Flexible Spaces in Architecture

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Abstract:
This research will analyze the designing fields, the ideas and the structure of moving and flexible architectural elements for multi-purpose utilization of the spaces. The peculiarity of some of the architectural spaces is about the fact that it can be useful for different applications. In this direction or because of the type of design and the multi-purpose use of a space and or the result of change, movement and displacement is the interior components of the building. Using the new technologies in the buildings gives the opportunity those elements of the interior space such as the ceiling, the floor, the walls, the furniture, etc., not to be solid or rigid. This flexibility will allow the architectural space to be more flexible.

Key words: Flexible space, Ambulatory architecture, Multi-purpose space, Multi-application space.

1- Introduction
Thoughts and activities of our community have been affected by increasing international communication. As a result new dimensions of mobility and complexity in many science and education have been made by human. While conceptual changes in Architecture are followed slowly, mobility and flexibility can act as ideas of future architecture that would draw more attention. On the other hand, unpredicted events (such as earthquake, floods, etc...) have always put the residents threatened and the occurrences of such events are still expected. Short-term housing procedure after disasters and use of some public buildings and places of towns and villages as settlements and Treatment place are of the issues related administrators and operators are facing with. Public and large buildings spaces would better to be more flexible to use in emergency situations.

2- A brief look to the past
When early human considered plains as hunting and agricultural purposes, he thought of manufacturing a housing based on his own idea. Caves and trees are two main paradigms in the nature as a human shelter. Hence trees and cave became ideas of building wooden and hard stone shelters respectively. Human being also demonstrated considerable progresses in living and architectural evolution in a way that gradually came up with the idea of utilizing bones and skins of huge animals (such as mammoths) to build shelters flexibly opening or closing. Based on abovementioned background it could be concluded
that light weighted dynamic structures have been created and utilized by human beings since long time ago.
Structures involving light weight and mobility have been manufactures in various forms using different materials and system. Tents, Black Tents, Arbor, Gazebo, and Pergola … are such structures that have widely been used by nomads and Bedouins. A house carried on back of a four-footed animal requires simple and genius manufacturing procedure which is in result of hundreds or thousands years of experience.

Fig 1: Inside the tents, East Asia.

3- Flexible Spaces
The objective of flexibility in the architecture is to provide spaces with simply changing structures respect to changes in required performance and application. Though architectural spaces could be identified and restricted through physical elements such as floor, ceiling, and walls and so on, it should be designed in a way that changes flexibly. For example the space may be required to be uncovered most of the time and sometimes be roof covered, or simply the space may be required to be shrunk or expand. Since constructional elements identify the space, application of flexible design of such elements are necessary for making up flexible spaces. Flexibility of constructional elements depends on dissociation of mobility and load. Therefore it could be pointed out to more cases of flexible design since structural systems succeeded to separate above said features (i.e. mobility and load).
Since 18th century evolution of skeleton frame work idea in construction of structures has eliminated load walls and replaced by cast iron pillars and supports. This point made structure’s inner design easier.
By the end of 19th century most of the buildings constructed through abovementioned procedure, were designed excluding inner walls. Such walls were added to the building based on residents needs. "Le Corbusier", modern architecture, proposed his quintuple principles in the early 20th century that one of them is known as "Plan Libre". "Domino house" was designed using this principle in 1914. The plan included flat plates (as floor and roof), some pillar supports (to stand against level loads) and stairs to connect levels together. No inner walls were included except for space partitioning. So inner walls could be located wherever required that result in absolute liberalization in form and design flexibility.
During the years of modern architecture, "Theo Van Doesburg" (founder of "De Stijll" ideology) expresses his theories in a paper titled “toward a flexible architecture” as follow; “Modern architecture is an open one. A unique space constitutes the whole house that is partitioned according to required application and performance. Such partitioning takes place through internal divider walls and external supporting ones. The former divide the house space in accordance with performance and application which could be portable (in contrast to traditional dividing walls), that is such walls could be designed in a way that frames and handy plates could be replaced.”

In the residential complex of "Weissenhof", designed by "Mies van der Rohe" in 1927, internal walls of each room were envisaged to join floor and ceiling using fastenings. Hence each resident could arbitrarily expand or shrink the room. There is no door between rooms and anyone would be surprised of spacious features of such 70 m2 residential space. "Scheroder House", made by "Gerrit Rietveld" in 1924, is triggered by "Neo Plasticism" cause. Such effects are created through decomposition of structural elements and recombining them in another way. First floor plan is flexible and individual rooms are evolved in glasses using solid walls and parts of ceiling protrude the structure in a way that no support could be observed. Horizontal and vertical elements having pure colors as well as white, black and green colors could be distinguished inside and outside of the structure, internal architecture, and furniture.

