PARAMETRIC ARCHITECTURE AS A MANIFESTATION OF DIGITAL AESTHETICS: A CASE STUDY OF THE TAICHUNG NATIONAL THEATER

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Abstract: The advancement of digital technology has transformed the paradigm of contemporary architectural design, including through the implementation of parametric architecture, which enables the creation of non-conventional forms and complex digital aesthetics. This study examines the *Taichung National Theater* in Taiwan as a concrete representation of parametric architecture in a public building. The main issues explored include how parametric design influences form, function, and spatial experience, as well as its reception within the local social and cultural context. This research employs a qualitative case study method, with data collected through interviews, direct observation, and visual documentation. The findings reveal that the parametric approach enables organic and efficient design, while also offering dynamic and interactive spatial experiences. The integration of digital technologies such as BIM and generative design plays a crucial role in realizing complex and unique architectural forms. In conclusion, parametric architecture is not merely a visual approach, but also a design strategy that impacts spatial perception and local architectural identity. This study offers both theoretical and practical contributions to understanding the potential of digital architecture as a medium for innovation and a shaper of future public space character.

Keywords: Parametric Architecture, Digital Aesthetics, Organic Design, Generative Design Technology, *Taichung National Theater*

1. Introduction

The advancement of digital technology has transformed paradigms in the field of architecture, including in Taiwan, which has demonstrated significant progress in integrating technology and architectural aesthetics. One of the most prominent manifestations of this transformation is the application of parametric architecture in the design of large-scale public buildings, such as the *Taichung National Theater*, designed by Toyo Ito. This building reflects the dynamic nature of contemporary architecture, which no longer adheres to conventional geometric forms but instead embraces organic, fluid, and dynamic shapes that are difficult to achieve through traditional design methods. The use of parametric software enables the efficient design of complex forms, but at the same time presents challenges related to structure, function, and spatial legibility for users [1], [2].

Although parametric architecture has become a significant discourse within digital aesthetics, several studies have highlighted a disconnect between its visually spectacular approach and the actual spatial experience it offers users. Many researchers have noted that parametric forms often prioritize external façade expression while neglecting the coherence of interior space [3], [4]. Furthermore, existing theories of parametric aesthetics have yet to fully explain how formal complexity can be culturally and functionally accepted within local contexts [5]. Therefore, there is a need to more deeply integrate generative design approaches with social, cultural, and user experience dimensions [6].

This study aims to analyze the application of parametric architecture in the design of the *Taichung National Theater*, by examining the interrelationship between form, structure, and the digital technologies employed. Additionally, this research identifies how digital aesthetics are embodied through parametric design approaches and their impact on spatial perception and user experience. The study seeks to evaluate the extent to which parametric design can

serve as an expression of cultural identity and contemporary architectural character in Taiwan, particularly in Taichung—a city undergoing rapid development as a cultural hub. It also aims to assess the challenges and potentials of digital technologies in the design and construction processes of parametric buildings, with the hope of enriching both theoretical and practical understandings within the domain of digital architecture [7].

The urgency of this research lies in the need to understand more deeply how parametric architecture not only produces visually stunning forms, but also engages with the social context and functional needs of public space. In the case of the *Taichung National Theater*, this phenomenon is particularly relevant, as the building serves not only as a visual object but also as a medium for urban spatial experience. Based on the background and objectives outlined above, this study is crucial for strengthening both the theory and practice of digital architecture—particularly in evaluating the effectiveness of integrating form, technology, and culture into a cohesive design. Through a case study approach and empirical analysis (Figure 1), this research is expected to contribute to the development of a more contextual and applicable theory of parametric aesthetics in real-world practice.

Figure 1. Parametric Façade of Taichung National Theater

2. Research Method

This study focuses on the phenomenon of parametric architecture as manifested in the design of the public building *Taichung National Theater* in Taiwan. The theater is regarded as a concrete representation of digital aesthetics within contemporary architecture. The phenomenon under investigation involves how organic and non-linear forms generated through parametric technology influence spatial function, user perception, and integration with cultural and urban contexts. The *Taichung National Theater* was selected as the object of study due to the complexity of its design, which reflects both the challenges and potentials of generative design approaches in the context of public architecture. This phenomenon is not only visually intriguing but also raises critical questions about how space is designed, used, and interpreted in today's digital architecture.

This research adopts a qualitative methodology with a case study approach. Primary data were collected through in-depth interviews with key informants who were either directly or indirectly involved in the design, construction, and use of the *Taichung National Theater*. These interviews aimed to explore their perceptions and experiences regarding the application of parametric architecture and digital aesthetics within the context of the building. Additionally, secondary data were gathered from various academic sources, journal articles, and official documentation relevant to the research topic, particularly those addressing parametric architecture, organic design, and generative technologies. The combination of primary and secondary data is intended to provide a comprehensive understanding of the phenomenon being studied.

