



# Proposing a Model for the Design of Post-Disaster Temporary Housing Based on the Needs of the Injured with Post-Implementation Evaluation Approach (Case Study: Earthquake-Stricken Villages in Heris of East Azerbaijan)

Maziar Asefi <sup>\*1</sup> - Shahin Farrokhi <sup>2</sup>

1- Associate Professor, Faculty of Architecture and Urbanism, Tabriz Islamic Art University, Tabriz, Iran

2- Ph.D. Candidate in Islamic Architecture, Tabriz Islamic Art University, Tabriz, Iran

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## Abstract

**Purpose:** This study aimed to design a temporary housing pattern tailored to the needs of the injured after a natural disaster.

**Design/methodology/approach:** This study had an applied objective and employed a descriptive-analytical method with an approach to survey and post-implementation evaluation. The criteria for temporary accommodation design were collected through library research and the victims' satisfaction of these criteria was considered through field research. The criteria included socio-cultural, physical-functional and technical-structural elements. Field research was carried out in 10 villages of Heris County, East Azerbaijan, which were destroyed completely by earthquake in 2012. Field research was conducted through user-oriented procedures of questionnaires, interviews and field observations. In total, the criteria were evaluated in separate tables based on the Likert spectrum.

**Findings:** The results indicated that the victims were dissatisfied with temporary resettlement after the earthquake in all three criteria.

**Research limitations/implications:** The main limitation of this study was the high cost of numerous visits to villages and low willingness of their inhabitants to cooperate with interviewers and answer the questions for various reasons.

**Practical implications:** Improvement strategies were proposed to enhance the quality temporary housing through organized interviews with the injured. Suggestions made by experts led to proposing some improvement strategies as well. Finally, the design of the temporary housing model was put forward in accordance with these solutions.

**Originality/value:** This article initiated an innovative design of temporary housing which was tailored to the needs of those who had experienced the disaster based on their perceptions, not merely based on existing theoretical foundations.

**Key words:** Design, pattern, earthquake, temporary housing, earthquake-stricken villages of Heris, East Azerbaijan.

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## 1. INTRODUCTION

**N**owadays, Natural disasters have become an important and undeniable research issue that has engaged many researchers worldwide. (Sadeghi Jadidi, Goli Ali, Hatef Nader, 2016).

Iran is one of the five earthquake-stricken countries in the world, being located on the Alpine-Himalayan orogenic belt. Engineering statistics and probabilities indicate that, on average, a severe earthquake occurs every four years in Iran. These earthquakes result in the destruction of 97% of rural housing in the earthquake-stricken area (Shafaei & Madani, 2011). After the occurrence of the natural disasters, people suffer from severe mental conditions due to loss of their families and dispersion of their properties and houses and they require a safe and peaceful shelter to gradually return to their normal lives (Asefi, 2009). Loss of dwelling is the loss of dignity, identity and privacy rather than a physical deprivation; hence, the design, planning and provision of minimum standards for emergent temporary settlements are of the basic rights and needs of to the victims of disasters or conflicts. Meanwhile, shelter plays a crucial role in preserving and rescuing people at an early stage of the disaster just like water, sanitation, nutrition and mental care. Provision of shelter is necessary as it protects against diseases and a variety of dangers and it is of great importance to preserve human dignity within a family and social system in difficult circumstances. In fact, sheltering includes choosing the right place and plan to meet the basic personal, family and social needs in order to create a healthy, safe and relatively comfortable environment for living (Fallahi, 2007). This is more important in rural areas. As most of their activities are carried out at home, their economic, cultural and social affairs would vanish if they lose their homes and they would need a shelter to carry out their activities. In addition, the collective life of the villagers makes their temporary housing distinct from that of urban areas. Given the evidence and documents available and despite the numerous studies already carried out in this regard, it seems that no proper shelter has been proposed in accordance with the culture, lifestyle and livelihood of the villagers and in most cases, they lack the necessary resistance to atmospheric conditions. Therefore, the study seeks to evaluate the post-earthquake temporary accommodation, to offer solutions for its quality improvement and to design

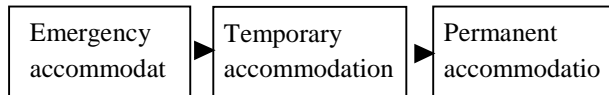
temporary housing in accordance with the needs of the victims. The questions investigated in this study included: 1. what criteria and design strategies are considered for temporary housing; 2. which characteristics and elements affect the individual satisfaction with temporary accommodation 3. What kind of temporary properties makes houses capable of meeting the needs of the injured; and 4. how a temporary housing plan for villagers should be.

In the summer of 2012, a moderate earthquake (measuring 6.2 on the Richter scale) destroyed a large part of the villages Varzaghan, Ahar, and Heris. Many rural dwellings were destroyed in addition to physical, psychological and financial losses. Since the design of temporary accommodation has not been assessed from the villagers' point of view, this study can be regarded as a small but valuable step towards planning and designing temporary housing.

## 2. Research Theoretical Literature

The occurrence of natural disasters, such as earthquakes, has often got destructive effects in geographic areas, especially in rural areas. Being considered a serious risk, natural disasters often endanger health of the inhabitants, especially the elderly and children, as they have a huge impact on inhabitants' income and biological resources (Barghi, Hashemi, Jafari, 2017). Therefore, dwelling is one of the basic needs of the people who have experienced the bitter taste of a catastrophe. Since construction of post-traumatic houses for refugees requires a lot of time and money, the issue of temporary accommodation is raised and found to be of utmost importance (Asadi Nazari, 2004). The concept of temporary housing is a combination of both physical and non-physical aspects of shelter and post-disaster habitats. Therefore, a temporary settlement can be a set of activities including the collection and identification of injured and homeless people, transferring them to the shelter and providing safe and hygienic living conditions until return to their primary habitat. The duration of temporary accommodation is estimated from 6 months to 2 years according to the circumstances, type of crisis and facilities and some scholars and resettlement agencies consider temporary shelters as the primary source of permanent residency (Fallahi, 2007). In emergency literature, suitable shelter and accommodation for refugees encompasses a continuous flow of emergency to

permanent housing, usually classified as 3 groups of emergency, temporary and permanent accommodation (Fig. 1).



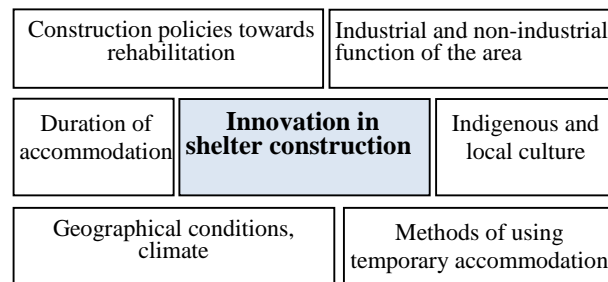
**Figure 1. Process of providing permanent settlement after an incident**

(Source: Research findings, 2017)

Emergency accommodation refers to conditions in which survivors of an accident seek a place outside their permanent house to reside for a short period; temporary accommodation includes conditions in which survived families continue their daily activities and responsibilities in their new dwelling, being aware that their living conditions are no more emergency. Permanent accommodation refers to

when survivors return to their permanent homes (Quarantelli, 1995).

There is a widespread debate over temporary accommodation as the middle stage between emergency and permanent accommodation, but creative, innovative, and somewhat indigenous methods for construction of temporary shelters are indisputable. What has been seen in previous earthquakes illustrates the variability of such individual creativity and indigenous initiatives due to factors such as geographical conditions of the region, climatic conditions, indigenous and local culture (urban or rural), industrial and non-industrial functions of areas, construction conditions during rehabilitation, duration of temporary accommodation, methods of using temporary accommodation and so on (Omidvar, Qasemi, Zafari, 2007). These factors can be represented as follows (Fig. 2).



**Figure 2. Effective factors of innovation in shelter construction**

(Source: Omidvar et al, 2007)

In order to provide all with essential facilities and achieve a suitable residence in post-earthquake temporary housing, it was necessary to investigate, analyze and evaluate case studies of post-accident temporary accommodation used in the past events and determine features, advantages and disadvantages of this type of housing; this led to employment of advantages in the new design and prevention of the factors that caused dissatisfaction among victims of earthquakes. In Table 1, a few examples of temporary accommodation used after earthquake in Iran and out of it are investigated.

