

## Housing methods and sustainability strategies in attention with nano technology effects in architectural planning

S. Iranli<sup>1,2\*</sup>

<sup>1</sup> Department of Architecture, Tehran University, Iran, Turkey

<sup>2</sup> Department of Architecture, Science and Research Branch, Islamic Azad University, Tehran, Iran

Received: 24 August 2019; Accepted: 26 October 2019

**ABSTRACT:** Adaptability to a dwelling space depends on two main groups of variables: physical attributes of a space and family status. This article intends to focus on human and architectural aspects of housing projects. It evaluates selected case studies according to economic and flexibility parameters. The housing needs and requirements of a family may change gradually according to the family structure. Users get adapted to their living place by having a chance of changing the physical characteristics of their environments to create more adaptable spaces. Flexibility, as a quality characteristic of a space, and economy are two factors effective in achieving an adaptable environment. This study presents the results of a comparative analysis of three types of residential projects by evaluating 10 housing units of each, which have different plan organizations and physical characteristics. Factors of families' structure and spatial organization of the housing units in terms of size and physical characteristics of dwelling spaces have been evaluated. Comparisons have been made to find out the level of changes made to the plan types in regard to the level of spatial flexibility of the projects. The users' expectations, their family status and structure have also been evaluated through face-to-face interviews. This study is based on the data of a comprehensive post-occupancy evaluation of 5- to 20-year-old housing settlements in 3 different neighborhoods in Tabriz, Iran.

**Keywords:** *Adaptability, Flexibility, Residential Satisfaction, Variability of housing requirements and Tabriz.*

## INTRODUCTION

### Methods and Data

Comparative results of the General Population and Housing Census in 2002 and the years before demonstrate the constant improvement of housing production in the city of Tabriz [1,2]. As in the past three decades, the ratio of housing units to the number of households has increased. The scarcity of housing units in the past has always caused the issue of housing quality to be neglected, and the authorities remain oblivious to the quality of residential units. Today, in the subject

of housing, flexibility, adaptability, and user satisfaction are the most vital and basic issues which matter more than ever. This study has undertaken the evaluation of the spatial flexibility level in multiple residential buildings of Tabriz [3,4]. The presented arguments and reviewed projects which are implemented through the time in different regions of Tabriz and the findings which are provided directly through the inhabitants of the projects will allow us to infer a certain definition of flexibility. Tabriz, as one of the five biggest cities of Iran, has recently been under the effect of urbaniza-

(\* ) Corresponding Author - e-mail: spdh.iranli@gmail.com

tion. In fact, housing development in Tabriz does not basically depend on population growth and increase in demand; an immediate increase in the profitability of housing construction has led many people drawn to these occupations and, consequently, has increased the production of housing projects. Rapid changes occurring in family size and structure have always been met with the construction of multi-storey buildings and residential complexes in Tabriz. Due to this fact, the matters of flexibility and adaptability, which are the most basic factors of providing satisfaction for the users, have always been behind the scenes. In this study, the purpose is to evaluate the level of adaptability by focusing on the flexibility of space and income level of the users as two main factors that cause users to get adapted to their living place. To this end, the issue of flexibility has been reviewed by focusing on architectural aspects according to the architectural plans of the selected cases. The level of adaptability of the users has been evaluated through face-to-face interviews and observations. Among the existing projects in Tabriz, three sample projects have been selected and have been analyzed as study cases [4-6].

## LITERATURE REVIEW

### *Spatial Flexibility as a Factor of User Satisfaction for Quality of sustainability in Housing*

Under various socioeconomic circumstances, adaptability becomes one of the essential spatial features for residential satisfaction of dwellings of mass (standard) production types that result in quality factors such as residential satisfaction, adaptability, and spatial adequacy [7,8]. Residential satisfaction and the quality of housing are two mutually related concepts in housing evaluation studies. To Habraken (2008) and Schneider and Till (2007) "flexibility" and "adaptability" are very similar in meaning and often overlap, but the technical meaning can provide a departure point for their clarification and the conceptual framework of the study [9, 10]. To them, in its ordinary usage, "flexibility" indicates not only a physical change, modification or adaptation, for a variety of purposes or uses, but also freedom, which emerges as one of the key meanings. Flexibility makes it possible for users to get eas-

ily adapted to their residential spaces based on various purposes and needs. The term "flexibility" refers to use of space for various purposes without making physical alterations. To Nabeel Hamdi (1991), the higher level of flexibility in the use of a living space where there exists a potential for adaptation with physical changes can be met by flexibility [11]. Achieving this requires flexibility in managing the relationship of standards, costs, and user demand.

