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Move-tecture: A Conceptual Framework for Designing Movement in Architecture

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Abstract. Along with the technological improvements in our age, it is now possible for the movement to become one of the basic components of the architectural space. Accordingly, architectural construction of movement changes both our architectural production practices and our understanding of architectural space. However, existing design concepts and approaches are insufficient to discuss and understand this change. In this respect, this study aims to form a conceptual framework on the relationship of architecture and movement. In this sense, the conceptualization of move-tecture is developed to research on the architectural construction of movement and the potentials of spatial creation through architecturally constructed movement. Move-tecture, is a conceptualization that treats movement as a basic component of spatial creation. It presents the framework of a qualitative categorization on the design of moving architectural structures. However, this categorization is a flexible one that can evolve in the direction of the expanding possibilities of the architectural design and the changing living conditions. With this understanding, six categories have been defined within the context of the article: Topological Organization, Choreographic Formation, Kinetic Structuring, Corporeal Constitution, Technological Configuration and Interactional Patterning. In line with these categories, a multifaceted perspective on the moving architectural structures is promoted. It is aimed that such an understanding constitutes a new initiative in the design practices carried out in this area and provides a conceptual basis for the discussions to be developed.

1. Introduction

Architecture has had to face the continuous change of living conditions over the years. In this sense, radical changes in many areas triggered from the 1960s and gaining momentum along with the 1990s have once again made the existence of architecture problematic and created many problem areas to face. One of these problematic areas is the relationship between architecture and movement. In line with constantly changing modes of life, dynamic spatial constructions that can accommodate changing dynamics and become part of the change have gained importance. The integration of movement to built environment has challenged the way the buildings are designed. Accordingly, kinetics in architecture have been revisited many times in context of technological innovations to address the changing socio-cultural and functional needs of the age. [1] Along with developing technologies, changing and diversifying design tools and methods have provided a comprehensive cognitive domain that allows designing elements that could not previously be incorporated into the design. With the expansion of the scope of design processes to include processes of manufacturing and usage, researching on the design potentials of movement in architecture has become easier. Thus, the movement, which has been on the

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agenda from time to time since the very being of architecture, has begun to find a wider area within the architectural design activity and to define a common problem area.

This study, which focuses on the relationship of architecture and movement in context of design, opens a debate on the factors that are on the agenda in the design of moving architectural structures. It aims to explain the complex range of issues that are crucial for creation of architectural structures capable of movement. In this perspective, the concept of move-tecture is developed to problematize the design of movement in architecture. Within the conceptualization of Move-tecture, a flexible, qualitative categorization of the design elements that are determinative in the design of moving architectural structures is created. This categorization defines a network of relationships intertwining each other for the creation of movement and for the continuous and dynamic construction of space through movement. In this sense, it is intended that the categorization made in context of the article contribute to the creation of a conceptual framework for the design and reading of complex relationships that leads to the formation of movement in architectural structures.

2. Move-tecture

Along with the innovative technologies of information age, the production of movement as a basic structural element in the built environment challenges the very nature of architecture and the role of the architect. [2] Newly developing practices of designing computational and relational architectural objects transform the production of architecture largely. [3] Articulating the dynamic possibilities of built form, a formless architecture arises through process-based transformation of forms. [4] Through information-driven transformation processes, how information should be structured, connected and used to produce forms of growth and strategies of behavior gain importance. Accordingly, production of architecture, which is held common to physical and virtual environments, becomes an open dynamic process. [5,6] In these circumstances, architects start working like a programmer and become designers of systems of data collection and processing that activate movement for continuous production of architecture. Thus, beyond designing a completed building, architects design an initial state of a dynamic structure that is interwoven through interactive network of relationships to direct its evolution throughout its course of existence. [7,8,9,10]

Within this perspective, there is a need for a conceptualization problematizing the architectural production of movement in order to understand and explain the radical changes that dynamic structures have created both on the architectural production and the architect's design practice. In this respect, Move-tecture, created by combining the concepts of movement and architecture, expresses a conceptualization on the architecture of movement in built environment. Concentrating on the design of architectural structures that create movement, it opens up a discussion on the design of movement itself rather than the visual dynamism that evokes movement. Although there are many conceptualizations focusing on the different aspects of movement in architecture like Kinetic Architecture, Interactive Architecture, Responsive Architecture, Liquid Architecture, the conceptualization of Move-tecture directly addresses the architectural construction of movement rather than the effects of movement in architecture. Accordingly, it deals with all the factors that affect the creation of movement and comprises all the different approaches of its design.

