



A REVIEW PAPER ON KINETIC ARCHITECTURE: CONCEPTS, HISTORY AND APPLICATIONS

G. Hymavathi¹, Dr. K. Chandramouli², Dr.N.Pannirselvam^{3*}, J. Sree Naga Chaitanya⁴, G.Neelima⁵

^{1&4}Assistant Professor, Department of Civil Engineering, NRI Institute of Technology, Perecherla, Guntur, AP, India.

²Professor and Head, Department of Civil Engineering, NRI Institute of Technology, Perecherla, Guntur, AP, India.

³Associate Professor, Department of Civil Engineering, SRM Institute of Science and Technology, Kattankulathur, Chennai, Tamilnadu, India

⁵B.Tech Student, Department of Civil Engineering, NRI Institute of Technology, Perecherla, Guntur, AP, India.

Abstract: In architecture abstraction, the various stages of the design process, from beginning till the end, present themselves in the final product. Abstraction is used in the environmental knowledge acquisition and developing opinion phase of the designing process. From the concept of tried to create spaces, building components and buildings that can be taken action from the surrounding environment such as a movement, sound, light, wind, heat or humidity. The history of kinetic architecture is present in architecture applications and highlights its implementation in environmental design. This paper addresses to review based on the literature and descriptively analyze the interactive application of kinetic architecture method, systems and its applications by the comparative analysis of the various building.

Index Terms - Facades, Kinetic Architecture, Structure.

INTRODUCTION

Kinetic architecture allows the idea of change over time. Developing buildings as complex systems adjusted to climate and energy optimization is necessary. Recently, architects have responded to the needs of humans by using new design techniques and technologies. The structure of any built environment includes town planning, urban design, and landscape architecture to furniture and objects. They imagined transformable buildings able to change their physical geometries, such as stadiums with movable seating's and retractable roofs and flexible buildings with air-filled or revolving structures. Historically, humans used their buildings to provide shelter from external weather conditions, like rain, wind, heat and cold. So, the building envelope acts as an outer shell that controls internal climatic conditions and maintains indoor comfort. Therefore, most modern building constructions are made to enhance indoor climate. Depending on this consideration, Improvements in design and construction of building play an important role in research for intelligent architecture. Therefore, most modern building constructions are made to enhance indoor climate. Depending on this consideration, Improvements in the design and construction of buildings play an essential role in research for intelligent architecture.

INTELLIGENT ARCHITECTURE

The set of structural components in which perception, reasoning, and action occur, by the topology among components of the powerful range of knowledge and skills. Intelligent architecture is responsive to human needs to be using high technology to achieve the needs such as comfort, productivity, energy saving, return investment, and life cost decreasing by contrast, is working from a conditioned response, not an intelligent response.

INTERACTIVE ARCHITECTURE

Interactive interface allows the understanding level between human and computer. It considered the building as an enclosure defines a space, which supports some activates. The building enclosures like walls, floor, and ceilings act as interactive spaces. This type of architecture doesn't deal with people as users but as participants. It is based on two ways communication between people and built components which are divided to: input, processing and output devices.

RESPONSIVE ARCHITECTURE

It is defined as an active shape-shifting building system which is a response to environmental conditions and user activities. Bionics allows the design and performance of natural systems to design engineering systems and modern technology. The responsive architecture was introduced by Nicholas Negroponte in the late 1960s and defined an environment that plays an active role.

ADAPTIVE ARCHITECTURE

Adaptable space means that it compliantly reaction to the human activity which requires from habitation, leisure, education, medicine, commerce and industry. The adaptation ranges from an interior, which is multi-use reorganized to a structure and it transform and programmatic response. Therefore, adaptive architecture can be considered a responsive architecture adapting with time.

KINETIC ARCHITECTURE

The designs of buildings with transformative and automatic elements. They are six types

1. Internal controls.
2. Direct control.
3. Indirect control.
4. Responsive indirect control.
5. Ubiquitous responsive indirect control.
6. Heuristic, responsive indirect control.

INITIAL KINETIC DESIGNS

Rotary building designed by Thomas Gaynor in the year of 1908 but it was never built. The villa is two storied and L shaped, which as follows the sun by 44 meters circular base in diameter and a 42 meters tall tower in the centre. Kinetic design is to be visual effects as editorial design is to be type sizes and weights. The visual effects are not usually considered primary factors unless they are the main purposes of the project.

YONA FRIEDMAN

Introduced “Mobile Architecture Manifesto” in 1958 and later in 1959, the author introduced “spatial town planning” with flexible structures to change their spaces as they need.

GORDON PASK

In 1960's, Gordon Pask and other cyberneticians – scientists of communications and automatic control systems using both machines and animals. Conversation theory and developing a model in which architects understood spaces and users need by the way of feedback systems.

