

# Comparative Study of the Strategic System of Flexible Housing Design in the West and Iran

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## ABSTRACT

The principle of flexibility, as an environmental capability of meeting various uses compatible with people's various goals, is one of the significant approaches to housing architecture. In Western architecture, this issue has been widely raised with an organized structure after World War I, while in Iranian architecture, it is inherently evident in traditional housing. Unfortunately, due to lack of sufficient knowledge of this principle and the reasons for its use in traditional housing, flexibility has become known as a modern western innovation by people, with the phenomenon of globalization, its western appearance has entered the contemporary architecture of Iran, and even changed the lifestyle of the Iranian people. The present study is descriptive-analytic research in which the factors forming a flexible housing, flexibility typology, and constructive elements of the western and Iranian flexible residential architectures are studied comparatively. The results show that flexibility in Iranian traditional house has originality based on needs, abilities, and knowledge raised at that time and is fully in line with the standards set at modern times and claimed by western architecture. The most important difference between the two is the issue of privacy, which has been ignored in the use of Western design structures in the Iranian context, leading to the change of Iranian lifestyle. By understanding this issue, this social dimension of housing (i.e. privacy) can be considered in the flexibility issue to see the richness of this concept in Iranian architecture.

**Keywords:** Flexibility, Housing, Typology, Iran, West.

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## 1. INTRODUCTION

The present century has seen unprecedented growth of human education, social changes, and living standards in most parts of the world. These developments have made environmental design practice more difficult, not easier. The reasons for this are clear. There is now technical capability (and often technical enthusiasm) to build buildings, neighborhoods, and cities in different ways and without understanding the effectiveness of their designs for human behavior. Clearly, simplistic investigation of the changes required for human living space leads to unpredictable and unpleasant side effects of the design (Lang, 2014, p. 1). The designers and users' interest in applying the methods common in the world has significantly changed the values hidden in our housing culture. Application of imitating design, regardless of its results as well as its efficiency over time, has shown its effects such as changes made by spending economic, social, and environmental costs (Mohtasham & Hamzehnejad, 2015, p. 52). Flexibility, which is emphasized as an innovation of the West, is one of the issues changing the Iranians' lifestyle, while this study claims that this design style has been inherently in Iranian architecture, and to clarify this, it is required to make a comparison between the West and Iran.

Some studies have been performed on flexibility in Iran and the West, which separately have different results and goals. The application of this design method has been started in modern times and from early twentieth century by Le Corbusier, Mies van der Rohe, who defined a model of structure with open design and a desired definition of interior walls, and by Habraken, to meet the structural needs, and also due to pure thought and humanist changes with personalization of superficial physical and spiritual desires. Habraken, in his book entitled "Types of House Building", first translated in Persian in 1988, has noted to this, and in short, defined the concept of flexibility as the capability of a building for physical change and adaptability according to the changed conditions. He knew flexibility "as a new way to challenge the architecture". People like Schneider & Till (2005; 2006; 2007), in their books and articles on flexible housing, identify functional areas in homes with the ability to change and specify limited places for changes. Bentley et al., (2008), in their book entitled "Responsive Environments: A Manual for Designers", translated in Persian by Behzadfar (2012), have studied flexibility and adaptability in communal (urban) environments and considered micro and macro scales in this design to design residential complexes. Moreover, one of the important references for research on this topic is John Lang's (2014) book entitled "Creation of Architectural Theory", in which the flexibility and adaptability of any environment and how they are practiced by designers are discussed according to human behavior.

In their theses on the flexibility and adaptability of

housing, Albostan (2009), Agyefi-Mensah (2013), Danko (2013) have reviewed minimal housing in Turkey, the relationship between functionality and adaptability of housing in Ghana, and affordable housing for adaptability, respectively. However, these studies do not present a new output. Flexible architecture is also observed in Iranian traditional buildings despite executive constraints, on which a research project entitled "Flexibility in Iran's traditional housing" has been carried out under the supervision of Einifar at the University of Tehran, and its output was an article entitled "a model for the flexibility analysis of Iranian traditional house", published in 2003. In this article, adaptable, variable, and changeable patterns of Iranian traditional house are discussed and in fact, it is one of the important references of the present study. In 2015 and 2016, Mohtasham, and Hamzehnejad, in their two studies, have suggested that a correct understanding of the dimensions of privacy in housing limits the possibility of changes and flexibility in internal spaces and that by applying privacy, selective options will not be as numerous as Western samples of plan changes.

The present study aimed to identify and compare the principles of flexible housing design in Iran and the West, in order to use them in the contemporary era. In fact, to localize architectural approaches imitated from the West and to make them lasting among residents over time, it is required to identify contextual factors. This is followed by the following questions:

- Do the strategic flexible housing design systems in Iran and the West have the same tendency and goal?
- In the contemporary era, what changes does residential flexibility in Iran require, compared to the West?

