

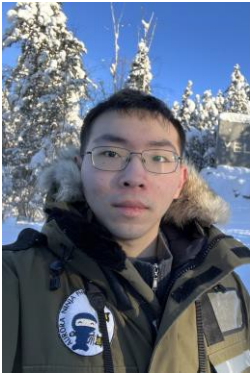
Exploring The Generative Art Of Integrating Natural Elements Into Geometric Architecture

Han Xuan

MA Student in Digital Media

School of the Arts, Media, Performance & Design, York University, Toronto, Canada

e-mail: hanxuanapply@gmail.com



Abstract

My work is titled 'Flowering.' It is a tower building generated using Rhino/Grasshopper. The entire structure is composed of tubular elements and hollow surfaces, drawing inspiration from the natural structure of a flower. Inside the hollow interior, a flower-like structure is concealed, faintly visible from the outside. The building features a double-roof structure, with two symmetrical hollow roofs connected by a tubular framework. Surrounding the sides of the building are sheet-like structures that resemble both flower petals and wings.

In this project, I explore the transformation of natural elements into geometric structures and their integration into our built environment. Geometric architecture is renowned for its modern

visual appeal. I believe that incorporating floral forms into geometric architecture preserves its visual impact while also enhancing its human connection.



Figure 1. "Flowering", model image.

Keyword : *Generative Art , Geometric Architecture , Rhino/Grasshopper*

1, Introduction

Since ancient Rome, geometric elements have been widely used in the field of architecture, and the Roman Colosseum is the most famous case, which contains a large number of geometric designs. In modern times, with the development of science and technology, digital media

technology has been more and more used in architectural design. In the last two decades, the CD techniques applied in architectural design surpassed the automation of drafting tasks. [2]

This makes the design of geometric architecture more and more convenient, and brings us a large number of geometric architecture works. Modern geometric architecture often have a simple, regular, contemporary appearance, that makes the modern geometric architectures are usually aesthetically attractive. However, excessive geometry will also make the building appear monotonous and lack of intimacy with people. Therefore, I aim to integrate natural elements into geometric buildings, believing that this can enhance the connection with people while preserving the visual appeal of geometric architecture.

2, Project Structure

The whole project was generated by Rhino/grasshopper, and it has three different structure.

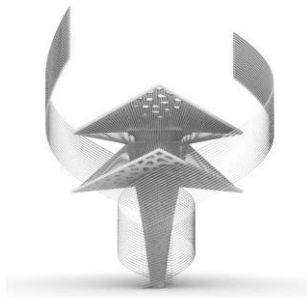


Figure 2. Model Image.

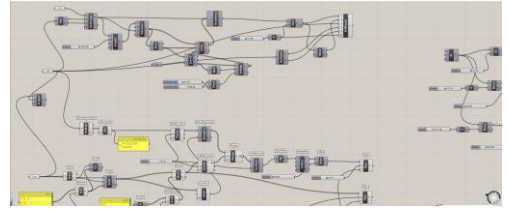


Figure 3. Grasshopper code screenshot.

2.1, Outer Structure

The outer layer consists of a pair of flaky multi-storey structures that surround the subject building, it simulating the leaves of a flower in its shape, also it like a pair of wings that surround the main building.

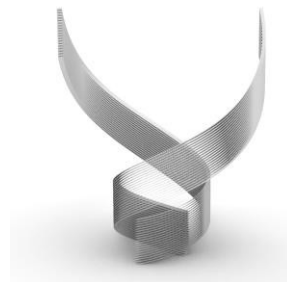


Figure 4. Outer structure model image.

2.2, Main Building Structure

The main building is a tower with double roof structure, the whole tower is composed by tubular structure, with two hollowed roofs that are symmetrical up and down. Each roof is connected to the tower by tubular structure.

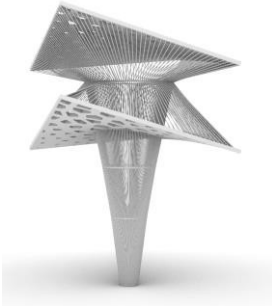


Figure 5. Main building image

2.2, Inner Structure

Inner structure is a flower-shaped hollow column structure, from the outside through the tubular structure, you can see the shape of the tower flowers.

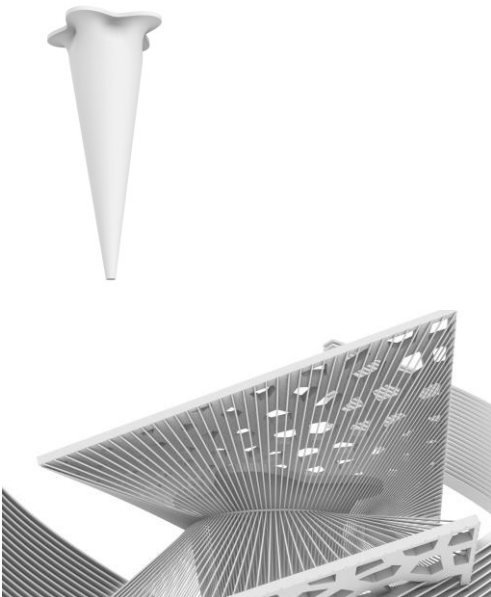


Figure 6&7. Inner structure image.

