

The Theory and Method of Architectural Design Innovation Based on Extension Thinking

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Abstract: with the Economic Prosperity and Political Stability, the Citizens Pursue the Higher Life Quality That Reflected in Architecture Beauty. Besides the Functional and Effective Purpose of Architecture, the Literary Pretty is Required by Public as Well Which Needs a Strong Foundation of Innovation. the Architecture Design Innovation is Important for Modern Architecture, and the Extension Thinking is the Key Point of Design Innovation. Based on the Whole Design Process, This Paper Researched the Influence of Conduction Though and Rhombus Thought on the Innovation and Thinking Theory and Architectural Pattern Design Method with the Case Studies of I.m.Pei.

1. Introduction

The extension thinking is a comprehensive way to combine the human thinking logic with the problem solving, in order to innovative the traditional thinking method, which could improve ability further. With the rapid process of urbanization, the style of urban design is changed as well. As the unit component of city, each simple building should satisfy the cultural requirement from its city, which raise higher requirement of architecture design innovative. The modern architecture design has transformed into diversification and multiple stylize, because of the developing of modern architecture technology. The architects face tough challenges from the design innovation that mostly depends on inspirational flash, experience, and thinking methods currently [1]. However, the excellent innovative design ability is a talent that could be accessed by systematic training as well, and the extension thinking is the most effective way to inspire the architecture design.

The difference of architecture design between traditional and modern architecture could be explained in design property and process. The property of traditional design focuses on the technic of building, while the modern one highlights the organic combination with cultural context to achieve better design outcome. Meanwhile, the modern architecture design emphasizes the logic and layer of design which has been ignored before.

There are lots of contradictions existing in reality world, and the human society is developed from the way of solving various problems [2]. The extension thinking is the theory and method to study the innovation, and could become the theory foundation of innovation generation. From formalization, logicity and mathematics of the appearance and approach of those contradictions, the deep thinking logic has been summarized as extension that has been applied in artificial intelligence, computer, detection and management control field. The extension thinking plays a guided role in modern architecture design not only in the innovation of design method, but also inspires the awareness of architectural appearance, which has a significant influence in this field.

2. The Theory of Extension Thinking Applied in Architecture Design Innovation

In order to maximal the value of extension thinking in architectural design innovation, the architect should combine the logical thinking as well as illogical thinking to form a new thinking model. Meanwhile, the summary of effective thinking could present the extension thinking in the form of text or data [3]. Therefore, the extension thinking is the foundation of architectural design

innovation, which could assist architect to break up the traditional design method. The modern design theory and method has been applied to make up the shortage of inspiration during design process. The conduction though and rhombus though are two widespread applied extension thinking in architectural design innovation.

2.1 Conduction Thought

The definition of conduction though is the process that appropriately transforming the existing stuff into new one. During the architectural design process, there is inevitable contradiction between new design theory and existing design content, which could be solved by transforming with conduction thought. The specific method could be summarized as three steps [4]. First of all, analyzing the existing design content from all relevant aspects, such as surrounding, geography, lighting, greenery, transportation and function distribution. Secondly, figuring out the most extraordinary feature from above analysis, and adding the creative theory into this specific feature. Finally, transform this feature with the creative theory into new pattern to solve the contradiction. However, the conduction though could not be applied into architectural design directly, and should be changed into equal design problems and handled indirectly. The application of conduction though in architectural design innovation could propose a reasonable solution.

2.2 Rhombus Thought

The rhombus thought could be classified into divergent thinking and convergent thinking referring to the Figure 1, and the combination of those two could achieve the repetitive and continuous thinking model.

