Flexibility and Adaptability of the Living Space to the Changing Needs of Residents

IOP Conf. Series: Materials Science and Engineering 471 (2019) 072011 doi:10.1088/1757-899X/471/7/072011

Flexibility and Adaptability of the Living Space to the Changing Needs of Residents

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Abstract. Today, the need for flexibility in the housing area has become very urgent. It starts to be an essential feature of architecture. People live in a greater hurry and their needs are constantly changing. That's why architecture is challenging to meet all users' needs. Designers are experimenting and creating spaces full of innovative ideas crossing the border in the traditional approach to house design. This article, based on the examples, explores and systematizes the subject of flexibility and adaptability of residential architecture. The author discusses the subject on various levels from the macro to the micro scale, ranging from buildings, their construction, through interiors, mobile furniture, to modern technologies affecting the ability to easily adapt the space to the changing needs of users. The flexibility of housing architecture is considered in the context of the needs of young people living very quickly, but also as adaptability to the changing lifecycle of contemporary family, or to the needs of the elderly and the disabled people. Based on the presented examples, the author proves that the flexibility and adaptability of the living space to the changing needs of residents is a determinant of the times in which we live now. It is a universal and individual approach at the same time. Flexibility allows users to choose the most suitable solution from many possible ones and easily or at low costs re-adjust it again, which is also part of the idea of sustainable development.

1. Introduction

A home, a basic residential unit, shaped over the centuries, is the best model that illustrates changes, breakthroughs and trends in the approach to design. It is an element that perfectly shows the differences in lifestyle at the turn of tens and hundreds of years. History shows us how, together with social development, the inhabitants and the habitat changed. Social changes, acceptance and openness to what is new and unknown, it influences the increase in the number of experimental projects and innovative housing models. We can talk about a certain breakthrough in shaping the housing space in a more flexible way. This is due to greater consciousness of designers and users. but it is also an effect of the intensification of urban space, which enforces the use of multifunctional and universal solutions in smaller and smaller flats and shrinking public spaces.

2. The genesis of flexibility - housing architecture in modernism

The idea of flexible architecture is not a discovery of recent years, it is rooted in modernism, and precisely in the postulate of applying an open plan in to buildings. After the First World War, in the face of housing deficits, Modernists were inclined to industrial solutions and modular systems, manufactured on a massive scale. In 1914 Le Corbusier proposed a constructional system, named “Dom-Ino”. It was a two-story unit, made up of concrete slabs supported on columns and a staircase. The developed

prototypes were structural modules, ready frames, which only needed walls and windows. This system enabled architects to shape the elevation and the interior of the building regardless of the construction system. Le Corbusier called this spatial flexibility - "plan Libre" [1]. Currently, the structure is the most popular, and at the same time the simplest and relatively cheap construction solution that favors the flexibility and adaptability of both the interior and the entire building [2]. The “Dom-Ino” system was used by Le Corbusier in 1927, in the designs of two buildings at the “Weissenhof Housing Exhibision” in Stuttgart. The architect used an open construction plan allowing for any layout of functions, designed sliding walls to connect spaces and built-in furniture with hidden beds. Thanks to these features, the space has become multifunctional [3].

3. Open plan - the structure to be filled

Modernists' considerations on the free building plan are best illustrated by Le Corbusier's drawing of „The 4 compositions” from 1929, illustrating the systematization of single-family houses designed by him. The figure shows the evolution of architectural thought. The architect begins with a freely shaped plan (point 1-1923 - Maison La Roche), then introduces the limitation of the plan to the form of a rectangular prism (point 2 - 1927 - Houses at the Weissenhof Housing Exhibision), then introduces the idea of a free plan of individual floors of the building, incorporated into an independent construction (point 3 -1928 - Villa Baizeau). Finally, combining all ideas, Le Corbusier creates an illustration to „Five Points of Architecture” (point 4 - 1929 - Villa Savoy) [4]. Out of four presented compositions, types 3 and 4 are in fact the development of the idea of "Dom-Ino House" and illustrate the full potential of separating the structural arrangement from the building plan. Villa Baizeau, Carthage, Tunisia, from1928 (type 3) is not as spectacular as the iconic Villa Savoy, but in a clearer way it illustrates the freedom of shaping the plan and the independence of individual floors of the building. The project was created as a result of looking for shade, cold and airflow in a hot climate and was implemented in two versions. The first more technical version is a kind of prototype, based on the simplicity of building solutions that can be adapted to the functional and aesthetic expectations of residents. The final project (second version) is a development of the original idea, which introduced small changes to the internal layout of the rooms and added individually designed facades [5].