The research involved ten informants, each with different backgrounds and roles related to the *Taichung National Theater*. The informant, Dr. Mei-Ling Huang, is a digital architecture lecturer offering a theoretical perspective on parametric approaches. Jonathan Wu, is a practicing digital architect with expertise in generative design. Mr. Tzu-Hao Lin, is a construction project manager involved during the building phase. Mrs. Shu-Yi Chen, serves as an art curator and public space manager. Ms. Claire Hsu, is an active user of the building. Prof. Wei-Chen Lai, is an expert in architectural aesthetics. Mr. Jason Liu, was the project's BIM coordinator. Ms. Vivian Chang, is the building's interior designer. Mr. Ethan Lee, represents the Taichung city government. Hendra Santoso, is a foreign architectural observer offering a neutral, international comparison.

The research process was carried out through several strategic stages to obtain in-depth and contextual data. It began with the selection of the study object, followed by the identification of key participants and the development of interview guidelines. The primary data collection techniques included semi-structured in-depth interviews, direct observation of the building conditions, and documentation in the form of photographs, videos, and digital design archives of the project. Observations were conducted to assess the coherence between visual form and users' spatial experiences, while documentation served as supporting material to understand the design process and visual interpretations that may not emerge

through interviews. All data were collected using triangulation methods to enhance reliability and depth.

Data analysis followed the Miles and Huberman model, consisting of three main stages: data reduction, data display, and conclusion drawing with verification. Data reduction was performed by selecting relevant information from interviews and observations. Data were presented in the form of thematic narratives to facilitate interpretation. Conclusions were drawn inductively, based on emerging patterns and field findings. To ensure data validity, various validation techniques were employed, including credibility (through source triangulation), dependability (process reliability), transferability (applicability of findings), and confirmability (objectivity of the analysis). The final analysis was interpreted in-depth within the case study context to offer conceptual contributions to the development of knowledge in the field of digital architecture.

3. Discussion

Data gathered from interviews, observations, and documentation reveals that digital aesthetics in parametric architecture emerge as a central element in shaping visual perception and user experience within architectural design. This concept materializes through the appearance of unique and complex forms that are not merely decorative but also functional. Documentation indicates the use of software such as Rhino and Grasshopper to generate innovative generative forms. These digital aesthetics are heavily influenced by algorithmic processes that are non-linear and adaptive to spatial and user needs [8], [9]. This phenomenon reflects how generative design can manipulate form through adjustable parameters in real time. This aligns with previous studies emphasizing that generative aesthetics are defined by algorithmic systems and cannot be separated from the performative aspects of design [10], [11]. In this context, architects are no longer merely shaping forms, but rather scripting the underlying logic that generates them.

One of the main challenges in conventional design lies in its limited capacity for form innovation. Parametric architecture offers a solution by freeing designers from rigid geometric patterns and enabling the exploration of more complex and adaptive visual expressions [12]. In practice, many public and commercial buildings now utilize digital aesthetics to establish strong and attractive visual identities.

Interview and observation data indicate that users have positive emotional reactions to parametric buildings, especially due to their element of surprise and distinctive forms. Parametric design is perceived as not only visually appealing but also providing spatial experiences that differ significantly from conventional designs [8]. This demonstrates that generative architecture focuses not only on form, but also on the relationship between form and user experience. Prior studies have shown that the integration of parametric forms with spatial function can enhance comfort, orientation, and positive emotional responses from users [9].

Unlike conventional designs that often overlook user experience dynamics, parametric methods enable architects to simulate various user interaction scenarios to improve design effectiveness [10]. This opens new opportunities for developing inclusive, user-centered public spaces. Field documentation and observations further reveal that the integration of parametric design with technologies such as Building Information Modeling (BIM) facilitates collaborative processes between architects, engineers, and clients. Interviews show that planning becomes more efficient because any parameter changes are automatically updated across the entire system [11].

These findings align with literature emphasizing the benefits of parametric-BIM collaboration, such as the ability to test hundreds of design alternatives rapidly and reduce costs [12]. This accelerates decision-making and reduces construction-phase risks. In conventional practice, gaps between design and execution often become obstacles. Parametric technology provides a seamless bridge between creative design and integrated construction systems, offering a practical solution for the complexities of contemporary architecture.

This research demonstrates that the parametric architectural form of the Taichung National Theater is a synthesis of algorithmic logic and generative design approaches integrated with digital aesthetic principles. Field observations and documentation show that the building's organic structure and geometric complexity are manifested in spatial configurations that are adaptive and responsive to their environment. Expert interviews also reveal that parametric application is not merely technical, but serves as a new aesthetic language bridging function and expression. The design embodies how technology is redefining the representation of beauty in contemporary architecture (Figure 2).