**Table 1. Post-disaster experiences of temporary housing**

(Source: Research findings, 2017)

Type	Date and location of disaster	Features and disadvantages	Reference
Tent	Bam earthquake in 2003	Inadequate strength of tents for long-term use Poor insulation of tents against environmental factors Inadequate space inside tents Plastic sheets used to prevent penetration of rain into tents, due to poor insulation High cost of conex boxes	Fallahi, 2003
	Lorestan earthquake in 2006	Poor protection of properties, cattle and food supply Inadequate space for a family Rapid decay	Omidvar et al, 2007: 42

**Table 1.**

Type	Date and location of disaster	Features and disadvantages	Reference
	Varzeqan and Ahar earthquake in 2012	Insufficient sanitation in temporary housing Large size of household's vs inadequate living space inside tents and conex boxes Contamination and poor ventilation inside tents Problems caused by collective living in temporary dwellings Cooking and heating problems inside tents	
Conex box	Italy earthquakes in 1968, 1976, 1980	People's dissatisfaction with imported conex boxes Long process of reconstruction and people's misunderstanding about their temporary and permanent dwellings, vast changes applied by people in facades and interiors High cost of this type of prefabricated temporary housing	Authors' observations
	Japan earthquake in 1995	Inappropriate design for the disabled Great height of showers and bathrooms Ramps not applicable for the disabled and elderly due to technical factors Inadequate space for temporary settlement of large families	
	Gujarat (India) earthquake in 2001	Providing shelter by NGOs using public funds and suitable materials Supplying construction materials merely to build shelters for refugees	
	Southeast Asia tsunami in 2004	Inadequacy of metal buildings due to sunlight High cost of prefabricated buildings	Fallahi, 2007
	Muzaffarabad (Pakistan) earthquake in 2005	Migration to areas far from earthquake-stricken lands Settlement of some households in camps and their relatives' homes Abandonment of some buildings not seriously damaged	
	Reconstruction of Qir and Karzin county in 1977	Construction of units using precast reinforced concrete Incompatibility of dwellings with climate High cost of repair and maintenance Using the units as recreation or sports center in the present	Fallahi, 2007
	Manjil-Rudbar earthquake in 1990	Temporary housing using traditional thatching technique (a kind of vernacular construction system) Floor area of 12-14 m <sup>2</sup> Wood structures Adequate resistance to slide	Fallahi, 2007
	Gilan and Zanjan earthquake in 1990	Construction of temporary dwellings by people at a price of 20000 Tomans using construction materials	Fallahi, 2003

The advantages and disadvantages of tents as temporary housings can be categorized as follows (Table 2). As seen in the table, the use of tents as

temporary housing is not appropriate for the injured, due to their numerous disadvantages.

**Table 2. Advantages and disadvantages of tent as the most commonly used type of temporary housing after accidents**

(Source: Research findings, 2017)

Advantages	Disadvantages
Light weight, compacted, portable and quickly mounted Easy storage Available at emergency supplies provided by rescue teams Significant appearance which indicates the rescue organizations in attendance and pacifies the victims relatively easy provision and transport to the accident site Not changeable to permanent dwellings, opposed to other temporary housing types	Excessive heat inside tents Inadequate space inside tents, inappropriate entrance door and lack of privacy Problems with collective living inside tents Sanitation problems (pre-fab bathrooms, etc.) Inadequate wind resistance in tents supported by tensile tools (ropes and pins) Inadequate height of tents (people can stand up only at the central part pf tent) Poor ventilation and daylighting due to inadequate number and area of windows Penetration of water, dust and polluted stuff due to the same level of tent floor and the ground Inadequate protection of individual properties, cattle and food supply

About US \$5, in 2017.

Given the importance of temporary housing in post-accident reconstruction, many researchers and experts have proposed solutions in order to improve temporary settlement, properly help the victims and

provide them with relative comfort and peace. Some experts and their opinions are listed in the table below (Table 3).

**Table 3. Solutions for improvement of temporary dwellings from the experts' views**

(Source: Research findings, 2017)

Social-cultural	Safety	Safety and resistance to environmental factors	Omidvar et al, 2007
		Respect for safety precautions	Khorrarn et al, 2014
		Psychological security	Saedi Khameneh & Hoseini, 2010
		Insecurity and fear of somebody's life	Fallahi, 2007
		Protection from crimes	Mohammadzadeh & Farrokhi, 2015
	Risk of trust (possibility of leaving children alone)	Bahreini & Akhundi, 2000	
	Privacy	Protection of indoors from others' interference, dominance or control	Asefi & Ahmadnejad, 2016
		Respect for private spaces and individual privacy	Khorrarn et al, 2014
		Provision of privacy and loneliness	Bahreini & Akhundi, 2000
	Participation	Participation in construction	Saedi Khameneh & Hoseini, 2010
		Participation in forming the place	Asefi & Farrokhi, 2016
		Coordination with executive authorities	Fallahi, 2007
	Environmental perception	User comfort	Saedi Khameneh & Hoseini, 2010
		Vitality of resettlement environment	Johnson Cassidy, 2007
		Discipline and tidiness of the environment	Saedi Khameneh & Hoseini, 2010
User culture	Suitable types of tents in accordance with victims' culture and lifestyle (Urban or rural life)	Omidvar et al, 2007	
	Particular identity	Khodadadeh & Ziaee, 2007	
Physical-functional	Walls and floor	Material (hard-wearing fabric, durable, water-proof, fire-resistant, affordable, resistant to environmental factors and decay)	Fallahi, 2007
		Color (bright colored fabric with dark colors in the most polluted parts of tent)	Khodadadeh & Ziaee, 2007
		Resistant to decay, waterproof protective layer, low heat transfer to the tent	Khodadadeh & Ziaee, 2007
	Sanitation	Ability to waste management	Mohammadzadeh & Farrokhi, 2015
		Appropriate quality of place and health care factors	Mohammadzadeh & Farrokhi, 2015
		Sanitation facilities	Mohammadzadeh & Farrokhi, 2015
	Justice	A just distribution of temporary housing among victims	Fallahi, 2007
	Form	A product with a nice simple look	Bemanian & Bakhtiaran, 2013
		Form in accordance with the function	Nickravan Monfared, 2007
		Using simple forms and avoiding complications	Khodadadeh & Ziaee, 2007
	Architecture and design	Usable for various areas	Asefi & Farrokhi, 2016
		Adequate living space	Khodadadeh & Ziaee, 2007
		Attention to the size of tents according to the household size	Asefi, Farrokhi, nesarnobari, (2016)
		Separation of spaces	Asefi, Farrokhi, nesarnobari, (2016)
	Technical-structural	Utilities and energy	Protection against heat, cold, wind and rain
Proper indoor ventilation			Omidvar et al, 2007
Daylighting (increasing the number and area of windows)			Khorrarn et al, 2014
Provision of adequate heating and cooling systems			Mohammadzadeh & Farrokhi, 2015
Possibility of installing a heater chimney and fan			Mohammadzadeh & Farrokhi, 2015
Maintenance, installation and setup		Compacted volume in pre-setting mode	Johnson Cassidy, 2007
		Easy storage conditions	Bemanian & Bakhtiaran, 2013
		Easy to transport	Sartipipour, 2011
		Easy to install and mount	Khodadadeh & Ziaee, 2007
		Ability to reuse temporary housing	Khodadadeh & Ziaee, 2007



**Table 3.**

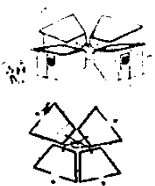



Technical-structural		Easy and non-polluting dismantling	Dadashpoor et al, 2012
	Technical and structural issues	Possibility of prefabrication	Bemanian & Bakhtiarian, 2013
		Light weight, durability and structural strength	Nickravan Monfared, 2007
		Few types and number of connection and fast construction	Fallahi, 2007
		Ability to replace components	Asefi & Ahmadnejad, 2016
	Vernacular solutions	Available materials and native labor force	Bahrololuni & Omid Avaj, 2014
		Vernacular construction method	Bemanian & Bakhtiarian, 2013

Many famous designers and architects have proposed a variety of shelters and models in recent decades. Many ideas have been developed as prototypes, and despite industrial mass production of some products, their application for homeless people has often led to unsuspecting failures. The

current experience suggests that those temporary shelters used by homeless people are surprisingly affected by alteration, addition or elimination of space so it has made these units more vulnerable and most proposals have failed consequently (Fallahi 2007). Table 4 gives an example of these proposals.