In the debates on flexibility, the words "adaptability" and "flexibility" are often used interchangeably, although they have many commonalities and distinctions. In order to develop this approach, we follow this issue from the perspective of experts in this field. Then, by examining the factors forming a flexible housing, typology, and constructive elements of flexible residential architecture in the West and Iran, commonalities and distinctions are extracted.

## 2. FLEXIBILITY AND ADAPTABILITY: COMMONALITIES AND DISTINCTIONS

According to Schneider and Till, an adaptable and flexible housing is broadly defined as housing that can meet changing needs and social and technological patterns. However, it is important to note that there is a difference between adaptable and flexible housings, adaptable housings have different social uses, while flexible housings have different physical arrangements (Schneider & Till, 2007). Schneider and Till define flexible housing as a housing that can address changing (personal, practical, or technological) needs and (demographic, economic, and environmental) patterns and/or both (Schneider & Till, 2005).

Of course, Grotter also describes flexibility, as a physical change, in a different way and defines adaptability as an adaptation to different conditions. Architectural space is a definite thing, but for various reasons and as needed, space can be designed in such a way that it can be changed. Within a system, it is possible to change the space or adapt it to different conditions without changing the whole system or its main elements. So, it can be said that space has flexibility (Grotter, 2010, p. 108). He believes that full flexibility is not possible and there are some boundaries because it is required to maintain the whole system and its main structure. One of the prerequisites for flexibility is the separate function of the retaining and separating elements of the building, and therefore the history of flexibility is closely related to the evolution of skeletal building structures in the modern era. In large British spinning mill buildings, cast-iron columns were replaced by internal concrete walls in the 18th century, and this was the beginning of developments leading to today's skeletal building structures (Ibid, p. 08).

Lang uses the term "versatility" to define adaptability and states that some environments provide many activities without any change and reorganization. Adaptable design is a design that provides current patterns of behavior at different times without the need for physical changes (Ibid, p. 108). Similarly, he states that in flexible designs, the structure is easily changed to meet different needs. Such flexibility is more than that obtained just by a semi-stabilized space (Lang, 2014, pp. 34-35).

Friedman shows that "facilitating and matching the needs for space with the limitations of the home, before or after habitation is an interpretation of adaptability" (Friedman, 2002). The term "before or after habitation" in Friedman's definition, refers to a house suitable for the residents' basic needs, which is adaptable to future needs. Like Friedman, in the definition by Schneider and Till, it is referred to the flexibility before habitation, but their focus is on flexibility after habitation.

In the definition of adaptation, Schmidt et al. point to four characteristics: the capacity to make a change, the ability to remain, maximization of value, and time (the rate of change through life changes) (Schmidt, Eguchi, Austin, & Gibb, 2010). In the definitions by Friedman and Schmidt et al., it is referred to as long-term adaptation, indicating a similar description of time. For example, Schneider and Till believe that long-term flexibility allows housing providers to combine various unit types, change interior layouts, and to promote the house using their own economic model in order to prove adaptability (Schneider & Till, 2007); this argument is more consistent with the definition of changeability in the future by Schmidt et al.

### **3. FACTORS FORMING WESTERN FLEXIBLE HOUSING**

Western flexible housing has grown with similar

definitions of adaptability (versatility) presented to respond to many programs. In fact, in this area, stimuli, with the aim of economic stability, led to many strategies, as described below:

#### **3.1. Population Growth and Social Housing Program Policy**

After World War I, to provide mass housing for the working class, European social housing programs were implemented. In order to provide housing for many people, smaller space standards have been adopted. Schneider and Till point to "modernity and minimal house," and argued that early modern architects sought to create this minimal houses as a function by using adaptable design elements. For example, a bed can be used in the living room or office space during the day (Schneider & Till, 2007).

#### **3.2. Paying Attention to People's Needs**

These findings provide varying degrees of adaptable housing. The Schroder House was designed in close collaboration with the customer. It is a sophisticated system of sliding and adjustable folding walls designed for everyday family use. Another way was the design presented by Bruno Taut for an apartment complex in Berlin in 1925, where there are rooms with unlimited development, i.e. similar and non-hierarchical units in the layout. Therefore, residents can choose the adaptable functions appropriate for their needs (Danko, 2013, p. 14). Additionally, the design function of semi-public spaces, such as a private garden, provides large-scale flexibility, which allows residents to grow the food they need, resulting in the reduction of housing costs.

#### **3.3. Growth of Industry/Factories**

In the evolution of adaptable housing in the period 1930 to 1940, it was basically believed that flexible housing could be made available to everyone using prefabrication and other emerging technologies (Schneider & Till, 2007). Following the widespread use of steel, this was designed for maximum use of factory production capacity.

