



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 11, November 2022

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.118

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

[www.ijirset.com](http://www.ijirset.com)



# Kinetic Architecture as a Tool for Architectural Adaptation

Eman Shaban Jaber Abdul Jaid<sup>1</sup>, Amir Saleh Al-Mahdi<sup>2</sup>, Rabab Salah Mohammed<sup>3</sup>

<sup>1</sup>Demonstrator, Department of Architecture, Faculty of Engineering, Fayoum University, Egypt

<sup>2</sup> Assistant Professor, Department of Architecture, Faculty of Engineering, Fayoum University, Egypt

<sup>3</sup>lecturer, Department of Architecture, Faculty of Engineering, Fayoum University, Egypt

**ABSTRACT:** In recent years, many interactive solutions have been invented that are able to adapt and respond to external environmental variables and changing human needs, and then back again to the normal position of the building while the influence ends without any deformation in the interacting element. These solutions have motivated architects to take advantage of them to create a new interactive architecture capable of achieving human needs, requirements, desires instead of static architecture. Some of those needs are innate while others are acquired, some are fixed or variable, and meeting those needs is what makes a person feel comfortable and satisfied, all of them directly affect architecture, this is what changes the architecture from one society to another and from time to time in the same society, so the main motive appeared for the kinetic architecture that meets those changing and different human needs. To eradicate the contradictions between architecture's statics and changing human needs. It must present the theoretical framework of kinetic architecture and human needs and their characteristics. Then, identifying the role of kinetic architecture in meeting each of the different human needs. The research ends with a show of design criteria as a way to achieve changing human needs.

Kinetic architecture and human needs was presented and classified according to its impact on kinetic architecture, then presented the relationship between kinetic architecture and the changing physical human needs (thermal comfort - interaction with changing the level of humidity - achieving shadows - achieving ventilation (clean air) - protection from wind and storms - visual comfort - acoustic comfort - possibility of changing the function - generation and energy saving - good water management), and non-physical human needs (providing the external view - achieving the element of beauty - achieving privacy and containment - achieving safety - emphasizing the psychological and social aspect - emphasizing belonging and identity). then addressing an analytical study of a model of kinetic architecture. The search ends with the results being displayed

**KEYWORDS:** kinetic architecture, adaptive architecture, interactive buildings, responsive buildings, human needs, meeting the needs of users, design standards.

## I. INTRODUCTION

In recent years, the world has witnessed a clear development in various branches of science, and it has become necessary for architecture to interact with these variables to make the work of the building a success and employ it to meet the ever-changing and constant needs of users, and for this reason the so-called "kinetic architecture" appeared.

**1.1. MAIN OBJECTIVE:** Addressing the contradictions that exist between the stillness of architecture and the ever-changing needs of users by defining design criteria for kinetic architecture that respond to those needs, and this can be achieved through several secondary objectives

- :
- Identify and classify the concept of kinetic architecture and the changing needs of users.
  - Study the relationship between kinetic architecture and changing human needs (physical and non-physical).
  - Model analysis of a kinetic building according to physical and non-physical needs.

**1.2. RESEARCH PROBLEM:** Lies in the contradictions between static architecture and the ever-changing needs of users, and the problem can be identified through two axes:



**1.2.**

-The first axis: the stillness

**1.3.** of architecture

-The second axis: Change of needs

**1.3. RESEARCH HYPOTHESIS :** we apply kinetic architecture, buildings will become adaptable to the urgent and changing needs of users.

**1.4. THE RESEARCH IS BASED ON SEVERAL STUDIES , WHICH ARE AS FOLLOWS:**

**Theoretical study:** A presentation of kinetic architecture and human needs, and the classification of needs based on their impact on kinetic architecture and the impact of kinetic architecture on human needs.

**The Analytical Study:** Analysis of a Model of Kinetic Architecture

**III. THEORETICAL STUDY**

**2.1 INTRODUCTION: KINETIC ARCHITECTURE AND HUMAN NEEDS**

In recent years, the world has witnessed a clear development in various branches of science, and it has become necessary for architecture to interact with these variables to make the work of the building successful and employ it to achieve the needs of users and for this reason appeared the so-called "kinetic architecture", and the term "kinetic" refers to everything produced by the movement, and the term architecture is a name that refers to the design or style of construction followed or group of buildings, and when the two terms are combined together the term (Kinetic Architecture) becomes the concept of designing buildings produced by movement.