CEDRIC PRICE

In 21st century with the fun places campaign for cultural democracy, with community-led events in many locations. The project contains theatres, cinemas, restaurants, workshops and rally areas. The architect Cedric Price came up with the idea of Fun Palace as one building in 1961. The dream to build a space their community to celebrate arts, science and culture.

ARCHIGRAM GROUP

Between the 1960 and 1974 Archigram created over 900 drawings, among them the plan for the “Plug-in City” is in fact not a city, but a constantly evolving mega structure that incorporates residences, transportation and other essential services.

KINETIC CONCEPT AND COMPUTER SCIENCE

The kinetic architecture, with co-author Roger Clark, in the early 1970's sees the kinetic architecture; numerous experimental structural engineering articles; and many technical articles. When the “dynamic spatial design problems were explored in mechanical systems”. Zucand Clark defined kinetic architecture based on time changes by using systems with embedded actively controlled kinetic devices.

CEDRIC PRICE AND THE GENERATOR PROJECT

Cedric price was proposal for the Gilman Corporation was a series of relocatable structures on a permanent grid of foundation pads on a site in Florida. It's self by a computer program to organize the layout of the site response to changing requirements. In the addition to be suggested that a single-chip microprocessor should be embedded in every component of the building make it be controlling processor.

NEW TECHNOLOGICAL INNOVATIONS

In 1987, Jean Nouvel introduced a major example of a kinetic architecture: The Institute du Monde Arab in Paris build south facade with a grid of 24 × 10 m of square bays for simulating the geometry of traditional Arab screens. Each bay contains grid of small shutters with a central circular shutter set.

KINETIC BUILDINGS AND TWENTY-FIRST CENTURY

Viewed from the exterior, the Parkade's entire exterior face will appear to ripple fluidly as the wind activates 118,000 suspended aluminium panels. This is a facade consists of 250,000 aluminium panels which tend to move along the direction of wind. The movement of the facade gives the interior surfaces attractive patterns of sunlight inside the building. Retractable roofs has a rose shape and it's consists of eight panels that open in a diagonal slide like a camera aperture.

KINETIC ARCHITECTURE APPLICATIONS

The various types of applications in kinetic systems in architecture.

- a. kinetic structure systems.
- b. kinetic interior.
- c. kinetic facades.

KINETIC STRUCTURE SYSTEMS

Buildings and building components with variable mobility, location and geometry. The compounds of telescopic bays that are designed to be easily opened and closed. Section of walls and roof move as a bay unit can be collect at either end. When the opened retractable structures are provides an unobstructed view of the sky above making them in ideal for applications for restaurant ratio that generated zero dollars of revenue weather conditions exist.

These are the 3 types of kinetic structures.

- a. Embedded kinetic structures.
- b. Deployable kinetic structures.
- c. Dynamic kinetic structures.



Kinetic-architecture-dynamic-buildings-that-will-move-you

DYNAMIC KINETIC STRUCTURES

These are the part may be large architecture system but acts to the independently with respect to control the large system.

1. Mobile system.
2. Transformable system.
3. Incremental kinetic system.

It the devices can be the organized in pattern in two or three dimensions to be creating the different kinetic structures most common patterns:a) Centricconfiguration. b) Linear configuration.



Dynamic kinetic structures

CONCLUSION

The kinetic architecture concepts, history and its application lead to the development of new buildings along with orientation for better ventilation.

REFERENCES

1. Alotaibi, Fahad, 2015, The Role of Kinetic Envelopes to Improve Energy Performance in Buildings, *Journal of Architectural Engineering Technology*,4(3), 1-5.
2. Asefi.M, 2012, Transformation and Movement in Architecture: The Marriage Among Art, Engineering and Technology, *Procedia-Social and Behavioral Sciences*, **51**, 1005-1010.
3. Kronenburg, Robert, 2013, Architecture in Motion: The history and development of portable building, 1-318.
4. Mathews.S, 2005, The Fun Palace: Cedric Price's experiment in architecture and technology, *A Journal of Speculative Research*, 3(2), 73-92.
5. Nashaat, Basma & Waseef, Ahmed, 2018, Kinetic Architecture: Concepts, History and Applications. 7. 750-758.
6. Sherbini.K, Krawczyk.R, 2004, Overview of intelligent architecture, *Proceedings of the 1st ASCAAD International Conference*, 137-152.
7. Stevenson.C, 2011, Morphological principles of kinetic architectural structures, *Proceedings of the Adaptive Architecture Conference*, 1-12.
8. Velasco.R, Brakke.AP, Chavarro.D, 2015, Dynamic façades and computation: towards an inclusive categorization of high performance kinetic façade systems, *Proceedings of the International Conference on Computer-Aided Architectural Design Futures*, 172-191.
9. Vijaya Kumar.D, Chandramouli.K, & Kartheek Babu.K, 2018, Study of Present Environmental Conditions at National Level, *North Asian International Research Journal of Sciences, Engineering & I.T*, **4**, 10, 1-4.