#### **3.4. User Participation Due to the Need for New Facilities**

In one of the successful examples of buildings in Amsterdam, the design process became two-step; First, future residents, overall function, layout, and priorities of the complex were discussed. Next, the architect and contractor consulted with the residents individually to design 28 unique units in a support structure. Adaptable layout and function of units easily allow the complex to have various floor plans or additional use to obtain a high degree of intrinsic value (variability and adaptability) (Kendall, 2011; Schneider & Till, 2006; Danko, 2013, p. 16).

### 3.5. Achieving Sustainability Goals From the Perspective of User Participation

In order to reduce the cost of fuel consumption and thereby reducing its pollutants, to determine the area of a residential unit according to the user needs, household size and the amount of capital is important, reducing or increasing the area of the interior space with no attention to needs increases fossil fuel consumption and imposes surplus costs on the family and the government. In fact, the area disproportionate to needs is equal to the waste of energy and air pollution (Mohtasham & Hamzehnejad, 2015, p.66).

Manewa et al. (2009), with an emphasis on economic sustainability, develop a conceptual framework for the

whole life analysis in the West in order to meet the need for flexibility at two scales. According to them, the national scale affects this process and user participation is an important factor in determining the obsolescence of facilities and the solution to this issue is the demand for change and as a result, new construction. They consider the adaptable building as a practical strategy by providing the following conditions:

- Flexible;
- Available;
- Changeable;
- Movable;
- Reusable;
- Refittable, and;
- Scalable (Fig. 1).

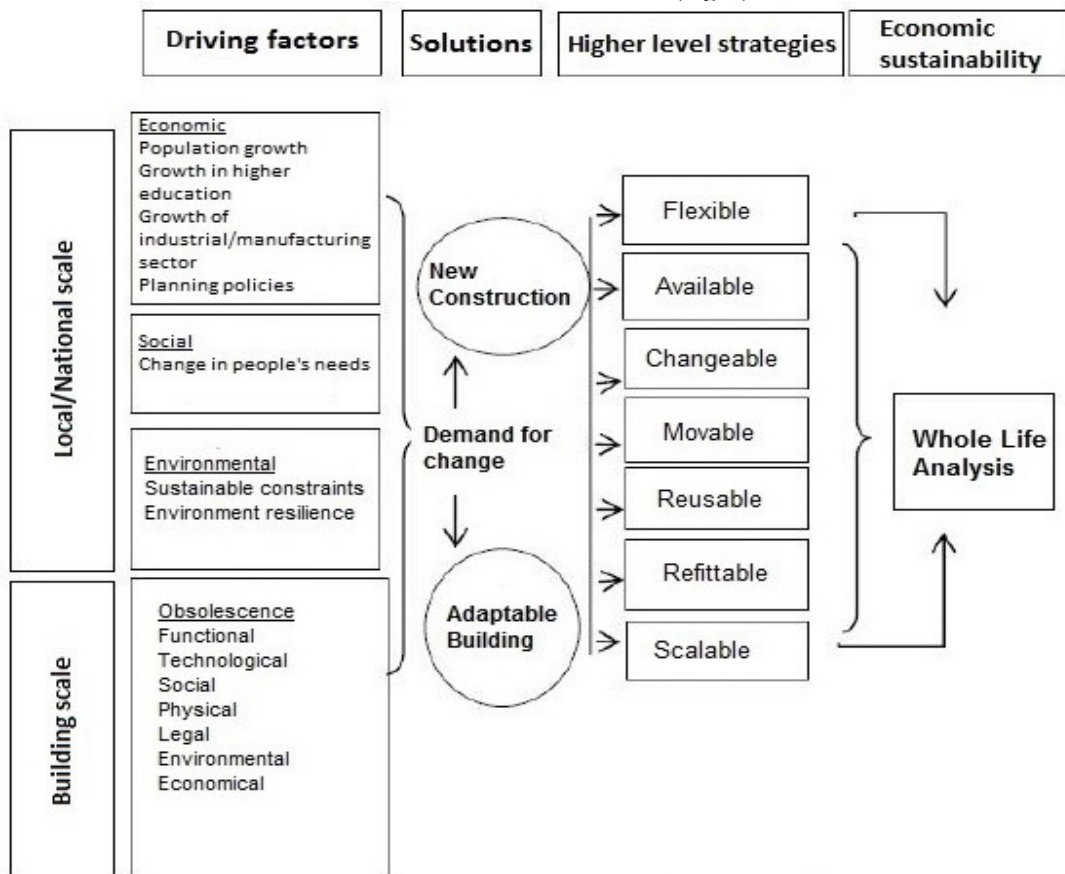


Fig. 1. Conceptual Framework of the Need for Flexibility in the West  
(Manewa, Pasquire, Gibb, & Schmidt, 2009)