**Table 4. The history of the design of temporary housing units**

(Source: Authors, based on research by Fallahi, 2007)


Designer	Type of temporary settlement	Proposal	Properties	Disadvantages
Alvar Aalto	Four-part units		It can turn to 4 separate units, suiting 4 groups. Ready to use when trucked to the site A shared central heating unit is embedded among 4-part units. Portability	Refugees did not welcome it.
Italian designers	A plan for residential units		A design of 70's that became common for emergency or temporary use.	It has not yet been mass-produced and used.
Friez	A shelter for hope		An inclusive design Transportable and quickly-mounted Establishment in the form of interconnected or isolated modules	Not being used in accidents, not applying indigenous materials and solutions
Variety of designers	Made of plywood		Easily mounted Used in Katrina's tornado in the United States	Applicable in areas where wood materials are abundant.
	A semi-permanent room	-	Sometimes equipped with heater Mounted using injection molding foam.	Ready to use when material and molds are trucked to the site





Tents are usually used as temporary post-disaster settlements in Iran. Therefore, considering the large number of tents used as temporary accommodation in Iran, it is important to examine and analyze the qualities of this type of dwellings. Table 5 presents patterns, features and drawbacks of tents.

According to previous studies, despite the variety and special characteristics of each tent, they are not a suitable model for temporary settlement, as they do not provide comfort, calmness and security for survivors in most cases.

**Table 5. Examples of tents for temporary dwelling and their features and drawbacks**

(Source: Research findings, 2017)

Examples of tents used in emergency	Title	Form	Features	Drawbacks
	Dymax emergency relief shelter		Open at the ends either, with no cover No mat considered for that	Individual privacy not ensured The rush of water and mud on rainy days

Camping tent		Used in the tsunami in 2004 Packed inside a box	Suitable for short run use, not durable
Paratech tent		An airborne tent whose structure is blown by air compressor to support the whole tent.	Produced and mounted at a high cost, individually used only in special circumstances
UniFold folding shelter tent		Designed and constructed by Steven Ostrovsky	High cost No opening for ventilation
Springy tent		Designed by Khodadadeh and Ziaee Mounted as a self-supported unit with no need to ropes to create tensile forces	Inadequate space inside the tent Individual privacy not ensured

## 2. Research Methodology

### 2.1. Geographical Scope of the Research

Completely destroyed villages of the north Mavazekhan rural district were selected in order to evaluate the temporary housing provided for the villagers and their satisfaction and to identify the strengths and weaknesses of the temporary housing. Since a total number 49 villages were destroyed in the earthquake in East Azerbaijan in 2012, villages that were very similar to each other in terms of culture, climate, economy, technology, livelihood and lifestyle were chosen to be studied; accordingly, a densely populated area was selected from 100%

destroyed rural areas. The villages of Afshard, Chubanlar Sardarloo, Bajabaj, Chay Kandy, Sarand, Chakhmagh Bolagh Sofla, Chakhmagh Bolagh Olia, and Sorkkeh Gav were studied amongst the villages in northern Mavazekhan rural district, Heris County (Fig. 3). In all these villages, temporary housing was often provided after the earthquake in the form of tents or temporary residential units for the injured (Fig. 4).

Subsequently, the number of interviewees from each village was determined using the Cochran formula. Therefore, on average, 20 people were randomly selected from each village for interview.

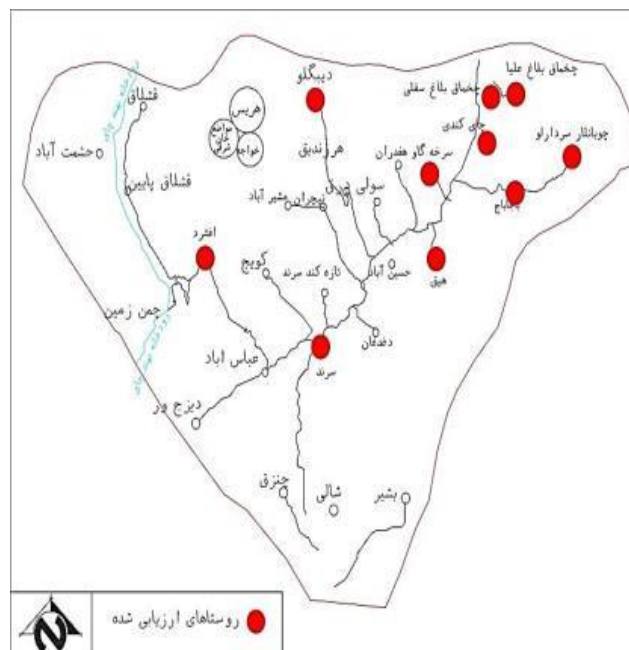


Figure 3. Villages studied in northern Mavazekhan rural district, Heris County (Source: Research findings, 2017)



**Figure 4. Temporary housing in the studied area**  
(Source: Research findings, 2017)

**2.2. Methodology**

This paper is an applied post-implementation study employing the descriptive-analytical method. The information was collected through library research and field studies and according to the provided data, temporary housing is designed and constructed (Fig. 5). The study mainly focused on identifying qualitative components needed for the optimal design of temporary housing after an earthquake. The criteria were chosen through a comparative analogy between the extracted measurements and the characteristics of previous temporary housing. Certain methods of field observations such as questionnaires and oral interviews were used to assess each criterion and its quality. A user-oriented approach was adopted to study and evaluate shelter

standards. The user-oriented design approach has proven to be effective in generating products with the highest efficiency and adaptation to the demands of the consumers. To examine the temporary accommodation and satisfaction and discover its strengths and weaknesses in the next step, the criteria were evaluated in separate tables using the Likert spectrum; in each table, the sum of standard grades was the lowest when all factors were equal to 1 and the highest when all items were multiplied by factor 5 and the score of each table is ranged from the number of items × 1 to the number of items × 5. Three qualities types of good, moderate and poor were analyzed according to the following equation. (Salimi, Shahbaz Moradi, Bamdad Sufi, 2008).

$$\left. \begin{array}{l} \text{Score of each table} = a \\ \text{Max } a - \text{min } a = b \end{array} \right\} \Rightarrow \left\{ \begin{array}{l} \text{Items} \times 1 = \text{min } a \\ \text{Items} \times 1 = \text{max } a \end{array} \right. \Rightarrow \left\{ \begin{array}{l} \text{Poor quality} = (\text{Min } a - b/3), \\ \text{Medium quality} = (b/3 - 2b/3), \\ \text{Good quality} = (2b/3 - \text{max } a) \end{array} \right.$$

The final stage, a temporary housing was designed for rural refugees using strategies from organized interviews with the injured and according to the criteria obtained from library and field studies.

**1. 4. Research Findings**

In general, research findings are classified as social-cultural, physical-functional and technical-structural criteria as follows:

**Assessment of social-cultural criteria-** As the results of evaluation showed, the rural victims were less satisfied with safety elements including safety and resistance to environmental factors, respect for safety precautions, psychological security and risk of trust and possibility of leaving children alone in temporary dwellings, while they have a moderate satisfaction with protection from crime. None of the

elements of privacy satisfied the people in the settlement area, including protection of indoors from others' interference, dominance or control, respect for private spaces and individual privacy and provision of privacy and loneliness. Meanwhile, participation is the only social criterion that the victims were satisfied with. This included participation in construction, participation in forming the place and coordination with executive authorities. There is a lot of discontent with environmental perception which includes user comfort, vitality of resettlement environment and discipline and tidiness of the environment. Lack of



suitable types of tents that satisfy villagers' needs based on rural culture and the particular identity

were another reason for the villagers' dissatisfaction (Fig. 6).

