ANALYSIS OF TRADITIONAL AND GENERATIVE SHAPING APPROACHES THROUGH ARCHITECTURAL PROJECT CONTESTS

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Abstract

Architecture; beyond its social, economic and technological usage is concerned with designing spaces and shaping objects. How architects begin the process of design and which methods they employ is a considerable research interest. This study has evaluated some of the generative shaping approaches dused for architectural design. This topic was investigated through the lens of architectural design contests held over the world in the 21st century, a time when design methods have recently been bolstered by advancing information and technology networks. Decision-making processes of generative shaping approaches from architecture contests were analysed and factors and approaches influencing design were attempted to be found.

1. INTRODUCTION

Architecture is a branch of art with an emphasis on visuality and aesthetic values. Style in Architecture first began with structures built for shelter, protection and separation from the environment and diversified throughout history, based on the method employed in that particular historical era [1]. In the process of architectural formalization since the Renaissance, products of architecture differed based on the prevalent architectural paradigms of their age. Contemporary methods to architecture have especially diversified in the last twenty years due to the ongoing information and technology based transformation of our age [2].

In the process of shaping architectural products, the elementary question is that of how the style should be formed. Architects have tried to discover the ideal style and to define rules for design. The first design method in architecture is the traditional method laid out in architectural sources. This method appears to us as a tool for guiding the course of design. In this method, the architect creates style by borrowing from the users and previous researchers, and applying corrections and innovations [3]. However, with the development of information and computation technologies lately, paradigms regarding architectural design and design have also changed. This has allowed for architects and designers to produce complex, hitherto unknown styles and readier expression of styles previously considered difficult to produce. As a result, generative shaping approaches which are used to create distinct styles began to take shape. Generative shaping approaches derive their data from quantitative design and were formed with the aim of using numerical data in the design process, and offer new opportunities while differing from traditional methods[4].

In order to understand, define and investigate the usage architectural methods, this study has aimed to comparatively explore the effects of traditional and generative shaping methods on conceptual design and style development using architectural design contest and therefore to analyze the differences created by design methods in the process of design and its adaptability.

For this purpose, architectural design contest examples chosen from Turkey and the world were analysed comparatively in regards to traditional and generative shaping approaches and an evaluation table including figures on the conceptual design and stylistical formation of examples from architectural design contests was created. The study was conducted in 2 stages. Firstly the effectiveness of design methods on a conceptual level was investigated, followed by design development and activity in the design's stylistical formation. It was therefore intended to present the opportunities and differences presented by traditional and generative shaping approaches.

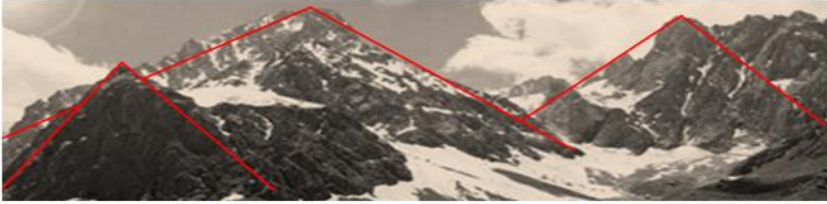## 2. TRADITIONAL AND GENERATIVE SHAPING APPROACHES

Design methods generally define the conventions used to create styles. These conventions, which are either traditional or generative, are separated into sub-methods. Broadbent defined four sub-types in deisgn methodology: analogic, iconic, canonic and organic methods[5]. The analogic method represents an object with its most similar conceptual counterpart in way of analogy[6]. The iconic method is the intergenerational transfer of architectural style, formed through effects of climate, culture and society with little change and its continued use[5]. The canonic method is forming architectural style using established, proven ratios and grids. "Canon"s are formulated using axes and grids to define plans, cross-sections and appearances and the ratios between them[7]. The organic method is design that is in harmony with the immediate environment, using unconstrained and deformed forms conforming to the environment and local topography.