**2.2 CLASSIFICATION OF NEEDS BASED ON THEIR IMPACT ON KINETIC ARCHITECTURE :**

The human needs are many and varied, some of which are affected by kinetic architecture and others are not affected, and therefore the focus will be on the needs that kinetic architecture achieve and the needs that kinetic architecture do not affect will be excluded, so the human needs that kinetic architecture achieve can be divided into physical human needs and non-physical human needs, which are as follows:

\*physical human needs: thermal comfort - interaction with moisture level change - achieving shades - achieving ventilation (clean air) - protection from wind and storms - visual comfort - acoustic comfort - possibility of changing the function - generating and saving energy - good water management.

\* non-physical human needs: providing external view - achieving the element of beauty - achieving privacy and containment - achieving security - emphasizing the psychological and social aspect - emphasizing belonging and identity.

Thus, the first objective of the research has been achieved, which is to identify and classify the concept of kinetic architecture and the changing needs of users, and in the following is the impact of kinetic architecture on each of the human needs.

The first objectives was achieved, which is to display the classification of human needs according to their impact on kinetic architecture.

**3.2 THE IMPACT OF KINETIC ARCHITECTURE ON HUMAN NEEDS:**

The role of kinetic architecture in influencing every human need, whether physical human needs and non-physical human needs.

**3.2.1. PHYSICAL HUMAN NEEDS:**


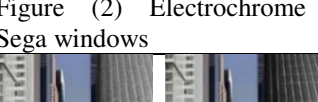
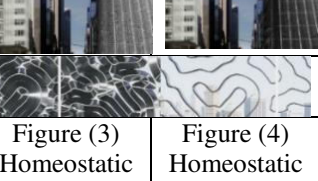
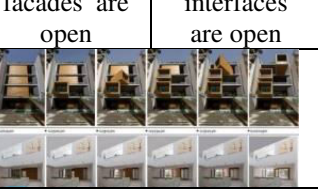
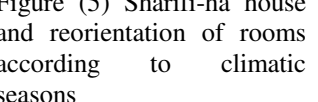


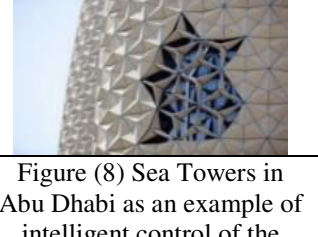
**A- The effect of kinetic architecture on thermal comfort:**

It includes the possibility of using solar energy control throughout the year and avoiding excessive heat of the interior spaces, and the temperature of the interior space of the buildings can be controlled by:










