International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

http://TuEngr.com

A REVIEW ON FLEXIBILITY IN ARCHITECTURAL DESIGN

Hanieh FarokhiFirouzi [a*]

[a] *Department Architecture, Faculty of Art & Architecture, Islamic Azad University, Khorramabad Branch, IRAN.*

ARTICLEINFO

Article history:
Received 16 January 2019
Received in revised form
23 April 2019
Accepted 02 May 2019
Available online
10 May 2019

Keywords:
Architecture with Flexibility; Ambiguities in flexible design; Flexibility of the Criteria of the User; Flexible Creator of the Architect.

ABSTRACT

Since the modern movement, 'flexibility' has become one of the most appealing words in architecture and today's modern society needs buildings that can fit itself with technological advances and, consequently, modern user needs. And the need to maximize the use of limited space that is one of the axioms of today's society has attracted attention to the concept of flexibility and the effort to achieve a flexible environment. In the meantime, the efforts made to achieve flexibility in some cases have led to the creation of spaces with incomplete functional characteristics or the neglect of spatial quality. This paper focuses on the concept of flexibility as a fundamental prerequisite for residential architectural in order to extend its life cycle design, through strategies and constructive solutions that ensure both the convertibility of the space in response to changing usage and the use of building materials that encourage the reversibility and the long-term easy maintenance of the technological choices that have been implemented. The flexibility of the user's creature and the flexibility of the creature's architect. It is not necessarily a way to achieve flexibility through a form or a steady rotation path, but it can be by organizing the spaces effectively and giving the user the right to choose between spaces, as well as the clever use of building systems that support multi-functionality of the space. They achieved spatial flexibility. The purpose of this research is to study the idea of spatial flexibility in a library, documentary and overview method. Also, the challenges ahead in achieving the flexibility of spaces and providing solutions for space flexibility by examining some of the historical examples implemented in architectural flexibility is to find a pattern for designing spaces.

1. INTRODUCTION

In 1954, Walter Gropius, a German architect, emphasized that to have the features of modern living, architecture must be flexible enough (Forty, 2000). Spatial flexibility is defined in the ability to achieve change in conditions without changing the system. While variability is the ability to re-

*Corresponding author (Hanieh FarokhiFirouzi) E-mail: farokhi.haniyeh@yahoo.com

condition by changing the system. (Dluhosch, 1974)

In addition, the modern movement, which was accompanied by advances in building structures, paved the way for designing an open plan for architect and subsequently became "flexible" to one of the most appealing words in architecture. According to Richard Rogers, the fundamental impact of the rapid changes on the physical form of the city, modern life can no longer be defined in the long run. As a result of this thinking, today buildings are not a symbol of static hierarchy; instead, they have become flexible spaces for use by a dynamic community. (Rogers, 1998)

Initially, despite the structural constraints created by the Barber system, these limitations seemed to be out of reach for all architectural design aspects such as the position of the walls, the height of a room, the distance between the columns, and the determination of space functions. Space construction was far from accessible. In 1890, the steel and concrete frame structure the armed forces enabled architects to design "free plans" and thus made the issue more flexible. (Collins, 1998)

In the decades later, with the advancement of material knowledge and construction engineering, there were far fewer structural constraints for building a long ceiling and open-plan wide pillar than before. Other structural constraints for flexible space were not a big problem. However, flexibility is a comprehensive concept, including space, user and relationships. This makes it somewhat difficult to achieve flexibility. In the case that spatial flexibility is one of the controversial issues in the present era; So, the purpose of this research is to provide solutions for flexibility in the spaces by examining some of the historical examples of architectural flexibility, to find patterns for designing spaces, and to examine the idea of flexibility and the challenges ahead in achieving resilience.

1.1 FLEXIBILITY

The flexibility is equivalent to changeable, meaning it can be changed so that the change is made easily and in accordance with the conditions.

This concept is built in the architecture of responding to the new requirements and conditions of space by changing human space. However, the flexibility to define architecture in some words is difficult. Each space has the potential of flexibility. This flexibility can be created by designing the architect in spatial layout or choosing space users. Users can use the space they have for their intended function. For example, when a dining room does not have the capacity to host family and friends, you can use a dining room as a dining room. Or, to the gym's gym, a lecture hall for a graduation party. In short, you can use a space for multiple users.

