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FEASIBILITY OF CONCRETE USAGE IN RURAL HOUSING IN IRAN

G. Raheb[1], A. Tarkashvand[2]
[1]Assistant Professor, Building & Housing Research Center, Tehran, Iran
[2]Ph.D., School of Architecture & Urban Studies, Iran, University of Science & Technology, Tehran, Iran

ABSTRACT

Concrete has been used since the 1970s in construction of rural houses in Iran. Despite extensive use of concrete in rural housing in Iran and the huge allocated budget, the quality of construction is not acceptable. The aim of this paper is to evaluate the influence of using concrete in construction of rural houses in Iran. For this purpose, the effective factors on the development process of rural housing have been identified first. They could be counted as:

1. Efficiency and Effectiveness
2. Compatibility with climate, economy and social aspects
3. Dynamism and Flexibility
4. Stability and Durability
5. Cultural continuity and visual desirability

Then, sample cases -25 villages- have been surveyed through these factors by authors. Minimum of 3 houses have been surveyed in each village. The result of this research recognizes some problems of using concrete in rural housing in Iran. The most common difficulties are providing materials with good quality, lack of technical knowledge in villagers as the main workforces and lack of required equipments.

Keywords: rural housing, feasibility, concrete

1. INTRODUCTION

According to development of rural settlements in Iran, current use of concrete in building construction of rural areas has been begun since the seventieth decade (c.c.). Concrete has been used in the following methods of construction in Iran:

- Bearing wall system with tie beams and columns
- Structural reinforced concrete with beam and column or moment- resisting frame
- Reinforced concrete slab

In the above classification, the first one has the maximum usage in rural settlements of Iran. Despite extensive use of concrete in rural housing in recent years in Iran, the quality of construction has not been acceptable, according to the experts' views. This lack of desirability is related to structural and architectural aspects. However, efforts undertaken in the development of rural housing by making use of new material and methods of construction- such as concrete- have

not considered all related aspects of housing development in rural areas.
This paper is going to evaluate use of concrete in building construction by a general and multi-aspect overview considering physical aspects of rural concrete constructions which is related to social, economical and cultural properties of rural housing. The result of this research is to declare the difficulties of making use of concrete in renovation of rural housing in Iran.

2. RESEARCH METHOD

Effective factors on renovation process of rural housing are identified first. Identification of these factors is a process in itself and is not covered in this paper. However, a summarized explanation of steps of exploiting the factors is mentioned in continuation of the report. Final factors and evaluation of the influence of using concrete in Rural Construction by them has been introduced. The factors are based on derivation of a conceptual framework effective on selection of proper rural housing development method, using the existing resources. In this condition, the framework is chosen out of the following domains:

1. Theories including identification of the concept of village and rural housing, theories connected with the way of interfering in man-built environment, especially rural regions (with emphasis on theories relying on dwellers' participation) and theories related to proper technology
2. Internal experiences including macro-policies and programs and experiences on construction and reconstruction of rural housing
3. Experiences of other countries (with emphasis on countries that have similar condition as Iran)

The research is based on surveys in rural samples. The research method is Qualitative and based on observation (profound observation) and interview (focus group). The factors and sub factors have given a checklist for surveying. Each factor has been supported by a question in questionnaire that the surveyor answers by observation.

3. SAMPLING

Sample cases have been selected through a categorized random sampling method. Statistical community consists of villages that have minimum of 15 implemented projects of rural house renovation. Also minimum of three years might have passed from implementation of the projects. In accordance with the sampling method, statistical community has been categorized in a few clusters through the following criteria:

1. Climate categorization of Iran
2. Cooperation of villagers
3. Population

Then, a portion of each cluster has been calculated on the scale of each cluster to the whole amount of final samples. Due to validation of sampling, amount of final samples has been set to 25 villages. Finally, in accordance with the portion of each cluster in statistical community, sample cases have been selected randomly from each cluster. Sample cases have been surveyed by authors with prepared checklists trying not to intervene in the prevailing situation of the villages and houses. A

minimum of 3 houses have been surveyed in each village.
Checklist focuses on five major aspects of renovated rural houses:

1. Efficiency and Effectiveness
2. Compatibility with climate, economy and social aspects
3. Dynamism and Flexibility
4. Stability and Durability
5. Cultural continuity and Visual desirability

Each aspect has been surveyed by a number of correlated indicators mentioned below (refer to 4). Achieved data has been categorized and analyzed. Finally, guidelines are provided in accordance with the results.

