KINETIC ARCHITECTURE: TOWARDS THE POETRY OF SPACE IN MOVEMENT[1]

İREM YILMAZ[2]

ABSTRACT

The concept of "Kinetic Architecture" provides an extensive framework for the broad-array of inquiries upon the relationship between movement, human and space. Focusing on the dynamic configuration of physical space via movement in Kinetic Architecture, in this paper it is asserted that in order to understand kinetic spatial embodiments, a new aesthetic conception that goes beyond our conception of static spatial embodiments is needed. Using the conceptual frameworks; Eco's poetics of the "Work in Movement" in context of his theory of "The Open Work", Dewey's theory of "Art as Experience" and Heidegger's conceptions of "poetry as building" and "poetical measuring" as an explanatory tool, it intends to conceptualize aesthetics of the space in movement. As considering the movement as existential manifestation, poetical building of space in movement is opened to discussion as an alternative way of production of space in relation to aesthetics.

Key words: kinetic architecture, movement, human, space, poetry, aesthetics

1. INTRODUCTION

Kinetic Architecture is developed as a field of study in order to examine how architecture can respond to diverse needs, desires and conditions within the constantly changing modes of life. Going beyond the traditional conception of space which is static, immobile and determinate, it introduces movement as a new element of building to generate a new conception of space which is dynamic, mobile indeterminate and unpredictable. It promotes continuous change of space via movement bringing forward dynamics, flexibility and adaptability of artificial environment and establishes an interactive adaptable relationship between the natural and the artificial environment. In this interactive relationship, movement which can only be grasped within time, becomes an element of communication. And this leads to a challenge for architecture in terms of conceptualizing changing patterns of human interaction with artificial environment through time and via movement. To deal with such a challenge, architects develop many diverse approaches to kinetic spatial design.

Although there are many kinetic spatial design approaches in the literature,

[1] This study is developed in context of the PhD lecture of "Formation Of Spatial Image in Architecture" directed by Prof. Dr. Aysu Akalın in Gazi University

[2] Research Assistant Gazi University, Department of Architecture, ANKARA

Michael Fox explains them in two categories as **pragmatic** and **humanistic**. In his definition, whereas pragmatic category concerns practical aspects of movement such as space efficiency, shelter, security, transportation, safety, economics and etc., humanistic category interests phenomenological aspects of it focusing on personal spatial experiences. And he asserts that even though one should consider design in relation to both of these categories, it is important to understand and accommodate an inclusive range of humanistic considerations on top of the more pragmatic spatial optimization of the space.[1] In this context within the scope of this paper, the humanistic category is brought forward to discuss the aesthetics of kinetic architecture objects in terms of their phenomenal attributes.
As Robert Kronenburg stated aesthetic value of motion challenge the very nature of what architecture really is.[2] Kinetic architecture structures as behaving like living organism changed the way we communicate to artificial environment. In this sense Sokratis Yiannoudes uses Shery Turkle's term of **"marginal objects"** for kinetic architecture structures which he defines as beings on the boundary of human and machine. As they blur the boundaries separating the living and the non-living, their phenomenal attributes stand on the boundary between these categories.[3] In this case, traditional aesthetic conceptions lose validity to interpret such structures. So that in order to understand kinetic spatial embodiments, a new aesthetic conception that goes beyond our conception of static spatial embodiments is needed. Accordingly, this paper aims to examine how can **a new aesthetic conception** can be developed and it opens factors that affect the aesthetic value of such structures up for discussion. In this framework it brings forward three phenomenons:
- **movement** as an element of interaction in architecture
- **human** as a performer of space
- **space** built by movement as an existential manifestation
Thus and so, it intends to explain poetry of space in movement in relation to aesthetics.

2. MOVEMENT IN ARCHITECTURE

To understand the phenomenon of movement in architecture, Kinetic Architecture serves as an extensive research field. It defines a new spatial design praxis closely related to kinetics which refers to the study of motion and its causes. Substantially shaping as a distinctive research field in the second half of the 20th century Kinetic Architecture carries out its study on rethinking architecture in terms of movement going beyond conventional static and single-function spatial design. 20th century architectural trends of Expressionism, Futurism, Constructivism, Kinetic Art Movements have been widely influential in the development of such a field along

[1] Fox, M., Kemp, M., "Interactive Architecture", Princeton Architectural Press, 2009, p.30, 34
[2] Ibid.,2009, p. 27
[3] Yiannoudes, S. "Kinetic Digitally-Driven Architectural Structures as 'Marginal' Objects - a Conceptual Framework", Digitally-Driven Architecture, Footprint Delft School Of Journal, Delft, 2010, p.46.