Furthermore, Move-tecture examines the potentials of spatial creation through architecturally constructed movement in the light of both the pragmatic and the humanistic concerns. [11] Patterns of movement emerging in relation to environmental and operational factors continuously rebuild space in a state of flux and they promote adaptation, transformation, relocation and interaction. Thus, as Oostherhuis mentioned, the built environment works as a mediator that creates movement within interacting flows of forces. [12] In this sense, Move-tecture poses the problem of ephemeral-fluxional spatial construction that can only be grasped through time. Therefore, in such a conceptualization, time becomes an integral design issue. And in relation, movement constitutes a meaningful whole only in a spatio-temporal context. However due to the reason that Move-tecture mainly seeks for the architectural ways of creating movement to create space, it constitutes an indirect point of view for the creation of the space.

To expand and deepen the conceptualization of Move-tecture, this study builds a discussion on designing movement architecturally in terms of its determinative design components. In this respect categories of Topological Organization, Choreographic Formation, Kinetic Structuring, Corporeal Constitution, Technological Configuration and Interactional Patterning are explained and opened to discussion to review the complex networks of designing architectural structures that creates movement.

3. Topological Organization

Topology refers to continuity and connectivity in spatial or formal transformation, and deals with relative associations. [13] And the movement defines a topological field by creating a flow between different locations and situations within the space. [14,15] Therefore, it is not possible to think of topology apart from the movement that creates a constant change and transformation within the space. For that reason, while designing movement as a structural element, its topological field also becomes a design problem. In this sense, topological organization forms a network of relationships within which movement can be activated and defines a context for movement. In other words, it describes a field of relationships in which the movement is activated. In this sense, it can be expressed as a flexible installation that includes the whole structure or a part of it. Topological organization refers to a layout that hosts multiplicity of forms of relations rather than a singular layout specified by pre-defined relations. Because the possibility of creating many arrangements in the direction of the positions and situations of the nodes that make up the organizing within and in relation to each other, arises via topological organization. In this sense, continuous flows of movement over the nodes form the space over and over again. Thus, many different forms of space that are created by movement within the same topological organization come into the agenda. However, the diversity of spatial forms varies in line with the possibilities and the interpretive potentials of the topological organization.

4. Choreographic Formation

Choreography is an integral part of the design of movement allowing thinking of it in terms of spatio-temporal relationships. In this perspective, choreographic formation refers to the movement patterns composed of the flows of movement within the topological organization. Considering the ways of movement (move, rotate, scale, etc.) and the spatial forms of moving elements (linear, planar or volumetric), diverse types of movement are created within the same topological organization. [16] With reference to types of movement, choreographic formation fictionalizes how the geometric formation and position of architectural elements change over time. In this respect, choreographic formation closely relates to kinematics in order to configure speed, acceleration, direction and position of objects. Accordingly, movements are combined in a kinematic chain to form their chorographical acts. In this sense choreographic formation examines the design of individual and united movements of dynamic building elements in interaction with environmental and operational factors. Although the sequences of movement are fictionalized in context of choreographic formation, it offers an undetermined open structure in which sequences can be assembled in many different ways creating a continuously evolving choreography.

5. Kinetic Structuring

Kinetic in architecture is about “the capacity of the moving structure to be affected by reversible geometrical changes in whole or in part without losing the integrity of the system.” [17,18] Kinetics is crucial for the design of moving architectural structures in terms of their ability to move. In such a consideration, the behavior shown by the structure under the influence of the forces acting on it, gains importance. In this sense, kinetic structuring is concerned with the design of the mechanism that will lead to the behavior that will carry out flows of movement defined in the choreographic formation. The mentioned mechanism is a jointed-structure which is developed in relation to the nodes and the relationship of the nodes determined in the topological organization. Thus, it serves for an articulation for the different states -initial state, final state and states in-between - that the structure takes on through the flow of movement. Besides these, designing kinetic structuring, different typologies as embedded

kinetic structures ("structures that exist within a larger architectural whole in a fixed location"), deployable kinetic structures ("structures that typically exist in a temporary location and are easily transportable") and dynamic structures ("structures that exist within a larger architectural whole but act independently with respect to control of the larger context") come to the agenda. Furthermore, the quality of the acts of structures such as muscular action, hydraulic action, pneumatic action, gain importance. [19, 20] Taking advantage of the recent developments in robotics, evolutionary patterns also become crucial for kinetic structuring to produce forms of growth and strategies of behavior. [21] With this understanding, kinetic structuring deals with the performative aspects of the moving architectural structure. [22]

