

FOR COMPARISON OF VILLAGE HOUSING CONSTRUCTION PATTERNS OF EARTHQUAKE AFFECTED REGIONS IN THE LORESTAN PROVINCE ---BEFORE AND AFTER AN EARTHQUAKE

H. Fatemi aghda¹ and I. Rasoolan² and H. Zafari³

¹ Assoc .Prof, Dept. of Structural Engineering, Institute of Engineering Mechanics, Harbin. China

² Ph.D. Student of civil Eng., Dept. of Structural Engineering, Member of Young Researchers club,

³ Msc,Natural Disaster management , Member of Young Researchers club, IRAN

Email:rasoolan82@gmail.com,hosseinzafari@gmail.com

ABSTRACT :

The first section Experience shows that earthquakes not only cause loss of life and economic damage but also bring about transformations in their wake, with regard to construction patterns in the earthquake affected society. According to studies that have been conducted so far, in traditional methods of construction, social and economic considerations, and on the whole the livelihood system in society have been taken into consideration and are considered as having fundamental importance in rural living and lifestyle..

Before the occurrence of earthquake in Lorestan , the general pattern of residential and office buildings had a multi –lateral function , in a way that the residential units and livestock shelters were built alongside other systems of livelihood of the villagers. In addition to this, the buildings had terraces which were customarily used for rest and relaxation and for family gatherings all the year round. The material used for construction was local and traditional, however, presently, sudden and unexpected changes have been observed in the reconstruction patterns in the Lorestan region in which the traditional ways and their positive aspects have not been considered. Obviously, sudden changes in the customary patterns of physical construction could bring about negative impacts in the manner and culture of society, since the fabric is the reflection of the cultural and socio-economic system, governing the people of each region that is shaped according to its socio-cultural values and is conducive to its environmental characteristics.

The objective of this article is a comparison of two traditional and new patterns of village housing construction , before and after the Lorestan earthquake and will be followed by an elaboration on construction methods, components, materials, architectural designs and livelihood values .

KEYWORDS:

Traditional and New Construction Patterns, Reconstruction , Livelihood System

1. Introduction

The Silakhor Plain Earthquake of Lorestan that occurred on the 11th of Farvardin 1385 caused considerable damage to the urban and rural housing in the area. This damage was due to several reasons; some of which were construction methods, cultural features of construction, age of buildings, distance from the main fault, kinds of materials etc.

The type of local construction, simplicity of construction, repairs & renovation, protection and coordination with livelihood system and climatic conditions, were the most important characteristics of traditional construction patterns of provincial rural areas.

From the middle of the 40's till now, with the dissemination of western culture in cities and its influence in the rural areas of the country, this pattern, in its various dimensions has undergone unknown changes that are contrary to the culture, livelihood system and in particular, the climatic conditions in rural areas. The earthquake stricken region of Lorestan was also not an exemption from the above mentioned situation.

The reconstruction of the earthquake stricken villages has provided an opportunity for upgrading traditional patterns, as well as offering a review of structural elements, buildings, materials and building designs and to remove the weaknesses and shortcomings of the past.

In order to get a better understanding of the above mentioned, a detailed elaboration has been given below:

2. Construction Patterns

2.1. Materials

In the past few decades, construction of rural buildings in our country was completely dependant upon native/local building materials and local workers. With an increase in relations between rural areas and urban centers and with an input of new material into rural areas, it has gradually changed considerably. Dependence on local material leads to reducing construction costs and coordination with climatic and natural environmental conditions. However, lack of familiarity of the rural inhabitants with the correct and appropriate usage of material and its unsuitable implementation and poor quality of construction, in addition to lack of resilience against natural disasters, can be counted as the most damaging factors for traditional buildings in rural areas. The advent of new resilient and durable building material in rural areas was welcomed by the rural inhabitants, although they had to bear high expenses for these changes. However, in spite of all this, due to incorrect usage and unsuitable implementation of material, the expected results have not been achieved.

The native texture of Lorestan buildings, with respect to an early cold winter and unexpected rainfall in spring carries special significance. Most of the construction in the native texture of this region is mud and bricks and most of the residential houses are made of wooden beams, with moisture and heat insulation, clay and straw thatched roofing which stand upon clay and brick walls

It is worth mentioning here that with the advent of iron beams and bricks and other new materials for constructing an arch / barrel vault roof, changes have occurred in most of the villages in the façade of the rural houses, but unfortunately horizontal and vertical chengage that can withstand earthquake's lateral forces have mostly been neglected.