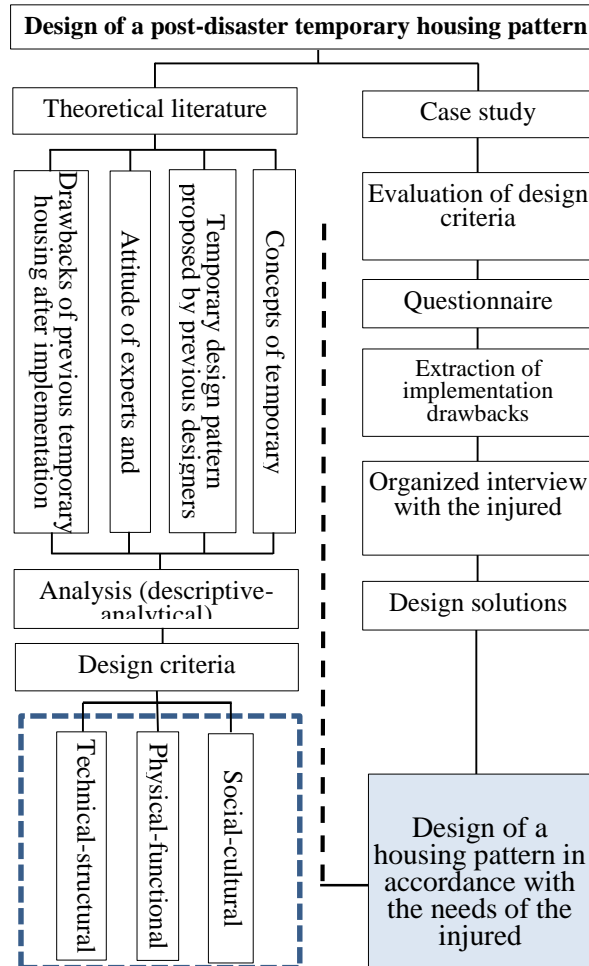


Figure 5. Conceptual model of the research' (Source: Research findings, 2017)

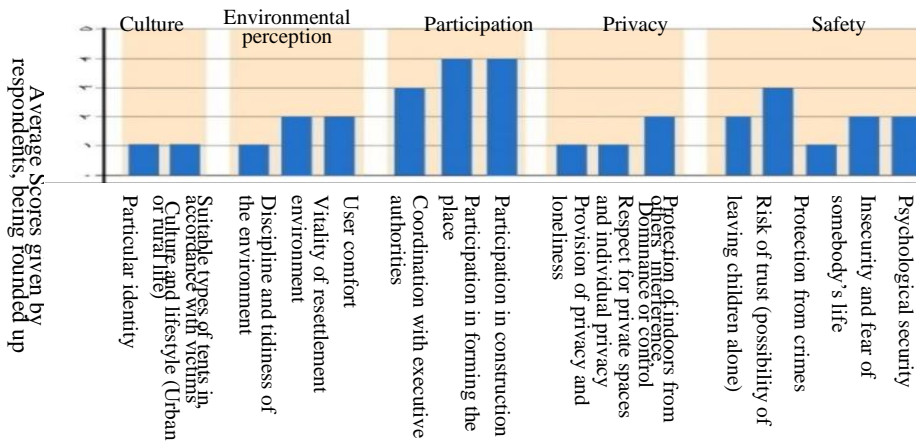
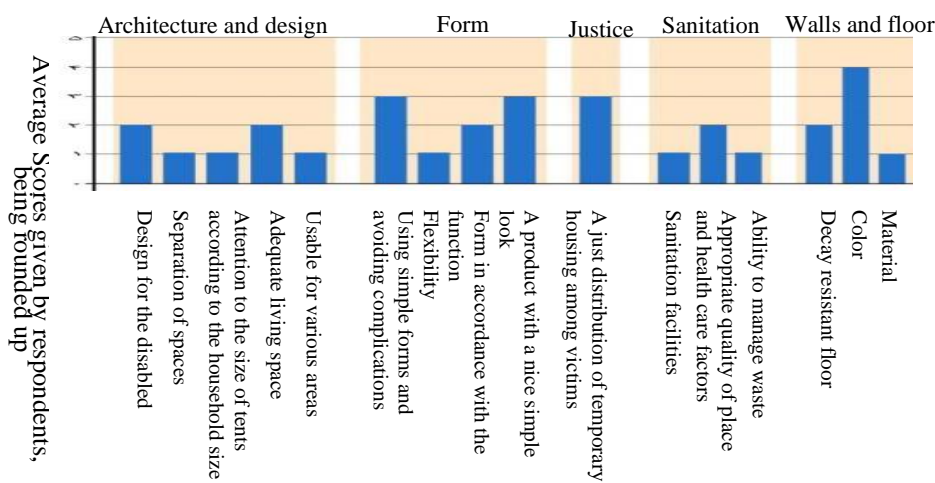


Figure 6. Results of evaluation of social-cultural criteria for temporary housing (Source: research findings, 2017)

**Assessment of physical-functional criteria-** The results of physical elements of temporary housing indicated that the victims were rarely satisfied with elements of wall and floor, including the material and resistance of temporary housing, while they were fairly satisfied with the color. There was a slight satisfaction with all elements of sanitation including ability to manage waste, appropriate quality of place and health care factors and sanitation facilities.

The element of a just distribution of temporary housing among victims also receives moderate

satisfaction. People expressed less satisfaction with inadaptable and inflexible temporary housing, which is considered as an element of the form, and a modest satisfaction with its simple appearance. They felt discontented with all elements of the architecture and design that included being usable for various areas, adequate living space, attention to the size of tents according to the household size, separation of spaces and design for the disabled (Fig. 7).



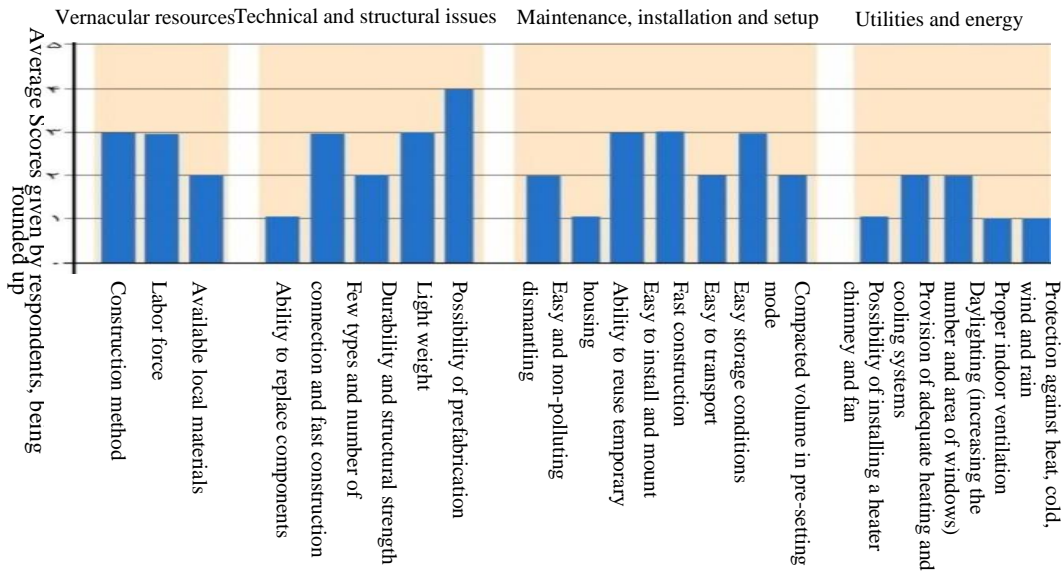
**Figure 7. Results of evaluation of physical-functional criteria for temporary housing**

(Source: Research findings, 2017)

#### **Assessment of the technical-structural criteria-**

The results of the evaluation of technical-structural criteria demonstrated that the villagers expressed little satisfaction with elements of the utilities and energy including protection against heat, cold, wind and rain, proper indoor ventilation, daylight (increasing the number and area of windows) and possibility of installing a heater chimney and fan. The elements of maintenance, installation and setup also failed to satisfy the injured. The occupants have low satisfaction from compacted volume in pre- and post-setting mode, the strategy used for the transportation of their shelters. The result also shows that the provided shelters have less ability to be reused with minimal degree of environmental pollutions. It is also concluded that their shelters cannot be stored easily and require more time to be installed than expected. The technical and structural element was hardly satisfactory. This element includes durability, structural strength and ability to

replace components. However, moderate satisfaction was expressed with the weight and the number of connections used for installation. The degree of prefabrication is a promising points that most of the occupants are happy with it. Using non-vernacular materials was another factor of the rural residents' dissatisfaction with regard to local resources. Nevertheless, they were fairly satisfied with items of native labor force and vernacular construction methods (Fig. 8).



**Figure 8. Results of evaluation of technical-structural criteria for temporary housing**  
(Source: Research findings, 2017)

According to the score obtained for each item in the charts above, the total score of each element and the total score of each criterion was calculated. The victims were dissatisfied with all elements of the three criteria, while there was moderate satisfaction only with elements of maintenance, installation and setup, technical and structural issues and vernacular resources. Participation is the only element that had well satisfied the victims’ needs.

