Research on the Architectural Design Method of Green Materials Related to Teahouse Space: Taking the Bamboo House for example

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Abstract. Bamboo is widely used in many types of architectural space because of its unique green material properties. The architectural space constructed by bamboo presents a kind of light and ethereal space intention of “modest architecture”. Kengo Kuma is the representative figures of contemporary Japanese architects, within his architectural works also possess such a deliberate weakening of the form of expression, pay attention to the nature of the operation of space. With the analysis of bamboo house and architectural design ideas, this article wants to explore the concrete application of bamboo material in contemporary teahouse space design based on "modest architecture" design idea. It provides a different perspective for the study of spatial design theory related to green materials.

1. Introduction
Architecture embodies the spirit and pursuit of the times. Architecture has gradually become a symbolic symbol of capital and power along with the rapid development of modern society. The architectures are becoming more bloated and stronger in order to cater to this need. It has brought many negative effects to nature and society which is called "strong architecture". So the concept of "green material" was proposed for the 1th time at the 1th IUMRS International Conference in 1988 (Tokyo). Green material means that the Earth's environmental load is minimal or beneficial to human health refers to materials material acquisition, product manufacturing, use or recycling, as well as waste disposal [1]. Then it gradually formed a greener, environmentally friendly "modest architecture" design concept related to the theory of architectural design. Kengo Kuma is one of the world renowned architects of contemporary architecture in Japan; He made the following interpretation of "modest architecture": “The so-called modest architecture, my own definition is that a building is not just only a good looking with a beautiful appearance, but also focusing on the relationship between the building itself and the human body. In this space, it will make people feel very comfortable, and even some treatment, healing soothing effect, I think this trait is the most important thing”[2].

Kengo Kuma mentioned that the conception of "modest architecture" in related to natural architecture, negative architecture, anti-modeling, particle-architecture and other viewpoints. The Bamboo house where located at the foot of the Great Wall is leisure residential architecture designed by Kengo Kuma, and the teahouse space is the core of the whole building. He use the bamboo materials to shape the teahouse with a quiet and peaceful space quality, and it also becomes the representative works based on “modest architecture " design concept.
2. Space design method of bamboo House

This article will analyze the bamboo house by means of four aspects, such as site environment, space organization, material characteristic and light perception. The aim is to reveal the particular expression of bamboo material in the space design of teahouse based on the design idea of "modest architecture".

2.1. Anchoring of the site environment

The site environment is a complex multidimensional concept; it includes that the natural and the humanistic environment in a broad sense, and also contains some constructed space with special place spirit. Site environment is the primary factor to be faced in architectural design, and it has a mutually reinforcing relationship with architecture space. A good architect can anchor a building in a unique form in its surroundings with the help of fully exploiting the positive factors in the site at the same time. Good architectural works can also build a good dialogue relationship with the environment to enhance people's awareness of the environment. He question the building's "independent body" formed after the double division of the building's red line. Kengo Kuma thinks the place is "an area governed by a conventional system" [3] and questioned the building's "independent body" formed after the double division of the building's red line. He thinks the architecture should be unified with the surrounding space to form a whole relationship [4]. He uses the word of "field" and "object" to describe the relationship between the site and the building in his concept system. All objects in this "field" are free to act including architecture as "object". Architecture must become lighter and smaller to achieve this mutual contact with the environment.

While the design of the bamboo house at the foot of the Great Wall, Kengo Kuma found that the Great Wall extends along the rolling ridges, but it build organic connection to the surrounding environment. Kengo Kuma has been inspired by the relationship between the building and the site formed by the special construction method of the Great Wall, and he believes that the nature of this relationship is the space treatment of building pedestal. Building pedestal is the intermediary of building space and site environment. It has the function of load-bearing and moisture-proof, it also helps to strengthen the overall image of the building. From another perspective, the pedestal also has the significance of "splitting" that isolates the building from its environment. The disappearance of the building pedestal cut off the relationship between the main body and the ground, and can establish the direct connection between the building and the site environment. In one of Kengo Kuma’s architectural works related to observation deck designed in Japan, he intends to let the building disappear into the environment and establish a close relationship between the building and the environment by burying the foundations of the architecture in the mountains. By hiding the building base of bamboo house, Kengo Kuma gave the architecture a "growth intention." and made it conform to the natural height of the site and tightly anchored in the surrounding environment: Deliberately control the body volume of the building, so that it becomes compact; Using Bamboo's density combination to form the permeability effect of the building interface, combining the reflection and refraction of the transparent glass act to the surrounding environment, weakening the weight sense of the building; Strengthen the level of building roof extension intention, so that it can be more harmonious with the surrounding environment.