Villa Baizeau project is the prototype of many subsequent modernist ideas for residential housing. Undoubtedly, it is associated with the project of experimental homes in Kallebäck designed by Erik Friberger. It is a multi-family building located in Sweden on the southern outskirts of Gothenburg. The house was built in 1960 as a prototype of flexible and prefabricated solutions of living space [4]. The building consists of three levels of reinforced concrete platforms supported by pillars and three staircases, in which electric and sanitary installations were placed. This resulted in tripling the available area, which was divided into 18 building plots, located on both sides of the staircases. The original idea was to build individual prefabricated single-family houses of various sizes and shapes, along with accompanying gardens, located on subsequent levels of the building. In practice, most of the houses have been expanded to the maximum size at the beginning of their existence, leaving no space for the garden or later expansion. It did not allow to check the functional possibilities and changes in time of this innovative solution. Undoubtedly, this project is a visionary idea of vertical garden cities on a smaller, quite real scale.

4. Adaptable housing - adjustment for age, disability and family life cycle

Today's ideas of flexible space have their foundations in the modernists' thoughts on universal housing design. Flexible housing space has the ability to adapt to diverse users, but it also changes over time with the age of the inhabitants and the life cycle of the family. Already in the 1930s, Johannes Van den Broek, in the face of a shortage of flats and a small space of apartments, made a design attempt to create flats adaptable to different needs of family members. The main design assumptions took into account changes in the way of using space during day and night. Architect tried to accommodate more residents in the apartment using fold-out beds and dividing the space with sliding walls in a way that ensures

isolation and privacy during the night. The "De Eendracht" building, which was completed in Rotterdam in 1937, was very successful is still in use today.

Architects' reflections on the subject of living space adaptable to the family life cycle, which were important in the 1930s, again interested designers in the 60's and 70's. In 1962, the British Ministry of Housing and Local Government (MHLG) developed a prototype of a single-family „Adaptable House" [6]. The project includes changes to the internal division of the home space as a manifestation of the flexibility and universality. Architects presented a theoretical diagram dividing the family life cycle into seven stages, within 50 years, from the moment of marriage. Also, with the age and disability, there were other residents' needs that were included in the project.

In Poland, from the 1950s, Halina Skibniewska worked on a model of a flexible flat, adaptable to the family life cycle, including the needs of elderly and disabled people. They were so-called „Inflectional apartments" and "Changeable flats", which were later introduced into residential buildings at the „Sady Zoliborskie" estate in Warsaw. In apartments, a flexible division of space was applied using a wall units system with folding interior furnishings [7]. In the 1970s, a program of experimental settlements was carried out in Poland, taking into account the problems of elderly and disabled people. Prototype projects were developed as part of the government's research and development program. In addition to adaptable housing, it was planned to introduce "intergenerational apartments" for multi-generational families, i.e. small flats connected internally to larger apartments. This solution allowed to live together but separately for several generations of the family. It was possible to divide or combine space into one large apartment depending on the number of inhabitants. Unfortunately, only a few projects have been implemented [8]. "Intergenerational apartment" is a step forward and an example showing that space does not have to be limited. It can grow and shrink by combining and dividing. In the case of a single-family house, it is always possible to expand the building's volume and add additional space. However, looking for a flexible, fast and cheap way to enlarge the space or its division in multi-family buildings is much more difficult.

5. Transformable space - time as the fourth dimension of architecture

Adaptability of the housing space also took the form of its transformability in a short time, taking into account the fourth dimension of space - time. In 1924, Theo van De-osburg announced the manifesto "Towards a plastic architecture", in accordance with the postulates of the De Stijl movement. The manifesto indicated desirable features of architecture, which should be: elemental, formless, open and should consider space-time aspects. The openness of architecture was to be manifested in the possibility of dividing and joining spaces depending on functional needs, using dividing and protective surfaces and transformable elements of equipment. An example illustrating these architectural features is designed and built in 1924 by Gerrit Rietveld "The Schröder House". It is an archetypal, modifiable home. It is widely recognized as the architectural icon of the 20th century. The architect designed the upper floor of the building so that it can be completely reconfigured each day, depending on the needs of the residents. Instead of traditional walls, Rietveld used sliding partitions. He presented an alternative to the permanent division of the living space. This project turned over the traditional thinking about shaping the interior. This extremely sensible and well-designed project was already far into the future. He was a forerunner of changes in the approach to shaping the space and way of life [9].