Figure 1: Thermal Bimetals






<p><u>-Use of materials that respond to the heat of the surrounding temperature:</u> materials that affect and change their shape and properties when exposed to heat, such as: Thermal Bimetals, which expand and contract with temperature fluctuations; It acts as protection from the sun [1]. It was used in the Bloom pavilion at the Los Angeles Fair (Fig. 1).</p>	
<p><u>-Materials that respond to electric current:</u> A change in its properties, whether in shape, color, or optical properties when electric current is passed, for example: Sage Electrochromic windows[2] Figure (2)</p>	<p>Figure (2) Electrochrome Segra windows</p> 
<p><u>- The use of a system that responds to internal temperature:</u> It is based on the idea that it opens and closes itself in response to the internal temperature of the building, for example: Homeostatic façade system. The façade looks like a window with swirling lines that distribute an electric charge across its surface, causing it to deform, and when the internal temperature decreases, it contracts to allow more light to penetrate into the building as in Figure(3) and (4).[3]</p>	 <p>Figure (3) Homeostatic facades are open</p> <p>Figure (4) Homeostatic interfaces are open</p>
<p><u>- Change the orientation of the building during the seasons of the year Spatial features:</u> Spatial features can be manifold, from location, orientation, and connection between interior and exterior to changing interior design, and the location of buildings can change during the life cycle of a building[4]. There are many examples of this, including: The Sharifi-ha house in Iran is a building designed so that ninety degrees of the room can be rotated so that the direction can be changed. Figure 5</p>	
<p>Figure (5) Sharifi-ha house and reorientation of rooms according to climatic seasons</p>	
<p><b>B- The effect of kinetic architecture on moisture:</b></p>	
<p>The movement caused by moisture is a natural phenomenon that affects the components of the building, and it is called thermal movement, and it is one of the main sources of defects in building elements. Hygroscopic materials can be used to reduce these negative effects which respond to moisture and its water content or internal moisture and its changing behavior based on its moisture absorption.</p>	 <p>Figure(6) Open wood panels - 45% relative humidity</p>
<p>One of the most famous examples of the use of moisture humidifiers is the HygroSkinMeteorosensitive Pavilion which used wood that affects the humidity levels in the air to be opened in low humidity conditions (Fig. 6), and closed when wet conditions (Fig. 7) without providing operational power nor any kind of mechanical or electronic control [5].</p>	 <p>Figure (7) Closed wood panels - relative humidity 75%</p>
<p><b>c- The role of kinetic architecture in achieving shadowing:</b></p>	
<p>Responsive shading systems can be defined as kinetic shading systems that analyze and interpret changes that occur in the surrounding environment and respond to these changes to achieve the different needs of users [6]. For example: AlBahar Towers in Abu Dhabi Figure 8[7]. It is modular as automatic shading means that it opens and closes in response to the path of the sun at night the awnings remain folded to allow the appearance of the main glass facade of the building, and when the sun rises in the early morning in the eastern region of The building opens awnings located in the eastern area. [8]</p>	 <p>Figure (8) Sea Towers in Abu Dhabi as an example of intelligent control of the process of shadows with solar breakers.</p>

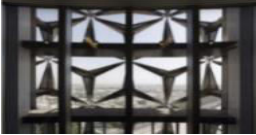



<b>D- The role of kinetic architecture in achieving ventilation (clean air and calm breeze):</b>	
<p>The importance of ventilation is mainly due to the renewal of air and contributing to the reduction of heat in addition to being a design strategy for a low-energy building, eliminating odors and gases, and controlling the level of humidity inside the building. Kinetic architecture can facilitate good natural ventilation in buildings through mobile facades. There are many mobile buildings that use this strategy, including: <u>One Ocean Building</u>, <u>Thematic Pavilion EXPO 2012</u>, whose panels move to achieve the needs of The building is provided with natural ventilation by capturing the wind and directing it through the building (Fig. 9). [9]</p>	 <p>Figure (9) Change the shape of the moving curved panels in the single ocean building</p>
<b>E- The role of kinetic architecture in protecting against wind and storms:</b>	
<p>Many changes occur in the atmosphere such as the difference in atmospheric pressure between regions, which leads to wind movement and damage to interfaces[10]. It is therefore important to consider that the building is well protected from wind and storm by using tightly closed windows to prevent wind damage [11]. For example: Sherifha's house in Iran The building itself provides few openings that limit the influence of wind on the building during cold and snowy winters. [12]</p>	 <p>Figure (10) Protection from storms in case of closure of building boxes</p>
<b>F- The role of kinetic architecture in achieving visual comfort:</b>	
<p>Visual comfort is achieved by relying on natural lighting, which plays a major role in the ability to see. There are many examples of them: The Environmental Building in England <u>BRE</u>, an office building in Garston-England Figure (11). In it, the opening of windows is controlled automatically according to the users' need for lighting. Two sensors are installed in each row of ceiling lighting units, as shown in Figure (12). The level of lighting and the external shading system is characterized by the presence of a group of rotating glass slides that do not obstruct the entry of light to achieve visual comfort (Fig. 13).</p>	 <p>Figure (12) Ceiling lighting sensors</p>
	 <p>Figure 11: Environmental Building in England</p>
	 <p>Figure (13) Open and close horizontal slats reflecting sunlight</p>
<b>g- The effect of motor architecture on the achievement of acoustic comfort:</b>	
<p>Acoustic comfort is one of the important pillars of the human environment that affects his mental and physical health [13]. Acoustic comfort includes improving the acoustic performance of the building spaces and protecting against external noise from the building by creating the zone which is the facade cavity of the intelligent double envelope to separate the interior and exterior of the building. There are many kinetic buildings that achieve acoustic comfort, for example: <u>Lumenhaus in , USA</u>, as shown in Figure (14). It is a portable housing concept designed and built at Virginia Tech School of Architecture 2010. It is based on the Eclipsis system that automatically controls the indoor environment and blocks noise by changing the angle of the raised tab when holes are raised as shown in Figure (15)</p>	 <p>Figure (14) Lomen House in the United States of America</p>
	 <p>Figure (15) Eclipsis system which is an automatic slider screen wall.</p>