### *Some Factors in Determining the Degree of Housing Flexibility*

From the perspective of a user, there are two issues that should be considered in housing design in order to achieve flexibility: firstly, the capacity of the project to offer a variety of choices in housing types prior to occupation and secondly, its capacity to allow changes after occupation. Both of these issues require long-term thinking in the design process [10].

Initial Flexibility

The Structural System

The Position of Service Space

The Architectural Layout of the Residential Blocks

## CASE STUDY

In the following research, the adaptability of the original plan arrangements of dwellings was investigated. These dwellings have been used for 5-20 years in Region 2 of the housing settlements in Tabriz. This evaluation study comprises the search on social characteristics as well as the physical characteristics of the settlement. The selected housing projects have been evaluated based on two aspects:

### *Architectural*

By focusing on the flat plans and comparing them according to the theories and factors of flexibility presented in the second chapter. According to the requirements, opinions, and living conditions of the inhabitants. The data collection system is in the form interview Based on the extracted data from the municipalities of Regions 1 and 2 of Tabriz, about 50 housing projects have been registered in a decade after

1991.

In other words, most of the housing projects are located in these regions; other regions mostly include apartments or old private buildings due to the historical urban fabric in the central parts of the city. Due to the fact that the localization and qualitative criteria are important in categorizing the study samples, three cases were chosen as case studies, which are located at 3 different neighborhoods in Region 2 of Tabriz [11,12]. Regarding the divisions and the total area of the municipality, Region 2 can be divided into three districts:

#### ***North Range, Kooye Valiasr***

Considering the location and the residents' desire for living in this neighborhood, this area is one of the best regions of Tabriz. The land and house prices are considerably high in this region.

#### ***Elgoli***

According to the location and the inhabitants' desire for living in this neighborhood, this area can be considered as the most-desired neighborhood. The land and house prices are quite high in this region.

South and south west area, including Zafaraniye, Mirdamad, Rajayishahr and Maralan areas. There are 17 residential complexes in this area in total [12].

### **EVALUATION OF THE CASE STUDIES**

Based on the location and the residents' desire for living in this neighborhood, this area can be considered as the least-desired neighborhood. The land and house prices are not high in this region. In Iran, land prices are based on the unit price of per square meter, and the unit price of per square meter depends on so many factors, such as the proximity to the transportation system, historical elements of the city, proximity to the landmarks, etc. Due to the fact that the localization and qualitative criteria are important factors in categorizing the study samples, three cases were chosen as case studies:

Residential Complex, Located in Valiasr, Asman-e-Tabriz located in Elgoli District, Sahand Complex Located in Mirdamad Rajayishahr.

#### ***Aseman***

One of the residential projects is Aseman, which was put on sale in 1999. The number of its housing units is 928, and the unit types are two- or three-bedroom units. Their areas vary between 114 and 223 square meters. In this project, structural system is concrete. For this reason, the dimension of columns has become 1\*1 cm. This dimension increases in the lower flats. The shear walls are not located in a simple way. The existence of numerous and large ducts has limited any possible changes. From this data, it is obvious that in this project, the housing units are "hard use" and "hard form". According to the unit plans, it can be observed that all of the spaces are defined and also the construction system is defined so specifically. The number of architectural layouts (number of plan types) is so variable. Although the level of flexibility is not enough for the inhabitants for making changes as they wish or require, there are about 7 types of flats that provide opportunity for the users to choose their unit according to their interests and requirements [13].

