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The Role of Parametric Architecture in Modern Times

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ABSTRACT

This research paper on the role of parametric architecture in modern times is essential to explore the principles, benefits, and limitations of parametric design tools in building design and construction. The use of algorithms to generate forms and patterns based on specific parameters offers architects and designers flexibility, customization, and optimization of resource utilization. However, the high cost of software and hardware, limited compatibility with traditional construction methods, and the need for specialized skills are some of its limitations. This paper aims to study the relevance of parametric architecture in modern times and analyze its benefits and limitations in building design and construction. The study will also investigate case studies of successful implementation and formulate effective strategies for form design using parametric architecture.

1. INTRODUCTION

Parametric architecture is an approach that utilises computational tools to create complex and flexible structures. This report aims to explore the relevance of this approach in modern times by analysing its principles and methods , benefits and limitations, and case studies of successful implementation. Additionally, this aims to formulate effective strategies for designing forms using parametric architecture. It is a unique modern style that combines knowledge in the field of sculpture, architecture and mainly mathematics, going beyond simple constructive solutions and forms. This type of architecture has a very strong connection to mathematics, and the connection between the human factor, the building built, and the environment must be taken into account. Creating projects in parametric architecture requires not only modelling of objects, but also long work in modern computer programs such as Grasshopper, which helps to develop logical conditions and mathematical algorithms. This gives architects more options for creating complex structures and shapes, giving them the best solution for a project in automatic mode. Most of the designers' work in this area has focused on

shopping malls, restaurants, galleries, museums and other commercial buildings.

The field of architecture has been revolutionised by the use of computational tools and digital fabrication methods. Parametric architecture is one such approach that offers architects and designers the ability to create complex and innovative structures that are efficient, sustainable, and aesthetically pleasing. With the use of software programs such as Grasshopper, Rhino, and Revit, architects can generate forms and patterns based on specific parameters, leading to highly customised and optimised designs. However, the adoption of parametric architecture comes with certain limitations such as high costs, the need for specialised skills, and limited compatibility with traditional construction methods. Therefore, there is a need to study the principles and methods of parametric architecture and their relevance in modern times, to ensure effective and sustainable use of this approach in building design and construction.

- To study the principles and methods of parametric architecture
- To analyse the benefits and limitations of using parametric design tools in building design and construction in the contemporary scenario
- To study the case studies of parametric architecture and their relevance to generative design
- To formulate the strategies and cases where this methodology is relevant for designing forms

2. CASE STUDY 1 THE RIVER CULTURE PAVILION (ARC)

The River Culture Pavilion (ARC) in Daegu, designed by Asymptote Architecture, is a stunning blend of nature, technology, and space that represents a bold architectural statement along the city's riverfront. The ARC's bold, curved form creates a strong focal point against the scenic surroundings, and its facade is covered with transparent ETFE pillows that reflect the surrounding colours and create a unique and colourful appearance. The building's shallow pools and reflective surfaces make it appear different depending on the season, weather conditions, and time of day, contributing to the building's symbiotic relationship with its natural surroundings.

The building is designed to create a dialogue with the elements of the surrounding environment, including the intertwining rivers, hilly landscape, and open fields. The ARC Theater, housed within the building, features a contiguous 60m x 20m flawless projection surface installed in the configuration of a moebius strip, and a 360-screen projection system configured and installed precisely for the 34-channel projection system. Visitors to the pavilion can experience the alternating play between the real surroundings and virtual multimedia representations of the environment, culminating in the large reflecting pond on the roof.

The interior of the building features a sweeping 360-degree digital projection of animated natural scenery across its high-ceilinged walls, and a spiraling staircase provides visitors with different vantage points for viewing the projection. The building's shifting experience of the natural environment and artistic representations of it is designed to make visitors question their perception of reality. Visitors begin their journey at the top level, transported by elevators to the wood-covered roof deck that offers panoramic views and a small restaurant. The main circulation path then descends along a trussed stair that cuts through the rotunda, giving access to the multimedia galleries before finally reaching the ground floor, where visitors exit back into the landscape.

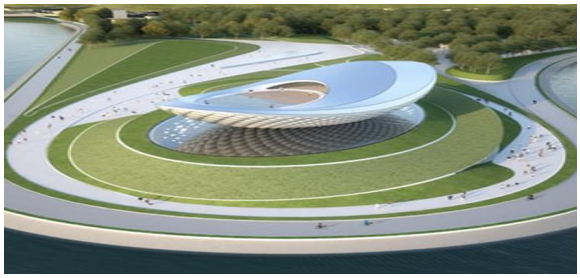

Figure 1: ARC River Culture Pavilion views

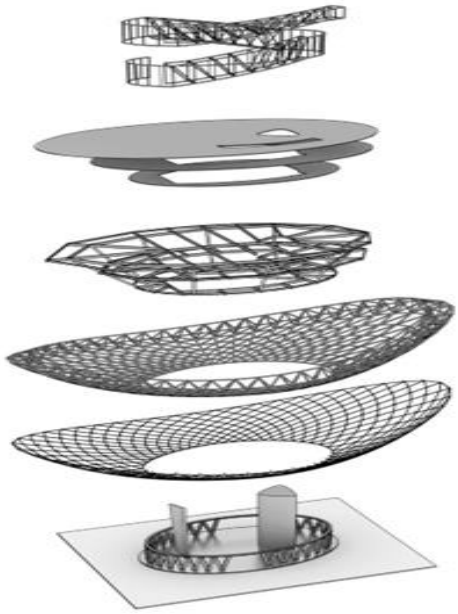

Figure 2: Exploded isometric diagram

3. CASE STUDY 2 INFINITY TOWER

The design process started with a study of the site configuration and the city codes, which dictated that the building be offset from the property line by 1.2 metres and that the tower placement be at least 20 metres away from the adjacent building on its right. Based on these constraints, the optimal footprint emerged as a narrow, elongated configuration. This led to the choice of the twisting tower design theme, as it exposed the best units in the top third of the tower to the best views of the ocean and the city skyline.