2.2. The purity of spatial organization

The architecture provides the human activity space, some certain space also meet the spiritual needs of people's space experience and perception. The architect organizes and integrates the space of the building subject according to a certain way, and gives it the corresponding space significance. Kengo Kuma made an analysis of the architectural techniques of the residential "architect faction" represented by Tadao Ando in the book of "The Theory of ten curtilage" which is written by himself, he recognized the space aesthetics of "leisure, indifference and tranquility" which is mentioned by Tadao Ando based on opposing "the Worship of Tang objects"[5]. Ando's representative works “Row House in Sumiyoshi” embodies the two characteristics of this spatial aesthetics: cramped spaces and crude materials. In the aspect of appearance, the "architect faction" advocates the pure geometrical form. The
abstraction of geometry can elevate the primitive material texture to the aesthetic height of carefree and indifferent. In the design of Bamboo house, Kengo Kuma uses the above method of space operation consciously.

The plane of the bamboo house is very compact, and it is unfolded by a core rectangular, and then cut the upper left corner of the rectangle to form an "L" shape. The facade is composed of bamboo according to a certain spacing to form a uniform architectural epidermis, and also presents a simple rectangular geometry. The entrance of the Bamboo house has a slender rectangular guide path, and it is the purpose that the architect intentionally allows visitors to use this path to gain an excessive and spiritual cleansing of the space experience. The interior streamline of the space is concise and changeable, traffic streamline change into another direction where in the toilet place, showing a kind of winding style of Chinese garden space effect. The interior function space is arranged in the middle of the teahouse in order, and it is composed of a rectangle of different sizes. The Teahouse that in the middle of space forms a "box-type" spatial structure constructed by two rectangles from inside and outside, and has two rectangular outlets connected to the dining room and stairwell. In the design process, the unstable and disorderly factors are excluded from the operation of the pure geometrical shape. And these different sizes of rectangles are combined in a stable and coordinated manner, and the resulting morphological groups make them become a unity of the integrity. This spatial approach also has its structural considerations: The balanced geometry thus becomes the actual structure of the building as it is, and the simplicity of its form can guarantee its structural stability [6]. The facade of the bamboo house and most of the interior space were wrapped in bamboo, giving it an aesthetic characteristic of the crude material which is mentioned above. In order to form the purity of the spatial interface, the connecting elements between bamboos are also deliberately weakened and hidden. In the Bamboo House Kengo Kuma consciously uses the rectangle to organize the space to display the different spatial characteristic such as "compact Plane", "Pure Interface" and "homogeneous material", these characteristics endow the teahouse with the space atmosphere of "leisure and tranquility".

2.3. The simplicity and aboriginality of the material
Architecture materials form the material interface of the main body of the building and shape the inner space of the building. Different building materials give people different perceptual experience, but also can show some kind of architecture qualities. The building material has its own physical property and conveys the intrinsic emotional attribute made by the architect. Kengo Kuma is good at combining regional materials with their cultural connotations. In his work called Hiroshige museum, he studied the relationship between the local straight fir trees and the lines in the art of Japanese painters and apply it to the design with the thin, silky line. He also studied the significance of bamboo in Chinese culture, such as “The Seven Sages of the Bamboo Grove". He thinks the Great Wall used to represent the watershed of two different cultures, and now the world should emphasize communication and trust. The bamboo epidermis which focuses on dialogue with the external environment also has this deep significance in the bamboo house. Kengo Kuma selected bamboo, stone as the main building materials for Bamboo house derive from its rejection of "heterogeneous materials". Heterogeneous materials mean that which are different from the material that makes up the surroundings, such as concrete, steel, etc. [7] He believes that architecture built by these heterogeneous materials will be treated as isolated and separated element from their surroundings. Compared with these heterogeneous materials which cannot be recycled, bamboo, wood, stone and other raw materials have a unity of time. He believed that the use of natural building materials can give the architecture a "negative building" existence form. The so-called negative buildings, is not the pursuit of symbolism and the pursuit of visual needs, plus that it doesn't deliberately pursue some kind of possessive desire [8].

