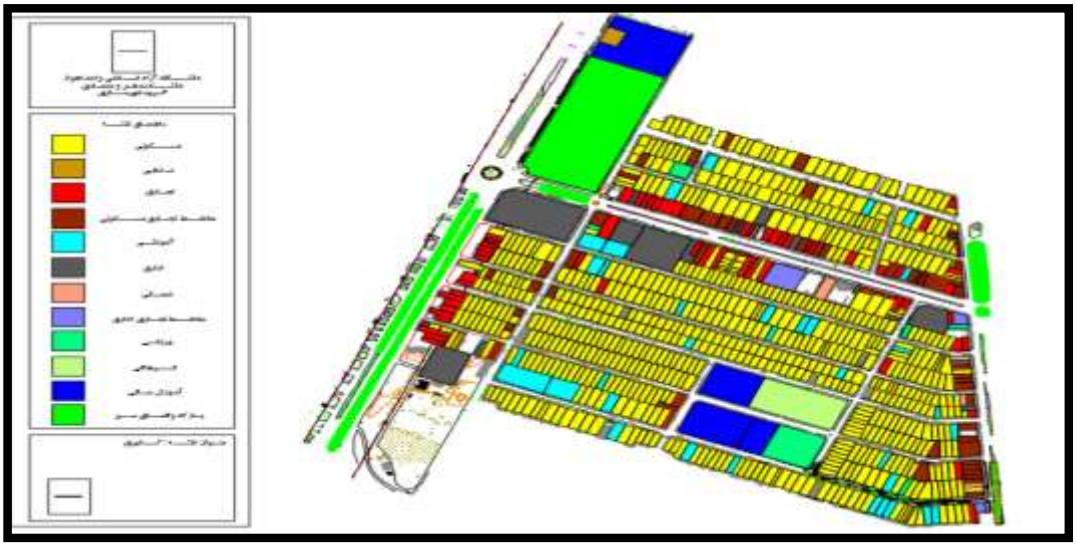

Figure 6 : Land use map of Padadshahr neighborhood

Table 5 : Fuel Stations (Source: National Iranian Oil Products Distribution Company, Khuzestan region)

No.	Station Name	Address	Number of Pumps	Distributed Products
1	Saedi	South end - Shariati St.	9	Gasoline
2	Zibashahr	Next to Road Block	10	Gasoline
3	Baset	East end of Imam Khomeini St.	12	Gasoline and CNG
4	Company Station 3	Abadan Intersection	20	Gasoline

4-5 External Spatial Development Capacity

Figure 7: External development

Considering the figure below, outside the study boundary (red dashed line), there is a relatively suitable land area (green dashed line) for development, partially designated for sports use (playground) and mostly allocated to green space according to upstream plans. Therefore, suggestions and instructions for space use during crises will be provided.

5- Findings

Based on the status assessment of the study area, it is noted that the area is important in terms of threat vulnerability and opportunities such as the amusement park and Javad Al-Aemeh park. Internal and external development lands are also significant. Threat points include sewage pumping stations and teachers' houses. Javad Al-Aemeh mosque is recognized as an important and functional landmark in the surrounding neighborhoods; although it is officially considered part of the Zibashahr neighborhood and omitted from main maps, this study addresses its effective role during crises.