The final score of the elements and each criterion was calculated as follows: given that the sum of standard grades of each table is the lowest when all items are multiplied by factor 1 and the highest corresponds to the state where all items are multiplied by factor 5; the score of each table varies from number of items × 1 to the number of items × 5. Three qualities types of good, moderate and poor were analyzed according to the equation presented in the research method section. The final score of

the table is also calculated as follows: the score for the number of options checked out of the total weight of the item. Therefore, it can be said that scores of the social-cultural criterion with the range of 16-80 is classified as poor quality (16-37), moderate quality (38-59) and good quality (60-80); scores of the physical-functional criterion with the range of 17-85 is classified as poor quality (17-39), moderate quality (40-62) and good quality (63-85); and finally, The scores of the technical-structural criterion with the range of 25-100 is classified as poor quality (25-50), moderate quality (51-75) and good quality (76-100). In summary, according to the acquired data, the victims’ satisfaction with all three criteria falls into the poor quality with 32 scores for the social-cultural criterion, 28 scores for the physical-functional criterion and 44 scores for the technical-structural criterion (Table 6).

**Table 6. Victims’ satisfaction with elements of post-disaster temporary housing in villages of Heris, East Azerbaijan, Iran**

(Source: Research findings, 2017)

Criteria	Elements	score	Evaluation	Total score	Final evaluation
Social-cultural	Safety	10.25	Poor	32/80	Poor
	Privacy	4.15	Poor		
	Participation	11.15	Good		
	Environmental perception	5.15	Poor		
	User culture	2.10	Poor		
Physical-functional	Walls and floor	7.15	Poor	28/85	Poor
	Sanitation	4.15	Poor		

**Table 6.**

Criteria	Elements	score	Evaluation	Total score	Final evaluation
Physical - functional	Walls and floor	7.15	Poor	28/85	Poor
	Sanitation	4.15	Poor		
	Justice	1.5	Poor		
	Form	9.25	Poor		
	Architecture and design	7.25	Poor		
Technical-structural	Utilities and energy	7.25	Poor	44/100	Poor
	Maintenance, installation and setup	16.35	Moderate		
	Technical and structural issues	13.25	Moderate		
	Vernacular solutions	8.15	Moderate		

### Proposal 1 for temporary housing

Temporary housing solutions were developed according to the result gained from previous chapter in three main categories of social-cultural, physical-functional and technical-structural. The design considerations and were also summarized and obtained from the three main issues explained in the paper including 1) defects and shortcomings of temporary housing used in the recent disasters; 2) solutions suggested by experts and researchers to improve temporary housing; and 3) the results of the

questionnaires and interviews with the victims of 2012 Heris earthquake (Table 7). Therefore, proposals 1 and 2 were presented through an investigation into existing solutions for the provision of temporary housing in accordance with the needs of the injured as listed in Table 7. Considering different tastes of residents in choosing temporary housing and the type of suggested flexible structure, the victims will be able to select one of the two proposals for their temporary residence.

**Table 7. General and particular solutions to improve the design of temporary housing in Heris County**

(Source: Research findings, 2017)

Criteria	Elements	Scope	Solution
Social-cultural	Safety	General	Using durable material to construct temporary housing Using suitable coatings
		Particular	Setting family homes up beside each other
	Privacy	General	Delineating the temporary settlements Entrances not across each other
		Particular	Setting temporary dwellings at suitable distances from each other
	Participation	Particular	Participation in forming the place in coordination with executive authorities
	Environmental perception	General	Settlement where access to work is possible Temporary settlement with a specific order within the camp Provision of temporary entertainment for children
		Particular	Settlement near the stricken site but far away from debris
	User culture	Particular	Congruence between type of temporary housing and people's culture and lifestyle (rural or urban)
Physical-functional	Walls and floor	General	Using sturdy, water-proof, affordable, fire-resistant materials Using bright-colored textiles; using dark colors for the polluted parts (the floor)
	Sanitation	General	Installation of fixed trash bins with proper cap Provision of a large container to collect garbage Construction of temporary housing away from the waste Construction of bathrooms inside the temporary housing
	Form	General	simple elegant forms, avoiding complications Congruence between form and function
		Particular	Designed to be used as a warehouse later
Architecture and design	General	Separation of entrance and anteroom from main living room creating storage areas through dividing the interior space by shelves design for the disabled	

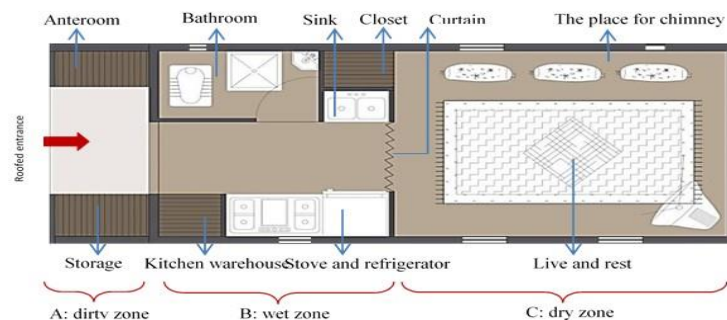
**Table 7.**

Criteria	Elements	Scope	Solution
	Architecture and design	General	Separation of spaces Design for various areas in accordance with user needs
		Particular	Specific identity in terms of general, technical and functional specifications
Technical-structural	Utilities and energy	General	Using double-layer floor Using Double-glazed windows Increasing the number and area of windows for better daylighting and ventilation Appropriate infrastructure like water supply Possibility of embedding chimneys, fans and stoves
	Maintenance, installation and setup	General	Compacted volume in pre-setting mode Easy storage conditions Easy to transport and install Fast construction Ability to reuse Easy to dismantle without pollution
	Technical and structural issues	General	Possibility of prefabrication light weight durability and structural strength Ability to repair and replace components Few types and number of connections

**Architectural plan of proposal 1-** Considering the proposed solutions in Table 7, attention should also be paid to the size and dimensions of each space (for example kitchen, sitting area, toilet, etc.). The plan of the proposed temporary accommodation was designed in accordance with the following points:

- 1) The plan has a simple, orthogonal scheme in order to have a coordination with rural homes and infuse the injured the sense of security confidence and visual comfort.
- 2) The plan is composed of three parts: A) Entrance (anteroom): the entrance area includes an anteroom and a storage space for the property left behind after the earthquake and it is in front of main door; this will keep the living space clean from contamination of shoes and prevents cold air flocs from entering the main space directly as it acts like a filter. Hence, the entrance area is referred to as the dirty space; B) Kitchen and bathroom: as the place for cooking,

washing the dishes and toilets, kitchen and bathroom are separated from the anteroom by a door. A warehouse was placed for storing kitchenware (dishes, powders, cooking utensils) in this space to prevent a mess inside the temporary housing. This part is referred to as the wet space in the temporary house. C) Living room: in order to preserve privacy and delineate space, this part is separated from cooking and sanitary facilities by a curtain. This space is 3 x 4 m, suitable for 4 people to rest and live in. Three windows are designed across each other to ventilate the space. The windows are embedded at a height of 1.70 m from the ground level, so that the privacy of individuals is preserved. Since heating appliances like heaters are a must in the area because of its mountainous and severely cold climates in most seasons, a space is considered for the installation of chimney (Fig. 9).

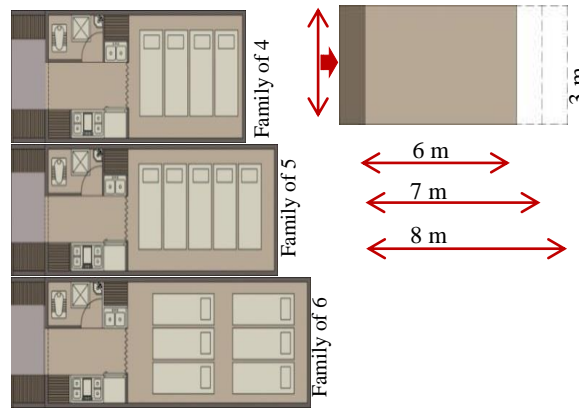


**Figure 9. Plan of the proposal for temporary housing**  
(Source: Research findings, 2017)



3) The general layout of the temporary housing is flexible and can transform and extend longitudinally, so it may suit households of 4 to 6

people (Fig. 10) (According to field studies, it is found that the households of 4-6 people have the maximum frequency).