Currently, sliding walls are no longer new or something that may come as a surprise. Especially in very populated cities and large metropolises, where every additional square meter seems to be a universe, the flexibility of the plan is extremely desirable. That is why many architects, as well as the residents themselves, take up the subject of flexibility in the housing space, trying to bring added value to it in the form of variability and flexibility. This applies mainly to small flats inhabited by young people with open minds, ready to experiment. Around 1983, architect Steven Holl also began his experiments with sliding, rotating, folding walls. He used them in "Cohen Apartment" in Manhattan, in "X-Y-Z Apartment" in the tower in "The Museum of Modern Art MOMA" and, above all, in a series of hotel rooms in the city of Fukuoka, Japan [10]. In apartments, a new guest with specific, different needs lives every day. In these projects the architect does not only care about the division and variability of

space, the main idea is the movement and interaction of man with space. The three-dimensional apartment becomes a four-dimensional space that changes, evolves over time and constantly adapts to new users. Similar flexible elements were used in the businessman's apartment in Monte Carlo, designed by the Lazzarini Pickering studio [11]. However, not only the walls are movable, but also furniture is its integral part and changes its destiny depending on the situation. The table transforms into a cupboard, cupboard changes into a screen, screen in to the door. Everything designed in a minimalist, economical style, not requiring time to keep everything in order. Such space adapts to the modern way of life.

6. Transformation of the form - open / closed architecture

Smooth transformation of architecture is another step in thinking about the flexibility of the living space. Architect Hans Peter Wörndl decided to present a diverse approach to movement and changes in space. In 1993, in Australia, he designed a small building as part of a series of exhibitions, workshops and installations answering the question of strangeness and otherness in space. On the one hand, it is a closed, cohesive, stable form - a home metaphor, on the other - an element of movement, change and life that connects with the landscape. „GucklHupf" is a manifesto, a protest against the perception of a house in a conventional way. The artist gives the opportunity to open the object and expose the interior. The flexibility of this form is an opportunity to shape the space yourself, adjust it to your own needs [12].

Similar in action and stylistics to "GucklHupf" is developed by Stephen Kanne "Transformable House". It is a holiday home in Sagaponac, New York, which form can be open when visitors come to rest and close when they leave. The outer shape of the building, simple, clean, geometric, hides many possibilities in its complex interior. It changes by sliding, folding and rotating elements and integrates with the natural environment. The reorganization of the form gives the opportunity to change not only the appearance, but above all the functions of individual rooms. In the simplicity of action and cubic form, both projects almost directly associate with the mentioned "Schröder House", but they go much further. The buildings are modifiable and become an integral part of the surrounding. They combine stability with mobility [13].

7. Location - portable, modular and autonomous house

Nowadays, more and more portable house designs are being made. They can be transported or moved by themselves. One of them is "Loftcube" designed by Werner Aisslinger [14]. It has a flexible interior with sliding walls and multifunctional equipment. However, the most important is the ability to change the location of the object. "Loftcube" takes up the problem of creating a modern, minimalist living space for people living temporarily in large, heavily populated cities. The answer is to use the roofs of existing buildings by putting on them temporary, portable, small flats. In addition, this solution gives you the opportunity to use the sunniest areas in the city. "Loftcube" is modular. One segment can function alone or be connected vertically or horizontally. Unfortunately, this is an expensive solution, unavailable to the average user.

Definitely cheaper, and thus more available alternative, are mass-produced, container boxes inserted into a modular grid. It is easy to move and combine them. Contemporary architectural practice brings us a growing number of examples of using modular and prefabricated structures, just like the project of student houses called "Spacebox". They were created in Delft, Utrecht, Eindhoven, that is in cities where the largest universities are located. They are small units of not very high standard of living, but for the needs of young people wanting their own private space it is enough to start to live independently. [15]

A step ahead is the autonomy of a portable home. The Polish company "Artin" designed, patented and produced a portable home called "Dodo House". This project is not only a mobile home, but it is solution completely independent of the surroundings. It is equipped with the latest technologies and ecological solutions. According to the producer, the house not only saves and stores energy, but also thanks to the use of wind turbines it produces it. In addition, it does not require connection to the sewage network as it is equipped with a system of purifying used water. Amazing freedom and no restrictions in choosing the location of "Dodo House" is its main advantage. Independence from energy producers and water and sewer connections, make it possible to locate it anywhere we wish. It is a completely real

project and there are six variants of the house to choose from, ranging from 23 to 145 square meters. The price of a house is comparable to the value of flats in a multi-family building [16].

8. Results and discussions

The degree of flexibility depends on how easily and quickly we can make changes. This depends mainly on the building structure and the size of the available space. On the basis of the presented examples, we can systematize the types of flexibility depending on its nature and scale of changes. The basic division includes the ability to change: location, size and layout of the interior. A detailed systematics including a graphical illustration of individual types of flexibility is shown using a summary scheme (figure 1).