1.2 OPEN PLANE FEATURE FLEXIBILITY

With the advancements of the past few decades, the entry of a free platform into architecture with its main characteristics, continuity, continuity, transparency, interoperability, and differentiation and, in short, synchronization of locations, has been released. The flexibility of spatial features was released by the plan. Faces that are visual, coherent, distinct and transparent. It should be noted that space needs to meet the existing performance requirements, and each space requires its own specific feature according to its intended purpose. For example, space design and lighting conditions in a gallery must be different from one cinema and the materials of the floor in a gym should be different from a typical classroom. Thus, each space requires its own particular conditions and space flexibility cannot be considered without considering the performance of the rules. Creating a defective space is

the result without considering the same thing in the design of the flexible space. The English architect John Wicks refers to large projects, such as hospitals and airports, designed with a flexible approach. Projects that ultimately have become inadequate spaces with inefficient flexibility. (Weeks, 1963). Therefore, simply having enough space and free plan cannot guarantee spatial flexibility. In other words, an open plan space is just a prerequisite for flexible space, but this is not enough.

1.3 UNLIMITED FLEXIBILITY

Each function in the environment of its particular implementation environment and its specific requirements require performance. Henry Lefebre, in the production of space, says, "Every function has a specifically defined space at the same point, which limits the possibility of more multiplication in a space. (Lefebvre, 1991)

Also, Herzberg criticizes the maximum use of multi-functionalities in a space and considers it a space fragmentation factor. Simultaneous use of multiple functions in a space, each of which requires space and conditions during its execution, cannot be unlimited, and ultimately some functions in space are limited. Thus, in a given space, there is no elastic flexibility. (Hertzberger, 1991)

1.4 FLEXIBLE BACKUP BUILDING SYSTEMS

For a space to be able to meet the specific conditions of performance. Need to equip with suitable building systems such as lighting, audio, structural system, etc.

In his "Last Apple" article, Koolhaas (1995) spoke of the close relationship between space and building systems and beliefs in the effective role of building systems in achieving spatial flexibility. In order to achieve flexibility, building technology can be used in conjunction with space design. But despite the influential role of advanced building systems in helping to achieve flexible space, it should not sacrifice spatial quality. Effective organization of spaces along with advanced technology can bring us into a flexible, high-quality environment and, in short, not advanced technology. It can be a factor in achieving optimal flexibility. (Koolhaas, 1995)

Figure 1: Flexibility based on the user's interpretation.

2. CRITERION ON FLEXIBILITY

2.1 EFFORTS TO ACHIEVE FLEXIBILITY

Efforts to achieve flexibility through the use of flexible equipment such as doors, sliding

*Corresponding author (Hanieh FarokhiFirouzi) E-mail: farokhi.haniyeh@yahoo.com Volume 10 No.6 ISSN 2228-9860 eISSN 1906-9642 http://TUENGR.COM/V10/779.pdf DOI: 10.14456/ITJEMAST.2019.71

partitions or mobile platforms. The use of sliding doors can be seen in the traditional architecture of Korea and Japan. With the ability to adapt to the changing position of the space, these doors are closed to the wall to divide the space and in the open to connect the spaces (Figure 1).

2.2 FLEXIBILITY WITH CLASSIFICATION

Roberk et al. (1974) reviewed a lot of historical forms implemented and concluded that the commonality of these centrally oriented forms is the existence of a kind of flexibility in their ambiguous planes. This flexibility is the result of user interpretations. They arranged the classification of some historical forms with this type of flexibility:

The courtyards of Mediterranean and Mesopotamian households in Iraq where the courtyard is surrounded by rooms with different functions. The function of the yard in these forms is the circle of travel, which can be interpreted differently by the inhabitants. (Figure 2, ground floor)