Table 1 shows the materials that have been used before and after an earthquake in the region:

Task Force assigned for villages under reconstruction	Material used before earthquake	Material used after earthquake
Rural Esfahan	Pressed bricks-foundation material-without observing technical requirements, brick-cement-adobe & mud Lime mortar, roof wooden beam, jack arch/barrel vault	Concrete collar, high quality sand, pre-fabricated steel roof framework with technical specifications, ceramic-bricks, ceiling blocks, concrete-steel beams polystyrem for roofing
Urban Esfahan	adobe-mud, brick-iron –wood	Sand- iron -concrete, joist & block, ceramic brick

Tehran	Wood & adobe walls 80%-20%, also brick with steel roofing and few units with structural frames	Steel welded structural buildings, different kinds of bars in foundation and stirrup, ready mixed concrete in the foundation and a small quantity of site mixed concrete, variety of beams for structure, ceiling bars for joist, ceramic brick, sand- cement
Fars	Adobe-mud-wooden beam, iron-brick- cement-jack arch/barrel vault	Material with complete technical specifications, steel frame-work-ceramic tiles, pitched roofing or joist& blocks, or chrome magnesit brick, interior of building also ceramic tiles with stone finish
Hamedan	Mud-adobe wooden beam- brick - iron - cement	Bars-iron beams-frame-ceramic bricks-cement-sand -skeleton frame
Khuzestan	Mud-adobe - brick, blocks	Bars-iron beams-skeleton-ceramic bricks, cement, sand
Yazd	Mud & adobe- stone-wood-brick	Concrete steel skeleton-cement-bars- ceramic blocks – sand
Lorestan	Pressed brick – cement- wooden beams -mud-adobe-iron	Concrete steel framework cement, bars ceramic blocks – sand

2-2 Structural Elements for Rural Housing

Building and load bearing elements are of fundamental importance and can be observed in construction of rural housing and therefore, in this part we shall make an assessment and comparison of these specific elements, before and after the reconstruction of an earthquake stricken region

2-2-1 Foundation

In villages, in the province of Lorestan, with regard to local material that already exists in the region, the foundations of the houses constructed are illustrated in the figures given below :

a-Stone Foundation b-Adobe Foundation c- Stone- Brick Foundation



Figure .1 Stone foundations laid under brick walls with chenage are constructed with new material before and after an earthquake



Figure .2 Stone walls are built of stone, sand and cement. These walls, due to climatic conditions should have hooks (chenage), in addition the walls' vertical joints (mortar joints,) should be filled in completely

This type of foundation is exposed to climatic conditions; therefore, in spite of its cohesive appearance, the foundation's vulnerability decreases the building's resistance against earthquakes.

Left side of the wall shows defective construction

2.2.2 Wall

Brick work is of primary importance in the construction of a building, since walls are the basic and most important element in structural static and in the protection of the building's interior against natural disasters.

In general, walls can be illustrated in the figures given below:

- i. Stone wall made of Viking stone(fig.2)
- ii. Walls made from non- rough rubble stone
- iii. Regular stone wall
- iv. Mud wall
- v. Adobe wall
- vi. Brick wa

2.2.3 Roof

Most of the roofs of the rural buildings in the Lorestan region have a flat surface and one rarely finds arched roofs (sis roofs) for animal shelters in the agricultural villages in the north- eastern parts and in the cold mountainous areas of the province. This, however, depends on two main factors; climatic conditions and abundance and easy accessibility to the raw material. In general, roofs of these houses are made of material easily available in the village or in the surroundings. The simplest methods are used in construction, using wooden beams for covering the entrance and leaves and branches of trees with layers of mud for completion and a final touch. With the advent and accessibility of new and latest material in the market, various other methods for coating of roofs have come into practice. In studies conducted, in the Lorestan region three kinds of coverings of roofs have been observed:

- i. Roofs with wooden beams : Roofs made of forest wood and roofs made of white wood
- ii. Jack - arched roofs
- iii. Sis roof(fig.3)



Figure 3 :Sis Roof: This kind of sis roof in the shape of an arch is made of clay and mud. The reason for selection of this kind is due to the suitable nature of the arch in resisting and shifting of pressure. Since these roofs are usually made on the lower floor, the elevation is increased in order to have a flat surfaced ground floor



Figure 4: Roofs with wooden beam covering: These are made of straight white wood and are placed in an orderly manner at a measured distance from one another. In this kind, the primary (main) beams are vast in number, whilst the secondary ones are placed cross wise upon them

2.2.4 Column

Columns are used in construction in order to bear the weight of the terrace, balconies and the animal sheds. Columns that are commonly observed in Lorestan are as follows:

- i. Wooden columns
- ii. Stone
- iii. Wood & Steel

2.2.5 Hooks System, Vertical and Horizontal

In a limited number of houses this system is used for strengthening and reinforcement of the building



Figure .5 : Brick column in the balcony



Figure .6: Wooden column



Figure .6: Brick lintel



Figure .6: Concrete Lintel

2.2.6 Lintel

This Is usually used to cover small openings, shelves, and crevices. Due to the fact that covering of these spaces is a sensitive and important matter, utmost care needs to be taken to make sure that the weight of the ceiling and that of the upper wall is shifted to the side wall in a suitable manner. In addition to this, it should be able to provide a correct contiguity between the two parts of the wall to one another.

