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Form is Function: New Comprehension through Parametric Architecture

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Abstract. While form and function are distinct elements in the design, they share an inseparable correlation. The form, in conjunction with the architectural space, embodies its intended function; the form itself is the function and structure of the architecture. In parametric design, the relation between form and function becomes closer. Functional requirements often direct the form with parameterization according to the needs and conditions presented or given as parameters. This paper explores the concept of "Form is Function" in the context of parametric architecture, examining how parametric design challenges conventional notions and offers new comprehension of the relation between form and function. Case studies and theoretical frameworks are analyzed to illustrate the innovative possibilities that parametric architecture introduces for form-function integration and its implications for contemporary architectural design. This paper, through theoretical exploration and practical case studies, unveils how parametric design reshapes the form-function relationship, heralding a new paradigm in architectural aesthetics and utility.

Keywords: Form, function, parametric architecture, relation, architectural design

1 Introduction

"Form follows function" concept as a principle in architecture mostly attributes by Louis Sullivan in the realm of architecture theory, articulated in his 1896 essay "The Tall Office Building Artistically Considered" asserts that a building's design should stem directly for its intended purpose. ¹

However, understanding of form and function in architecture is complex and multi-layered, transcending the simple dictum of "form follows function." This approach encourages a broader perspective on architectural design, considering both the aesthetic and functional aspects and their historical and theoretical implications. ²

¹ Sullivan, L.: The Tall Office Building Artistically Considered. Getty Research Institute (1896)

² Hendrix, J.: Theorizing a contradiction between form and function in architecture. South African Journal of Art History (2012)

In contemporary architecture discourse, this principle has evolved with the advent of parametric design. The design method, reliant on algorithmic processes, has fostered a more integrated approach, where form and function are closely intertwined.

This paradigm within parametric architecture is approached by examining the redefined relationship between a structure's form and functionality. By incorporating functional requirements directly into the design process, parametric architecture achieves a synergy of form and utility, adapting to environmental conditions and user needs.

In the context of parametric design in particular and architecture in general, the transformation of the "form is function" concept indicates a shift in architectural thought towards a more holistic and integrated approach to design, where the boundaries between aesthetic form and practical functionality are less blurred.

2 Form in conjunction with the architectural space

In architectural design, form and function, are deeply interrelated. A structure's form, in synergy with its spatial design, reflects and supports its intended function. In essence, form is not only an aesthetic aspect, but it embodies the function and structure. This interweaving of form and function, a fundamental principle in architecture, has been a subject of much discourse and evolution over time.

Trying to give a modern interpretation, especially in the context of parametric design, we can gain the meaningful comprehension. Parametric design uses algorithmic processes to create patterns where form and function are seamlessly integrated. This approach allows a level of dynamism and responsiveness in architectural design, previously unattainable with conventional methods.³

The dynamic and complex relationship between form and function in architecture reflects the evolving nature of design practices. As architectural techniques and technologies advance, so does the conceptualization of how form and function can come together to meet the challenges and demands of contemporary society.

3 The Evolving synergy of Form and Function in Architectural Design

In architectural design, there are no strict rules dictating the precedence of form over function or vice versa. Instead, it posits that the relationship between function and form converges into a unified method contributed to the expression of architectural form, which is open to interpretation by observers. Architects can approach the function-form

³ Monedero, J.: Parametric design: a review and some experiences. Automation in Construction (2000)

relationship in their design, emphasizing the significance of meaning reflected in the form.⁴

Concept of “organic functionalism” seeks a close harmony between form and function, drawing inspiration from principles found in nature. It underscores the idea that the function of a building should predetermine and organize its form. This concept is reflected in the works of notable architects who believed that architectural forms should express and be directly influenced by their intended function. For instance, Louis Sullivan’s famous principle “form follows function” embodies this idea, suggesting that a building’s shape should be primarily based upon its intended purpose or function.⁵