with scientific and technological developments.[1]Although there are many definitions of Kinetic Architecture in the literature[2], it is possible to define it as a field that problematizes situations of the production of responses via movement in artificial environment to the effects of natural environment in terms of formal, functional and technical issues. In this perspective as Fouad also indicated in his thesis, Kinetic Architecture is about creating a relation between natural environment and artificial environment.[3]

To interrelate natural environment and artificial environment, Kinetic Architecture problematizes the continuous re-building of space via movement in terms of dynamics, flexibility and adaptability of artificial environment. Moreover, as considering natural environment with all its constituents (human, heat, wind, etc.) as a set of forces which are energizers of the movement, it explores the effects of these forces on material forms. And in relation, it works on the changing and evolving patterns of that constituents' interaction with the artificial environment.[4] Working on such patterns leads to thinking in scenarios of movement revealing different levels of possible engagements. And architectural state built on these scenarios turns to be in flux. So that in Kinetic Architecture, space transforms from a former static modular order into **a topological field**[5] which responses to the forces of its environment and dynamically changes.[6]

In order to investigate how to design such a dynamic space, Kinetic Architecture lays its foundations on an interdisciplinary base and accordingly relates to other fields of knowledge such as material science, biomimetic, robotics, cybernetics, informatics and also other concepts in architecture such as interactive architecture, responsive architecture, and liquid architecture. Via its interaction of all these fields, Kinetic Architecture provides a generic base of knowledge for directing the movement to build a dynamic space. As to direct the movement in space, Kinetic Architecture brings forward the ways and means for operability. The ways consists

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[1] See also. Alkhayyat, J. M. J., "Design Strategy for Adaptive Kinetic Patterns: Creating a Generative Design for Dynamic Solar Shading Systems", MSc Digital Architectural Design, School Of Build Environment, University of Salford, Manchester 2013, p.17
Parkes, A., "Phrases of the Kinetic: Dynamic Physicality as a Construct of Interaction Design", Thesis Proposal for the degree of Doctor of Philosophy, Massachusetts Institute of Technology, Cambridge, 2008, p.10-12.
Fouad S. M. A. "Design Methodology: Kinetic Architecture", B.Sc. of Architecture Thesis, Alexandria University, Alexandria, Egypt, 2012, p.9,16.

[2]Although the resources that one can see in the references bring a variety of definitions for Kinetic Architecture, especially the thesis study of Soha Mohamed Abd El-Hady Fouad presents a comprehensive literature analysis on Kinetic Architecture definitions.
See also Fouad S. M. A. "Design Methodology: Kinetic Architecture", B.Sc. of Architecture Thesis, Alexandria University, Alexandria, Egypt, 2012, p.9,10.

[3] Ibid., Fouad S. M. A., 2012, p.10

[4] Fox, M., Kemp, M., "Interactive Architecture", Princeton Architectural Press, 2009, p.26, 28

[5] Umberto Eco explains the concept of "field" in relation to its origins in physics. In this sense the concept of "field ,evaluates the classical one-way casual relationships from a new stanpoint and regards complex effects of forces, configurations of possible events and the dynamisn of the structure.
See also, Eco, U. (1989).The Open Work, Harvard University Press, p.14.

[6] Grünkranz, D., "Towards a Phenomenolofy of Responsive Architecture: Intelligent Technologies and Their Influence on the Experience of Space", Vienna, 2012.p.6

of kinetic methods by which kinetic structures perform such as rotating, folding, sliding, transforming, expanding and etc. But these performances are closely related to quality of the materials used. The materials varying as rigid, plastic, elastic play a decisive role on the performance type. And the means are described as the impetus for actuation such as pneumatics, chemicals, magnetism, electrical systems, mechanical systems and etc. Additionally the means are also differentiates according to their performance in an analog or digital way. However, the ways and the means as working in unison build up the embodiment of movement and constitute the **topology of movement**. Besides these, Fox divides basic topologies of movement in three categories as embedded, deployable and dynamic systems. Embedded systems define integral and necessary parts of the building coupled with computational control. Deployable systems characterize deconstruction and reconstruction possibilities which afford mobility. And dynamic systems determine movable part of the building that act independently with respect the control of a larger context. [1] In

[1] Fox, M., Kemp, M., "Interactive Architecture", Princeton Architectural Press, 2009, p.46
Schumacher, M., "Move: Architecture in Motion- Dynamic Components and Elements" Birkhauser, 2010, p.32-35, 44