6. Corporeal Constitution

The term corporeal refers to the nature of the body and the material properties. In this sense, corporeal constitution expresses the physical material body of the movement. It is essential in terms of designing the bodily existence of the moving architectural structures in physical reality. It is closely related to the properties and the behavioural characteristics of the materials and the combination of the materials within the movement system. It deals with the exploration of the usage possibilities of the material in line with its unique qualities. In designing corporeal constitution, the moving form itself, different states of the moving form under transformation and the forces acting on the moving form become crucial for the choice of material and the way the material is integrated. Accordingly, materials used in moving structures vary as rigid, plastic or elastic depending on their behavioural characteristics and many different configurations come to the agenda depending on the characteristics they have. [23] Besides these, developments in material science and nanotechnology expand the properties and the behavioural characteristics of the materials. In this respect, computational capabilities embedded in physical materials enable considering material as hardware augmented with software in line with the production of programmable materials and increasing the opportunities of designing. [24, 25]

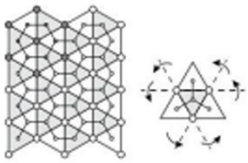
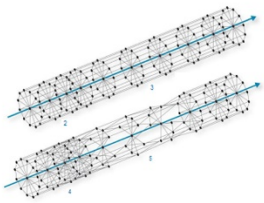
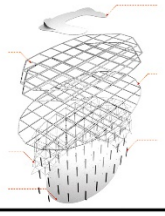
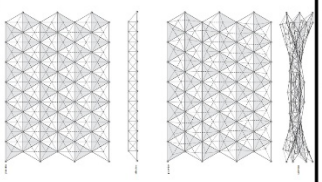
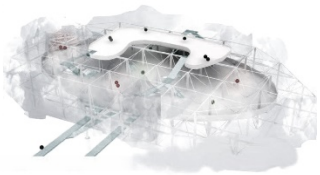
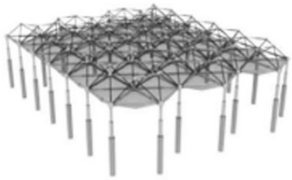
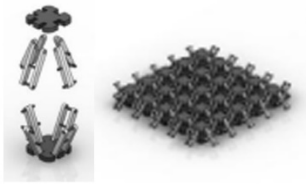
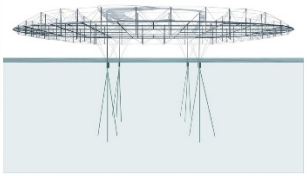
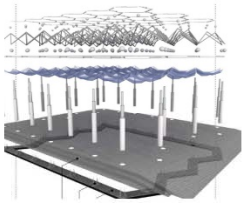
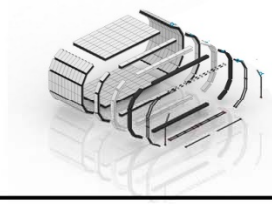
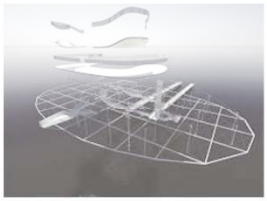
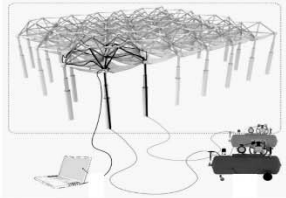
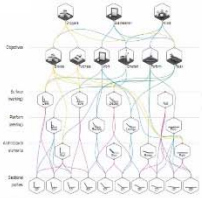
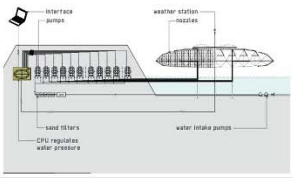
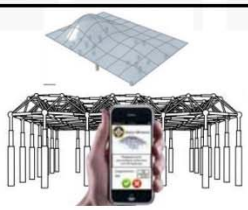
7. Technological Configuration

Technology is an important design element in terms of structuring the tools and methods to be used in moving architectural structures. In this sense, technological configuration refers to the entirety of interactive systems that play a role in the formation of movement. The fact that all the physical and non-physical forces affecting the creation of movement can be interfaced by technology opens a way for combining kinetic structuring systems and material systems with computation-based systems. [26] Thus, configuring moving structures technologically, the systems consisting of both hardware and software components come to the fore and they establish a flow of information between different systems to direct the movement. In this sense, newly developing digital technologies common to design, production and operation processes enable continuous and effective flow of information between hardware and software components. On this basis, swarms of vehicles are configured in a complex manner to enable open collaborative processes of movement creation. Accordingly, sensor systems, processing or control systems, actuator systems and interface systems are closely interrelated to manipulate movement of architectural structures. [27] In relation, different systems of manipulation that Sterk categorizes as direct manipulation, automation and hybridized models, come to the fore.[28] Furthermore, new species of software that is more intuitive, more immediate, less hierarchical and non-linear, expand the possibilities of interpretation and allow for autonomous operation and evolution of movement. [29] In this respect, heuristic and learning capabilities of the systems also gain importance. [30]

8. Interactional Patterning

Interaction is inherent to the very nature of movement. Therefore, it is not possible to design moving architectural structures regardless of the ways of interacting that they offer. With this understanding, interactional patterning is concerned with the ways that the human interacts with moving architectural structures and manipulates them. Effectiveness of the conversational relationships that human establishes with the moving architectural structures becomes crucial in terms of interactional patterning.