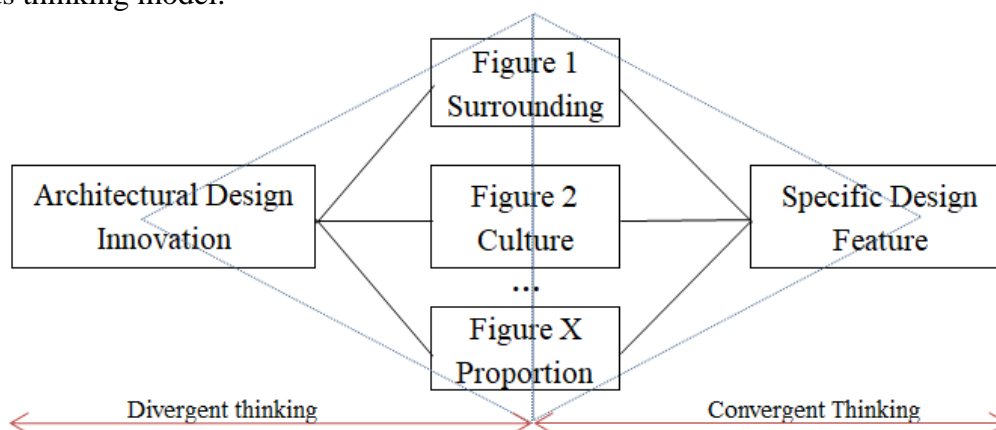


Fig.1 : the Divergent and Convergent Thinking Model of Rhombus Thought

The thinking process that transformed from divergent into convergent is the primary rhombus thought, and based on the primary thought, the continuous thinking is named as multiple rhombus thought. During the architecture design process, the architect should located the design theory and structure, and fully considering about the actual function to connect the design content and reality effectively [5]. Therefore, the innovative and holistic thinking model could be generated to avoid the repeated modification during the traditional design process. However, the purpose and feasibility of design should be paid additional attention when architect using rhombus thought. The design purpose has to be clear since beginning that could guide decision in a dilemma. The feasibility is the precondition of design innovation, which should be considered during the whole process. While, some inspiration based rhombus thought without feasibility could be used during the design process only for further inspiration not the design proposal.

3. The Method of I.M.Pei's Architecture Design Innovation Based on Extension Thinking

I.M.Pei is one of the greatest modern architects who have been influenced by both eastern and western culture. I.M.Pei's architectural works are inspired by two different cultures and form

classical samples that cross century and cross culture. Not only facing the traditional world value, but also influenced by the diversity, the design innovation I.M.Pei created reflect the extension thinking. Therefore, the following paragraph will demonstrate the method of architecture design innovation based on conduction and rhombus through I.M.Pei's architectural work.

3.1 The Glass Pyramid in Louvre with Conduction Thought

The Louvre is one of the most important architectures in the world, and in 1980s, there is an opportunity for extension to open the Louvre as a museum [6]. The proposal I.M.Pei raised is quite debatable, because a glass pyramid has been distributed in the middle of courtyard, which form a strong contradiction and conflict with the existing surrounding. Unexpected, the pyramid as a traditional geometrical symbol could present the literary of architecture without destroy the existing surrounding, and the glass material generate a crash between modern and classical. In the artistic and romantic Paris, the glass pyramid in Louver guides the development of culture and art with new perspective.

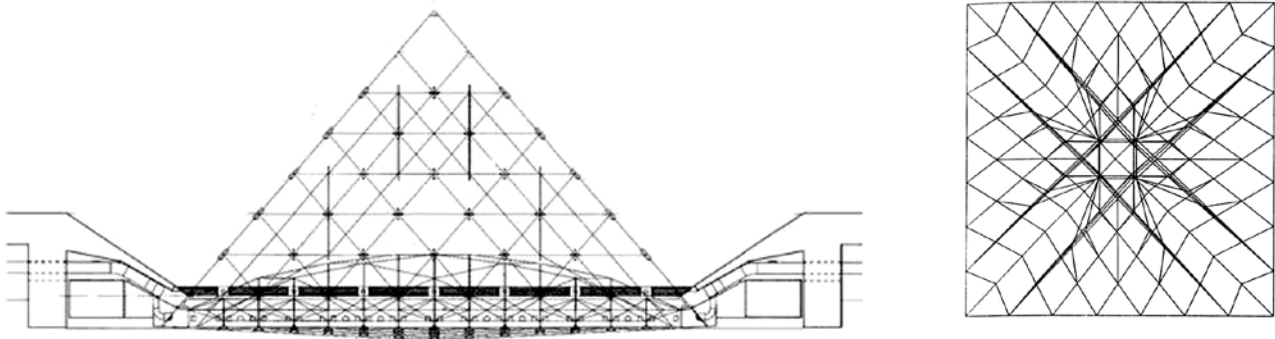


Fig.2 : the Structural Section (Left) and the Plan (Right) of Glass Pyramid

The successful of the glass pyramid reflects the conduction though from extension in some degree. The pyramid geometrical symbol has been summarized from the elegant and artistic component existing in the original Louvre. The visual appearance I.M.Pei firstly inspired perhaps is not the simple geometry, but after repeated modification and simplification with the conduction thought, the finally appearance is not connecting to the original Louvre but reflects its spirit indirectly [7]. If the pyramid is the extension of traditional language, the material choosing is the expectation of modern future. The glass provides more natural lighting for Louvre, and the mental allows light and elegant structure. The great light, shadow, reflection and refraction make the whole architecture energetic, and make the pyramid looks like a marvels diamond which form a strong conflict between the classical courtyards.

3.2 The Suzhou Museum with Rhombus Thought

The Suzhou Museum is located in the north of ancient city of Suzhou, where is the traditional protection area. Similar with the Louvre in Paris, this museum combines the traditional architectural element in ancient Suzhou with the modern feeling. The overall distribution of Suzhou Museum refers to the classical garden which is the most traditional architectural form in the east of China. The lake and steam is the main connection between Suzhou Museum and surrounding protection historical building, and generate an extension of the existing content.

