

TRANSFORMATION OF EARTHQUAKE DISASTER VICTIMS' SHELTER INTO SUSTAINABLE HOME: THE CASE OF LAR CITY, IRAN

Dola, K.^{*a} and Parva, M.^b

^aDepartment of Landscape Architecture, Faculty of Design & Architecture, Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia

^bIslamic Azad University of Shiraz, Shiraz, Iran

*Corresponding author: drkamariahupm@gmail.com

ABSTRACT

Earthquake damages are immeasurable. To cope with losses, especially when it involves thousands of victims is not easy. Often, the survivors need immediate shelter and counselling especially when the lost involved homes and their love ones. This paper discusses transformation of temporary shelters for earthquake victims into a more sustainable home, using the case of Lar city in Iran. The paper centered on the issue of mismatch of the design of the shelter with occupants' socio-cultural needs that resulted dissatisfaction among occupants leading to various transformation designs and chaotic facades. The study documents transformation of 365 immediate shelters into what the owners finally called homes over a period of more than 40 years. Methodology involves document analysis of maps and records during the occupancy period, observation, questionnaire survey and interviews. This paper concludes that majority of transformations were into traditional architectural design. This paper suggests that to improve residents' satisfaction for future development for housing for disaster victims, consideration of socio-culture of local and user needs should be given priority to avoid dissatisfaction and further house transformation cost.

Keywords: Shelter; Earthquake Victims; Sustainable Home; Iran

1 INTRODUCTION

According to UNDRC's (1982) definition, post-earthquake housing consists of policies and applications following a disaster for meeting the urgent, temporary, and permanent sheltering, and housing needs of the survivors of the disaster. Although there is no accurate statistics about the hazards of earthquake in Iran, the earthquake of Bam on 2003 was reported to have destroyed more than 35,000 housing units which consist of 63 percent of all houses in the city (NDGI, 2005). The reconstruction process of took 3 years, however, the complete products have been criticized because of its lack of quality and lack of appropriate planning and the inadequacy of funds (Arsalan 2007). Reports have shown that, houses were abandoned after certain period of time (NDGI 2005). This reveals that current post-earthquake housing design should take into consideration about the long-term issues and needs (Fallahi 2007).

According to Tasa, Cosgumb, and Tasa (2007), the issues and transformations of post-earthquake houses significantly differ from the ordinary houses. In normal conditions, occupiers transform their houses in order to adapt them to their life-style (Friedman 2002), while in post-

earthquake area, victims/occupiers transform their temporary shelters to become permanent houses (Al-Naim 2008) and as in the case of this study, transformations are to get back the comfort and attachment as before.

Literature highlights that the quality of post-earthquake houses depends on the specifications of original post-earthquake dwellings and the latter transformation (Mahmud 2007; Nguluma 2003; Tasa et al. 2007). In this regard, the specifications of post-earthquake dwellings depend on decisions and efforts made by local governments, international contributing bodies, the NGOs and the contractors, whilst latter transformations are controlled by people's preferences and lifestyle.

2 BACKGROUND OF THE STUDY

Lar is located in Fars province, at the southern part of Iran as shown in the Figure 1. On 24th April 1960, a 6.4 magnitude earthquake devastated the city of Lar, where 650 houses were destroyed or heavily damaged (46% of city), and 622 other units experienced minor damages. During this disaster, a minimum of 400 people died in their houses or in public buildings (Alizadeh 2003). Reconstruction process started with relocating the city to a nearby area as shown in figure 2, which is known as Lar New-City. The new city was planned for 1600 permanent houses. However, the first phase of construction only managed to provide 375 semi-permanent houses, completed within 6 months (Comprehensive Plan of Lar 1985). Initially, there were a lot of complaints on the design and comfort of the new shelters and some people even refused to move in, and some even abandoned the house after a short period (Parva and Dola, 2010). However, after a decade, the New City gradually gained population where occupants gradually accepted the new housing, new occupants moving in and started to transform the houses in order to meet their needs and requirements. This huge tendency for changing the houses indicates that the initial post-earthquake houses failed in satisfying people's requirements. Consequently, after 50 years, majority of post-earthquake houses have been transformed into different forms based on household needs and abilities (Parva and Dola,

2012; Alizadeh 2003), which is not in line with the city design and created disharmony for the overall city visual.