Work	Kind of Work			Mobility		Natural Effect		Technology		Reason			Movement			Movement Topology
	Art Work	Architectural Prototype	Architectural Building	Fixed	Non-Fixed	Human	Other	Analog	Digital	Pragmatic	Humanistic	Building Components Int.	Building Components Ext.	Complete Building Structure	Ways & Means
Naked House (2000)-Shigeru Ban			x	x		x		x		x		x			Move - Wood boxes
Turn-on House (2000-05) - Alles Wird Gut		x			x	x			x	x				x	Rotate, Move – Steel structured roller units
Wind Veil (2002) – Ned Kahn			x	x			x	x			x		x		Swing - Aluminum panels
E-motive house (2002) – ONL		x		x		x			x	x	x			x	Move - Pneumatic and hydraulic cylinders, wooden beams and air chambers
Mobile Dwelling Unit (2003) – LOT-EK			x		x	x		x		x				x	Move - Metal container units
Leaf Chapel (2004)- Klein Dytham Arc.			x	x		x			x	x	x		x		Slide - Steel structured perforated metal surface

Figure 1a. Examples of Kinetic Structures in Categories

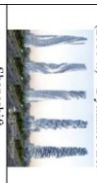
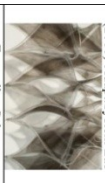
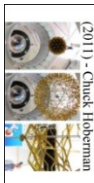
Work	Kind of Work			Mobility		Natural Effect		Technology		Reason			Movement			Movement Topology
	Art Work	Architectural Prototype	Architectural Building	Fixed	Non-Fixed	Human	Other	Analog	Digital	Pragmatic	Humanistic	Building Components Int.	Building Components Ext.	Complete Building Structure	Ways & Means
Bubbles (2006) - Michael Fox 		x		x		x			x		x		x		Expand - Airbags
Hylozoic Soil (2009) - Philip Beesely 	x			x		x			x		x	x			Wave - Acrylic tiles
Interactive Wall (2009) - Festo 		x		x		x			x	x	x			x	Swing – Bionic Fin Ray structure
Dynamic Tower (2010-..) – Dynamic Arc. 			x	x		x	x		x	x	x			x	Rotate - Prefabricated Steel Structured Units
Shapeshift (2010)-Adapt.Sy.stem Lab 															
Expanding Sphere (2011) - Chuck Hoberman 	x			x		x			x		x		x		Fold - Electroactive polymers
		x					x		x	x	x			x	Expand – Aircraft grade aluminum structure

Figure 1b. Examples of Kinetic Structures in Categories

this sense, topologies of movement, a mixture of different ways and means and also systems, promotes a way of continuously building space spreading over its whole process of being. This process actualizing in interaction with natural environment constituents is full of numerous possibilities and potentials base on the constituents' effect on movement. Among these constituents, human as being the performer of space at the same time faces extensive field of possibilities. Each time he performs in the space, he experiences a different series of spatial situation in line with the effect of his own decisions or the environmental factors. Thusly, any experience of him cannot be exactly the same as the other. And he combines all his experiences to generate a general perception of space. So that this kind of perception of such a dynamic space consists of multiple spatial appearances. And to make sense of all these appearances a new aesthetic conception is required.
To enable interpretations of new aesthetic conception and to draw a general view upon kinetic structures, a table[1] is constituted analyzing them in categories of Kind of Work (Art work, architectural prototype/installation, architectural work), Mobility (fixed, non-fixed), Natural Effect (human, other), Technology (analog, digital), Reason (humanistic, pragmatic), Movement (building components, complete building structure) and Movement Topology (ways and means). By way of choosing kinetic structure examples that has different combinations of these categories, a general perception is constituted in relation to field of Kinetic Architecture.(Figures 1a-1b)

3. POETICS OF THE "WORK IN MOVEMENT"

To develop a new aesthetic conception for Kinetic Architecture, Umberto Eco's poetic of the "work in movement" sets the pace. Eco develops the poetics of the "Work in Movement" in context of his theory of "The Open Work". Thereby he explains the poetics of the "Work in Movement" in relation to the openness of art work. Based on his studies on many fields of art such as music, literature, sculpture, architecture, he asserts that although a work of art is complete and closed form in its uniqueness as a balanced organic whole, it is also open on account of susceptibility to countless different interpretations which do not impinge on its unadultarable specificity and he evaluates aesthetic value of the art work according to its potential of interpretation. But beyond this kind of openness, he also mentions about another kind of openness which he calls **an intentional openness** of the art work different from typical openness of other art works. In this framework he defines the work in movement as formed by structural units that are unplanned or incomplete physically so as to allow many interventions. However this doesn't mean that a work in movement creates a random state. On the contrary, he mentions about that the artist builds up a network of relationships to which the performer can join in a directed way and constitutes an incomplete work of art for