## 4. FACTORS FORMING IRANIAN TRADITIONAL FLEXIBLE HOUSE

The most important factors forming traditional flexible house in Iran are the following:

### 4.1. Social (Cultural, Physical and Religious) Needs

The need for flexibility in Iranian traditional house can be mentioned as follows:

### 4.1.1. Change in the Family System; Attention to the Variety of Functions and Behaviors

Residential spaces need to be transformed. Currently, living in nuclear families and in new housing is affected by the age changes of children and adults in the family and the change in their needs over time. Marriage and the separation of children from the family on the one hand, and the possibility of dependence and living together with the elderly on the other, lead to the need for more flexible housing. In the traditional house, these changes occurred in a large family whose

house sometimes accommodated three consecutive generations, and it was possible to meet the needs caused by changes in household size and marriage of children using different spaces in the house (Einifar, 2003, p. 66).

#### **4.1.2. Change in Lifestyle; Variety of Connections between Spaces**

Each building has different spaces because it is composed of different activities. These spaces need to be connected or organized. One of the factors determining this connection is culture. Culture determines what spaces are connected to each other, what spaces are not connected, to what extent they are connected, and what the connection between them is (visual, behavioral, etc.). Since culture determines the extent to which a home is connected with the outside, it creates a particular hierarchy of access, a particular entrance form (Mahdavi-pour, 1994, pp. 57-58).

### **4.2. Environmental Needs**

Environmental needs include:

#### **4.2.1. Adaptation to Seasonal Changes; Determining the Type of Function**

In Iran, in housing design, it has been paid attention to the design adaptive to nature, environmental aesthetics, climate friendship, and physical and mental peace and comfort. In Iran, in the construction of housing, two aspects are more important than others: 1. housing compatible with the nature and climate of the house site, and 2. the spiritual and divine aspect (religious beliefs of residents (Bahadori & Yaghoubi, 2007, pp. 6-7). Part of the needs of traditional house was met by adapting to seasonal and daily changes in life. The traditional house had a central yard, which was used during daylight hour, and different spaces, which were used in different seasons (Einifar, 2003, p. 66).

### **4.3. Economic Needs**

Economic needs depend on the following factors:

#### **4.3.1. Changes in the Activities of Family Members; Determining the Function**

Sometimes, changes in the activities of family members can change the use of spaces in the house. In the past, these changes were a function of people's livelihoods. Some home workshops, such as carpet weaving workshops, could be converted to spaces with other uses as the livelihood changed. Today, the centralization of work centers in non-home workshops and factories and the use of local and global communication networks have changed the form of these functions but have not completely eliminated domestic employment (Ibid, p. 66). The activity of family members is a factor determining the form and size of space; for example, different places are

differently defined by different people, such as sitting and gathering places, which have different meanings in different cultures (Mahdavi-pour, 994, p. 57).

## **5. TYPES OF FLEXIBILITY IN THE CONTEMPORARY ERA IN THE WEST**

Schneider and Tile discuss different types of flexible housing considering the use of "soft" or "hard" tactics. The term "soft" versus "hard" refers to the technologies and construction methods used in adaptable housing. Hard refers to elements that are unmovable, these cores with hard domains should be located in a place where they do not limit the function of other spaces (Bentlry, Murrain, McGlynn, & Smit, 2012, p. 78.). These elements are load-bearing walls and ducts, stairs, and elevators. Soft is a practical approach to the use of open and unlimited plans. Various and centralized physical techniques of flexible housing in the West are discussed in the following. They can be used to design a flexible housing.

### **5.1. Movable Furniture**

This method allows residents to change the use of a room on a daily basis with minimal effort and time.

### **5.2. Joint Space between Units**

The joint room is an idea of a space between two adjacent houses, where the owners of the two houses can use it by negotiating; The use of this room between the two users requires negotiation. The only disadvantage of this type of flexible housing is the conflict between the two users, because both may need additional space at the same time or, conversely, this space may remain empty.

### **5.3. Movable Separating Walls**

- Movable and sliding walls are of elements that can be moved quickly and help to reconfigure the space organization in a space;
- This movable and sliding element can also provide additional space for a variety of functions;
- The design of these elements should be well thought out so that it is possible to completely change the space within a few minutes, and vice versa;
- The flexibility of this system can be defined as two pre- and post-design options for spatial configuration in the home;
- The practical issue is the sliding movement of the wall panels. The placement and location of furniture in the space or the movement of furniture should be considered in the spatial configuration;
- Movable and sliding walls allow the design of different permanent and semi-permanent shells.

### **5.4. Partition and Aggregation of Spaces**

This method has a strong background in Japanese architecture. Since most spaces do not have any

constant uses, and there is very little furniture in a Japanese house, flexible spaces were created. These spaces can be opened, closed, or connected to each other as needed (Grotter, 2010, p. 113). The two adjacent spaces are connected to each other to create a larger unit in response to the needs of some growing families. It is a long-term strategy. Sharing an entrance is one of the most common methods allowing two units to be connected, or used separately (Schneider & Till, 2007).