Figure 1: Map of Iran showing Lar City (source: www.lonelyplanet.com)



Figure 2: Aerial view of Old City and New City of Lar (source: Google Earth)

2.1 Housing Transformation and Sustainable Development

The decision to relocate Lar to new location and constructing new houses to give quick shelter to earthquake victims, through mass housing was deemed to be as the best option (Comprehensive Plan of Lar 1985). The disadvantages of mass houses are often designed for a typical user, with typical abilities in mind, for the typical needs of today, without considering the future changes of the user (Baldwin and Tomita 2007) and often, the housing design is the lack of social and cultural considerations and insensitive to local context (Parva and Dola, 2007; Hashim et al. 2009). Mismatch between the current house and the residents' needs, preference and aspiration may lead to adjustment of aspirations, or adjustment of the current house through modification or relocation (Baum and Hassan 1999). Tipple (1996) claimed that housing transformation could contribute to sustainable development in the urban and rural environments. He focused on architectural opportunities in terms that housing transformation that involves occupiers in their houses is capable to increase households' affection at their houses. Therefore, the sense of belonging is higher in transformed houses and the residents of such houses have better feelings when living in their houses (Tipple 1996).

From another perspective, Habraken (1975) believes that housing transformation develops the quality of housing spaces and adjusts social and economic conditions of living spaces. On the other hand, Tipple (1996) argues that any improvement in the quality of living environment needs to be done during a long time and based on the changing needs and interests of households. He posits that this improvement also follows the emerging socio-economic factors.

The need to modify or transform houses allows home owners express their uniqueness individually and even as a group (Lawrence 1987, Rapoport 1981, Giuliani et al. 1988). Habraken (1975), asserts that housing transformations demonstrate the households' viewpoint about their houses. Transformation of houses provides personal control, resulting in increase in satisfaction, better work performance, physical and mental well-being (Wells, 2000), as well as improving place attachment and facilitating

changes to assist occupants to stay and adapt to the changing needs (Fernandez 2007). Habraken (1975) argues that people want to modify their environment based on individual idea. According to Salam (2006), housing transformation is an approach for obtaining affordable houses.

However, without proper control and professional advice, transformation of houses could lead to defacing immediate surrounding and bringing about problems to adjacent neighbours (Parva and Dola, 2010; Hall 1996). In addition, changes and modification without proper control could result in chaotic facades (Marcus and Sarkissian, 1986), clash with the building's unity and incompatible with the façade treatments (Giullani and Bucchignani, 2000) and often irreversible as much money have been invested into the transformation (Parva and Dola, 2010).

This research explores housing transformation includes the extension, renovation, changing, modifying and dividing interiors and exteriors of post-earthquake houses since early occupation until 2010. The positive and negative impacts will be assessed and suggestions will be made to create a more sustainable living for occupants and for the city. This research also shows that culture and the need for attachment are main motivators for house transformation. According to Rapoport (2000), culture exerts a great influence on the development of living environments and is often expressed in terms of needs, values, dreams, ideals, images, norms, standards and meanings.

In term of architectural transformation, housing transformation in Iran can be categorized into two groups: 1) traditional housing transformation and 2) modern housing transformation. In Iranian traditional housing transformation system, which was a continual activity, houses were transformed based on changing in household size (Memarian 1999). However, in modern housing transformations in which houses transform into apartments, the transformation is done due to emerging economic factors and change in taste (Soltanzadeh, 2005).