Even though serious attempts made on space flexibility, no individual independent method known as flexible architecture was created. Because of large constructional costs and technical issues after usage, development of the flexibility theory halted in that time. Most of the buildings inspired by high degree of flexibility couldn’t meet acceptability criteria. Practical considerations revealed that residents didn’t move the portable walls of buildings.

1. Multi-Purpose Spaces

Abovementioned items include adaptation of space restrictive elements against modern space performance. Another approach to this issue is creating multi-purpose space that is the space capable of meeting different requirements. In other words such space is designed for multi-purpose activities and by changing furniture one could utilize the space without any further general modification.

"Robert Venturi" in his book titled: “Complexity and Contradiction in Architecture” states that: multi-purpose spaces could probably meet the reasonable requirements of modern architects who attempt to get flexibility. Spaces designed or various purposes and portable equipment are utilized in them instead of moveable walls inspire the observer of a changing space. Such flexibility could mentally be perceived and there are no physically changes in the space. Besides such space makes us believe such perceived feeling. Multi-attribute features of the space could lead to performance flexibility.

Background of multi-purpose space utilization goes back to foaming early records of architectures more than thousand years ago. Because most of the issues used to be treated in one residential place and a unique space was capable of being utilized for various application and purposes.

The fact that creation of exclusive one-purpose spaces for short-term utilization is not cost effective, strengthen the idea of manufacturing a multi-purpose space. Different forms of such idea could be observed in various countries.

By the early 21st century causes concerning multi-purpose space design appeared in Europe. "Walter Gropius" designed the comprehensive project of the city theatre of Berlin in a way that could be utilized for various musical and demonstrative theatrical programs.
by introducing little changes in middle stage of the theatre that could rotate 180 degree, without any further constructional operations.

**Fig 3:** project of the city theatre of Berlin. (stage rotate 180 degree)

"Herman Hertzberger" is one the prominent pioneers and supporters of creating multi-purpose spaces in the 21st century. He believes that there is no unique design for each individual so the space should be flexible enough to be utilized freely by each person. The building he designed for an insurance company in Netherlands illustrates this idea clearly and obviously. The building has comprised of square shape scaffolds located over each other and side-separated where the light absorbents located. Such scaffolds together form a network of spaces that could be integrated if required.

2. **Walking Architecture**

"Walking City"

**Fig 4:** The idea of Walking City.

This fancy dream emerged in "Ron Herron”’s plan in 1965. In those plans buildings of a city are depicted as a living creature with walking foots same as an octopus and are capable of walking around. It is probable that this idea comes true same as old sci-fi stories of "Joule Wren", however it would serve as a motive to create simpler abstract models for the today’s architecture. Though no moving building has been constructed yet, it is reasonable to find similarities between small building and vehicles riding on the ground, going into the deep part of ocean, and flying up to the sky.

3. **Dynamic Walking**

Dynamic walking in parts of the structure may represent the high-tech constructional arts and engineering of current era. Dynamics of the structure’s basic elements (such as ceiling, floor, walls and so on) in the modern architecture take place for two main objects; better utilization of space, and creation of an abstract and delusive concepts.
Structure of dynamic configuration is one of the main concerns of architect such as "Santiago Calatrava" in recent years. He is one of the experts of linking structure and modern architecture and has researched on dynamic behaviors of structures and architectures. He believes that “buildings as a part of the nature could change”. So he has inspired his ideas of dynamic plans from the nature. One the prominent sample of such idea could be seen in Art Museum of "Milwaukee" which is a metaphor of wing hove of a bird.

4. Opening-Closing Structures
Everything in the nature experiences change, evolution, and movement. Movement also includes expansion and shrinkage of body forms. Expanding structures or simply opening-closing structures same as other artifact manufactured by human being are inspired by the nature. Blooming of bud or blossom is the design origin of "Fre Otto" and "Mahmood Bodo Rosch" in forms of ceiling of Prophet Mosque in Medina that is made of canvas to be opened and closed at ease so in hot weather of the day could provide people with shadow and could be opened if not needed.
5. Multi Purpose Equipment- Folding Furniture- Furniture Collection and Shrinkage
Maximum & optimum utilization of the space require multipurpose design of furniture in the space as combined and easily moving. Today lots of furniture is designed using folding patterns or drawer included with mechanical or electrical features. Space limitations and constraints of the modern generation made manufacturing of furniture as simple and efficient as possible and provide features such as easily moving, folding, shrinking, and combining with other applications to be accepted by the public. Industrial design of such tools with the aim of maximum efficiency takes place through ergonomic and human fitness.