### 5.5. Neutral-Function Rooms (Multi-Capacity Spaces)

Multi-functional spaces have several origins. Herman Herzberger is a well-known fan of multi-capacity architecture. According to him, it is impossible to design a special space for each person, but space should be designed such that different interpretations can be deduced from it (Grotter, 2010, pp.110-111). The possibility of adding, expanding and changing the space inside a house by connecting additional units in order to expand and increase the potential volume should be considered in the design stage in order to show that in the initial design, it is possible to add new spaces in the future. This type of addition is not performed not only in the horizontal direction, and it is possible to do it vertically.

### 5.6. The Identical Boxes

In this type, flexible units are based on prefabrication. This working structure has reduced the costs of implementation on the site and operation time. The composition of building boxes is such that it can be changed according to the residents' changing needs, if necessary.

## 6. TYPES OF FLEXIBILITY IN IRANIAN TRADITIONAL HOUSE

Considering the characteristics of the Iranian house and discussions related to definitions and concepts, types of flexibility are defined as variety (multifunctional space), versatility (seasonal and daily movement), and variability (partition and aggregation).

### 6.1. Variety (Multifunctional Space)

Variety is the ability to provide different uses of space. This type of flexibility deals with the two variables of space and time. The residential unit space can be used for several functions simultaneously or at different times. Variety can be achieved by designing a map with a regular geometry, easy and legible access to housing equipment, or by adjusting the room size (Einifar, 2003, p. 69). In traditional house, first, each space has its own physical function, and second, it has a conceptual function. Physical function is the main use of space and conceptual function is the secondary function of it. Some of these spaces are described as

follows:

- **Yard:** in Iranian houses, the yard has been used in various forms: as an element determining the property limits, unifying several elements of the house, connecting several spaces in the house, creating a green and vibrant environment, as an artificial ventilator for proper wind flow, as an important element in organizing and partitioning different spaces inside the house, as a safe and quiet place for family comfort, as a place for public and social affairs, especially in the south of the country. In addition to unifying elements, the yard creates a kind of survey connection between them. This connection is made between the main parts of the house, between the entrance of the building and other scattered spaces such as warehouse, cage, etc. in the yard or between the main spaces used in summer and winter at different sides of the house (Zandieh & Parvardi Nejad, 2010).

- **Mashrabiya<sup>2</sup>:** Its two important functions are as follows:

- It is a place to use the breeze and pleasant winds and sometimes the shade, the beautiful view of the sea (Memarian, 1996, p. 100).

- **Sehdari and Panjdari rooms:** Sehdari and Panjdari rooms were the main spaces for hosting guests and also sleeping in Iranian housing. Also, they have been used for domestic jobs such as carpet weaving, according to the job and profession of the people living in the house.

- **Porch and entrance corridor:** In the Iranian residential architecture, creating a space such as a porch at the beginning of the entrance, provides a space with the function of collecting and distributing with other sub-entrances. It was also created to prevent a direct view into the house. Its other function was including, a space for waiting and communication between neighbors because there were usually platforms around it that made a place for sitting.

- **Niches and shelves:** emptying the walls of the rooms to create niches and shelves, was primarily performed to place something in them. This doing aims to lighten the wall load because weight is the cause of destruction during an earthquake (Ibid, p.100).

In Iranian architecture, due to the introduction of religion into the culture, there are differences between individual and social spaces and also there is a hierarchy for them. Like the porch that is the interface between indoor and outdoor space, each space in housing has its unique internal features. The interior spaces of the house with three general characteristics are categorized in terms of privacy in order to arrange spaces beside each other:

- There are spaces that produce smell and noises and other spaces should be protected from the smell and noises.

- There are spaces for which there must be a special visual and movement hierarchies. In fact, the privacy of these spaces need to be respected when entering them from other spaces, and also, they must be supported by other spaces.

- There are spaces that have the above two characteristics; In some cases, the first characteristic is dominant and in some cases, the second one is preferable.

In Islam, religious experts, jurists, etc., as theoretical human ethologists indirectly point out this issue. In the West, there is a common feature in the definitions

of solitude. "The main point of these definitions is the ability of individuals or groups to control visual, auditory, and olfactory interactions with others." The home, as a small social group, also needs such an attitude, which, of course, is very consistent with Islamic definitions of privacy (Mohtasham & Hamzehnejad, 2015, p.57).