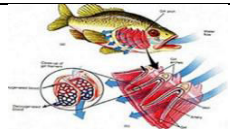




<b>H. The effect of kinetic architecture on the possibility of changing and developing function:</b>	
<p><b>A- Multi-functionality:</b> The concept of multi-functionality arises from the presence of multiple performance requirements or the need to make new changes over time. The "foldable balcony" is an illustrative example of the ability to multifunction. It is characterized by multiple capabilities depending on the surrounding conditions and the preference of users. It changes from window to balcony upon request Figure (16) [14].</p> <p><b>B. Evolvability:</b> The ability to multi-function mainly deals with short-term changes but scalability is the characteristic of flexibility that deals with changes over a long period of time. It is impossible Predicting the requirements of future construction to a large extent. [15]</p>	 <p>Figure (16) The foldable balcony called The Bloomframe® window</p>
<b>I- The impact of kinetic architecture on energy generation:</b>	
<p>Generating the energy of the building through its external facades is one of the most important creative trends that many contemporary architects have followed in order to benefit from renewable energy sources [16]. For example: <u>Orson Spencer Hall Building</u> in the USA. The SMIT Solar system was used, which was inspired by the way ivy leaves are arranged to capture sunlight in an optimal way [17]. This arrangement not only affects the surface used to generate photovoltaic energy, but also increases the natural cooling effect caused by the movement of the wind. (17). [18]</p>	 <p>Figure (17) The Orson Spencer Hall</p>
<b>J- Good management and exploitation of water in kinetic architecture:</b>	
<p>Water is one of the necessities of life and a means of vital interactions for the continuity of life. Architecturally, roofs can be developed with small grooves Filters which were simulated in nature to capture and transport rainwater and then collect it in designated places. This is what kinetic architecture can do in <u>the sustainable mountain capsule project</u>. The Syrian architect Ihab Al-Hariri designed a project called "a sustainable future mountain capsule" as shown in Figure (18). They are sustainable homes inspired by flowers to use for different needs.</p>	 <p>Figure (18) Sustainable mountain capsule</p>



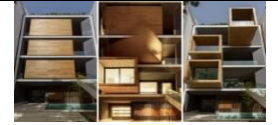

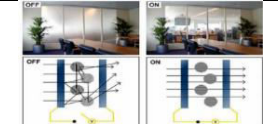

**2.3. 2. NON-PHYSICAL HUMAN NEEDS:**

<b>A - The role of kinetic architecture in providing the external view :</b>	
<p>Achieving the need to connect with the outdoor living environment is an important psychological component of daylight. The availability of sunlight alone does not mean that users do without outside vision. It should be used because it gives information about directions, weather changes, the passage of time during the day, the view of the sky as well as the landscape [19]. There are many kinetic buildings that have an external view for example, <u>the Al Bahar Towers</u> building, which has an attractive external view of the parks and public facilities (Fig. 19).</p> <p>Kinetic architecture can provide different external views. It is possible to watch the sunrise and sunset from the same room by using a mechanism that allows the building to rotate 360 degrees. The most famous building in its plurality is the revolving building tower in Dubai, where each floor rotates independently of the other floors, as shown in Figure (20).</p>	 <p>Figure (19) Exterior view in Al Bahar Towers building</p>  <p>Figure (20) the revolving tower in Dubai.</p>