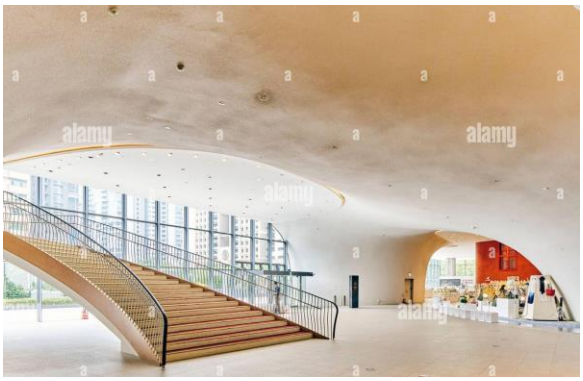

Figure 3. The interior curved structure of Taichung National Theater showcasing non-linear parametric character. Source: Wikimedia Commons

Compared to previous studies focusing on structural efficiency or technical functions of parametric design, this study emphasizes the aesthetic dimension as a deliberately developed element of the design process. For example, Christenson notes that parametric methods allow exploration of hidden formal logic in architecture that cannot be conventionally achieved [3], while Kourkoutas emphasizes that form-finding through parametric approaches is semi-automated and flexible [4]. This study reinforces that digital aesthetics in parametric design are not just results of form exploration, but responses to cultural expression and architectural representation needs.

Table 1. Comparison of Parametric Aesthetic Elements in Related Studies

Evaluation Aspect	This Study (Taichung)	Kourkoutas (2012)	Lee et al. (2014)	Chiarella & Costa (2018)
Form Focus	Non-linear, Organic, Generative	Algorithmic form-finding	Parameter-based creative strategy	Evolution of complex forms
Aesthetic Function	Aesthetics as spatial experience expression	Result of technical parameter control	Balance of aesthetics and design logic	Materiality as generative aesthetic
Supporting Technology	Rhino, Grasshopper, BIM	Rhino, Maya	Digital scripting & iterative modeling	Parametric scripting & evolutionary algorithms
User Experience	Spatial, theatrical, interactive	Visual and symbolic	Focused on creative exploration	Adaptive to space and context
Integration with Local Context	Reflection of Taichung's urban cultural identity	Not addressed	Project-dependent	Generally universal

The findings affirm that parametric architectural approaches represent not just a transformation of form, but a paradigm shift in how the relationship between space, technology, and aesthetics is understood. As noted by Wang and Nah, computational aesthetics introduce algorithmic logic into design processes that were previously more emotional or intuitive [12]. Thus, this study highlights the importance of technological integration in shaping architectural meaning, especially in cultural buildings like national theaters.

The implications of this study indicate that parametric architecture is not only useful as a form visualization method, but also as a conceptual approach in developing public spaces that reflect cultural values and user experience (Figure 3). This supports findings by Lee et al., who argue that parametric design strategies can offer creative solutions through reflective, problem-solving-based approaches. Therefore, parametric methods can be adopted as a strategic tool in the development of iconic building designs for the future.

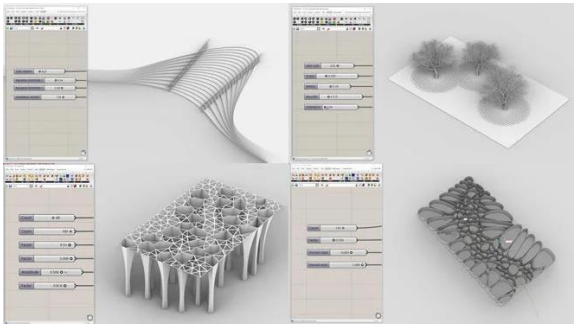

Figure 3. Parametric design process diagram using Rhino and Grasshopper.

Outcomes like these are possible because parametric design evolves through iteration and precise control of variables in digital simulation. This aligns with studies by Chiarella and Costa, who highlight that dynamic generative systems can create complex

spaces without being constrained by traditional compositional elements [13,14]. Additionally, the integration of parametric methods and evolutionary algorithms allows for more targeted exploration of design alternatives [15,166]. Based on the results of this study, it is essential for architectural education and design practitioners to incorporate parametric approaches grounded in digital aesthetics into curricula and professional practice]17.18]. As emphasized by Krunic, the application of algorithms and generative aesthetics offers opportunities to deconstruct value systems in modern architectural aesthetics [19,20]. Thus, concrete actions such as the development of parametric design software for education and hands-on training should be widely promoted.

4. Conclusion

This study reveals that the most imaginative and radical architectural forms are not merely the result of artistic freedom, but rather the logical outcome of structured digital algorithms. The *Taichung National Theater* demonstrates that parametric architecture has the capacity to transform conventional design paradigms in ways previously unimaginable. The building not only delivers a visually distinctive experience but also fosters deep emotional interaction between users and space through organically flowing, non-linear forms. Surprisingly, the sophistication of parametric systems can generate spatial intimacy once thought achievable only through manual form exploration and the architect's intuition.

The primary value of this research lies in its ability to synergize digital aesthetics, user experience, and generative design technology within a concrete case study framework. Theoretically, this study broadens our understanding of parametric architecture not merely as a design method, but as a medium for constructing contemporary cultural identity. Practically, the findings provide insights into how integrating digital design with local context can enhance design efficiency, spatial quality, and social responsiveness in public architecture.

Nonetheless, this study has limitations in terms of generalizability due to its in-depth focus on a single case. However, this limitation presents a valuable opportunity for further research to expand the scope to various building types and diverse cultural contexts. Future studies may explore the application of parametric architecture in more complex environments, including its integration with sustainability principles, community participation, or artificial intelligence, thereby enriching the evolving discourse of digital architectural knowledge.

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