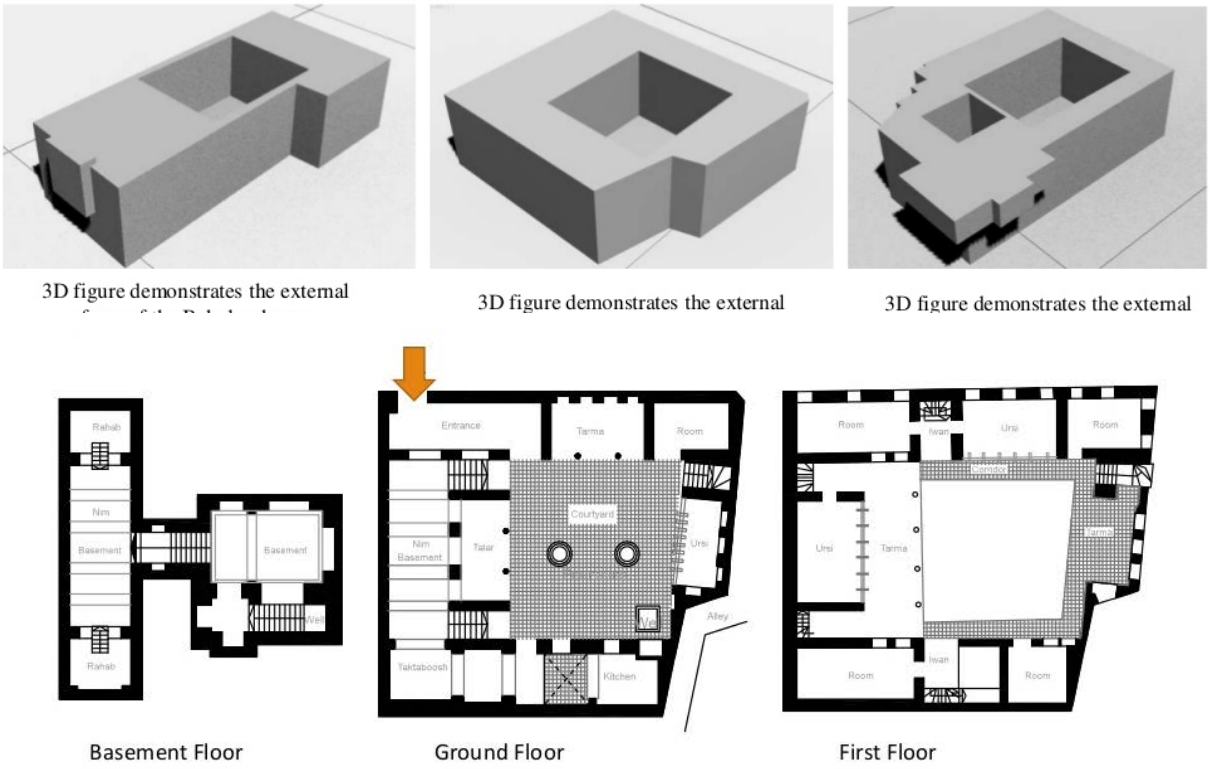


Figure 2: a) Iraq courtyard house, b) La Villa Rotunda, c) Summer villa, Peter Behrens, d) Kuhner villa, Adolf Loos (after Kim (2013)).

The intersection of the Palladian Villas, which is surrounded by hierarchies by organizing the courtyard. (Figure 2, first floor). In the design of center-oriented houses, the layout of the rooms has played a significant role. The view of the rooms around the courtyard allows residents to use the space for their functions. The center-oriented design has enabled residents to interpret space in accordance with their needs in a variety of ways. In other words, functions that are separate from the intended function for that space without changing the existing capabilities add space.

3. FLEXIBLE CREATURE ARCHITECT

3.1 FLEXIBLE MODULAR SYSTEM

The flexibility created by modular and interchangeable components. (Figures 3). The Moodon

House was a government project to build post-war residential airports. These houses are replaced by modular panels in a modular one-meter delivery jean prove designed for the government. The panels were interchangeable and light enough to be easily transposed by a person. Each house was made easily and in one day by four people. In 1972, Perve also designed the fully industrialized SIRA project with the architect Sandor Magnick. A completely industrial form, including eight components, was considered. In both projects, Peru was looking for a flexible solution, speeding up construction. These projects were the starting point for the use of prefabricated and modular industrial parts. Today, these industrial components play a significant role in achieving spatial flexibility.