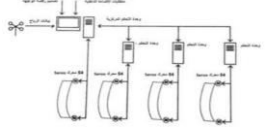



B- The effect of kinetic architecture in achieving the element of beauty:	
<p>Kinetic buildings achieve technical and aesthetic integrity due to the morphological change. Aesthetic, utilitarian and artistic indicators in kinetic architecture help the user's interaction with these buildings as influences that increase the usefulness of the building. The element of beauty in kinetic architecture has images and entrances, including:</p> <p><u>-Utility and Technology:</u> The utilitarian value of the architectural product is achieved by providing a clear benefit and the ability to achieve the aesthetic and functional needs of the recipient according to the mental image and physical need [20].</p> <p><u>Attracting attention and avoiding boredom:</u> The building is considered one of the works that aims to attract attention through its movement and constantly changing its shape. This leads to excitement and away from boredom [21].</p> <p><u>Representative aspect (inspired by nature or biomimicry):</u>                      This means that the shapes derive their shape from nature or according to the designer's innovations. The representational aspect of the movement can be realistic or abstract. For example: Yeosu building in Korea and the coastal project site is characterized by strong winds, so it was necessary for the building to perfectly adapt to this climate. The building consists of 108 movable panels with a length of 140 meters that are able to respond to changing sunlight conditions and ventilation requirements (Fig. 22). The method of bending the kinetic panels is inspired by the method of bending flower leaves, which bend when birds land on them (Fig. 23). The panels control the opening of the front slits like jelly in fish as in Figure (24).</p>	 <p>Figure (21) One Ocean, EXPO 2012</p>  <p>Figure 22: Change in the shape of curvature of moving plates</p>  <p>Figure (23) Paradise Flower, Fold Landing Platform</p>  <p>Figure 24 – Gas Exchange in Fish</p>
C- The role of kinetic architecture in achieving privacy and containment:	
<p>The definition of privacy differs from the definition of containment in architecture as follows:</p> <p><u>-Privacy:</u> privacy in architecture can be defined as independence, which is the ability of an individual or people to isolate themselves, and we must take into account the principle of privacy for some spaces of a special nature when starting to design projects and allocating basic areas</p> <p><u>Containment:</u> It is the deduction of a specific area from the surrounding environment and its formation according to the human needs of calm and protection and creating the appropriate environment for the life and activity of the human being. There are degrees of containment, including weak, medium and strong, according to the degree of permeability.</p> <p>Although the concept of privacy differs from the concept of containment in architecture, the relationship between them is direct. The greater the privacy, the greater the containment, and both of them can be controlled through several methods, including the following:</p> <p><u>-Opening and closing openings:</u> The kinetic architecture easily controls the opening and closing of openings in the building, which leads to easy control of their privacy and degree of containment, such as the HygroSkinMeteorosensitive Pavilion Figure (25) (26).</p>	 <p>Figure (25) Expansion of the openings in the wing at 45% relative humidity ( less privacy and less containment)</p>  <p>Figure (26) Closing the openings in the wing for an increase in relative humidity of 70% (more</p>