According to both above mentioned categories, Iran's traditional housing transformations were continuously done during occupancy period. Indeed, traditional housing transformation was a reaction to transforming household

structure. In other words, growing household size was the basis of traditional housing transformation. Normally, this type of housing transformations followed the traditional housing patterns, in which typical Iranian houses are organized based on central courtyard; in other words, they are inward-looking courtyard houses (Memarian 1999). Traditional houses in Iran usually are transformed in two stages: 1) first it expanded horizontally around the courtyard, and 2) then the house expanded vertically. Based on what discussed above, it can be said that in traditional housing transformation, original dwellings (initial housing plan) were preserved.

2.2 Factors Influenceing Housing Transformation in Lar

Erdayu, Esmawee and Masran (2012) wrote that when there is a low level of satisfaction, the tendency is that residents may adapt or modify to suit their needs. By transforming their home, homeowners could be able to cope with the inadequacy of their home (Mohd Jusan 2007) to adjust to their socio-economic level, culture and preferred lifestyle (Parva and Dola, 2010). Transformation in architectural studies refers to changing and modifying building into a better condition during occupation period. It consists of changing form, function, and pattern of buildings. Mostly, building transformation takes place in residential buildings (Brand 1994). According to Shiferaw (1998), residential buildings are transformed more efficiently compared to the other forms of buildings. Shiferaw (1998) argues that through housing transformation activities, the houses are adjusted to households' life style. What is apparent from this research is the needs of the occupants to transform the temporary shelter into house and finally home. Several studies in the housing field indicate that houses are built to accommodate different levels of expectations (Erdayu et al, 2012; Banham, 2007; Oliver, 2006). Unlike a house, a home is much more than a physical structure (Oliver, 2006; Bachelord, 1994). Shelters are provided to protect people, whereas the creation of a home represents deep social structure, reflecting the family's relationships to the domestic space it occupies.

Akalin et al. (2008) grouped housing transformation into two different types that are intrinsic, which relates to spatial and technical functions, and extrinsic, which refers to aesthetic act. Tipple (1996) proposes that

transformation is the incremental changing process in residential buildings for adapting to households' requirements. Votava (2006) defines housing transformation as a process which consists of some indoors and outdoors changes that are based on households' requirements only. Housing transformation process eventually promotes better shelters, from temporary or informal houses, into the permanent homes (Votava, 2006). In short, sustainable house will be achieved through these transformations.

It was recorded that the old city of Lar experiences slow and traditional transformation, that relates to changes in the size of households, as compared to the fast pace transformations in the new city of Lar, resulting in much higher rate and impact. According to Comprehensive Plan of Lar (1985), the built area in residential properties of Lar has increased for more than 320% due to arbitrary post-earthquake transformations. Although the existing infrastructures are sufficient to support the increase of new population, there are still many problems, socially and physically, caused by individual owners' ad hoc and unexpected transformations as mentioned above.

3 RESEARCH METHODOLOGY

Previous researchers have adopted two major research methodologies while identifying the specifications of housing transformations; which are architectural specifications and occupier's perceptions . (Al-Naim 2008; Shiferaw 1998; Salim, 1998; Tipple 1996; Votava 2006) Some researchers (Al-Naim 2008; Shiferaw 1998) obtained their necessary data through analyzing buildings' pictures and architectural drawings. On the other hand, some others (Salim 1998; Tipple 1996; Votava 2006) employed questionnaires in order to survey people's perceptions and motivations of the transformations. While the first approach provides a deep understanding about what really happens is in the physical context, the second approach provides subjective reasons behind such action.