According to the collected data, most of the inhabitants of the project are of the cultural elite (university professors) and affluent social class of the society with high incomes. Among the inhabitants, most of the young couples are tenants, and those in older ages are the owners of the units. One of the major requirements of these families is having a kitchen and living room with the area of more than 100 square meters. Based on the analysis done on the architectural plans of this project, and according to the inhabitants' ideas, the level of flexibility is so limited in design and planning. According to the extracted data, among the inhabitants who are the owners, only 40 per cent of them have made changes, which include removing infill walls, renewing the colour-wall, or bathroom-

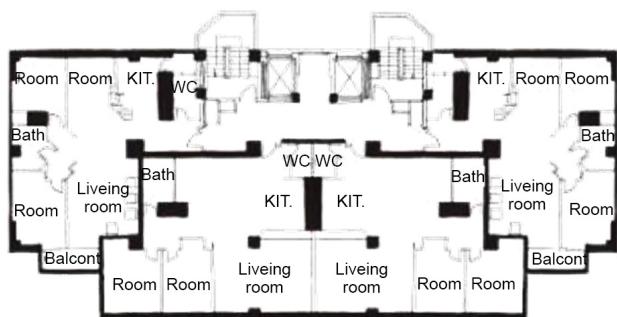


Fig. 1. Main flat plan, Aseman Project.

tiling. Some of the inhabitants, about 10 per cent of them, have bought another unit adjacent to their own and have tried to mix them for having a bigger unit. This is an individual fact which has happened only in the Aseman housing projects. Although some little changes have been made by the inhabitants due to the limitation of flexibility, almost 70 per cent of them are satisfied with their living place. 70 per cent of the inhabitants do not have long-term plans to reside there. More than 50 per cent of them haven't made any changes in the interior plan of their flats. According to the structural system of the housing units, flexibility is not considered in the unit plans, so this issue can be regarded as another factor for the limitation in making any changes. Although some of the inhabitants have made some changes in the interior plans, but due to the limited flexibility, most of the inhabitants have the idea of selling their housing flats and are not satisfied enough with their living place [8,11].

### **Sahand Project**

The construction of the project was finished in 1982. It is a social housing project which is constructed by the Iranian Housing Foundation. The number of the housing units is 216, and there are only units with one bedroom or two. The area of the units varies from 40 to 60 square meters. The units are designed in a way that there is a level difference between two adjacent units. There are structural elements between the units, so there is no possibility of combining them. The units are designed in a hard use system. No specific elements are used in the structure of the house for making it flexible, so it may be considered as a soft form

project. Almost all of the internal components are somehow changeable. In these projects, there are two different types of units: units with two bedrooms and three bedrooms. Units with two bedrooms have been designed the same, and those with three bedrooms have been designed similarly. No specific kind of design is considered for different family types. When families intend to buy a unit, they do not have much choice, considering their family structure.

The blocks are located away from each other and none of the complexes have adequate facilities such as children's playground and green space. There is very limited green space only in the first Sahand which is renamed as Zeytoon Complex. Due to the limited services like security, green space, clean and quiet area, and enough space for parking cars, almost 80 per cent of the inhabitants are not satisfied with their living place. More than 50 per cent of the inhabitants are the owners of their units and still pay the instalments on their houses. These families have low incomes, and their housing flats are too small and are not flexible enough. Moreover, they do not have the chance of making their desired changes in their houses. More than 60 per cent of them do not have long-term plans to reside in the same place. In this sample, almost 20 per cent of the inhabitants have long-term plans to reside in their present living place. At the present time, almost 80 per cent of them are not satisfied with their living place and they do not have any decision for making any changes in the interior design of their flats. Nevertheless, the architectural factors such as low flexibility in this project, and the economic condition of the inhabitants, are two factors which are limiting possible changes and, therefore, the level of adaptability [14].