The design team used a model to define the building's footprint and core, and then extruded and twisted the building's floor plates and placed columns based on a global twist parameter. The model also built the window wall and architectural fins based on this structure. Given a ground footprint and the twisting tower design theme, the rule constructed the footprint of the building core and the interior corridor. By considering the rotation of each floor at a constant angle, a circular core was anticipated as the most optimal configuration for achieving uniformity in the unit layouts. The model supported efficient exploration of design options within the range of the chosen theme. Since the tower had four unique floor types, rationalising the exterior wall as a single floor allowed rapid generation of new floors by adjusting the value of the floor height variable. In conjunction with structural engineers, the model was used to iteratively refine the design in response to the evolving structural solution.

In a distinctive application of architectural expressions through structural form, the Infinity Tower twists a full 90 degrees from its base to its crown, 305 metres (1,000 feet) above the ground, through a series of incremental plan rotations at each level. The dramatic architectural form of the tower presented the multi-disciplinary design team with unique challenges that are not typically encountered in the design process for more conventional building structures. The efficiency, constructability, and overall viability of the tower depended on the ability of the architects and engineers to develop and implement simple, straightforward building systems that work with the geometrically complex building form.

The 75-story cast-in-place reinforced concrete Infinity Tower consists of 122,000 square metres (1,312,500 square feet) of residential and amenity space, as well as six levels of below-grade parking. Currently under construction and scheduled for completion in 2011, it is located near the north inlet to the Dubai Marina from the Persian Gulf. The Infinity Tower serves as a testament to the capabilities of modern engineering and design in achieving remarkable feats of structural and architectural innovation.

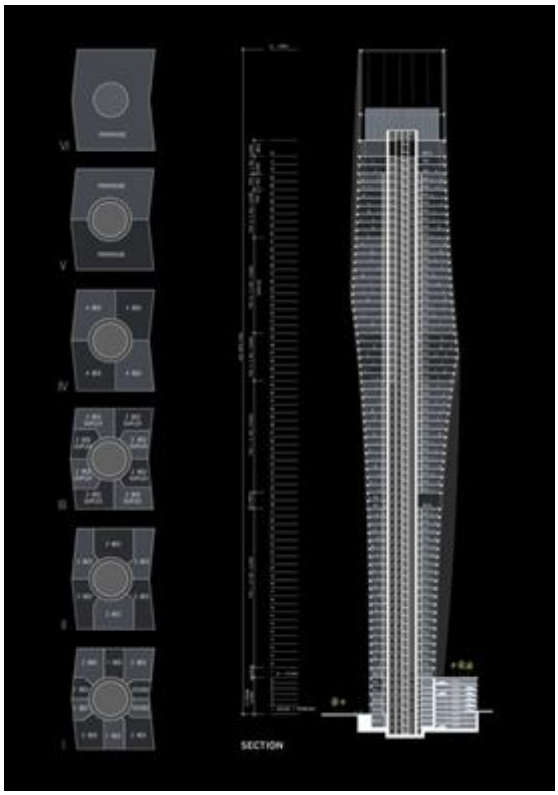

Figure 3: Sectional View

Figure 4: Under Construction

4. METHODOLOGY

- Qualitative research methodology will be used
- Secondary data sources (books and online resources) will be analysed
- Case studies of successful implementation will be studied
- Relevance to generative design will be assessed
- Software programs such as Grasshopper, Rhino, and Revit will be studied
- Case studies to be analysed
- Formulating strategies and cases where parametric architecture is relevant for designing forms
- Addresses design problems, optimises resource utilisation, and improves efficiency and sustainability

CONCLUSION

Parametric architecture has the potential to revolutionise the field of building design and construction. By using computational tools and digital fabrication methods, architects can create complex and innovative structures that are efficient, sustainable, and aesthetically pleasing. The use of parametric design tools allows for flexibility, customisation, and optimisation of resource utilisation, leading to improved efficiency and sustainability. However, the limitations of this methodology, such as the high cost of software and hardware and the need for specialised skills, must be considered. This report has analysed the principles and methods of parametric architecture and its relevance in modern times. Case studies of successful implementation have been presented, including the River Culture Pavilion, the Heydar Aliyev Center, and the CCTV Headquarters. Effective strategies for form design using parametric architecture have been formulated, including managing complexity, utilising data, and adapting to changing requirements. The parametric architecture offers a flexible and efficient approach to building design and construction, but its implementation requires specialised skills and resources. The study of parametric architecture is crucial for architects and designers in the modern era to create innovative and sustainable structures.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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REFERENCES

[1] https://architizer.com/projects/arc-river-culture-multimedia-theater-pavilion/

[2] https://www.academia.edu/25834349/PARAMETRICISM_IN_ARCHITECTURE

[3] https://www.dezeen.com/2013/08/30/arc-river-culture-pavilion-by-asymptote/#

[4] https://www.archdaily.com/331128/in-progress-infinity-tower-som

[5] https://ascelibrary.org/doi/abs/10.1061/41130%28369%29276