This study employs a hybrid research methodology which is called mixed method (Creswell 1994; Groat 2002; Mansuorian 2002). In other words, this research adopts a mixed method qualitative and quantitative research

methodology for studying post-earthquake housing transformation process. During data collection phase, the study relies on document analysis (aerial photographs and map), field studies (observation) as well as surveying people's perceptions through questionnaire survey and interviews. A systematic observation on aerial photograph images was conducted on selected 189 post-earthquake houses in order to provide basic insight into the physical transformations of post-earthquake houses in Lar city, in the time span of 50 years. This phase is to document all constructional phases and morphological changes related to transformations in post-earthquake houses. Based on the results derived through this phase, the study formed a perception survey questionnaire to evaluate people's ideas about post-earthquake houses and the latter transformations. The survey revealed motivations, possibilities, and problems of transformations in post-earthquake houses. Finally, a more advanced observation has been conducted in order to empirically get the affirmation for the results of the survey. In this study, a questionnaire survey assesses the people's perception of transformations in the post-earthquake houses after evaluating the transformations through the systematic observations. Data gathered from all methods were tabulated, triangulated and analysed.

3.1 Analysis of Housing Transformation

This study has selected Lar city as a case of study, which has over 40 years fully documented experiences of post-earthquake housing transformation process. Due to the time and financial constraints in designing and constructing the new-city after the earth quake disaster, the people of this city faced various problems when they started to live there. The main problems which were initially claimed by the people were as follows: 1) the housing design was not addressing the minimum comfort and social requirements of the area; 2) the road system was very inconvenient for the users; 3) the city was very far from the original downtown and there were inadequate facilities in the new city; and 4) the design of the houses was very alien for people of Lar, and cause difficulty for housing extension from the original structure (Comprehensive Plan of Lar 1985).

The approaches of post-earthquake original dwellings in Lar are dependent on design patterns and reconstruction this city during 1960-61. Although

there were no proper reconstruction policies at Lar, three approaches for reconstruction of the New City were observed as follows: 1) relocating the city, 2) constructing semi-permanent houses, and 3) preparing infrastructure for future housing extensions. The following section describes the specifications of these 3 approaches based on the descriptive analysis of data collected through systematic observations.

1) Relocating the city:

Taking into account the future risks of post-earthquake housings the first policy of post-earthquake house in Lar was relocating the city. To address this issue, the new constructions of new city have been located on a land 4 km from the original old city, a site which was deemed to be safer, unlike the previous land which was located on high-risk earthquake zone of Iran. The choice was considered as the best option as the location was not too far away and some people need to continue commute to their working place in the old city.

2) Construction of semi-permanent houses.

The next action was to construct immediate shelter for the victims to avoid further trauma. Immediately after the disaster, the government sector started to build 375 semi-permanent houses in order to house the earthquake victims' and meet their urgent needs. According to Alizadeh (2003), although this rapid construction assisted people by giving them some immediate shelters, the low consideration to local needs and house qualities were the most important reason that people mostly did not like the post-earthquake houses. Therefore, it was reported that the first task of the government was to convince people to move to the new city.

The preparation of infrastructures for the new city and also constructing semi-temporary houses were done concurrently and completed within one year (1960-1961). However, full occupation of this first phase of housing was reached only after 2 years and the government began to build another phase of houses in the third year. The very long delay between construction and occupation shows that the people were not quite sure and not satisfied with the built dwellings (Alizadeh 2003) therefore causing reluctance to move. This fact also is further affirmed based on this research survey

statistics that shows that only 22.3% of the respondents who lived in post-earthquake houses truly like their houses whilst 51.1% of them still do not like the houses at all after all these years (Parva, 2011).

3) *Preparing infrastructure for future housing extensions*

As mentioned above, the construction of post-earthquake houses was also accompanied by the provision of infrastructure, which is to cater population increase for about 300 percent in the period of 50 years. Although during the initial construction, there were problems to cater high number of people who need the shelter immediately, facilities for infrastructure was well planned in the Comprehensive Plan of Lar (1985). This long term projection shows that the government of Iran did a very careful consideration of future expansion of the city.

3.2 *Analysis on Architectural Transformation*

Lar's traditional houses follow predominant architectural style of Iran's arid zone and are organized around a central courtyard, with flat roof (Figure 3 and 4). According to Memarian (1998) this character was guided by both climatic and socio-cultural factors. The traditional design basically has many rooms, was to cater the privacy needs in segregating male and female and the courtyard was for family gathering. However, due to time and cost limitations, the post-earthquake house constructions occupied one side of the land (facing the street) and the big empty lot were purposely intended for future expansion (Figure 5 and 6). The design just provides one room, a kitchen and a hall.