Generative shaping approaches, unlike traditional ones, aim to provide large numbers of alternative, open-to-change designs by contextually evaluating the groups of data which shape design. The core attribute of generative shaping approaches is embracing and using scientific approaches to problem solving. These methods make use of language, mathematics and biology [8]. They can be broadly divided into six sub-methods. Shape grammar is used to formulate the rules governing architectural production, the geometric elements to be used, the initial shape and shape derivation [9]. This approach creates shapes deriving from but unlike the initial shape through an iterative process. Shapes made using the fractal design method resemble the initial shape no matter which point it is viewed from. This process provides the same results no matter the amount of iterations it goes through. The general properties of the method include repetition, self-resemblance and ratio[10]. The Voronoi – Delaunay triangulation method is a way of decompiling and breaking apart a surface using an origin set. Areas formed by routes which have the lowest energy expenditure going from pre-defined points to other cells are called Voronoi celles [9]. The genetic algorythm method employs algorythms developed using the principle of natural selection, used to find effective solutions based on natural evolution. In this design, different shapes belonging to the same family are created using different reproduction methods. This process of reproduction, transformation and differentiation continues until the fittest shape is found [11]. The self-organizing systems method bases itself on natural events such as the movement of bird flocks and the construction of ant nests. In this approach, the end product is generally a product of simple, repeating rules [12]. Finally, in the biomimetic method is a portmanteu of the Greek "bios" or life and "mimesis" or impersonation, defined by Benyus in the late 1990's [13]. Biomimesis places emphasis on the ultimate knowledge of mother nature and attempts to make use of it [14] .

3. MATERIAL AND METHOD

This study has aimed to compare design methods that have contributed to shaping architectural design. To this end, examples chosen from 21st century architectural contests in Turkey and the world were analysed comparatively on traditional and generative shaping approaches to design. The analysis was conducted in 2 steps. In the first step, conceptual design, an analysis of how the data influencing design was chosen was conducted, while in the second – design development – an attempt was made to determine how this data was transformed and to what extent it affected style. It was therefore meant to measure how effective design methods were in development of design and its stylistical transformation. In the conceptual design stage, the initial shape's conceptual relationship with the chosen design method was explored to determine how the initial choices in design were formulated.

Table 3.1.Conceptual design stage of analogic methods

COMPETITION-PROJECT INFORMATION	Singapore Bamboo Skyscraper Competition	Y B N O 1
	2014/3.Prize	
	Design Team: M. Olejar, J.Lenart, T. Boros.	

In the design development stage, design methods' influence and reflections on architectural development and transformation was examined through environmental, physical, functional, technical-technological and spatial data affecting the process of architectural design. For each design method, the development and transformation of designs was ensured based on all or some of these factors. An examination of factor-design method pairs and their usage details was conducted.

Figure 3.1. The sets of data that shape architectural design [15]