As a kind of enclosing form of building space, epidermis has the characteristics of ventilation, light transmission and formation of visual uniformity. Kengo Kuma’s epidermal operation method is different from other Japanese architects who admired the effect of the pure and lissome space interface, and also different from the unity of woven epidermis and structure of bamboo, which is emphasized by the famous Vietnamese architect Vo Trong Nghia. He pursues the pure epidermal material in
architectural space to form rich and delicate changes in light and shadow. In the design of bamboo house, bamboo and glass were used to construct the permeable double epidermis structure. The Double-layer epidermis not only enriches the spatial level and lighting effect, but also has some ecological and energy-saving effects. The permeability of bamboo epidermis can blur the boundary of the building and let it dissolve in the surrounding environment. Bamboo House uses a large number of bamboos to surround the architectural space of different interfaces according to the different diameters of bamboo and the combination of spacing. Bamboo serves as the enclosing system of architectural space, and also becomes its structure system and decorative interface. The interior space adopts the dark and reflective polished stone as the ground material, which can enrich the lighting effect and strengthen the uniformity of the interior space. The comparison of bamboo and stone makes the sensory and structural properties of each material to be expressed. Kengo Kuma uses natural building materials simply and truthfully, and through the comparison of materials to reflect the Architect's respect for the material itself, it makes the space quality of the architecture more real and vivid.

2.4. The light effect of tranquil poetry

As an important expression language of architectural space, the effect of light and shadow greatly enriched the building space, it also brings people different emotional experiences. Kengo Kuma once said, "I want to create a vague state like a flying particle. The closest thing to the state is the rainbow."[9] The Rainbow is a very special optical phenomenon: it only shows the outer form while the inner elements are concealed when the rainbow is formed. He uses the optical properties of rainbows to explain the theory of particle architecture. He thought that the architectural image should disappear or conceal as much as possible, but at the same time, it must embody a new holistic architectural intention and architectural phenomenon.

The teahouse space in the Bamboo house is the core of the whole building, and Kengo Kuma endow it a sense of poetry by means of the delicate and multiplex operation of light and shadow. The simple geometrical form of the teahouse and the uniform bamboo material provide the background of the light, and the shadow becomes the protagonist of the space. The day lighting of the teahouse mainly comes from the top of the bamboo grille skylight, the bamboo double-layer epidermis of the surrounding has played the role of filtering light and blocking scene, the gap between the bamboo curtains dissolves the sense of closeness of space. The top of the light through the Bamboo grille filter to form a uniform and delicate lighting effect with the change of time and light. This manipulation gives light a sense of time. The tea room is surrounded by a circle of static water and the base of the teahouse disappears into the water to gain a sense of buoyancy. The height of the pool is slightly elevated and the edge is extremely thin, with the reflection of the pool making the architecture more closely related to the surrounding environment. The space layout manipulation of teahouse is very similar to Kengo Kuma’s another design works which is called "water and glass". In the "Water/glass" works, the top light is filtered through the blinds to create a particle-lighting intention. Kengo Kuma once said: "Let the surface of the particles and the particles projected above echoes each other, if the light on the roof is not broken down into particles, the thick roof will kill the dance of the surface particles.”[10] In combination with the above statement, we can clearly find: The relationship between the roof skylight and the pool is consciously established in the light and shade expression of the teahouse. The quiet poetic effect of the teahouse was expressed through the diffuse, reflection, refraction, hidden and other manipulation of light.

3. Conclusion

The concept of "modest architecture" is a rational reflection on the spirit of the times, which has triggered a new thinking on the relationship between architecture and environment and human. Bamboo is widely praised for its unique properties of green materials, and it also accords with the connotation of concept of "modest architecture". Kengo Kuma’s architectural practice focuses on the use of regional materials, pay attention to inner feelings, and its design works have a kind of meaning of architectural phenomenology. In the bamboo house which located at the foot of the Great Wall,
Kengo Kuma uses the bamboo material with simple and pure expression technique makes people get a kind of free and tranquil space experience in the teahouse. It gives us a new view of green materials in the space design of Teahouse and also indicates a possibility for the future of architecture. Architecture will become something that is closely related to our daily life, and people will experience it in a low perspective instead of looking down on it, which is the fate of the architecture.

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