<p><u>-Moving walls:</u> The kinetic architecture enables us to control the location of the walls, whether by moving them from their position or erecting them or not, according to the needs of users, which leads to easy control of their privacy and the degree of containment, such as moving the walls in the Lumen House in the United States of America (LUMENHAUS) Figure (27) , (28).</p>	<p>privacy and more containment)</p> 
<p><u>-The movement of blocks:</u> the movement of an entire block of the building can be controlled and its position and direction changed according to the needs of users as in Figure (29), which leads to easy control of privacy and the degree of containment.</p>	<p>Shape (27) and opening walls ( less privacy and less containment)</p>
<p><u>The movement of breakers inside the double glass:</u> It is the presence of rotary breakers that operate with a motor inside the double glass as in Figure (30), and when the breakers are closed, they work as a closed interface with high privacy and a greater degree of containment, and when opened, the privacy decreases and the degree of containment decreases [22]</p>	 <p>Figure (28) Wall closure(more privacy and more contained)</p>
<p><u>- Change at the level of molecules when an electric current is passed:</u> they are substances that change in the arrangement of their molecules to achieve transparency or blur when an electric current passes, which leads to changes in the optical properties, physical and thermal properties or surface properties, so privacy and containment are controlled (Fig. 31).[23]</p>	 <p>Figure (29) The rotation of three rooms in the Sharifi-ha House in Iran (sharifi-ha house )</p>
	 <p>Figure(30) Spinners in the Cambridge Library</p>
	 <p>Figure 31 Change in the order of molecules when electric current passes</p>
<p><b>d- The role of movement architecture in achieving safety:</b></p>	
<p><b><u>First: Common security systems between static and kineticarchitecture:</u></b> Fixed and kinetic buildings share the need to achieve security within the building through video surveillance and video intercom systems.Each of them can be explained as follows:</p>	
<p><u>Video surveillance systems:</u> Video surveillance systems can be used primarily in buildings because they allow detecting any changes in the environment, in addition to</p>	<p>Figure (34) One Ocean Building</p>





<p>contributing to remote control of all functions, whether wired or wireless</p> <p><u>Visual Intercom Systems:</u> It is possible to take advantage of visual intercom systems, as they transmit sound and image inside buildings, then they control them through superior distribution systems and the Vidio Audio Matrix [24].</p>	
<p><b>Second: Safety systems for kinetic architecture</b></p> <p>Kinetic buildings are characterized by a different type of security system, which is the security of controlling the moving parts of the building. The building allows control of the outer envelope with the push of a button, a verbal command, or even by feeling through the movement of the outer shell components. There are several such systems that control the moving parts of a building, including:</p> <p><u>Bus system:</u> It is a building control system that is a path consisting of cables and connectors used to transfer data between a computer's microprocessor and main memory. (Fig. 33), and one example of buildings using this system is the One Ocean Thematic Pavilion EXPO 2012.</p> <p>- <u>HMI system:</u> This system is considered as a control station for the user, which is usually in the form of a touch screen or a screen with buttons connected to a device for monitoring and control on the screen. Examples of buildings that use this system are the construction of Al Bahar towers (Fig. 35).</p>	<p>Figure (33) Bus-System used in the façade of the single ocean building</p>  <p>Figure (35) Towers Building</p>  <p>Figure (36) HMI for Al Bahar Towers</p>
<p><b>e- The role of motor architecture in emphasizing the social and psychological aspect :</b></p>	
<p>Social psychologists have conducted many studies to find out the effects on the psychological and social health of users. They find that they are affected by the following:</p> <p>-<u>Natural Lighting:</u> Direct sunlight can be refreshing due to the lighting irregular and the difference in radiation [25]</p> <p>-<u>Privacy:</u> Kinetic interfaces have a clear social and utilitarian significance because they provide privacy for users.</p> <p>-<u>Changing the shape of the building:</u> Kinetic architecture plays a major role in user access to the passion due to the frequent change of the shape.</p> <p>-<u>External view:</u> It leads to users reaching a high degree of psychological calm .</p>	
<p><b>f- The role of kinetic architecture in emphasizing belonging and identity:</b></p>	
<p>Belonging is a permanent feeling. It is a factor in building society. When a person belongs to his society, this encourages him to preserve it and ensure its permanent growth and prosperity [26], There are many kinetic buildings in which affiliation appears, including: The Arab World Institute building in Paris, which was established as a tool for introducing and disseminating Arab culture. Eighteen Arab countries have agreed with France to establish it as an institution aimed at developing knowledge for the Arab world .Although this building is located in Paris, France, it shows the Arab character as a kind of national affiliation, as there are Arab heritage geometric motifs on the southern facade of the building (38).</p>	 <p>Figure (38) Mashrabiya of the Arab World Institute</p>


We conclude from this that kinetic architecture has a role in achieving many human needs, whether physical or non-physical, kinetic architecture is able to achieve human comfort, life requirements and desires, and respond to environmental changes and changing needs, and therefore the user feels satisfied and comfortable. Thus, **the second objective** of the research was achieved, which is to study the relationship between kinetic architecture and the physical or non-physical needs of man.