**Table 1. Variety of the Interior Spaces of Iranian Traditional House**

| Space                       | Main Concept  | Secondary Concept  |
|-----------------------------|---|--|
| Yard                        | A place used for partitioning spaces, providing sunlight and ventilating the building | A space for parties and celebrations   |
| Mashrabiya                  | A place applied for using breeze and pleasant winds and shade                         | A place applied for enjoying the beautiful view of the sea                   |
| Sehdari and Panjdari rooms  | A place for sleeping and hosting guests   | Carpet weaving   |
| Porch and entrance corridor | An interface between inside and outside, transmission space                           | Connection between neighbors   |
| Portal                      | Entrance hierarchy  | Pirneshin (two platforms on both sides of the building), a place for resting |
| Niches and shelves          | A place for decorative things   | To lighten the wall and reduce its thickness                                 |

### 6.2. Versatility (Seasonal and Daily Movement)

Versatility is the ability of a space to adapt to new conditions. In the new housing, versatility is a capability that meets the new needs by changing the interior walls and installing components in residential units, provided that these changes do not change the area of the residential unit (Table 2). In practice, versatility involves all internal changes including the changes in personality and structure, micro elements and spatial configurations. In new residential complex planning, the most effective way to achieve versatility is to use movable internal components and to variously combine them. For example, when the kitchen, toilet and bathroom, and entrance are considered fixed, other

spaces can be adapted to other functions (Einifar, 2003, p. 70).

The adaptation of lifestyle to the climatic conditions of different seasons can be observed in the introvert houses constructed in hot and dry regions of Iran. The rooms around the courtyard of these houses are used according to the seasons. Accordingly, the north-facing side of the yard (which was exposed to sunlight and thereby warmer) was used in winter and known as zemestan-neshin. The exact opposite of it, there was a south-facing side (which was back to the sunlight and cooler), which was used in summer and known as tabestan-neshin (Zandieh & Parvardi Nejad, 2010, p.7).

**Table 2. Versatility of the Interior Spaces of the Iranian Traditional House**

| Space | Physical   | Conceptual  |
|-------|--|---|
| Yard  | It adapts the elements of space with different functions | Pond and wooden bed as semi-fixed elements used in summer |
| Rooms | Tabestan-neshin and zemestan-neshin                      | Seasonal movement for the use of sunlight                 |

### 6.3. Variability (Partition and Aggregation)

In the design of flexible housing, variability refers to the quantitative increase and decrease or partition and aggregation of spaces and the possibility of returning to the original residential unit plan after the expansion or reduction of its area. In this case, flexibility means the ability to respond to the needs caused by household growth at different stages of life. In other words, this characteristic allows the housing unit size to change,

whether being smaller or larger. The concept of variability is related to changes in floor area, spatial needs and the residential unit form. The need for such flexibility may be due to long-term or short-term needs. The long-term needs appear as the household size changes and there is a need for more living space, and the short-term needs emerge when there are other reasons for changing space. Variability (in Iranian traditional house) was achieved in two ways: increasing the existing floor area or partitioning the house spaces

(without changing the area) (Table 3).

Some of the spaces in Iranian houses that have been formed on this basis are as follows:

- Porch: The porch is an indoor and independent space with a high arch that was intended for a set of activities.

One side of the porch is open to the courtyard, and two sides are semi-open and the fourth side is closed. The closed side usually leads to the alcove and the alcove is combined with the porch when its doors and windows are open (Zandieh & Parvardi Nejad, 2010, p.16).

**Table 3. Variability of the Interior Spaces of the Iranian Traditional House**

| Space              | Physical                                 | Conceptual  |
|--------------------|--|---|
| Pavilion and porch | The interface between two adjacent rooms | A place for gathering and resting, being enlarged or shrunk by limiting elements (sash) between the room and yard |

### 7. THE CONSTRUCTIVE ELEMENTS OF WESTERN FLEXIBLE HOUSING ARCHITECTURE

Since the constructive elements of any architectural space define its generality, flexible space will be achieved, if its constructive elements or components are also flexible. Schneider and Till discuss four major issues in housing in terms of innovative construction and design: “building structure”, “service spaces”, “architectural design”, and “flexible equipment” (Schneider & Till, 2005).