The synergy between form and form is a driving force behind many architectural innovations, reflecting broader cultural, social, and political changes. The form-function relationship in architecture has evolved from purely aesthetic considerations to incorporating scientific and political aspects, particularly in response to the demand of the modern world.⁶

Understanding architecture requires going beyond the simple formula of “form follows function.” There is importance of functionalism in architecture and there is a necessary relationship between form and function. However, the contradiction between form and function plays a significant role in architecture. This suggests that while function is a crucial aspect of architectural design, it is not the sole determinant of form. The aesthetic, cultural, and symbolic aspects of form also significantly influence architectural design, creating a more nuanced and complex interplay between form and function.⁷

4 From Form and Function to Form is Function: The Parametric Perspective

Digital fabrication and parametric design challenge conventional notions of form and function in architecture, offering innovative possibilities for form-function integration and reshaping contemporary architectural design.⁸

Parametric design has a potential in reshaping architectural form and function. Wabi emphasizes the iterative nature of the design process in architecture, where designers constantly improve solutions, leading to innovative and dynamic forms. Where parametric design is a transformative tool in contemporary architecture, facilitating a more rigorous, systematic and creative exploration of architectural possibilities. This

⁴ Adams, D.: The Form-Function Relationship in Architecture and Nature: Organic and Inorganic Functionalism. In F. Amrine (Ed.), *The Architecture, Sculpture, and Painting of the First Goetheanum by Rudolf Steiner*. SteinerBooks (2017)

⁵ Seelow, A. M.: *Function and Form: Shifts in Modernist Architects’ Design Thinking*. Arts (2017)

⁶ Hendrix, J.: Theorizing a contradiction between form and function in architecture. *South African Journal of Art History* (2012)

⁷ Ibid.

⁸ Wabi, J.: *Parametric Design for Architecture*. Laurence King Publishing (2013)

approach enhances the exploration of architectural possibilities, emphasizing the integral relationship between form, function and design logic.⁹

Parametricism as a concept that any architectural form is susceptible to being expressed in terms of constantly changing parameters, in the context of the progressive architectural style, the increase in formal capacity is seen as a precursor to the increase in functional capacity. In avant-garde design research, there can be two principal approaches: searching for new forms to fulfill functions or searching for new functions for existing forms.¹⁰

This concept aligns with two formulae: 'form follows function' and 'function follows form', representing different design philosophies like Modernism, Postmodernism, Deconstructivism, and Folding.

Schumacher outlines that all design innovation must lead to new form-function relations, where new forms organize and articulate new functions. This relationship can be approached either by searching for functions that demand new forms or by exploring new forms that could lead to new functions, described as the "double contingency" of design research.¹¹

5 Case Studies

The Opera House in Guangzhou, a creation of Zaha Hadid Architects and realized between 2003 and 2010, is celebrated for its distinctive curvilinear and fluid design, which imparts a sense of dynamic movement to the structure. Its design is characterized by a unified, monolithic appearance with continuous space, heavily relying on parametric techniques to develop its intricate triangular patterns across both structure and façade. This design strategy marks a departure from conventional architectural approaches that typically prioritize programmatic organized, instead highlighting Parametricism's ability to produce iconic structures.¹²

Diverse scholars have explored various instances of parametric architecture to elucidate its developmental trajectory. In this context, we present an exemplary case study. Figure 1, 2 and 3 illustrates the Ground Floor Plan Drawing, the schematic diagram of the extended triangular plane and a part of interior of the Great Theatre, as designed by Zaha Hadid Architects. In this design, the extension of the opera's constituent spaces is achieved through the interplay of form and function. Each form is uniquely developed, guiding its specific function and rationale. Consequently, these forms are not only structural elements but also serve as creative components that define and enhance the functionality of the space.

⁹ Wabi, J.: *Parametric Design for Architecture*. Laurence King Publishing (2013)

¹⁰ Schumacher, P.: *The Autopoiesis of Architecture: A New Framework for Architecture*, Volume I. John Wiley & Sons Ltd (2011)

¹¹ Ibid.