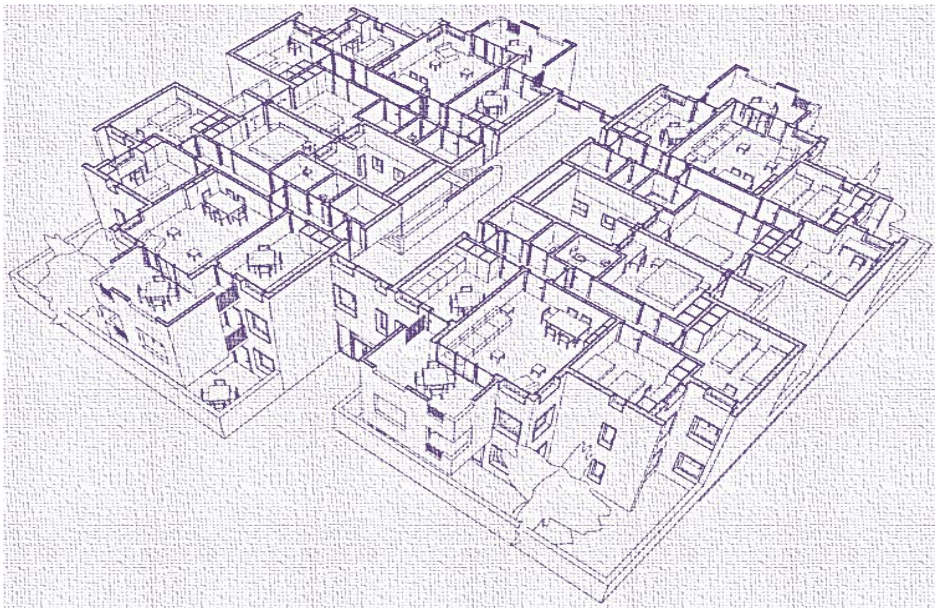
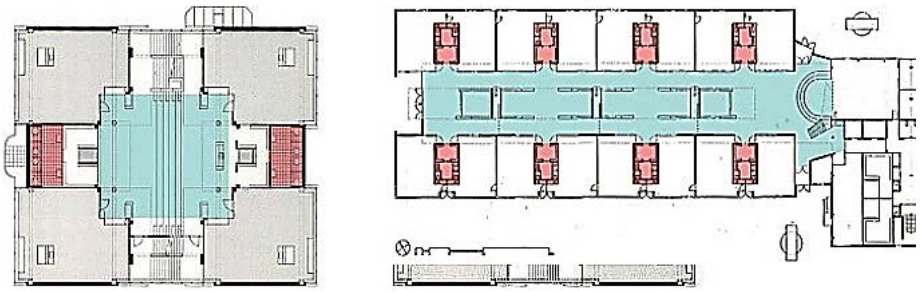


Figure 3: a) Meudon house (Left), b) S.I.R.H. system (Right) (after Kim (2013))

3.2 FLEXIBILITY BY ORGANIZING SPACES

A-Flexibility is created by minimizing spaces with a special function.

In this way, the architect tries to compress spaces with essential and irrefutable uses and allocate the remaining spaces to the user's choice. Herzberger brings his idea of flexible space, which shows the minimum functional space (compressed space) in the maximum permissible interpretations (free space) in many of his projects. In his design, he has spaces for specific purposes such as washing, bathing, and staircase and so on.



(a) (b)

Figure 4: a) Montessori school at Amsterdam (Left)
b) De Polygoon Primary school (Right)
(after Hertzberger (1991)).