Table 1. Moving Architectural Structures: Interactive Kinetic Structure Thesis Project (Costantinos Miltadis) Interactive Architecture Thesis Project (Tan Lihuan Linus), Blur Building (Diller&Scofidio)

	Interactive Kinetic Structure	Interactive Architecture	Blur Building
Architectural Construction			
Topological Organization			
Choreographic Formation			
Kinetic Structuring			
Corporeal Constitution			
Technological Configuration			
Interactional Patterning			

In this context, design of the interface that creates the interaction conversation emerges as the basic research field. Accordingly, interface design is developed to examine the ways of fluid and intuitive engagement with human body based on the principles of direct manipulation. In this sense, interface

design is closely related to the ability of moving architectural structure to embody and respond to information in context of human-computer interaction. [31] Along with the developing technologies, touch and multi touch, gesture and cognitive control emerge as new means of interacting and controlling through the interface. Furthermore, heightened level of realism that allows to organize information in a spatial manner come to the fore in interface design, [32].

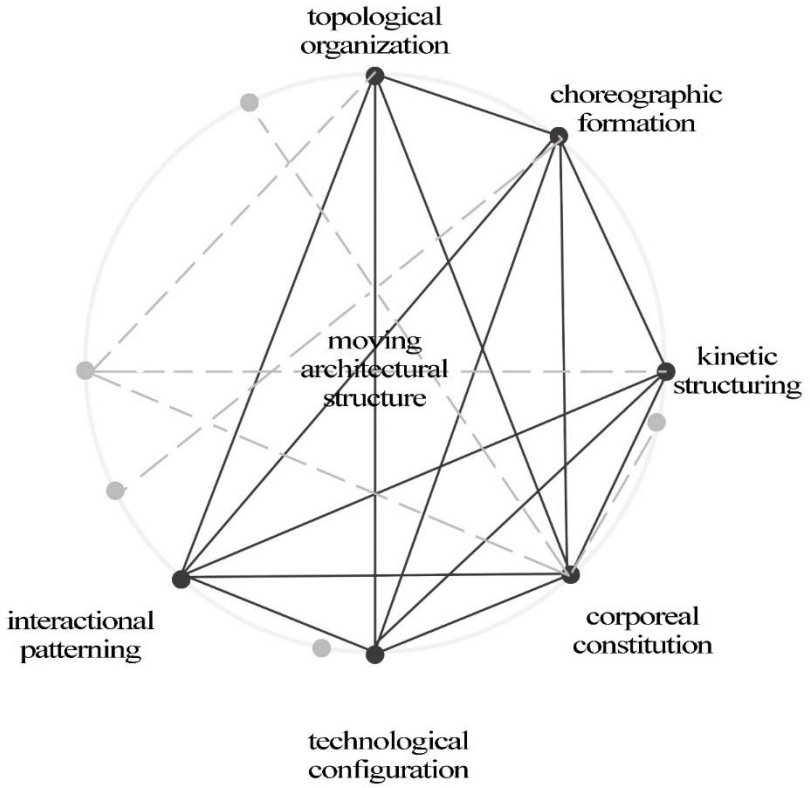


Figure 1. Categorization relationships and their potential for expansion

9. Conclusions

Move-tecture expresses a conceptualization on the architectural construction of movement and the potentials of spatial creation through architecturally constructed movement. Although this study has been specialized in creating an overview on the architectural construction of the movement discussing the factors of designing, further studies will provide a more comprehensive view of the subject by deepening this conceptualization. Thus, in context of Move-tecture, it becomes possible to establish a specialized research area for a new type of architectural production that questions the possibilities of the architectural design of movement and the spatial creation through movement.