¹² Scheeren, R., LIMA, D.L.C.: *The Parametricism manifest: prospects about a "new global style" for architectural design and urban planning*. Uirusu (2015)

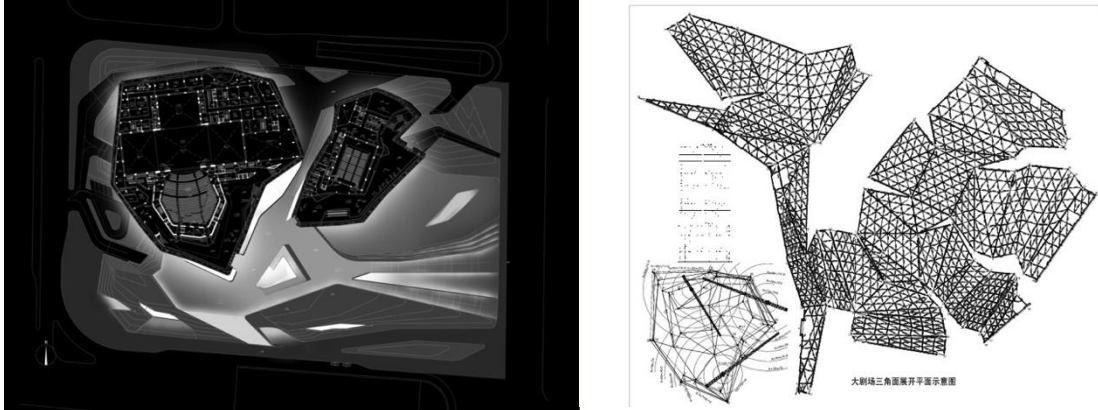


Fig. 1. Ground Floor Plan Drawing and the schematic diagram of the extended triangular plane of the Great Theatre. Guangzhou Opera House, China. Zaha Hadid Architects (2004-2010).



Fig. 2. A hall where ballet exercises are held. Photo © Iwan Baan. Guangzhou Opera House, China. Zaha Hadid Architects (2004-2010).

The Heydar Aliyev Center in Baku, designed by Zaha Hadid Architects exemplifies the modern architectural principle where ‘form embodies function’. Its design, both dynamic and fluid, breaks through the confines of traditional architecture, heralding a new era of open and forward-thinking design. Functioning as a central culture venue, the center encompasses an auditorium and various exhibition spaces. Its design, distinguished by visually arresting shapes, integrates state-of-the-art technology with architectural novelty. The center thus reimagines the interplay between form and function, showcasing how architectural design can seamlessly blend functional practicality with aesthetic appeal. External and internal views of the building, as illustrated in Figures 3 and 4, demonstrates this fusion of form and function.



Fig. 3. Exterior. Heydar Aliyev Center, Azerbaijan. Zaha Hadid Architects (2013). Photo by Iwan Baan.



Fig. 4. Concert Hall. Heydar Aliyev Center, Azerbaijan. Zaha Hadid Architects (2013). Photo by Hufon+Crow.

6 Conclusions

This paper has explored the evolving relationship between form and function in the context of parametric architecture. It has been established that in parametric design, the correlation between form and function is more intimate, with functional requirements often directing form through parameterization. This approach transcends the traditional dichotomy of form and function, fostering a more holistic and integrated design method.

Through the analysis of case studies such as the Guangzhou Opera House and the Heydar Aliyev Center, the paper illustrates the practical applications of parametric design. These structures exemplify how parametricism captures the essence of 'form is function', where each design element serves a specific purpose, contributing to the overall functionality of the space.

Parametric architecture represents a significant shift in architectural thought. It moves towards a design philosophy where aesthetic form and practical functionality are closely intertwined, responding dynamically to environmental conditions and user needs. This shift indicates a broader understanding of architectural design, where the aesthetic, cultural, and symbolic aspects of form are as significant as its functional aspects.

In summary, parametric architecture, as demonstrated in this study, offers innovative possibilities for form-function integration, reshaping contemporary architectural design and expanding our comprehension of the relationship between form and function in the built environment.

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