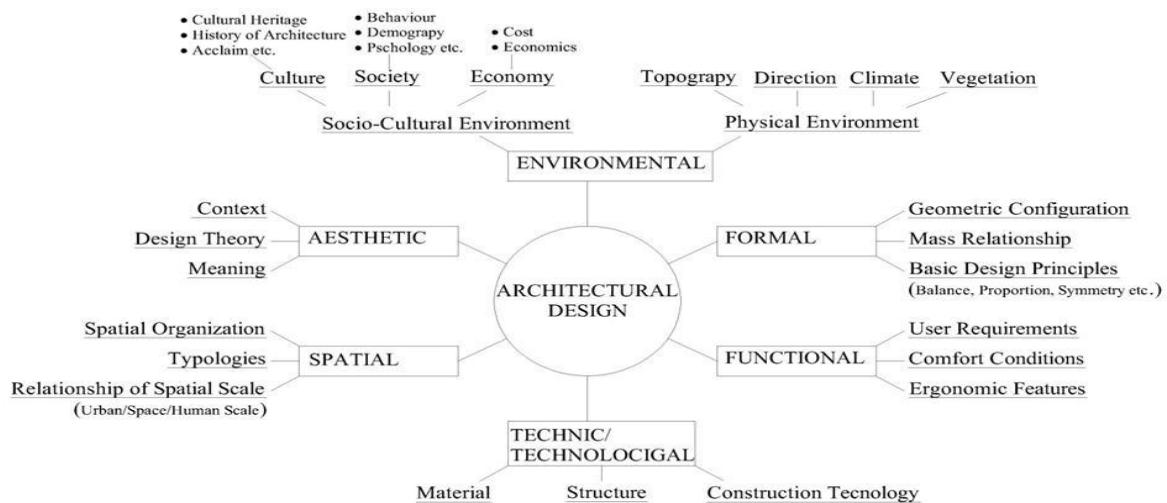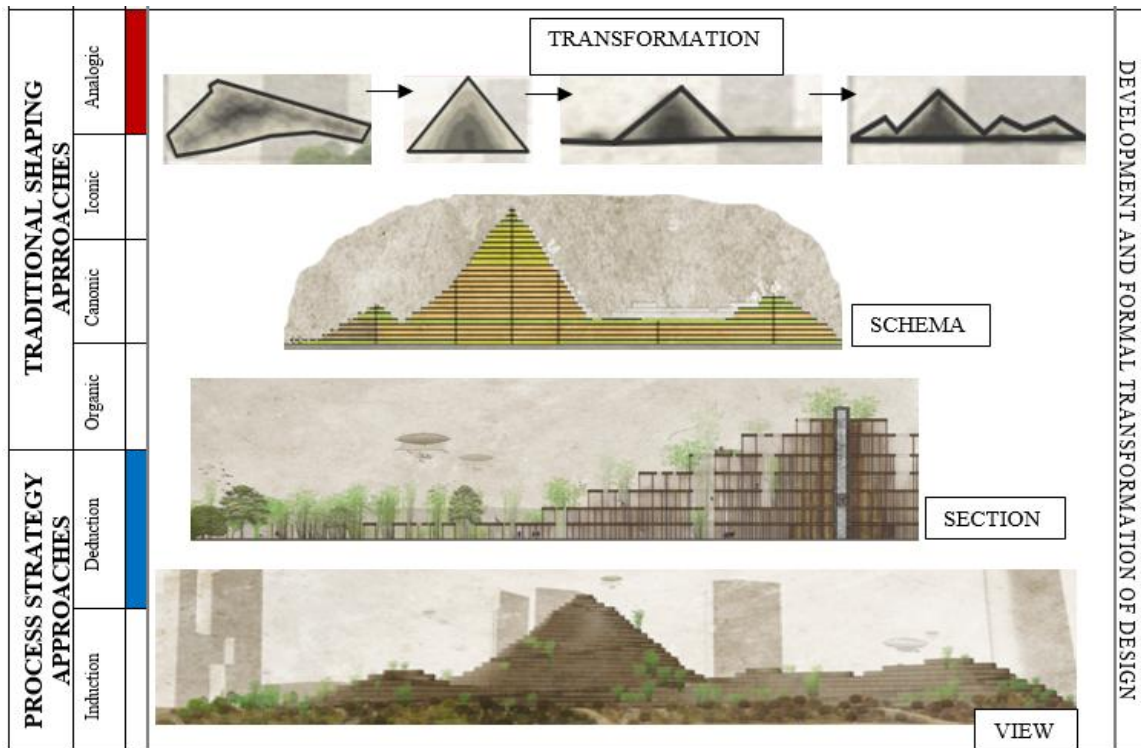**Table 3.3.** Development &formal transformation of design in the analogic approach

Following individual analyses, these two design stages were analysed comparatively over examples from Turkey and the world. It was therefore attempted to present theopportunities and differences presented by traditional and generative shaping approaches to design.

A summary of the comparisons and examinations can be found in Table 3.4.

Table 3.4. Evaluation Table

Evaluation Table			Competition Information	Conceptual Design		Development and Formal Transformation of Design				
				Conceptual Information	Result Product	Environmental	Formal	Functional	Technologic	Spatial
EXAMPLES FROM TURKEY	Generative Shaping Approaches	Biomimetic	Antalya Expo, 2014				■		■	
		S.Organizing System	Ytong, Contest 2014			■			■	■
		G.Algorithm	Balıkesir Municipiality Contest, 2016							■
		Voronoi	Yozgat Municipiality Contest, 2008				■		■	
		Fractal	İstanbul Gülsuyu Cemetery Contest, 2015			■				■
		Shaping Grammar	Pamukkale University Architecture Faculty, 2016				■			■
	Traditional Shaping Approaches	Analogic	Çanakkale War Center Contest,2015			■			■	■
		Iconic	Beylikdüzü Municipiality Cemetery, 2015				■		■	
		Canonic	Erbaa Social Habitat,2014			■			■	■
		Organic	Evka 3 Social Center and Station, 2016				■		■	
EXAMPLES FROM WORLD	Generative Shaping Approaches	Biomimetic	Eleven Magazine Contest ABD, 2017				■	■		
		S.Organizing Systems	Evolo Magazine Contest, 2011				■			■
		G.Algorithm	Taiwan Cultural Center,2013			■		■		■
		Voronoi	Evolo Skyscraper Contest, 2011				■		■	
		Fractal	Grand Egyptian Müzesi,2009			■				
		Shape Grammar	Vancouver The 2030 Challenge, 2009				■		■	
	Traditional Shaping Approaches	Analogic	Singapore Bamboo Skyscraper Contest, 2014			■			■	
		Iconic	Venice Biennale Pavilion,2013			■				■
		Canonic	Swiss Housing Contest,2013			■			■	
		Organic	Kazakhstan Expo Contest,2017			■	■	■		■