*Corresponding author (Hanieh FarokhiFirouzi) E-mail: farokhi.haniyeh@yahoo.com Volume 10 No.6 ISSN 2228-9860 eISSN 1906-9642 http://TUENGR.COM/V10/779.pdf DOI: 10.14456/ITJEMAST.2019.71

3.3 FLEXIBILITY FROM NON-HIERARCHICAL SPACES

Another kind of accommodation of rooms that is different from the center-oriented form in some of the historic houses can be seen in some types of traditional Japanese homes. For example, the most prominent example of homeowners' homes of the feudal period; the nougat nemesis originated in the early nineteenth century in Ibogawa, the prefecture of Hyogo, Japan, representing a different spatial organization for gaining flexibility (Teiji, 1967).

Most of all, the location of the rooms in this house is significant. There is no hierarchy between the rooms. Each room has a degree of spatial quality. There is also no walkway between the rooms. In fact, the route of travel with the user's choice is created by the door-connecting chambers (Figure 5)

In the design of the Casio Sejima (2000), especially in the project (Theater Theater), the plan is a rectangle that is divided into smaller rectangles in different sizes. The plan is roughly converted into a number of different geometric forms that respond differently. (Aoki ،1999) In this plan, there is a rectangle in use at the same time as the user's room and at the other end of the corridor. Therefore, because any space in the plan is not limited to a specific user, the plan is flexible.

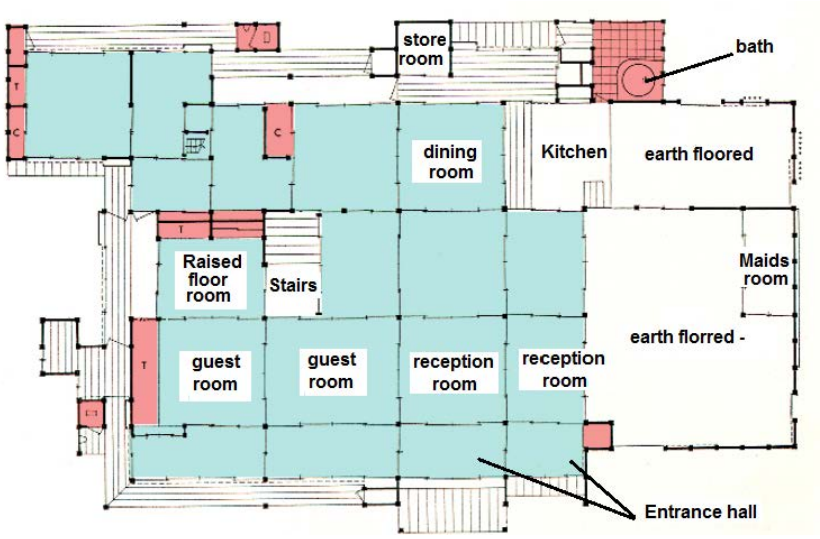


Figure 5: Nagatomi house (after Itoh, 1967)

4. FINDINGS & RESULTS

In his article "Architectural Flexibility", Jung Joe Kim outlines ways to achieve flexibility in architecture in another way. Kim based on the analysis and analysis of the architectural flexibility examples mentioned above. Two multi-functional and multi-capacity methods for achieving flexible space are described. Multi-functional flexibility is created at the stage of spatial design. This approach is accompanied by a change in the characteristics of space. Kim makes use of modular systems, such as the custom-designed project, and the use of advanced construction equipment in this category. In contrast to historic center-centric forms, the non-hierarchical and compact organization is considered as multi-functional flexibility. This type of flexibility is created in the post-design stage and is not at all architecturally based on the user's interpretation of space. (Kim، 2013)

An invaluable point in this category is to ignore the role of the designer in achieving flexibility. For example, in examining Japanese historical houses, the mere fact that the user at one time uses a

space as a room and at another time as a corridor cannot achieve flexibility in space entirely dependent on the user's choice. It is the designer who has provided the plan with the flexibility of his plan by organizing his non-hierarchical arrangement and avoiding the constant flow of path.

With regard to the methods of achieving flexibility in the case studies described above, there are generally two types of architectural flexibility:

The flexibility of the user's creature: This type of flexibility is by no means architectural and completely belongs to the domain of the user. The flexibility is based on the user's interpretation of the space after the space was provided by the architect. When the space with constraints to supply there are various user needs and cannot accommodate persistent space requirements such as dimensions, acoustics, materials and lighting with the user's diverse range of activities.