IV. ANALYTICAL STUDY

V.

The Al Bahar Towers building in the United Arab Emirates was chosen as the most famous kinetic building in the Arab countries To analyze the physical and non-physical needs of users

Concept and Concept	The construction of this project was completed in June 2012, and the height of the towers is 145 meters. Descriptive geometry was used to form dynamic facades. The team was able to simulate its work in response to exposure to sunlight and changing its angles of fall during different days of the year. Abu Dhabi towers are distinguished by a curtain wall. It is a set of triangular frames stretching a fiberglass mesh that has been programmed to respond to the movement of the sun as a means of reducing solar gain and glare.	
Thermal comfort	The three units are covered with fiberglass and programmed to respond to the movement of the sun and reduce heat gain	
Reaction with humidity variation	The building's outer shell acts as a wet film to control the moisture content.	
Achieve shadowing	Modular movement provides 70-80% shadows.	
Ventilation Realization	Air leaks through the holes in the outer casing	
Protection from wind and storms	The outer shell acts as a safety barrier against the wind.	
Achieve auditory comfort	The movable units are made of PTFE-coated fiberglass and act as acoustic insulation using sound wave scattering materials.	
Visual comfort	Easy control of the size of the outer openings of the casing.	
Possibility to change the job	Flexibility of the casing properties enable users to easily change the interior function.	
Energy Saving and Generation	The ease of control of the jacket resulted in 25% cooling loads and a 20-50% reduction in solar heat gain.	
water management	It didn't materialize.	
external view	Provides the quality of the external appearance continuously.	
Emphasis on the psychological and social aspect	Provides psychological comfort as a result of providing visual contact with the external environment of the building, ventilation and natural lighting	
Realization of the element of beauty	As a result of the presence of the technique, the dimpled aspect (simulating the construction of a honeycomb - simulating the method of opening and closing flowers) realized the possibility of changing the shape of the building.	
Achieving privacy and containment	Control openings when the degree of privacy need varies.	
Achieve security	Using the control software and HMI cover interface for sea towers	
Emphasis on belonging And identity	The design of the movable units was inspired by the traditional "mashrabiya" that adorned the windows of traditional Arab houses since the 14th century, as a kind of national affiliation.	

Thus, the **third objective** of the research has been achieved, which is to analyze one of the models of kinetic buildings

**Results:**

- We conclude from the above that:
- Proving the validity of the research hypothesis, which is that kinetic architecture makes buildings adaptable to the urgent and changing needs of users.
  - Kinetic architecture is the product of the interaction of the environment, occupant and other elements
  - The importance of kinetic architecture is to meet the changing human needs according to different environmental changes.
  - The concept of kinetic architecture integrates a set of terms, including smart, interactive, responsive, flexible, and others.
  - The success of the kinetic building is measured by the amount of change and interaction with the environmental conditions and with the users
  - It is possible to combine in the design of the interactive kinetic buildings the personality, function and idea of the building with achieving the maximum efficiency of the building during its operation in terms of: thermal comfort - interaction with changing the level of humidity - achieving shades - achieving ventilation (clean air) - protection from wind and storms - visual comfort - Acoustic comfort- Possibility to change the job- Generating and saving energy-



Good water management- Providing external view- Achieving the element of beauty- Achieving privacy and containment- Achieving safety- Emphasis on the psychological and social aspect- Emphasizing belongingness and identity.