[1] Although a version of this table is prepared for another study on analyzing movement of kinetic structures, in the context of this paper it is solelt used to construct a general view to the field.

the performer to complete. And this can lead to that the performer can configure the work in way that the artist cannot predict. So that as Eco mentions, each performance of the art work reveals a diverse appearance of it depending on the performers way to interpret it. In this sense each performance is complementary of other performances and solely the whole of these performances presents a satisfying appearance of art work. Because such art works cannot present all its artistic manifestations simultaneously. This fact brings forward the conceptions of **subjectivity** and **complementarity**. The work in moment reveals itself through the performers' subjective interpretations of it complementing each other. [1]

The work in movement creating a field of possibilities, comprises ambiguous situations open to diverse sorts of operative choices and interpretations. In this kind of works, there is **wideness of information** which is measure of one's freedom of choice when one selects a message. Within this wideness of information the performer choses and focuses on a few elements of it, but by experiencing it he binds together all the defined elements of which he is focally aware and makes them whole. Every whole created in such manner presents a way of existence of the work. But in this process, the reflection is generated by original pervasiveness of the work within which the performer exercises its selectivity. So that although the performer rebuilds the work multifacetedly via his experiences gained through his reflections and actions, constitutively the designer enables such a building via the field of possibility he created. And the aesthetic value of the work relates to the quality of this field of possibility. In other words the work in movement is open to the extent of the wideness of information and it raises in value in line with the multiplicity of its meanings that is to say the abundance of its all possible interpretations.[2]

In the work in movement, meaning is created through experiences. To comprehend such creation of meaning, besides Eco's theory his precedent Dewey's theory of art as experience is also a significant reference at this point. Dewey refuses to identify the existence of work of art apart from human experience and conceptualizes the word "aesthetics" referred to experience as appreciative, perceiving and enjoying. He asserts that the work of art is complete only as it works in the experiences of others than the one who created it. Emphasizing the individual property of experience, he claims that a work of art is recreated every time it is aesthetically experienced. Along with he explains that one have an experience when the material experienced runs it course to fulfillment and experience becomes conscious, a matter of perception, only when meanings enter it that are derived from prior experiences.[3]

Considering Eco's and Dewey's aesthetic conceptions, in Kinetic Architecture, meaning is created as a result of human's (performer) subjective experiments over the course of interaction with space in movement. Human connects the experiences gained through his experiments and the experiences he picked among his earlier

[1] Eco, U. (1989).The Open Work, Harvard University Press. p. 4, 19, 20, 24, 27.
[2] Ibid., Eco,1989, p. 42, 43, 44, 57.
[3] Dewey, J., "Art As Experience", Art and Its Significance : An Anthology of Aesthetic Theory, ed. Ross, D. S., State University of New York Press, 1994, p. 207, 213, 218

experiences to create meaning. In this sense, distinguishing appropriate experiences among a great deal of experiences to connect the diverse facts and establishing organic relationships between them build up **poetry**.[1] So that, each rebuilding of the work in movement reveals poetry as an artistic manifestation of it. Accordingly, each interpretation of the work in movement leads to poetical building of it.

4. POETICAL BUILDING OF SPACE IN MOVEMENT

Poetical building of space in movement is closely related to the poetry of movement. Michael Schumacher relates poetry of movement to one's sense of poetry as one's **sense of being** as a whole and directly connects it to the cultural identity.[2] To understand such a conception of poetry of movement and to discuss poetical building of space in movement, Heidegger's conception of poetical building in relation to human existence is significant for this study. Heidegger explains every act of building in interpretation of existence as **poetry**. He uses the term **poetical measuring** as an activity that enables to comprehend existential conditions by way of evaluating experiences.[3] He explains it as: "A strange measure for ordinary and in particular also for all merely scientific ideas, certainly not a palpable stick or rod but in truth simpler to handle than they, provided our hands do not abruptly grasp but are guided by gestures befitting the measure here to be taken. This is done by a taking which at no time clutches at the standard but rather takes it in a concentrated perception, a gathered taking-in that remains a listening."[4]And he defines poetical building of space by constant poetical measuring.