Architectural Flexibility: In this type of architectural flexibility, in the design phase of the space, the architect intends to create space with maximum use of space capacity. For this reason, the architect has tried to achieve this by effectively organizing spaces, minimizing fixed functional spaces, using advanced building equipment and prefabricated pieces.

In both categories, it can not be conclusively defined that flexibility is entirely the result of one of the two factors of the role of the user or of the architectural design. In this case, there is no certainty, and the flexibility of the interaction of these two factors is obtained on the other.

5. CONCLUSION

Flexibility is examined both from a conceptual point of view, so as to obtain a clear and logical definition that is distinct from related terms, as well as from a practical point of view, by finding ways to incorporate this requirement into the designing of housing. The objective of this research is to investigate the idea of spatial flexibility in a library, documentary and overview method. Also, the challenges ahead in achieving the flexibility of spaces and providing solutions for space flexibility by examining some of the historical examples implemented in architectural flexibility is to find a pattern for designing spaces. Following results are conclude based on our review:

1. Having a large space for flexible design is a prerequisite, but not enough because it creates a space with incomplete features to provide performance.
2. There is no definite flexibility in a given space; however, we face some limitations.
3. Building systems that support multi-functionality of space can be helpful in creating flexible space, but not the main determinant of space.
4. It is not a way to achieve flexibility through a form or a steady flow of plan but can be achieved by organizing the spaces effectively and giving the user the right to choose the space between the spaces, such as the architecture of the Japanese historic houses, to achieve spatial flexibility.
5. Flexibility is not achieved by changing and changing equipment of the space to the flexible equipment and the resulting flexibility cannot be considered the architectural design.

6. REFERENCES

Gropius, W. (1954). Eight Steps toward A Solid Architecture. Architectural Forum, UK, 157.

Rogers, R. (1998). Cities for a small planet: A review. Philip Gumuchdjian, 150-165.

Collins, P. (1998). *Changing Ideals in Modern Architecture 1750~1950*. McGill University Press, 234p.

*Corresponding author (Hanieh FarokhiFirouzi) E-mail: farokhi.haniyeh@yahoo.com Volume 10 No.6 ISSN 2228-9860 eISSN 1906-9642 http://TUENGR.COM/V10/779.pdf DOI: 10.14456/ITJEMAST.2019.71

Dluhosch, E. (1974). Flexibility/Variability and Programming. Industrialization Forum, 39-46.

Weeks, J. (1963). Indeterminate Architecture. Transactions of the Bartlett Society, Oxford, 85-106.

Lefebvre, H. 1991. *The production of space*. MA: Blackwell, USA, 369p.

Hertzberger, H. 1991. *Lessons for students in architecture*. Rotterdam: Uitgeveri 010, 134p.

Koolhaas, R. (1995). Last Apples. *Koolhaas, R. and Mau, B."S, M, L, XL, OMA". The Monacelli Press, New York.*

Andrew, R., Sheppard, D, Town, P. (1974). Flexibility/ Adaptability. *Architectural Design*, 76-90.

Teiji, I. (1967). *The Essential Japanese House: Craftmanship, Function, and Style in Town and Country, Tokyo*, 100p.

Aoki, J. (1999). The Flexibility of Kazuo Sejima. *Japan Architect*, 35, 6-7.

Kim, Y. (2013). On Flexibility in Architecture Focused on the Contradiction in Designing Flexible Space and Its Design Proposition. *Architectural research*, Korea, 2-4.

Sejima, K. And Nishizawa, R. (2000). *Kazuo Sejima + Ryu Nishizawa*. Madrid: El Croquis, 290p.

Forty, A. (2000). *Words and Buildings: A Vocabulary of Modern Architecture*. Thames & Hudson, New York.

Hanieh Farokhi Firouzi is associated with Department Architecture, Faculty of Art & Architecture, Islamic Azad University, Khorramabad Branch, Khorramabad City, Iran. Her research encompasses in Architectural Design with focuses on Flexibility.