## REFERENCES

- [1] Galloway, Andrew. "When Biology Inspires Architecture: An Interview with Doris Kim Sung." ArchDaily, [Online]. Available: <http://www.archdaily.com/505016/when-biology-inspiresarchitecture-an-interview-with-doris-kim-sung> accessed 28/8/2022
- [2] Ferrara, Marinella, BengisuIntention Materials that Change Color Smart Materials, Intelligent Design, Springer Cham Heidelberg New York Dordrecht London, eBook, 2014
- [3] Yeadon, Decker, Homeostatic facade system, Self-shading system for buildings, 22/4/2016,]
- [4] Schnädelbach Jennifer, Adaptive architecture: A conceptual framework, MediaCity: interaction of architecture, media and social phenomena, 2010.
- [5] Correa, D., Krieg, O. D., Menges, A., Reichert, S. and Rinderspacher, K., HYGROSKIN: A CLIMATERESPONSIVE PROTOTYPE PROJECT BASED ON THE ELASTIC AND HYGROSCOPIC PROPERTIES OF WOOD, 33rd Annual Conference of the Association for Computer Aided Design in Architecture: Adaptive Architecture, ACADIA 2013. ACADIA,
- [6] Responsive textiles vs. reactive façade systems.
- [7] Givoni, Baruch. Passive low energy cooling of buildings. John Wiley & Sons, New York, 1994, p. 29.
- [8] <https://www.albayan.ae/editors-choice/asfar/2015-11-23-1.2512401>
- [9] SUM IN PROGRESS: THEMATIC PAVILION EXPO 2012 / SOMA, 22/2/2012, [Online]. Available: <http://www.formakers.eu/project-117-soma-in-progress-thematic-pavilion-expo-2012> accessed 28/8/2022
- [10] SOMA, IN PROGRESS: THEMATIC PAVILION EXPO 2012 / SOMA, previous reference
- [11] Alaa Salah- Climate-adaptable facade design inspired by nature and their impact on daytime performance For the building – Master's Thesis-Fayoum University-Egypt- 2018
- [12] PHILLIPS, Derek, Daylighting: natural light in architecture, Routledge, Italy.
- [13] Responsive textiles vs. reactive façade systems.
- [14] Wages, R. C., Trčthat, M., Cóstola, D., & Hamilton, J. L. M. Climate adaptive building shells: State-of-the-art and future challenges. Renewable and Sustainable Energy Reviews, 25, PP 483-493.2013) ). [Online]. Available: <https://www.sciencedirect.com/science/article/abs/pii/S1364032113002670> accessed 28/8/2022
- [15] Wages, R. C., Trčthat, M., Cóstola, D., & Hamilton, J. L. M. Climate adaptive building shells: State-of-the-art and future challenges. Renewable and Sustainable Energy Reviews, 25, PP 483-493.2013) ). previous reference
- [16] Ghaith M. Fateh, Alice Keswani, Modar Ali - Essay (Interactive Kinetic Architecture – Architecture and Construction – Sustainability)-Syrian Researchers Newspaper-[Online]. Available <https://www.syr-res.com/article/9552.html> accessed 28/8/2022
- [17] SMIT (Sustainably Minded Interactive Technology), Photovoltaic 'leaves' generate wind and solar power, 21/12/2015, [Online]. Available: <https://asknature.org/idea/smit-solar-ivy/#.WJ4wOIV96Uk>
- [18] SMIT (Sustainably Minded Interactive Technology), Photovoltaic 'leaves' generate wind and solar power.
- [20] Iyad Hussein Abdullah, The Art of Design in Philosophy, Theory and Application, Sharjah, Part 3, Department of Culture and Information, first edition (p. 215) <https://www.neelwafurat.com/itempage.aspx?id=lbb365682-361688&search=books> accessed 28/8/2022
- [21] Ullmann ,Franziska, " Basic Energy Dynamics",



Vienna,2011,p106

[22] SMIT (Sustainably Minded Interactive Technology), Photovoltaic 'leaves' generate wind and solarpower.

[23] Bonsor, Kevin. "How smart windows work." HowStuffWorks website (2001) , [Online].

Available:<https://home.howstuffworks.com/homeimprovement/construction/green/smart-window3.htm> accessed 28/8/2022[24] Ferrara, Marinella, Bengisu, Murat, Materials that Change Color Smart Materials, Intelligent Design, previous reference.

[25] Lechner, Norbert. Heating, cooling, lighting: Sustainable design methods for architects. John wiley& sons, 2014.



**INNO SPACE**  
SJIF Scientific Journal Impact Factor  
**Impact Factor: 8.118**



**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details