Fig 8: Retractable furniture as a form of a statue.

6. Walking Houses
Early construction of walking houses could be seen in first generation of automobile manufacturing and travels using mobile-motor vehicles. Most of such tiny units were inspired by trailers and travelling vehicles that utilized as camping facilities. Larger dwelling units of such system used for months of living or more. In fact such housing units are made in manufactures and usually moved by big trucks to the right place. Focus and main objective of constructing such dwelling place is mobility. Hence such houses were utilized primarily by the people who couldn't live in one place for a long time.

Fig 9: Dymaxion house.

"Dymaxion" is the house name made by "Buckminster Fuller" in 1927. The title is a combination of two words: Dynamism and Maximum, which means maximum dynamism and differs from aesthetic art proposed by "Le Corbusier" in "Villa Savaii". "Fuller" put forward a machine for living purposes included individual separated and prefabricated spaces attached together to make a whole living house. Foundation and central basis of the house were located on installation part. Inner facilities could be easily expand and shrink. Even the furniture was pneumatic and none of the equipment was weight more than 4.5 kg.
In 1963 the idea of international walking house was proposed by "Marlette Homes". He believed that needs of the people who demand for such dwelling places differs from common individual. So design type and structure should be different. The title of “walking house” was replaced by “Prefabricated house” since 1970, because “mobility” was less important as “space expansion”. Considering recent increase in population growth and lack of dwelling place as well as high living costs of house construction & maintenance in cities make utilization of walking houses feasible and cost effective. One of the main advantages of such houses is their application at the time of disasters such as earthquake, flood, and so on until proper housing units could be rebuild for those displaced homeless because such houses could be settled and set up so quickly.

Walking house of "Loftcube" made by "Werner Aisslinger" that could be easily and quickly set up on the roofs having plain area. The size of the space is 36 m2 and 3 meters height having wooden walls and network plastic plates. Louvered form of the windows facilitates air conditioning required for the space. Such house is made for an individual and could be set up during 2 to 4 days. In addition to the house performance it could be utilized as an official work station. Besides it could be easily mobilized from one place to another location after assembly. The designer also suggests using helicopter for displacement of the housing unit to other roofs.

"Oskar Leo Kaufmann" designed a house know as "Su-Si" as a walking structure. Such design plan could be moved by a truck to the desired location and would be installed on a wooden network above concrete foundation. If basic supplies such as electricity, swage, and water could be achieved, installation of the project approximate as 5 hours. Such plan is same as a modern apartment based on architectural and aesthetic viewpoints. Internal space is spacious and transparent that could be easily fitted to different taste and plates if required.

**Conclusions**

- Walking through the life is one of the basic human needs.
  Humans are looking for ground shelter to provide us with physical, mental and sentimental security as well as calmness and stability. Nevertheless the characteristic of behavior adapt and reconciliation to existing conditions shall capable us toward building a dwelling place everywhere we desire. From the mother’s uterus up to the cloths, living place, and vehicles we use there are flexibility, mobility, and multipurpose applications.

- Flexible environment shall lead to dynamic space.
  Flexible environment meet the users requirements and satisfy them. Such flexibility includes portable appliances, easily displacement, and multipurpose performance. These devices may be internal components or elements of the building/structure.
Using the present method one can name his/her house as “multipurpose machine” and/or a machine that include capability of a house.

- Streaming and dynamism are in line with social values and are required by the need of the current society.
  Individual freedom/liberty together with its reflections is one of the most prominent features of current society and important human values. So it’s possible to regard it as an obvious special ad physical right. On the other hand environment effects on human behavior is one the main concerns. In today’s society everyone is affected by industrial services and information technology, distinction between public and private territory is hard to achieve. Personal life style and occupational/vocational activities merge together. There it is possible to create a space that everyone could utilize it base on his/her own favorite. The way most citizens are choosing for their life style is leading to environment space shrinkage. Increasing apartment demand, population growth, and economic issues are main parameters changes in modern societies that shall lead us toward tiny, smaller, less weighted, easily mobilized, and multipurpose design of elements around us.

References

3- Giedion, s . "Raum, Zeit, Architectur . 1965
5- Joedike J . " Les Structures en Voiles et Coques" . 1963