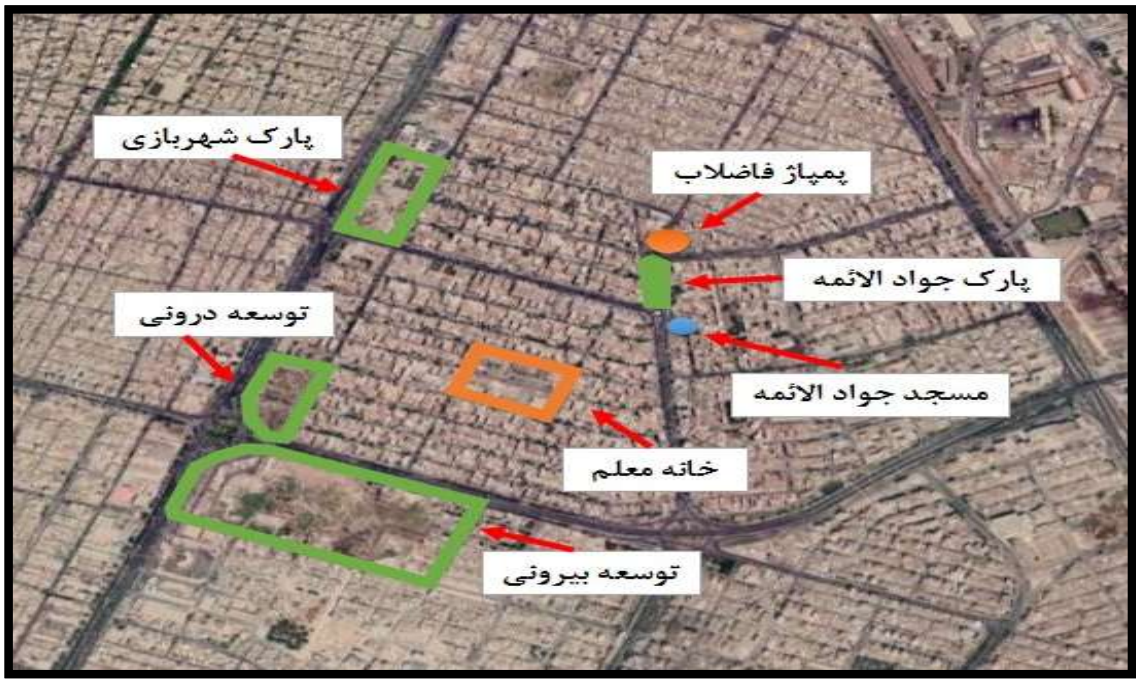

Figure 8 : Limitations and opportunities of the area

For optimal conditions in decision-making fields such as environmental, physical, functional, and social, strategic and executive policies have been formulated with micro and macro objectives, as shown below.

Figure 9 : Strategic ideas and goals

Weighting Alternatives Based on William Fine Evaluation

According to the options listed, weighting was performed, and options with rank H received the highest scores and were of lower importance but had higher risk levels. All options were assessed for reducing destructive effects in crisis conditions and ranked in the table below according to high, medium, and low levels. Each option was separately evaluated for all hazards mentioned in chapter two, and their average scores are shown below.

Table 6: Levels of proposed options in alternatives

Target Options	A	B	C	Rank Score	Level
Strengthening green spaces and trees	25	3	6	450	H
Creating decorative walls	25	3	6	450	H
Mosque as the main neighborhood landmark	5	1	2	10	L
Surrounding amusement park with mesh walls	15	2	6	180	M
Using appropriate furniture on main paths	15	2	6	180	M
Establishing camping sites	2	1	2	4	L
Necessary facilities and equipment for camps	2	1	2	4	L
Health, medical, and security services	2	1	2	4	L
Creating recesses in main path walls for shelter	15	2	6	180	M
Designating mosque as command and support center	2	1	2	4	L
Redesigning					

6-2- Proposed Examples of Temporary Shelter

For this purpose, many suggestions can be imagined, but achieving all these proposals is a very time-consuming and lengthy task and is not feasible within the scope of a single project. However, in general, the main goal of this research is to provide a design model for temporary shelter that creates an opportunity for architects and designers to achieve the most optimal choice for the model and site design of temporary shelter according to the mentioned guidelines. This research aims to find a pattern of instructions and guidelines for architects, designers, and relevant authorities in governorates and provincial offices so that, in times of need for temporary shelter, a proper design can provide the highest efficiency for the users. Some of these efficiencies are as follows:

- Should be quick, cheap, and economical to install so that it is cost-effective for the responsible parties.
- Should meet the needs of the users to encourage their willingness to use it.
- Should be manufacturable domestically and able to be designed and produced using existing industries.

There are generally three options for settling temporary housing for people affected by a natural disaster or a man-made incident. It can be considered that depending on the type of event, the number of homeless people, political issues, and the community's capacity to deal with specific disasters are defined:

1. People remain in the area and tend to settle near their destroyed homes. This mostly happens following earthquakes.
2. People leave their homes and settle in host communities, government buildings, or collective spaces. This usually occurs after storms, floods, wars, or ethnic conflicts.
3. People leave their homes but remain as a group. In this case, establishing temporary camps for displaced people who are forced to leave their homes and living areas is necessary. In these conditions, people generally live in relatively large groups for an unspecified time. Planning and designing camps and temporary settlements respond to the needs of people requiring safe accommodation.

Characteristics of shelters for the homeless after disasters:

- Easily transferable.
- Protect residents from weather conditions.
- Cannot be set up by a single household alone.
- Made from suitable and economical quality materials.
- Materials used should be recyclable.
- Not expensive.
- Provide private and peaceful space for residents.
- Meet various social and physical activities and functions of the household.
- Allow for future expansion and use (permanent housing).
- Protect the remaining belongings of the household.
- Be durable.

6-3- Suggestions for Researchers and Future Studies

Every research encounters limitations during its process, and this study is no exception. Considering recent rains in November and December 2019, which were outside the timeframe of this study, it seems soil liquefaction and ground subsidence should also be considered as natural hazards. This study has tried to use existing studies to provide a design model compatible with environmental conditions, leading to design rules and guidelines to pave the way for future research on temporary shelter design. Therefore, architects and designers in the relevant field can design multi-purpose sites in specified locations (such as the city amusement park, Javad Al-Aemmeh Park, and ready land plots within the internal and external development of the study area), using the given guidelines and standards, to ensure the design achieves the lowest level of risk in critical situations. This will help minimize damages and losses in these sites during emergencies and crises.

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