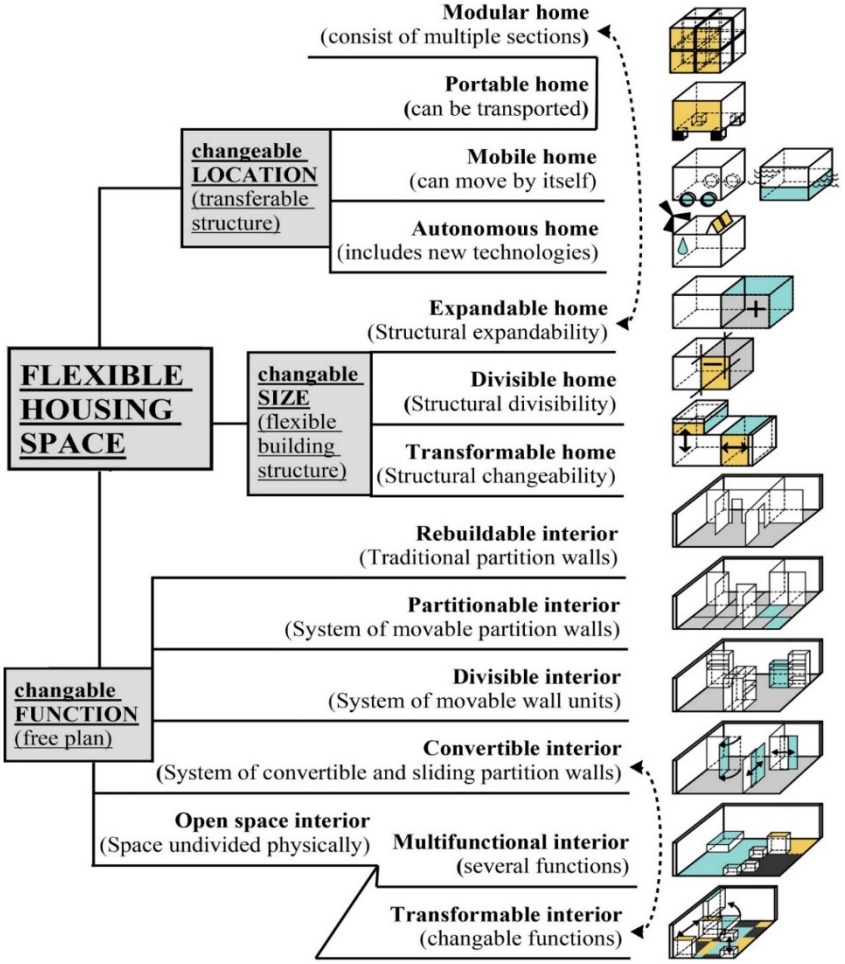

Figure 1. Flexibility systematics - types of flexibility depending on the nature and scale of changes.

It is worth noting that the flexibility and adaptability of space is very often associated with modular systems and prefabrication. However, it should be remembered that in the 20th century, the modernists imprisoned their imagination at the moment when they began to limit themselves to design based on a modular construction grid, which was originally intended to be the road to architectural freedom. It was a breakthrough in the facade design and gave the opportunity to use an open plan. However, at the moment when the modernists began to reduce almost everything, and the function became the supreme factor, the construction grid became a curse, it deprived architecture of all beauty and elegance. The vision of identical, prefabricated, flexible homes have some advantages such as: affordability, universality and accessibility for everyone, but it is far from the individuality that we desire so much today.

9. Conclusions

The idea of flexible architecture has been in the field of architects' interests for a long time. It arose from an authentic need for movement, changes in lifestyle and constantly growing needs. Nowadays, for a person who uses a portable computer and mobile phone, listens to music from the mini player, stores documents and photos in a virtual cloud, and for lunch eats instant soup - mobility of objects is everyday life, and the mobility, adaptability and flexibility of buildings is just another step in the same direction. Now, when the availability and easiness of communication dominates our lives, the situation of life transformations is more common. To support this process, we can design so that the environment adapts itself to the user's needs.

The flexibility and adaptability of residential architecture enable:

- Adaptation of the housing space to the individual needs and preferences of users.
- Adaptation of the same housing space to different numbers of users.
- Adaptation to the family life cycle.
- Adaptation to the needs of elderly and disabled people.
- Changes in the function and way of using the space.
- Introducing the fourth dimension of architecture - time.
- Reducing the usable size by introducing transformation and changing functions.
- Autonomy, mobility and individualization of a residential unit.
- Application of modular and prefabricated solutions.

The flexibility of residential architecture is reflected in the possibility of easy and quick changes in the division, expansion and arrangement of space, as well as the possibility of reducing the size without limiting its functionality. Thanks to these features, flexible and adaptable housing architecture is compatible with postulates of universal, affordable, accessible design and the idea of sustainable development.

Acknowledgment

The research was carried out within the framework of work No. S/WA/2/16 funded by the polish Ministry of Science and Higher Education.

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