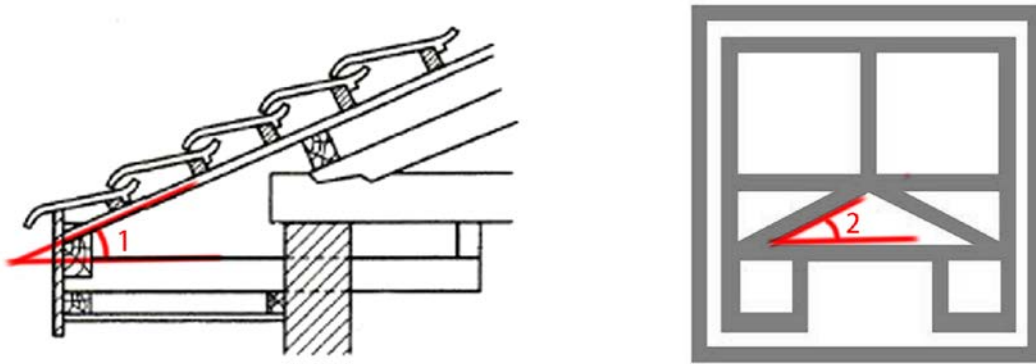


Fig.3 : the Traditional Slope Roof (Left) and the Symbol of Suzhou Museum (Right)

The architectural design concept could be explained by rhombus thought perfectly. Firstly, the design process is the divergent thinking, which is the primary rhombus as well. I.M.Pei began from the traditional Suzhou architectural style, and figure out its outstanding features such as the brick material, sloping roof, garden landscape, water view, the image of mountain and the courtyard. The continue step is the convergent thinking to narrow down the most extraordinary feature. For example, the traditional roof is made by tile and wood, the color is grey and the form is slope, while during the convergent thinking process, the shape of the roof is the feature I.M.Pei paid extra attention. The proportion of the triangle has been transformed into the architecture design as an innovation [8]. The horizontal and vertical ratio of roof proportion from traditional Suzhou house is 1 to 2, and this scale has been applied in each building distributed in the circulation, which could be proved by the angle 1 equal to angle 2 in the Figure 3. The traditional scale discovered during the rhombus thought is the harmonious connection between not only tradition and modern, but also geometry and space. However, the scale of roof is merely one of the present of rhombus thought in Suzhou Museum which could not leads to this wonderful work. The success of design innovation in Suzhou Museum relies on several way of architectural present generated by rhombus thought, furthermore, the organic connection between those languages should depends on rhombus thought as well. Therefore, the rhombus thought is the thinking model to assist the design, and it is not a simple one directional method, while it could be applied repeatedly and systemically.

4. Conclusions

In summary, the application of extension thinking in architecture design innovation is feasible and reliable with wide application foundation. The conduction thought and rhombus thought could assist architects to figure out the difficulties during creative proposal. However, the application of extension thinking is a comprehensive work, which has multiple layers and cross subjects. In order to maximal the value of extension thinking, the architects are supposed to enhance the specific thinking model as well as the complicated application. Furthermore, the extension thinking could push the development of architecture innovation, and satisfying the increasing requirement of both literary and function.

References

- [1] Abrishami, S., Goulding, J., & Rahimian, F. P. et al., (2014). Integration of BIM and generative design to exploit AEC conceptual design innovation. *Information Technology in Construction*, 19, 350-359.
- [2] Roush, R. E., Braun, M., McFadden, S. H., & de Medeiros, K. (2018). How the Arts and Humanities Can Help Older Persons with Dementia and Their Caregivers Be More Resilient. In *Resilience in Aging* (pp. 133-150). Springer, Cham.

- [3] Wiseman, C., & Pei, I. M. (2001). *The Architecture of IM Pei: With an Illustrated Catalogue of the Buildings and Projects*. Thames & Hudson.
- [4] Buchanan, R. (2019). Surroundings and Environments in Fourth Order Design. *Design Issues*, 35(1), 4-22.
- [5] Hsiao, L. (2018). IM Pei's Museum for Chinese Art, Shanghai, 1946. Modernism, regionalism and the search for an architectural representation of national identity. *REGIONALISM, NATIONALISM & MODERN ARCHITECTURE*, (1), 114-127.
- [6] Monga, A. B., & John, D. R. (2010). What makes brands elastic? The influence of brand concept and styles of thinking on brand extension evaluation. *Journal of Marketing*, 74(3), 80-92.
- [7] Wu, H. Y., Lin, Y. K., & Chang, C. H. (2011). Performance evaluation of extension education centers in universities based on the balanced scorecard. *Evaluation and Program Planning*, 34(1), 37-50.
- [8] Kilian, A. (2006). Design innovation through constraint modeling. *International journal of architectural computing*, 4(1), 87-105.