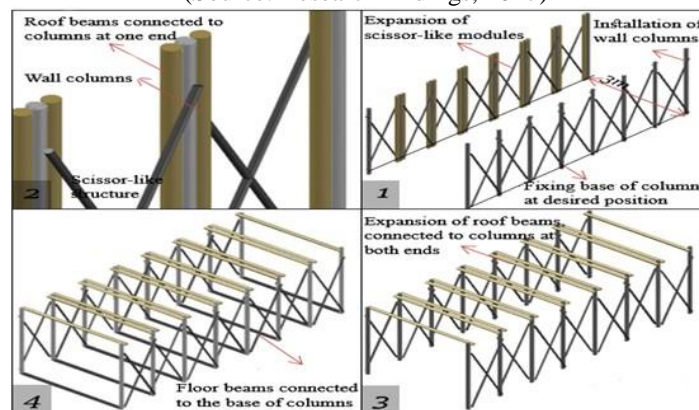


**Figure 10. Temporary housing proposal for various areas due to its longitudinal flexibility**  
(Source: Research findings, 2017)

**Proposed Structure-** The proposed structure is modular and has a stable form. It is easy to install and develop and its construction does not require sophisticated technology and experts so local people can set it up in some minutes. The structure of the shelter is a flexible interconnected structure made of aluminum profiles. The flexibility of the tent allows the area of temporary housing to be adjusted to the size of households and a module is expanded in longitudinal direction for the addition of one person. The structure is a scissor-like system prefabricated outside the site. The project involves various steps, such as installation of walls, ceilings and floors, explained below. The walls of the proposed design encompass columns in the form of modules of a single unit. The

columns are connected together by means of scissor-like elements. It is possible to fold the system longitudinally; the scissor-like elements allow the columns to be moved and fixed in the required location according to the user’s needs. (No. 1, Fig. 11); when the columns are expanded and fixed to desired position, the roof beams are added. The roof consists of prefabricated beams to bear its load, connected to the top of the columns of a wall at one end (No. 2, Fig. 11); they also connect to the opposite wall at another end after expansion (No. 3, Fig. 11). Subsequently, the floor should be implemented. For this purpose, the main beams are used to connect the base of the columns and make the structure useable (No. 4, Fig. 11).

**Figure 11. Steps of structural installation of the temporary shelter**  
(Source: Research findings, 2017)

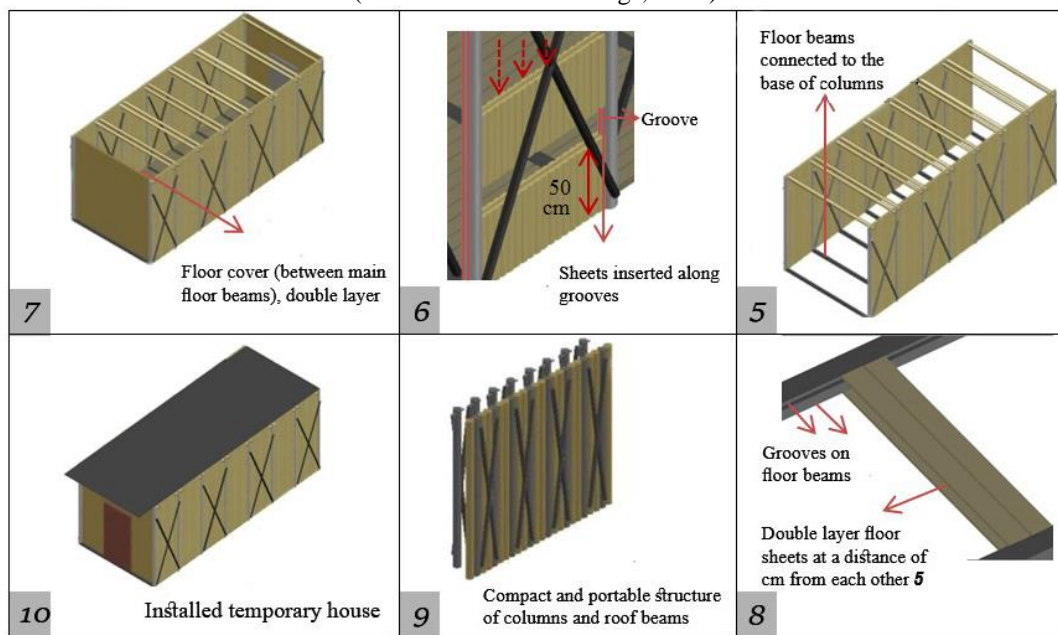


When the structure is assembled, it is necessary to fill the space between columns of walls on both sides, because the mountainous area is often cold and frosty, so it is better to cover the walls with two layers of insulated woodplast panels. Therefore, the walls will be covered by double-layer sheets, with the space between them filled with air to act as insulation and control the indoor temperature. This will solve the victims' problem in very cold climates of the region during the cold season. The sheets are also prefabricated and made of woodplast 50 cm piece. The sheets are placed on top of each other in order to create the required wall (No. 5, Fig. 12). In addition to the variety of colors, woodplast sheets provide strength and beauty for the wood. They also enjoy the following qualities: insulation, resistance to moisture, fungi, insects and fire while being completely recyclable. They slide into the grooves embedded on prefabricated columns from the upside (No. 6, Fig. 12). The sheets are precisely

inserted into grooves on columns; so there would not be any gap between the sheets and columns, preventing the air from entering through the gaps. The main beams of the floor are covered by two layers of insulated woodplast panels (No. 7, Fig. 12). Each layer consists of 15 sub-columns which are 10 cm in width and 1 m in length. These can be retracted on each other and transported in a packed state. It should be noted that the distance between the two layers of the floor is 5 cm. The existing space between the layers prevents moisture from entering the temporary house. The floor is embedded between two main columns which have grooves in the longitudinal direction. The transverse columns slide along the grooves to be fixed in desired position (No. 8, Fig. 12). Thus, the proposed temporary accommodation can be extracted and prepared for the injured (No. 10, Fig. 12) from its compact state (No. 9, Fig. 12).

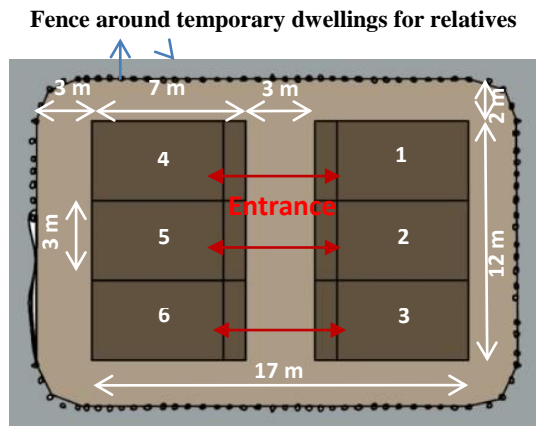
**Figure 12. The coverage of floor and walls in the proposed temporary housing**

(Source: Research findings, 2017)

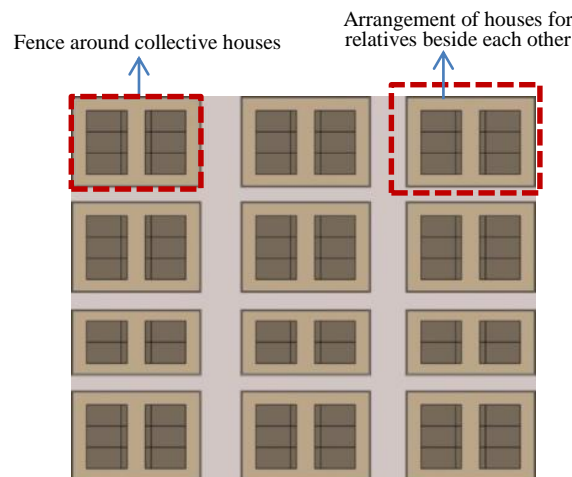


**How to set up a camp and a complex of proposed temporary housing-** In most rural areas, people tend to live in temporary accommodation with their relatives. This has the benefit of helping others when needed and feeling more secure. Therefore, it is attempted to consider a temporary housing camp made up of a series of temporary houses that belong

to relatives clustered together while separated from other temporary dwellings by fences (Fig. 13). The camp is formed through the organization of groups of temporary shelters beside each other. It is better to organize them orderly in order to facilitate the provision of services (Fig. 14).