4.EVALUATION AND CONCLUSION

When traditional design samples from contests in Turkey were evaluated amongst themselves; references to social themes, traditions and natural concepts were determined to be present in the conceptual designs. In the design development & transformation stage, influence from spatial and physical factors was a common theme. Furthermore iconic, canonic and organic design methodologies differed from the analogic method in being influenced by environmental and technologic factors.

When traditional design samples from competitions abroad were analysed, it was found that natural, socio-cultural and religious themes were prevalent in the conceptual design stage. In the development and transformation phase, physical shaping was a shared characteristic. Furthermore iconic, canonic and organic design methodologies differed from the analogic method in employement of functional factors.

Generative shaping approaches examples from contests in Turkey showed shared influence from spatial factors in shaping the design. Biomimetic, genetic algorythm, voronoi, fractal and shape grammar examples were affected by physical considerations while self-organizing systems were not affected by physical constraints due to their challenging attitude towards concepts of mass and continuity in architecture. It was seen that Biomimetic, genetic algorythm, voronoi and shape grammar examples employed functional factors.

When international samples of generative shaping approaches were compared as a group; influence from physical factors was shared amongst shape grammar, genetic algorythm, voronoi, self-organizing systems and fractals. Biomimetic, genetic algorythm, self-organizing systems and voronoi all employed material, structural and construction technologies.

While generative shaping approaches from Turkey made use of spatial factors in design development, their use in international samples was limited to those ascribing to the self-organizing systems, genetic algorythms and shape grammar methods.

It was also seen that contest entries from Turkey were affected the most by spatial factors and the least by functional and technological factors. Whereas in international entries, physical considerations were the most used while spatial considerations were the least.

Conformity to physical factors was common to examples from Turkey and the world in the development and transformation of design phase. Environmental factors were influential in genetic algorythm, self-organizing system and fractal design approaches, while functional considerations presented themselves in Biomimetic, self-organizing systems and genetic algorythms designs.

In both sets of generative shaping approaches examples, the formation of connections betwee concepts and design elements during the conceptual design phase proved the importance of procedural relationships in the method.

When evaluating traditional design approaches from contests in Turkey and the world, physical utilization of conceptual design was found to be common. In examples from Turkey, this was joined by spatial factors while examples from abroad tended to share influences from environmental factors.

All examples of both traditional and generative shaping approaches from Turkey and the world appeared to be most influenced by physical factors, then spatial and environmental ones and finally technical-technoogical factors.

Through evaluations conducted using the same design methods in different competitions; designs were found to be differentiated from eachother by their environmental factors (socio-cultural as well as physical environment), spatial factors(spatial organization), physical factors (geometry), functional factors (user requirements) and technological factors (material, structure).

It was found apparent that shapes whose conceptual designs were made using the same design method could be affected by different rules and techniques during the design development and transformation phase, leading to diverse final products.

In accordance with the evaluations, it was observed that generative shaping approaches were able to employ technological concepts in addition to the sociological, psychological, religious and political concepts and ideas commonly found in traditional designs; allowing these methods to formulate larger numbers of alternative shapes as a result. It was especially found that generative shaping approaches made themselves available to designers searching for a novel approach, aiding these individuals in honing their methodology and producing innovative designs.

During the study, the conceptual and physical stages of development and the rules, factors and approaches affecting design were defined and the transformations and developments undergone by different designs were observed. In conclusion, traditional design methods are still widely employed by architects. However, it was found that generative shaping approaches are also being used effectively thanks to their success in forming alternative designs, lenience for changes in design and usage of quantitative data in all facets of the design process from structure to material and from spatial organization to cultural-architectural interactions.

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