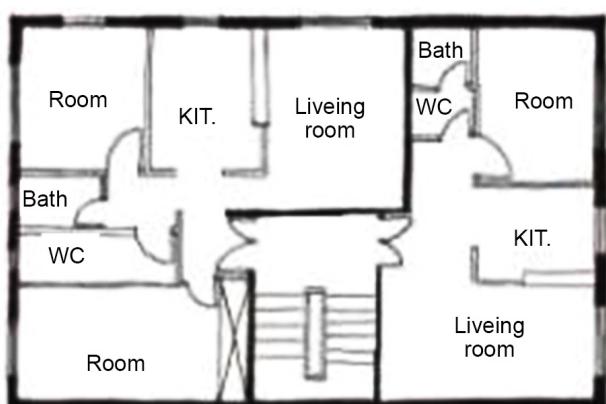


Fig. 2. Main flat plan, Sahand Project (by the Author).

### **Farhangshahr Project**

The third selected project, Farhangshahr, is located in one of the biggest and the most populated areas of Tabriz. Similar to a small town, it consists of boulevards, streets, squares, small bazaars, and many gardens. The residents of its surrounding area are mostly of high and wealthy levels of the society. The units of the Farhangshahr complex were sold by the government to the educators on 1982. This complex consists of 35 four-story blocks. In total, this complex consists

of 499 units. The units are three-bedroom or two-bedroom flats. According to the observations and the collected data from the visited units, the construction system which is used in this project is a prefabricated system. There is no evidence and no proof of the fact that there was a main and specific concept beyond this idea, but the result has provided housing units with soft use and soft form. No specific elements are used in the structure of the house for making it flexible, so it may be considered as a soft form project. The architect has used a modular system to form the project. In the straight lines/walls, the intersecting walls can move and be placed to every point of the main wall; however, if the walls are designed bent or curved, not more than a wall can be joined to the main one, and that would make problems in its flexibility. The shape of the plans is regular quadrilateral, which is the best form that provides an opportunity for making maximum changes.

In the Farhangshahr Project, there are two different types of units, and the base unit types were the same in all of the 35 blocks. Almost 80 per cent of the inhabitants of the units with three or two bedrooms have decreased the number of their bedrooms to 2 and 1 respectively, according to their needs and family structure. According to the extracted data, almost 90 per cent of them are of middle-income families. Although there are some residents who are newly married and have rented a unit or moved to this complex because of the reasonable rents, about 60 per cent of the current inhabitants have lived there for about 20-25 years; they have bought their units and are considered as the owners. The location of the complex, security,

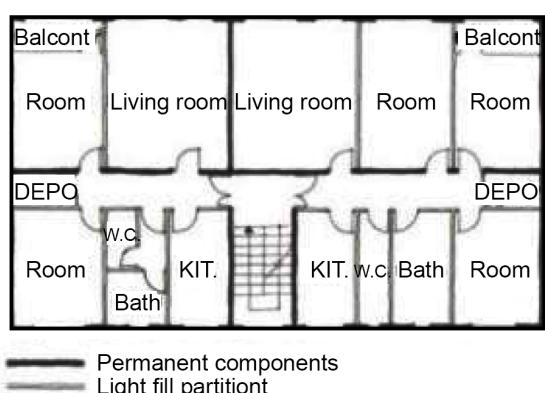


Fig. 3. Main plan, Farhangshahr Project (by the Author).

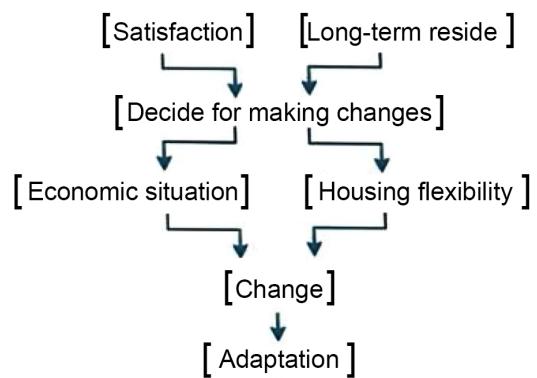


Fig. 4. Santee driven from the collected data (by the Author).

comfort and getting used to the surroundings, friends, and neighbors are some of the reasons that the users have referred to as the basic factors that have had an important effect on their long-term residence. These are some factors that encourage the families to continue their life in the same place without having any plan for changing it. These inhabitants have made as many changes as they could inside their houses to turn them into a desirable place according to their requirements. In the Farhangshahr Project, based on the observations, about 80 per cent of the inhabitants have made the maximum possible changes in their houses; removing some separating partitions, replacing wet spaces, and changing the usage of spaces are some of these changes. As a conclusion, the inhabitants need maximum flexibility in their houses to be able to make changes in a way that meets their needs in order for them to be adapted to their living place and to become satisfied [13].