**Figure 13. Arrangement of temporary shelters for relatives being together**  
(Source: Research findings, 2017)



**Figure 14. Arrangement of temporary shelters for relatives within a camp**  
(Source: Research findings, 2017)

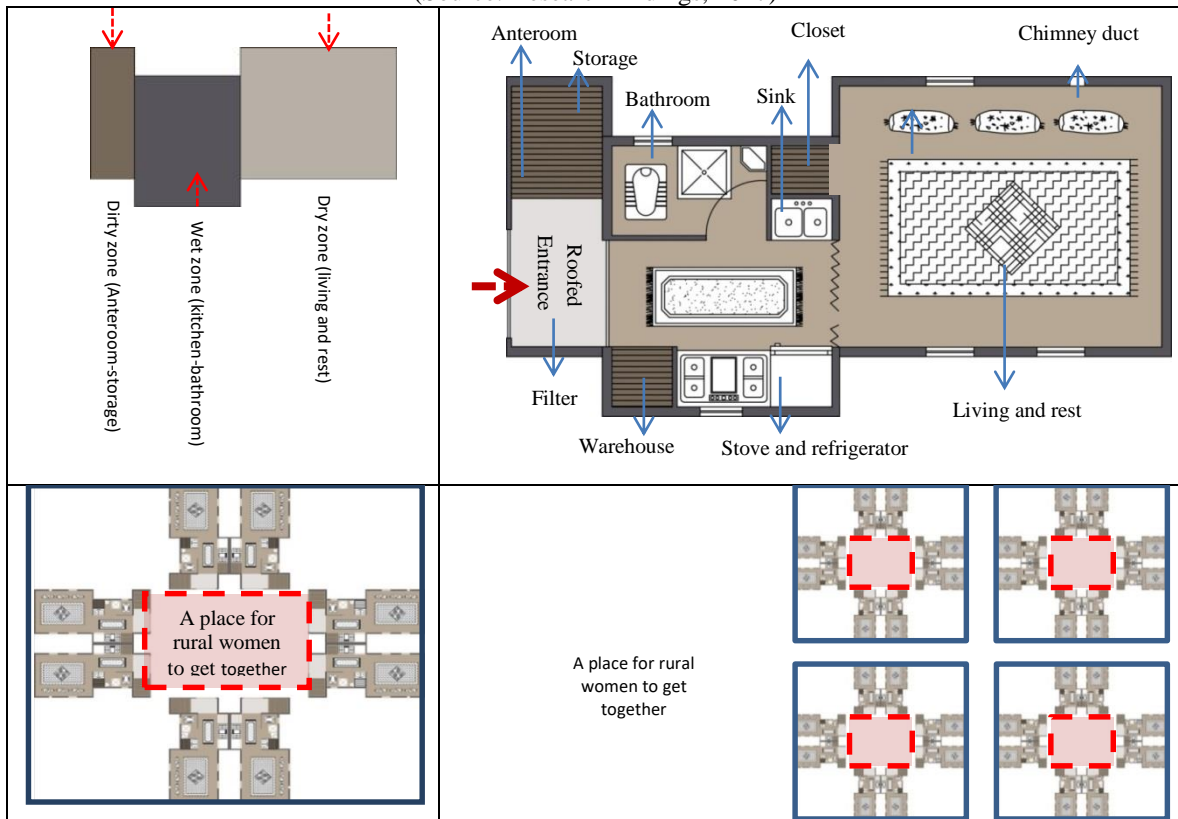
#### **4.1.2- Proposal 2 for temporary housing:**

As stated, the structure of the proposed design is modular and flexible. Now, we can come up with the following proposal through a slight change. So that the whole structures can be consisted of different units according to the required function for examples different units for toilets, bedrooms and living rooms (No. 1, Fig. 15). This proposal possesses all the features and benefits of the previous design, and it offers an increased privacy in the living room as it is located far from the entrance visually. Therefore, heat exchange between the indoors and outdoors and the warm air inside are directed outside. In addition, there would be a place at the entrance, so strangers can talk to the residents here (No. 2, Fig. 15). Houses belonging to relatives are arranged beside each other for the reasons mentioned above. Putting a fence around the complex raises their sense of

spatial and psychological safety. In such arrangement of temporary accommodation, a space is created in the middle of the set which can be a suitable place for rural women to get together in the post-earthquake period (No. 3, Fig. 15). A temporary housing camp is formed with a special order through the arrangement of temporary accommodation (No. 4, Fig. 15).

**Figure 15. Plans and arrangements for group Habitation of the recommended proposal and the temporary housing camp**

(Source: Research findings, 2017)



### 5. Discussion and Conclusion

This paper aimed to investigate the problems of temporary housing after natural disasters, especially in rural areas, and provided solutions to improve the quality of existing conditions, which ultimately led to the design of a pattern tailored to the needs of the injured in terms of two proposals. Given the different tastes of residents in choosing temporary accommodation and the type of proposed flexible structures, the victims could select one of the proposals as their temporary residence (two main alternatives were proposed in this paper. More proposals can be developed according to victims' requirements and aspirations).

Accordingly, factors affecting the victims' satisfaction with temporary housing were studied in terms of physical-functional, social-cultural and technical-structural criteria in ten villages of Heris. As a result, it could be declared that people expressed low satisfaction with physical-functional elements with the score of 28 out of 85, social-cultural elements with the score of 32 out of 80 and

technical-structural elements with the score of 44 out of 80. Safety, individual privacy, vitality of resettlement environment, cultural congruence with lifestyle, walls and floor, sanitation, the number of temporary accommodation provided, form, the interior space of housing, utilities and energy are some of the criteria that could not satisfy the victims living in tents and shelters. In the proposed scheme, an attempt was made to minimize the problems caused by temporary housing in earthquake-stricken rural areas through the consideration of design and construction solutions. Setting up temporary family homes beside each other and fencing would enhance the sense of security among the injured. A well-organized settlement in the camp might decrease the chaos of the earthquake-stricken environment and provide vitality. Using a light weight, sturdy, durable, waterproof (aluminum) structure, fire-resistant covering sheets (woodplast), double-layer floor and walls, double-glazed windows and embedment of places for installing heater chimneys, fans and stoves were factors in the proposed design which have an ability to counteract the climate



either separately or in conjunction with other components. Lack of a place for chimneys has often led to some dangers in the area. The measures taken in this plan would prevent incidents such as carbon monoxide poisoning due to lack of chimneys for heaters or fire caused by the use of valor fireplaces instead of a heater. Interior problems would be eliminated by the provision of bathroom and washbasin, separation of the entrance and anteroom from the main living room, creating storage areas through dividing the interior space by shelves, respect for privacy using two doors and filters, adaptable design for different areas in accordance with the users' needs, and flexibility and modularity of the structure. The factors that were taken into account in the proposed design included avoidance of unpleasant complexity, simplicity and elegance, forms following the function, specific identity in

terms of general, technical and functional specifications, design for the disabled, compactness in pre-setting state, easy storage conditions, easy transportation, quick construction, easy installation and setup without specialized people, possibility of prefabrication, light weight, durability and structural strength, possibility of repair and replacement of components, few types and number of connections. The proposed alternatives are considered to be suitable designs developed according to the victims' general and specific needs. These alternatives are argued to be well-developed research-based designs for temporary settlements.

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## ارائه الگویی برای طراحی مسکن موقت پس از سانحه، مبتنی بر تأمین نیازهای آسیب

### دیدگان با رویکرد ارزیابی پس از اجرا

(مطالعه موردی: روستاهای زلزله زده هریس-آذربایجان شرقی)

مازیار آصفی\*<sup>۱</sup> - شهین فرخی<sup>۲</sup>

۱- دانشیار تکنولوژی معماری، دانشگاه هنر اسلامی تبریز، تبریز، ایران.