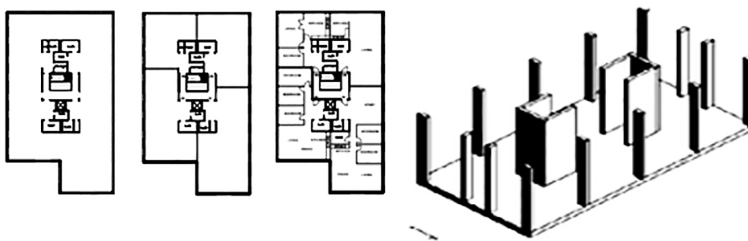
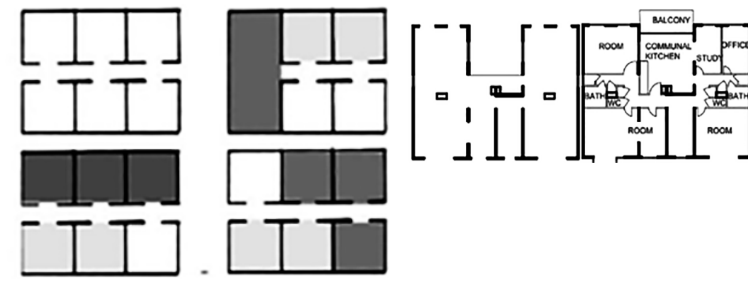
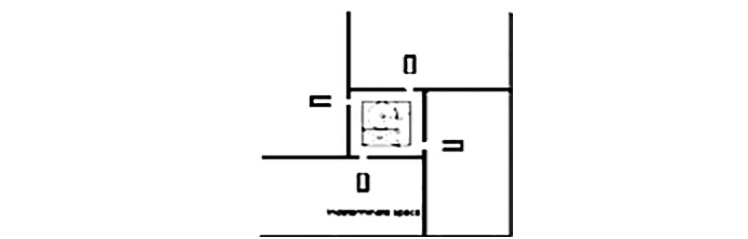
#### 7.1. Building Structure

The building structure is considered as one of the fixed and permanent parts of the building in determining the

building flexibility. Deciding how structural elements are and how load-bearing walls are used allows for future changes (Albostan, 2009, p. 28). The structural system, as one of the fixed and permanent parts of the building, plays a key role in determining whether the architectural design is flexible or not. For example, here, the use of flat slabs is recommended for architectural functions requiring unusual space with columns (Eghbali & Hessari, 2013, p.61).

There are two structural ways to achieve flexibility: “base structures” and “polyvalent organizations”. Base structure refers to a structural system allowing a design, in a fixed sense, to be a function of changes. This system mainly consists of beams and columns. A polyvalent organization, which is designed as cells that are suitable for each function (Schneider & Till, 2007). There is also a third type that is a combination of them (Table 4).

**Table 4. Base Structures and Polyvalent Organizations**

|  |  |
|--|--|
| <p><b>Base Structures</b></p> <p>“Plan libre” or “free plan” was a term invented by Le Corbusier, and meant open and integrated spaces that were formed free from structural considerations, beams, columns, and joints. In the architectural plans of Mies van der Rohe, the same free plan became the main and basic characteristic of his plans (Mozaini, 2011, p. 89).</p> |  |
| <p><b>Polyvalent Organizations</b></p> <p>Soft and hard forms discussed by Schneider and Till are observed here. They are based on their module and role in architecture.</p>  |  |
| <p><b>Hybrid Base-Polyvalent Structures</b></p> <p>It is a combination of base structures and polyvalent organizations.</p>  |  |

(Albostan, 2009, p. 29)



## 7.2. Service Space

Galfetti defines “permanent flexibility” as the potential to combine for new technologies over time to regulate changes, even the use of building from residential to something else, by the structural system and service spaces as permanent components of buildings to determine whether a housing project is flexible or not after a long-term period, i.e. the ability to meet the users’ changing needs over time (Galfetti, 2003, p. 90). In fact, permanent flexibility will be likely achieved by determining the permanent structure and the architect’s pre-determined plan (architectural prediction).

## 7.3. Architectural Design

The architectural design actually provides adaptability by relying on the residents’ needs, including changes in family through the types of flexibility described earlier. Changes in architectural design and composition of units have been made considering residents’ needs and the family structure. The architectural design includes the complex plan).

## 7.4. Flexible Equipment

Using furniture as a functional unit, prefabricated walls, folding furniture, pre-designed industrial modules are obtained.

## 8. THE CONSTRUCTIVE ELEMENTS OF IRANIAN FLEXIBLE HOUSING ARCHITECTURE

In Iran, Einifar (2003) generalizes another classification to the Iranian traditional architecture according to the definition of three types of spatial organization by Edward T. Hall: In general, in any built space, there are three types of organization: fixed space, semi-fixed space and variable space. According to this classification, fixed space consists of non-movable elements such as load-bearing walls, floors, windows, etc. (Einifar, 2003, p. 67).

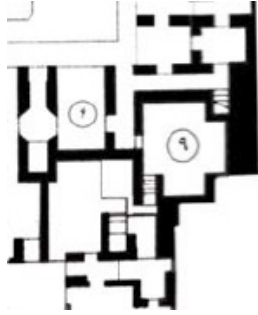


**a. Fixed space:** fixed space is closely related to the structural system and construction methods used in each period.

**b. Semi-fixed space:** It is a space that can be changed by changing the configuration of furniture and home furnishings. In Iranian traditional architecture, many semi-fixed spaces have been formed flexibly in the vertical layers partitioning the spaces (walls). Elements such as pedestals, shelves, niches, etc. play such a role in the organization and flexibility of the spaces inside the housing.