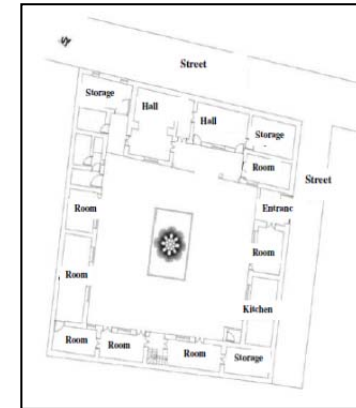


Figure 3: Spatial planning of a pre-earthquake (traditional) house with courtyard in Old Lar City (Source: Muhammad Parva 2008)

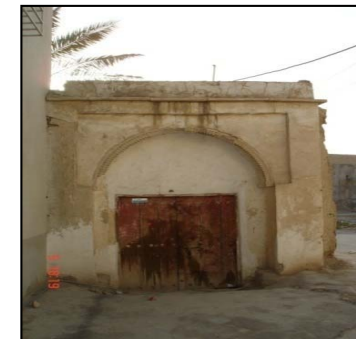


Figure 4: A Pre-Earthquake or Traditional House façade (with flat roof) in Lar. (Source: Muhammad Parva, 2007)

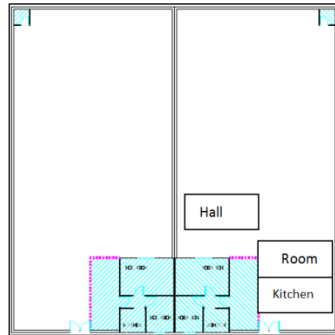


Figure 5: The design of floor plan of the typical post-earthquake (new) semi-detached houses in New Lar City. (Source: Muhammad Parva 2008)



Figure 6: A Post-Earthquake House façade (semi-detached houses sharing sloped roof and a wall). (Source: Muhammad Parva, 2009)



Figure 7: The sloped roof illustrates the form of original post-earthquake housing and seemed uncoordinated with the flat rooftop of the new extension to suit the local condition (source: Muhammad Parva, 2009)

Based on the perception survey, this drastic change in house design caused a significant disappointment and unsatisfactory among people when they first moved and lived there, therefore they tried to transform their houses. In other words, the results show that people tried to convert post-earthquake houses into the morphology of central court yard by constructing new parts at different sides of the land. This fact verifies Shiferaw's (1998) conclusion that sudden alternation in housing morphology can lead to some inconveniences in housing transformation and therefore as observed in this study, results in ad-hoc design (Figure 7).

The early investigations revealed that post-earthquake housing provision in the New Lar City failed in satisfying the people's needs and requirement due to some major problems in their design and planning. It fails to suit their lifestyle, socially and culturally. As a consequence, residents resort to renovate their house design and eventually transformed the whole area, which were not in harmony in terms of visual and housing architectural forms.

According to the results of systematic observations, 98% of post-earthquake houses have been transformed. From Figure 8, it can be concluded that more than 51.1% of houses transformed into type 7 and 8 houses. A simple comparison reveals that these types are very similar to pre-earthquake houses or traditional form of architectural design with central courtyard. Therefore, it can be concluded that people in Lar have a strong tendency and preference for going back to vernacular/traditional architectural forms which has central courtyard.

The most significant finding of this part was the identification of differences between pre and post-earthquake houses, and the fact that transformation of majority of houses are more similar to pre-earthquake houses design or traditional form (Figure 8). This confirms Rapoport's (2000) theory of the need to assert culture in living environment in that people always have tendency to restore their previous lifestyle that is lost after disaster.