۲- دانشجوی دکتری معماری اسلامی، دانشگاه هنر اسلامی تبریز، تبریز، ایران

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تاریخ دریافت: ۱۲ اردیبهشت ۱۳۹۶

#### چکیده مبسوط

##### ۱. مقدمه

برنامه‌ریزی و تأمین حداقل استانداردها برای سکونتگاه‌های اضطراری و موقت، از حقوق و احتیاجات اولیه و اساسی کسانی است که در معرض سوانح قرار می‌گیرند. سرپناه همچون آب، بهداشت، تغذیه و مراقبت های روانی، نقش تعیین کننده‌ای در حفظ و نجات انسان‌ها در مراحل اولیه وقوع سانحه ایفا می‌نماید. وجود سرپناه به منظور مصونیت در برابر بیماری‌ها و حفاظت از انواع خطرات امری ضروری است و برای حفظ شأن و منزلت انسان، در چهارچوب نظام خانوادگی و اجتماعی در شرایط دشوار، از اهمیت بالایی برخوردار است. این مسئله در مناطق روستایی بیشتر حائز اهمیت است. چنان‌که قسمت اعظمی از فعالیت‌های آنان در محیط خانه انجام گرفته و با از بین رفتن خانه‌هایشان امور اقتصادی، فرهنگی و اجتماعی آنان از هم گسیخته می‌شود و نیاز به سرپناهی دارند تا قسمتی از این امور را در آنجا انجام دهند. بنابراین هدف از این پژوهش، ارزیابی مسکن موقت پس از زلزله و ارائه راهکارهای بهبود کیفی آن و در راستای آن طراحی مسکن موقت متناسب با نیاز آسیب‌دیدگان در روستاهای زلزله‌زده منطقه ورزقان، اهر و هریس می‌باشد. پرسش‌هایی که در پژوهش حاضر بررسی می‌شوند عبارت‌اند از:

✓ معیارها و راهکارهای طراحی مسکن موقت کدامند؟

✓ رضایت فرد از مسکن موقت تحت تأثیر چه مشخصه‌ها و مؤلفه‌هایی قرار دارد و خانه‌های موقت با چه ویژگی‌هایی قابلیت پاسخ‌گویی به نیازهای آسیب‌دیدگان را دارند؟

✓ طرح مسکن موقت برای روستاییان آسیب دیده به چه صورت می‌تواند باشد؟

##### ۲. مبانی نظری

مفهوم واژه اسکان موقت ترکیبی است که هم جنبه‌های کالبدی و هم غیرکالبدی سرپناه و سکونتگاه پس از سانحه را در بر می‌گیرد. بنابراین سکونت‌گاه موقت را می‌توان مجموعه‌ای از فعالیت‌ها، اعم از جمع‌آوری و شناسایی افراد مصیبت زده و بی‌خانمان، نقل و انتقال افراد به سرپناه و ایجاد شرایط زندگی امن و بهداشتی تا زمان بازگشت آنان به موطن اصلی و یا زیست‌گاه اولیه شان دانست. مدت زمان اسکان موقت بر حسب شرایط، نوع بحران و امکانات از ۶ ماه تا ۲ سال تخمین زده می‌شود و برخی پژوهشگران و موسسات امدادی آن را به عنوان هسته اولیه اسکان دائم نیز قلمداد می‌نمایند. در ادبیات بلایا، تأمین سرپناه و مسکن مناسب برای حادثه‌دیدگان جریان پیوسته‌ای از سرپناه اضطراری تا احداث مسکن دائمی را در بر می‌گیرد؛ که شامل اسکان اضطراری، اسکان موقت و اسکان دائم می‌باشد. بحث درباره اسکان موقت به صورت مرحله‌ای میانی مابین اسکان اضطراری و اسکان دائم فراوان است، لیکن وجود روش‌های خلاقانه، ابتکاری و به نوعی بومی در ساخت سرپناه موقت انکارناپذیر است. آنچه در زلزله‌های پیشین دیده شده متغیر بودن این خلاقیت فردی و ابتکارات بومی برحسب عوامل فراوانی چون شرایط جغرافیایی منطقه، شرایط آب و هوایی، فرهنگ بومی و محلی (شهری یا روستایی بودن)، صنعتی و غیرصنعتی بودن منطقه، شرایط ساخت‌وساز در بازسازی، مدت استفاده از اسکان موقت، روش به کارگیری از اسکان موقت و دیگر عوامل است.

مسکن موقت فامیلی در کنار هم و حصارکشی دور تادور آن ها، اسکان با نظم و ترتیب خاص، استفاده از سازه سبک (آلومینیومی) جنس محکم، بادوام و ضد آب، استفاده از بدنه مقاوم در برابر آتش (چوب پلاست)، کفی دولایه، دیوار و پنجره‌های دوجداره، در نظر گرفتن مکان‌هایی برای نصب دودکش بخاری و هواکش و اجاق گاز در طرح مورد نظر از عواملی است که می‌تواند با شریط جوی محیط مقابله کند. استفاده از الوار به جای بخاری، تعبیه حمام و دستشویی، جدا کردن قسمت ورودی و کفش‌کن از قسمت اصلی، امکان قفسه‌بندی قسمتی از فضای داخل برای نگهداری وسایل، حفظ حریم خصوصی به سبب تعبیه دو در و وجود فیلتر، مدولار کردن سازه، جلوگیری از پیچیدگی‌های بی‌مورد، ساده و شکیل بودن، فرم با تبعیت از عملکرد، دارای هویت خاص از نظر مشخصات عمومی، فنی و عملکردی، طراحی برای افراد کم‌توان، حجم کم در حالت قبل از برپایی، شرایط نگهداری آسان در انبار، قابلیت حمل و نقل آسان، سرعت ساخت بالا، قابلیت نصب و برپایی آسان بدون نیاز به افراد متخصص، امکان تولید آن به شکل پیش‌ساخته، امکان تعویض و جایگزینی قطعات، کم‌بودن گونه‌ها و تعداد اتصالات نیز از موارد ارائه شده در طرح پیشنهادی می‌باشد.

**کلمات کلیدی:** طراحی، الگو، زلزله، مسکن موقت، روستاهای زلزله زده هریس-آذربایجان شرقی.

#### تشکر و قدرانی

پژوهش حاضر حامی مالی نداشته و حاصل فعالیت علمی نویسندگان است.

### ۳. روش تحقیق

پژوهش حاضر از نوع کاربردی و پس از اجراست و به روش توصیفی-تحلیلی انجام شده است. برای جمع‌آوری اطلاعات، از روش‌های مختلف اسنادی و کتابخانه‌ای و مطالعات میدانی استفاده شده و سپس اقدام به طراحی مسکن موقت گردیده است. در این بررسی تمرکز اصلی بر ارائه مؤلفه‌های کیفی مورد نیاز برای طراحی مطلوب مسکن موقت بعد از زلزله است. برای بررسی هر معیار و کیفیت آن، روش‌های خاصی از برداشت‌های میدانی، مانند پرسشنامه و مصاحبه شفاهی به کار گرفته شدند. برای انجام مطالعه و تدقیق معیارهای سرپناه از روش کاربر محور استفاده گردید. رویکرد طراحی کاربر محور در تولید محصولاتی با بالاترین کارایی و انطباق با خواسته مصرف کننده، کارایی خود را ثابت کرده است.

### ۴. یافته‌های تحقیق

عوامل مؤثر بر رضایت آسیب دیدگان از مسکن موقت در سه شاخه عوامل کالبدی-عملکردی، فرهنگی-اجتماعی و فنی-سازه‌ای در ده روستای هریس مطالعه شدند. یافته‌های تحقیق نشان می‌دهد مردم از مؤلفه‌های کالبدی-عملکردی با ۲۸ امتیاز از ۸۵، اجتماعی-فرهنگی با کسب ۳۲ امتیاز از ۸۰ و از مؤلفه‌های فنی-سازه‌ای ۴۴ امتیاز از ۸۰ رضایت اندک دارند. امنیت، حریم شخصی، سرزندگی محیط اسکان، تناسب فرهنگی با نوع زندگی، بدنه و کف، بهداشت، تعداد مسکن موقت ارائه شده، فرم، فضای داخلی مسکن، تأسیسات و انرژی از جمله معیارهایی می‌باشد که آسیب‌دیدگان از آن در فضای چادر و کانکس احساس نارضایتی می‌کنند.

### ۵. نتیجه گیری

با رعایت راهکارهایی در طراحی و ساخت آن مشکلات ناشی از مسکن موقت در مناطق روستایی زلزله‌زده را به حداقل ممکن رسانید. برپایی

**ارجاع:** آصفی، م. و فرخی، ش. (۱۳۹۷). ارائه الگویی برای طراحی مسکن موقت پس از سانحه، مبتنی بر تأمین نیازهای آسیب دیدگان با رویکرد ارزیابی پس از اجرا (مطالعه موردی: روستاهای زلزله زده هریس-آذربایجان شرقی). *مجله پژوهش و برنامه‌ریزی روستایی*، ۷(۱)، ۸۱-۱۰۱.

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