Post and Lintel can be divided into 3 groups on the basis of the type of material used in construction;

- Wooden Lintel - Concrete Lintel - Metal Lintel - Arched /vaulted Lintel- Chalk & Bamboo Lintel

3. Ecological construction models before earthquake

Culture, ecology and life style go hand in hand and greatly influence the methods of construction and the sort of life one leads. A review of rural buildings in the earthquake stricken areas of Lorestan show that most of the houses have the following characteristics:

- a. Since housing construction is closely related to the livelihood system of domestic animals and since most of the rural residents of Lorestan raise livestock, therefore, buildings are designed in such a way that there are two floors, a shelter for animals on the ground floor and residential quarters for the family on the first floor,

The following reasons could also be a contributory factor in this kind of design for rural housing:

- Creating safety and prevention of theft of animals
 - Avoiding wastage of energy and utilizing warmth of the floor due to the presence of animals, a special feature in the traditional system of use of energy
 - Lack of land area at the disposal of farmers and more use of land for agricultural purposes
- b. During Spring and Summer , the villagers in the region use the terrace to get together in their free time and for family gatherings
 - c. Taking into consideration the fact that wood is easily available and found in abundance, the frontal portion (facade) of the building is made of wood
 - d. Considering that in Lorestan families usually live in groups, the houses have many rooms, the limits and boundaries of which are duly respected.

4. Ecological construction models after earthquake

As we are already aware, architecture and construction are inseparable conditions of great important in the construction of every house. These two technical and architectural principles must be compatible with the climatic conditions, lifestyle and the livelihood system. In reconstruction/renovation of rural areas, some pre-fabricated screwed and welded structures and flat and pitched roofs have been used. The most important thing to be noted here is the lack of necessary attention paid towards the rural family life style where people try to fulfill their livelihood needs with the use of non- technical , " typical maps" not conforming to the accepted construction framework . By ignoring some of the positive aspects in new construction methods after an earthquake, some of the clearly important existing problems in construction of new houses can be mentioned as the following:

- i. Not taking into consideration the principles and standards of customary traditional patterns in the region
- ii. Ignoring relationships and necessary aspects of the livelihood system , for instance removal of the animal shelter from underneath the first floor or from the vicinity
- iii. Removal of spaces such as the terrace, which was suitable for the needs of the villagers in coping with the climatic & seasonal conditions in the traditional patterns
- iv. Lack of flexibility in new patterns, with regard to climatic conditions and spacing of necessary building components e.g. windows and entrance doors
- v. Flaws in architecture in the creation of necessary spaces for rural families. In traditional patterns, this factor is of primary importance and plays a very important role in the interior decoration of the house and in meeting the needs and demands of the families.



Figure 7: Reconstruction / Renovation design of a single floor in a rural area



Figure 8: Reconstruction/Renovation design with a sloping roof & terrace

5. Outcome Summary(Key points)

- Drastic changes in traditional rural patterns in the region following the usual process, overlooking the rural changes in the country commenced from the middle of the present century
- In traditional patterns due consideration was given to places of residence, work and livelihood which were part and parcel of customary standards in the region.
- Unexpected changes in the culture of construction and lack of appropriate use of new and old material; some of the positive and constructive aspects of pattern trends in new rural construction in the region have been eliminated altogether
- In these changes, local architecture in the region has undergone tremendous transformation. As a result, it has brought about some undesirable effects on the socio-cultural identity and economic benefits for the people of the region and it appears as though these influences will extend over time. Isolation of family, removal of facades, and symbols of cultural & historical places in the rural perspective , changing arable agricultural land to residential areas, increase in expenses for keeping livestock outside the residential area are some of the clearly visible examples
- It is clear that old patterns were formed due to the needs of the people. Therefore, making use of new patterns , without due consideration for the needs and culture of the people in the region will result in people going in for repairs and renovations, and indulging in measures not in line with " patterns of element type" in construction and architecture. These , naturally , without the supervision of an expert could result in the building becoming more vulnerable against earthquakes
- In these transitions and transformations from traditional to the new, specifically, in reconstruction after earthquake, ' more developed patterns and local material "were used. On the one hand, this leads to the improbability of a return to traditional patterns, and on the other hand they do not have access to the related technology and executive – technical factors are not available. The following figures illustrate the construction in the region before and after an earthquake ;



Figure 9 : Pattern of new building using new material – renovation after Earthquake



Figure 10 : Traditional building pattern using new material before an Earthquake



Figure 11 : Traditional building pattern using local material – before an Earthquake

5. Conclusion

Although traditional patterns are a product of history, needs and skills, as well as ecology of rural society and its positive aspects cannot be denied. However, due to its vulnerability against earthquake and inadequacy in provision of basic amenities of modern life in rural areas due to the present mechanical age and life style ; new material, technology, latest designs & architecture and positive and constructive values need to be utilized in the use of traditional rural residential patterns.

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