3, Architectural Generation

With the development of technology, the application of digital technology has been involved in all walks of life, and the architecture field is no exception. New digital architectures are emerging from the digital revolution, architectures that have found their expression in highly complex, curvilinear forms that will gradually enter the mainstream of architectural practice in the coming years. [4]

Digitally generated buildings are known for their complex structures and stunning geometry, and designers can use digital technology to realize many ideas that were impossible or difficult to achieve in the past. Also, there is a lot of differences in the design process. Instead of modeling an external form, designers articulate an internal generative logic, which then produces, in an automatic fashion, a range of possibilities from which the designer could choose an appropriate formal proposition for further development.[4]

This process also happened when I developed this project. I first thought about the general structure of the model and then generated the code for the model using Grasshopper. I designed multiple versions of the Grasshopper-generate code and adjusted the parameters to choose the best version. This design process is very different from traditional design methods and, in a way, I think it's more akin to software development steps.

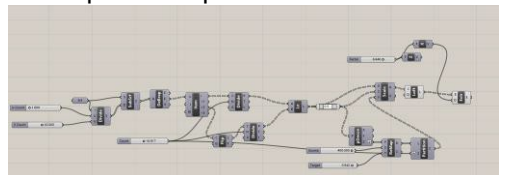


Figure 8. Grasshopper generate code (Outer Structure)

As digital methods, tools and techniques have become central to the design process itself, we are witnessing the emergence of novel processes of mediated design which challenge certain of the cherished assumptions of traditional design theory.[5] I think the digital generation is not just a technique, it is more like a new set of styles and trends. The digital generation techniques through the parametric modelling and scripting – have inspired a new collective movement with radically new ambitions and values. [6]

4, Incorporating Natural Elements Into Geometric Architecture

Geometric architecture, especially modern architecture generated by digital media technology, possesses a very strong visual appeal, which is its most prominent advantage. However, an excessive use of geometric effects can create a sense of distance and stress between people. Therefore, my goal is to integrate natural elements into geometric designs, preserving their visual impact while also reducing the sense of distance among people.

“Life creates conditions conducive to life,” writes Beynus, “and life, if we invite it into our buildings, can also create conditions conducive to our life.”[1] I agree with that. I think that inviting nature into our architecture is not just about incorporating nature into our buildings, but also about creating visually friendly modern architecture by imitating elements from nature.

I made this project with reference to the concept of “biophilic” design, use of shapes and forms in buildings and landscapes that directly, indirectly, or symbolically elicit people’s inherent affinity for the natural environment. [3] I attempted to structure the shapes of flowers and abstract them into various sizes of geometric shapes. I then combined these geometries with the tower’s structure that I aim to design.

I think the combination of plant form and geometric structure can reduce the pressure brought by geometric buildings. At the same time, the use of existing geometric shapes in nature as prototypes can also increase the viewer’s sense of closeness to the building.

5, Conclusion

I believe that digital generation technology will see wider applications in various fields in the future, and understanding how to utilize this technology to explore the boundary between technology and design will become increasingly important. Designers should not be constrained by technical limitations and should continually experiment with new possibilities.

Computational formal explorations do not intend to eradicate human imagination but rather extend its potential limitations. Computation is not a substitute for human creativity and therefore cannot be antagonistic.[7] Thinking about how to integrate technical means with their own design to create captivating works may be an important topic for future designers to consider.

in Europe (eCAADe), 2004.
<https://doi.org/10.52842/conf.ecaade.2004.201>.

6, Reference

[1] Africa, Julia K., and Naomi A. Sachs. "Book Review: Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life." *HERD: Health Environments Research & Design Journal* 9, no. 2 (January 1, 2016): 176–78. doi:10.1177/1937586715618076.

[2] Caetano, Inês, Luís Santos, and António Leitão. "Computational Design in Architecture: Defining Parametric, Generative, and Algorithmic Design." *Frontiers of Architectural Research* 9, no. 2 (2020): 287–300. <https://doi.org/10.1016/j.foar.2019.12.008>.

[3] Kellert, Stephen. (2005). *Building for Life: Designing and Understanding the Human-Nature Connection*. Bibliovault OAI Repository, the University of Chicago Press. 24.

[4] Kolarevic, Branko. *Architecture in the digital age: Design and manufacturing*. New York: Taylor & Francis, 2005.

[5] Oxman, R. "Theory and Design in the First Digital Age." *Design Studies* 27, no. 3 (May 1, 2006): 229–65. doi:10.1016/j.destud.2005.11.002.

[6] Schumacher, Patrik. "Parametricism: A New Global Style for Architecture and Urban Design." *Architectural Design* 79, no. 4 (July 1, 2009): 14–23. doi:10.1002/ad.912.

[7] Terzidis, Kostas. "Algorithmic Design: A Paradigm Shift in Architecture?" *Proceedings of the 22nd International Conference on Education and Research in Computer Aided Architectural Design*