4. FINAL FACTORS, MEASUREMENT COMPONENTS AND THEIR EFFECT ON DEVELOPMENT OF HOUSING

Final factors analyzed in the rural settlements of Iran and measuring components of each factor are as the following; In continue, Summarized results of analysis of data are mentioned in accordance with the above mentioned factors:

4.1. Executive Efficiency With Respect To Workforce and Cost

The objective is the complete fulfilment of related necessities by developing the building and providing smooth trend of its implementation in a way that interfering factors do not stop or delay the work trend. In addition, the budget spent to develop the housing and the special procedures taken to reduce spending are the criteria for logicality of the cost with respect to priority needs of the household.
Components for measuring the factor are: speed of implementation [3, 610, 15, 16, 24, 26, 30, 31, 32], independency of expert forces in making [1, 3, 6, 16, 26, 29, 31, 32], repairing and maintaining [1, 5, 6, 19, 23, 24, 26, 29, 30, 31, 32], lack of need for sophisticated and unavailable equipments [1, 3, 4, 5, 11, 15, 16, 19, 23, 32], achieving gradual durability [1, 3, 11, 15, 24, 26, 29, 32], possibility to avoid flaws and mistakes [1, 3, 4, 5, 6, 7, 10, 11, 15, 16, 19, 23, 24], ease of implementation [11, 15, 16, 19, 26, 29, 32], smoothly accessed resources [11, 15, 16, 19, 23, 31, 32], low cost construction and maintenance [1, 10, 16, 19, 23, 24, 26, 32], fair balance between housing budget and credits allocated to it [23, 24, 30, 31, 32], compatibility with current economic conditions and lifestyle, increased self confidence, avoiding luxury [1, 3, 4, 5, 6, 7, 10, 11, 15, 24, 31, 32], desirability to work and to construct a house, convertibility to a capital commodity. [4, 5, 6, 7, 10, 11, 15, 16, 29, 30, 31, 32]
Field studies clearly show a decrease in the quality of concrete constructions. It might be a result of the following reasons:

1. Lack of required equipments and machineries
2. Difficulties in providing high quality material such as mixing water, fine aggregate, coarse aggregate and additives
3. Lack of expert labor in production process.

Also, increasing the cost and time of the construction process has been observed. This is the result of non- industrial process of construction. (Figure 1,2,3,5,6,7)

4.2. Climate adaptation with natural environment

The concern is physical accordance of the building and its construction scheme using climatic elements and employing proper mechanisms to provide comfort relative to the elements used for exploitation of potentials to counteract its negative effects.

- Components for measuring the factors: wind, rain, humidity, sunshine, and temperature. [3,11,15,16,18,20,26,29,30,31,32]

In humid zone, because of high heat capacity of concrete elements, undesirable effect in thermal adjustment, has been seen.

4.3. Physical Effectiveness

- The concern is physical accordance of building with requirements, needs and demands of the residents such that fulfilment of the said needs is predicted in the development method and that physic and spaces created in this method have adequate capability to provide for engineering issues, human factors and are in compliance with human behaviours.

Components for measuring the factor: observance of proportions and dimensional and space criteria from operational efficiency and visional desirability [3,4,6,30,31,32], hygiene [10,11,19,29,30,31,32], caring for tastes and demands of the residents[15,16,19,29,30], compliance with needs [10,11,15,16,19,29,30], avoid shortages [19,29,30,31,32], provide safety [3,4,6,10,11,15,16,19], establish proper relationship between open and closed spaces[3,4,6,10,16,19,29,32], capability to construct infrastructures and facility services.[11,15,16,19,29,30,31,32]

Using concrete increases length of span up to 7 m which improves architectural characteristics of renovated houses. Diversity in interior design and space planning is the result of such structural potentials. Physical effectiveness of renovated concrete structures improves the ability of architectural design in shouldering responsibility to the new style of life, hygienic needs and infrastructures.

4.4. Social Capabilities and Compatibilities

The intention is to create coordination with social under-layer and its expected social functions, such that in proportion with configurations, values, beliefs and traditions, the building would be able to offer a desirable function to the residents relative to other sects of the society.

- Components for measuring the factor: care for social values [1, 3, 4, 5, , 20, 23, 25, 26, 29, 32, 33], coordination with social functions [1, 3, 11, 13, 14, 15, 16, 19, 20, 23, 25, 26, 29], enhancing sense of cooperation and contribution, control and management of the work [6, 10, 11, 13, 14, 30, 31, 32, 33], self-sufficiency, improved quality of the dwellers' life style and culture. [16,19,20,23,25,30,31,32,33]

Vast use of concrete structures decreases capabilities and social compatibilities, because of its need to expert labours. It also results in low proficiency of houses and also, low innovations in the design process by habitants.

4.5. Stability

The intention is the resistance of building against usual, common, unconventional and temporary natural forces and erosion due to withstanding and enduring the environment and its effects and making use of the building all along its life cycle.