Within the scope of the article, categorization made on the design factors that are significant for the design of the moving architectural structures should be understood as the first loops of an interlocking structure. The evolutionary nature of the design and the evolving systems of movement will further complicate and deepen this structure. In this sense, new horizons opened in time will bring new categories together. Therefore, the categories developed in the article constitute a flexible structure that allows interpretation of interrelated design relations of moving structures. Beyond being a defined trajectory, they are constituted as a tool for opening a design debate. In this way, it is aimed to structure a debate about the changing design problems as a result of the fact that movement becomes a basic

component of architecture. Thus, the article opens a way to constitute a new initiative in the design practices carried out in this problematic field and to provide a conceptual basis for the discussions to be developed.

References

[1] M., Fox, M., Kemp, "Interactive Architecture", Princeton Architectural Press, New York. pp. 18,27,29, 2009.
[2] Ibid. M., Fox, M., Kemp, pp. 27, 2009.
[3] A., Parkes, "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.
[4] Kolarevic, B., "Introduction" in Architecture in the Digital Age – Design and Manufacturing, ed. Kolarevic, B., Taylor&Francis ,New York. pp. 6, 2004.
[5] M., Fox, "Biorobotic Architecture" in Building Dynamics: Exploring Architecture of Change, ed. Kolarevic, B., Parlac, V.,Taylor & Francis, New York. pp. 238, 2015.
[6] T., Jaskiewicz, "Process-driven Architecture", in 3rd Int'l ASCAAD Conference on Em'body'ing Virtual Architecture Proceedings, ASCAAD-07, Alexandria, Egypt, pp.1, 2007
[7] Op.cit. M., Fox, pp. 251, 2015.
[8] Op.cit. M., Fox, M., Kemp, pp. 207, 2009.
[9] Opcit. T., Jaskiewicz, pp.1, 2007.
[10] K.,Ooestherhuis, "We Robots", CCC Conference Emotive Embodiments, TU Delft, 2015.
[11] Op.cit. M., Fox, M., Kemp, pp. 30-31, 2009.
[12] Op.cit. K.,Ooestherhuis, 2015.
[13] P., B., Jones, M., Meagher, "Architecture and Movement: The Dynamic Experience of Buildings and Landscapes", Routhledge, pp.253, 2014.
[14] Op.cit. M., Fox, M., Kemp, pp. 46, 2009.
[15] M., Schumacher, Move: Architecture in Motion- Dynamic Components and Elements, Birkhauser, Berlin, p.32-35, 44, 2010.
[16] Op.cit. M., Schumacher, pp.47, 2010.
[17] C., Sanchez-del-Valle , Adaptive Kinetic Architecture: A Portal To Digital Prototyping. Annual Conference of the Association for Computer Aided Design In Architecture (ACADIA) 05: Smart Architecture: Integration of Digital and Building Technologies. Savannah, Georgia, USA, 2005.
[18] S., M., A., Fouad., "Design Methodology: Kinetic Architecture", B.Sc. of Architecture Thesis, Alexandria University, Alexandria, pp. 10, 2012.
[19] Op.cit. M., Fox, M., Kemp, pp. 50, 2009.
[20] Op.cit. S., M., A., Fouad., pp. 31-33, 2012.
[21] Op.cit. M., Fox, M., Kemp, pp. 13,50,206, 2009.
[22] Op.cit. M., Schumacher, pp. 8, 226, 2010.
[23] Ibid. M., Schumacher, pp. 36, 2010.
[24] K.,Ooestherhuis, I., Lenard , "Powerlines" in Building Dynamics: Exploring Architecture of Change, ed. Kolarevic, B., Parlac, V.,Taylor & Francis, New York. pp. 413, 2015.
[25] S., Tibbits, "Self-Assembly and Programmable Materials" in Building Dynamics: Exploring Architecture of Change, ed. Kolarevic, B., Parlac, V.,Taylor&Francis, New York. pp.229, 2015.
[26] Op.cit. M., Fox, M., Kemp, pp. 28,51, 2009.
[27] B., Kolarevic,"Exploring Architecture of Change", In reForm( ) - Building a Better Tomorrow: Proceedings of the 29th Annual Conference of the Association for Computer Aided Design in Architecture (ACADIA), 58-61. ACADIA. Chicago, Illinois: The School of the Art Institute of Chicago, pp.60, 2009.

[28] T., E., Sterk, "Beneficial Change: The Case For Responsiveness and Robotics in Architecture" in Building Dynamics: Exploring Architecture of Change, ed. Kolarevic, B., Parlac, V.,Taylor&Francis, New York. pp.200-210, 2015.
[29] Op.cit. K.,Ooestherhuis, I., Lenard pp. 415, 2015.
[30] Op.cit. S., M., A., Fouad., pp. 39, 2012.
[31] Op.cit. A., Parkes,.2008.
[32] Op.cit.. M., Fox, M., Kemp, pp. 216, 217, 2009.