Within this conception, the relationship between the phenomenons of movement, human and space become more of an issue to quest poetical building of space in movement in relation to aesthetics. When human experiences a work of kinetic architecture, correlates to the space as multi-dimensional information field and rebuilds it via his experiences in the framework of the possibilities of space enabled by movement. And this process of building bases on poetical measuring. In this process performed in reflection and action[5] of the human, each configuration of space with the effect of human or other natural environment constituents carries a poetic nature on the extent that it turns into an existential manifestation in relation to the human experiences. In each interpretation of the space, human rebuilds it as poetry revealing an artistic existential manifestation of

[1]Opcit., Eco,1989, p. 112.
[2] Schumacher, M., "Move: Architecture in Motion- Dynamic Components and Elements" Birkhauser, 2010,p.11.
[3] See also . Heiddeger, M., "…Poetically Man Dwells…", Poetry, Lanaguage, Thought, New York: Harper and Row, 1971.
[4] Ibid., Heiddeger, M.,1971, p.223
[5] See also. Schön, D. A ., " The Reflective Practitioner: How Professionals Think in Action", Basic Books, 1983.

it. And in each poetical building of space, associating it to his own existence, he creates a unique spatial situation and becomes belonged to the spatial situation he created as individualizing it. So that space in movement due to its diversity manifests numerous existential situations establishing effective relationships with each performer. And the performer develops a multifaceted spatial perception to the extent of the diversity of these situations. And the kinetic structure forming the space in movement equally gains aesthetic value in accordance with this diversity.

4. CONCLUSION

Establishing its main discussion on the conception of space challenged by movement as a new element of space in context of Kinetic Architecture, this study aims to explore how to develop a new aesthetic conception for kinetic structures. Using the conceptual frameworks; Eco's poetics of the "Work in Movement" in context of his theory of "The Open Work", Dewey's theory of "Art as Experience" and Heidegger's conceptions of "poetry as building" and "poetical measuring" as an explanatory tool, it intends to conceptualize the way we interact and make sense of this kind of works. Analyzing the way one interacts and interprets Kinetic Architecture works, it also opens poetical building of space in movement up for discussion as an alternative way of production of space in relation to aesthetics.
In this context it present mainly three things:
- the movement as an element of interaction in architecture establishes a new kind of relationship between human and space which leads to dynamically changing experience of space.
- space in movement presenting an extensive field of possibilities, allow human to manipulate it according to his existential situation.
- space in movement gains aesthetic value depending on the diversification of the existential situations it enables.
And as concluding, this study opens and promotes the possibilities of further research in this field on the relationships movement, human, space and aesthetics of kinetic structures.

REFERENCES

- Alkhayyat, J. M. J., 2013. "Design Strategy for Adaptive Kinetic Patterns: Creating a Generative Design for Dynamic Solar Shading Systems", MSc Digital Architectural Design, School Of Build Environment, University of Salford, Manchester.
- Dewey, J., 1994. "Art As Experience", Art and Its Significance : An Anthology of Aesthetic Theory, ed. Ross, D. S., State University of New York Press.
- Eco, U., 1989. The Open Work, Harvard University Press.
- Fouad S. M. A., 2012. "Design Methodology: Kinetic Architecture", B.Sc. of Architecture Thesis, Alexandria University, Alexandria, Egypt.
- Fox, M., Kemp, M., 2009. "Interactive Architecture", Princeton Architectural Press.
- Grünkranz, D., 2012. "Towards a Phenomenology of Responsive Architecture: Intelligent Technologies and Their Influence on the Experience of Space", Vienna.
- Heiddeger, M., 1971. "…Poetically Man Dwells…", Poetry, Lanaguage, Thought, New York: Harper and Row.
- Parkes, A., 2008. "Phrases of the Kinetic: Dynamic Physicality as a Construct of Interaction Design", Thesis Proposal for the degree of Doctor of Philosophy, Massachusetts Institute of Technology, Cambridge.
- Schön, D. A., 1983 " The Reflective Practitioner: How Professionals Think in Action", Basic Books.
- Schumacher, M., 2010 "Move: Architecture in Motion- Dynamic Components and Elements" Birkhauser.
- Terzidis, K. , 2004. "Expressive Form: A Conceptual Approach to Computational Design", Routledge.
- Yiannoudes, S. , 2010. "Kinetic Digitally-Driven Architectural Structures as 'Marginal' Objects - a Conceptual Framework", Digitally-Driven Architecture, Footprint Delft School Of Journal, Delft.
- Zuk, W., Clark, R., H., 1970. "Kinetic Architecture", Van Nostrand Reinhold.