- Components for measuring the factor: resistance against earthquake, [6, 10, 24, 29, 30, 31, 32] natural and atmospheric conditions [1, 3, 4, 5, 6, 10, 24, 29, 30, 31, 32] construction quality[1,3,4,5, 32], and durability. [1, 4, 5, 6, 10, 24]

Reinforced concrete structure has a good lateral and vertical stability and also desirable durability, if it has been implemented perfectly. But in rural construction, because of low quality of the process of producing reinforced concrete constructions -such as inappropriate designs, bad curing, missing components portion etc, stability of rural concrete structures could not be guaranteed.

4.6. Dynamism

Dynamism means growth, movement and possibility for optimization of the building based on dwellers' ideas and desires. A dynamic building is the one that is capable of forming a process and a continuous life.

- Components for measuring the factor: partial diversity [1, 3, 10, 11, 29, 30, 31, 32], changeability [4, 5, 6, 10, 11, 26], development possibility. [1, 3, 4, 5, 6, 24, 29, 30, 31, 32]

Lack of expert labours, materials and equipments of concrete construction is a serious limitation for future development and growth of houses. Also, low diversity in design process of building and detailing has been seen. (Figure 8)

4.7. Economic Development

The concern is to measure effects of the chosen approach on economic growth of the region and improvement of economical development factors in the region.

- Components for measuring the factor: expand the native industries and increase production capacity [,7,8,10,11,18,20,24] , improve regional commerce of the area [1,6,7,8,10] , reduce unemployment and train expert men[15,16]

Because of low economic ability of villagers, concrete constructions are not affordable in many rural areas of the country. On the other hand, industrialization of concrete production has had visible effects on growth of economic indicators such as.

4.8. Coordination and Protection of Natural Environment

The intention is to find out how loyal a building development style and the capabilities embedded in a long constructed building during its different utilization steps have been in keeping up with the rules and basics of conserving the environment and how much have they protected the natural resources from getting damaged. In addition, coordination with natural bed, meaning the proportionality of the development procedure, hidden capacities of the structure in its different utilization stages with current environmental conditions, optimum usage of environmental conditions and natural forces must be considered.

- Components for measuring the factor: usage of less basic resources [1, 6, 10 , 15, 16, 17, 18, 24] ,use of renewable resources [6, 10, 15, 16, 17, 18, 19, purification of environmental forces [1, 4, 6, 10, 26], ground slope[1], conservation of environmental view [10, 20, 24, 26]

The most important problem of concrete buildings, according to this factor is recycling. The elements of buildings which have been constructed with concrete could not be recycled or reused in the other way in buildings. It has some visible effects on increasing pollution of closed environment of rural areas.

4.9. Cultural Continuity

The intention is the extent of notice given to the historical bed on which the building is constructed, in a way that the developed building is in logical accordance with construction traditions and that the resulting product does not contradict with the existing physical background.

- Components for measuring the factor: conserving the native identity and laying this building construction tradition [1, 10, 11, 15, 16, 18, 19, 20, 24], conserving appearance of the built environment. [10, 11, 15, 16, 18, 19, 20, 24, 26, 29, 30, 34]

New buildings which have been constructed by new materials and methods –such as concrete- often cannot provide acceptable architectural correlations to their existing context. Because of lack of skill in villagers to use these new methods of building and materials appropriately, the result is not in continuity with vernacular architecture. (Figure 4)

Figure 1. Kushalshad Village- Gilan Province

Figure 2. Shirinsoo Village- Qazvin Province

Figure 3. Jashnabad Village- Fars Province

Figure 4. Ghaesoo Village- Gilan Province

Figure 5. Kolangestan Village- Gilan Province

Figure 6. Abparan Village- Golestan Province

Figure 7. Eivazloo Village- Ardebil Province

Figure 8. AsbMarz Village- Ardebil Province

5. CONCLUSION

Concrete is one of the most important based materials for building construction. In spite of that, difficulties of its implementation in rural areas cause low efficiency. Most of the difficulties encountered can be outlined as the following:

- Difficulties in providing good quality materials, such as water, aggregates and appropriate type of cement.
- Low quality of particle size distribution.
- Lack of technical knowledge of implementation of reinforced concrete.
- Inappropriate curing of concrete.
- Inappropriate structural design.
- Missing standards in time of haulage.

Considering the above achievements, the solutions for increasing the efficiency of concrete usage are:

- Developing vernacular knowledge in concrete construction technology and methods.
- Providing and developing industrialization in concrete construction process and productions.
- Providing appropriate standards for implementation of concrete constructions in rural areas.

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