**c. Variable space:** This space is perceptible and related to the hidden function of that special space. Unlike modern architecture, where the transparency of space is achieved through visual communication and expanding and creating an interface between the functions of the building, in traditional house architecture, such interfaces are often created by multifunctional and multi-purpose space and fluidity of functions.

In the following, by analyzing an example of an Iranian traditional house, these three constructive elements are described.

Table 5. The Constructive Elements of Iranian Flexible Housing Architecture

|   |  |
|---|--|
| <p><b>Fixed</b><br/>Fixed elements such as thick walls</p>  |  |
| <p><b>Semi-fixed</b><br/>It was possible to partition and aggregate the pavilion (in Persian: sofe) with the Panjdari room through semi-fixed elements such as sash</p> |  |
| <p><b>Variable</b><br/>In traditional houses, the fluidity of space was provided by lightening the building volume and using an inside-out view with no obstacles.</p>  |  |

(Alavi, 2013)

## 9. DISCUSSION

Considering the above issues, in general, the strategic system of the flexible housing design in the West and Iran can be summarized in the following three areas.

### 9.1. Comparison of the Factors Forming the Western and Iranian Flexible Housing

Comparing the factors forming the Western and Iranian flexible housing shows that they are different in goal. In the West, the ultimate goal is to achieve economic sustainability, but in Iran, in order to comply with the principles of the time, this attitude has been different and specific to each region; In fact, the goal is social. In the West, the national scale has also given rise to flexibility, while in Iran, the building scale and human scale have been decisive. In contemporary Iran, due to the influence of the West, this approach has also become national, and sometimes housing policies are oriented towards the economic goal in order to keep pace with the world; In fact, it is necessary to preserve Western insights and knowledge alongside our original values and tendencies.

### 9.2. Comparison of the Western and Iranian Housing Architectures in Terms of Flexibility Typology

Comparing the flexibility types in the Western and Iranian housing architecture shows that what makes a difference between them is enlarging or shrinking spaces with changes in their areas. The change in types of flexible housing in the contemporary period are due to the emergence of technology and the use of maximum environmental power in order to meet the residents' needs in Iranian traditional housing as much as possible. In the western model, with the emergence of technology, a change in the overall dimensions of the floor area is seen, but in the Iranian model, there is flexibility in accepting different uses. In both cases, service spaces, including toilets, bathrooms and kitchens, are fixed elements, and not changed in Iranian and Western flexible residential housing types.

### 9.3. Comparison of the Constructive Elements of the Western and Iranian Flexible Residential Architecture

## END NOTE

1. Ancient Roman architecture is a type of hard architecture: the arched walls and vaults are made of brick and a kind of mortar, and the middle gaps were created as needed. Ancient Greek architecture is a type of skeletal architecture, where columns and beams are more noticeable than anything else and dominate the other components, and the space between them creates a gap. The degree of coherence is highly dependent on the type and location of the gaps (Grotter, 2010, p. 103).
2. It is a kind of balcony facing the road. It is made of wood and enclosed with carved wood latticework, so that air can easily flow in it or shade is created in it. However, it has been observed that in some cases they did not have a ceiling. Examples of this space have also been seen in some houses along the southern coast of Iran.

In terms of the constructive elements, there are some commonalities and distinctions between the western and Iranian flexible residential architectures which can be determined according to the definitions presented by different persons. In general, the West has built these elements by updating the construction technologies, and these elements have been fixed in traditional architecture.

## 10. CONCLUSION

In modern times, flexibility has reached its peak with the definition of "minimal housing" to meet the needs of low-income households, with the main aim of economic sustainability (reducing transportation costs, reducing fossil fuel consumption, etc.) and secondly, social sustainability (reducing the movements that naturally forms the more original neighborhoods). If this intellectual practice prevails in Iran with an Islamic background, it should be considered that the use of partitions that allows the changes in spaces at a low cost, has been greatly recommended in Iran, and given the cultural issues, those spaces needing to be properly placed adjacent to each other considering privacy, will be influenced, and flexibility, as a way to advance sustainability goals in housing design, will require special conditions from the Islamic perspective, like preservation of Islamic values, because every part of every Muslim's life must be mixed with moral values derived from divine teachings. According to various verses and hadiths raised in Islam, the maximum flexibility in the homes of the rich is questioned and it is believed that in the homes of the low-income groups, the privacy is spoiled, while none of these issues is observed in Islamic housing.

In Iranian housing, privacy may be considered the most important principle in the formation of spatial relations that may not conflict with Western typology. Privacy, as an important part of a flexible housing plan, may reduce the maneuverability of plans for change, but increase the durability by the Iranian user. Therefore, in contemporary Iranian housing, limiting the physical changes can be a solution as the main limiter of the architectural design, along with the principles requiring Iranian architecture according to the background and approach of traditional housing.

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