Figure 8:- Analysis on different types of post-earthquake houses transformation in Lar

	TYPE1	TYPE2	TYPE3	TYPE4	TYPE5	TYPE6	TYPE7	TYPE8
Plan Figure								
type	Contiguity Longitude	Separate Longitude	Contiguity Width wise	Separate Width wise	Type 3&4	Type 1&2	Semi courtyard	Courtyard
Number of house	2	4	15	123	32	1	148	40
%	0.5%	1.1%	4%	32%	8.5%	0.3%	39.4%	10.7%

The majority of complains by the residents of Lar's post-earthquake houses were on the size of post-earthquake houses. It was unclear that the size of build construction was intentionally small to give more space for future expansion or the small size was due to limited budget and time to provide immediate shelter to victim within a short period of time. However, this finding affirms Salam's (2006) idea that sudden changes in house size and design may lead to inconveniences. In other words, the findings show that people reacted negatively against the sudden changes in the size and design of the dwelling by changing its form. According to results of the conducted survey, the heterogeneity in appearance of the buildings preceded many problems in Lar. Firstly, use of sloped roofs hindered the possibility of vertical deployments. Secondly, it was impossible to attach a new structure to the existing building due to the limitations of the utilized construction system, and unless using demolition of the original structure. Figure 9 below illustrates the different types of transformation according to the preferences and ability of the occupants.



Figure 9: Morphological transformations in Lar's post-earthquake houses

According to Miromogtadaee (2009), housing transformations in Iran usually take place in both horizontal and vertical changes. However, as mentioned above, vertical developments were not easy to match with the design of Lar's post-earthquake houses due to the roof design. In other words, use of sloped roofs caused some limitations for vertical development of those houses. Nevertheless, it was not big matter in Lar as the land designated for each house was so huge so that it facilitated adequate horizontal developments in order to compensate the limitation for vertical development. However, in some aspects the impact of sloped roof was not completely overcome. For instance, since it was not possible to attach a new part to a sloped structure, horizontal development in Lar usually was independent or semi-dependent from the original dwelling. In other words, new developments of Lar's post-earthquake houses never have become integrated or blended well with the existing buildings and they served as some supportive spaces only in association with the original dwelling.

4 CONCLUSION

From the conducted study and also taking into account the existing financial and technological constraints in Iran, this study proposes a combination of temporary and permanent housing reconstruction models for Iran. The suggestion is adopting very basic but permanent reconstruction system and design after disaster. However, it is suggested to take into account some criteria for facilitating smoother transformation process in the future.

This paper verifies Salam's (2006) idea that those inconsistencies in pre and post-earthquake housing design and lifestyle may trigger motivations for transformations in post-earthquake houses. The paper therefore stresses on the importance of considering socio-cultural issues during post-earthquake house design phase. Reviving and sustaining socio-cultural qualities should be taken into account in constructing and designing post-earthquake houses in the same degree of importance as for rehabilitation of the buildings. Considering people's attachment in Lar's post-earthquake houses is another important issue to be stressed. The results from this study show that socio-cultural issues and attachment to previous lifestyle and place are the main motivators for transforming post-earthquake houses. It was found that socio-

cultural motivations and motivations for following traditional architecture of Lar influenced the design of new housing transformation. Two motivations namely "adjusting relationship between open and close spaces in pre-earthquake houses" and "re-applying ornamental elements of pre-earthquake houses" are the most important factors in determining the model of socio-cultural motivations.

Façade changes in Lar are guided by the motivation to follow traditional architecture of Lar as well as motivation to model the prevalent housing style. An interesting new finding of this research is that during early stages of post-earthquake housing, people are attached to their past memories from their previous lifestyle rather than influenced by current lifestyles. However, during the late 1980s some house transformations were based on the need to copy modern conventional housing design. It can be concluded that housing design for post-earthquake houses that fail to put into local socio-cultural considerations will definitely meet rejections. In other words, this paper claims that housing or shelter that was meant to become permanent resident should include socio-cultural considerations during the initial design and planning phase in order to allow residents to make adjustment and adaptation to their home sustainably.

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