### Evaluation and Synthesis

According to the evaluation of the extracted data from the three case studies, the level of the users' satisfaction and their level of adaptation to their living place have lead them to have a long-term decision to reside in their current living place. This fact leads them to modify their living place into a one that could meet their families' requirements [15].

Making some little or big changes in the interior parts of their housing unit could play an important role in making the families satisfied and could dissuade them from changing their living place. On this basis, to carry their demand into action, a flexible house would be important. The income level of the

family would have a decisive role in persuading them to make changes and, as a result, in making them satisfied with their living place.

## REFERENCES

- [1] Golizade, H. (2002). Effects of high-rise building on the structure of the physical space case of Valiasr Tabriz (Master thesis), Department of Geography and Urban Planning, Tabriz University, pp. 108-110.
- [2] Mohamadzade, Y. (2002). Assessment considerations in the construction of residential complexes in Tabriz city (Glpark, Shafizadeh, Shahid Rajayi and Kosar complexes) (Master thesis), Department of Geography and Urban Planning, Tabriz University, pp. 113-128.
- [3] Albostan, D. (2009). Flexibility in multi-residential Housing Projects: Three innovative cases from Turkey, Master thesis, graduate school of Natural and Applied sciences (Master dissertation).
- [4] Marans, R.W. & Rodgers, W. (1975). Toward understanding of community satisfaction. In: Rock, V.P. (Ed.), *Metropolitan America in Contemporary Perspective*. Halsted, New York.
- [5] Barker, K. (2004). Review of Housing Supply: Delivering Stability, Securing our Future Housing Needs, London: Her Majesty's Stationery Office, p. 23.
- [6] Esin, N. & Ozsoy, A. (1998). Spatial Adaptability and Flexibility as Parameters of User Satisfaction for Quality Housing, *Building and Environment*, Elsevier Science, Vol. 33, no. 5, pp.316-31.
- [7] Lutfi Kellekc, O. & BERK, L. (2006). Mass Housing: User Satisfaction in Housing and its Environment in Istanbul, Turkey, *European Journal*, Vol. 6, no. 1, pp. 78-81
- [8] Rabeneck, A., Sheppard, D. & Town, P. (1974). Housing Flexibility/Adaptability? *Architectural Design*, 44, pp. 76-90.
- [9] Habraken, N. J. (2008). Design for Flexibility. *Building Research & Information*, 36 (3), 290-296.
- [10] Schneider, T. & Till, J. (2007). *Flexible Housing*. Oxford, United Kingdom: Architectural Press.
- [11] Hamdi, N. (1990). *Housing without Houses: participation, flexibility, enablement*, New York: Van Nostrand Reinhold, p.45.
- [12] Keivani, R. & Edmundo, W. (2001). Modes of housing provision in developing countries, Faculty of Built Environment, South Bank University, pp. 4-6
- [13] Francescato, G. (1979). Residents' Satisfaction in HUD-assisted Housing: Design and Management.
- [14] Newman, O. (1980). Factors influencing crime and instability in urban housing developments / Oscar Newman, Karen A. Franck. Washington, D.C.: U.S. Dept. of Justice, National Institute of Justice: For sale by the Supt. of Docs., U.S. G.P.O.
- [15] Marans, R. and Spreckelmeyer, K. F. (1979). Evaluating built environments: A behavioral approach. Ann Arbor: University of Michigan.

## AUTHOR (S) BIOSKETCHES

**Sepideh Iranli**, Ph.D Student, Department of Architecture, Tehran University, Iran, Turkey & Department of Architecture, Science and Research Branch, Islamic Azad University, Tehran, Iran, Email: [spdh.iranli@gmail.com](mailto:spdh.iranli@gmail.com)