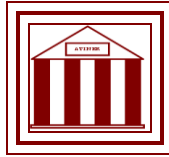


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**Material Autograph: Rethinking on the
Design of Qiqiaoweng Wooden
Pavilions from a Tectonic Perspective**

Xiaoming Hu
PhD Student
Architecture School of Southeast University
China

Athens Institute for Education and Research
8 Valaoritou Street, Kolonaki, 10671 Athens, Greece
Tel: + 30 210 3634210 Fax: + 30 210 3634209
Email: info@atiner.gr URL: www.atiner.gr
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Abstract

Material autograph means the character of space which is endowed with materials. It is embodied in architecture by sort of structure and the quality achieved. The nature of material essentially prescribes its method of joint, and the structure and construction are the results of this prescription. We can easily find out the material autograph of wood in Chinese traditional architecture.

It has been well known the strong tradition of Chinese wooden structure for the architecture academia, while the most existing interpretations has been based upon the architecture theory of stylistic, so that the scientific and tectonic issue of the tradition has not be expressed well. This situation very much influenced Chinese architects to learn the wooden structure as the cultural tradition and transformed into the application of modern architecture in China. In order to change this situation, we shall turn the academic orientation to the tectonic approach. Based upon the scientific analysis, the author has been able to explore the construction process of the particular connections and joints, such as Dougong, mortise and tenon joinery. With those studies, the author tried to re-evaluate the meaning of tectonic culture and mountainous human habitat culture on the wooden construction.

Nowadays, more and more architects noticed that if a defined architectural culture developed not along the stylistic evolution, it should be still based upon the tectonic evolution. Chinese wooden architecture can be better interpreted with tectonic view, and it demonstrated a relatively fair way.

The material used at Qiqiaoweng Wooden Pavilions was strictly limited with wood. Acting as a tectonic experiment, wooden structure itself performs as the enclosure and integrated way of austerity and authenticity. Based upon new technologies of wood and wooden structure, the three pavilions demonstrate the expressive potentials, which the material of wood provides to both construction and space perception.

Key Words: Chinese wooden architecture; Tectonic; Structure; Joint properties; Qiqiaoweng wooden pavilions.

Corresponding Author:

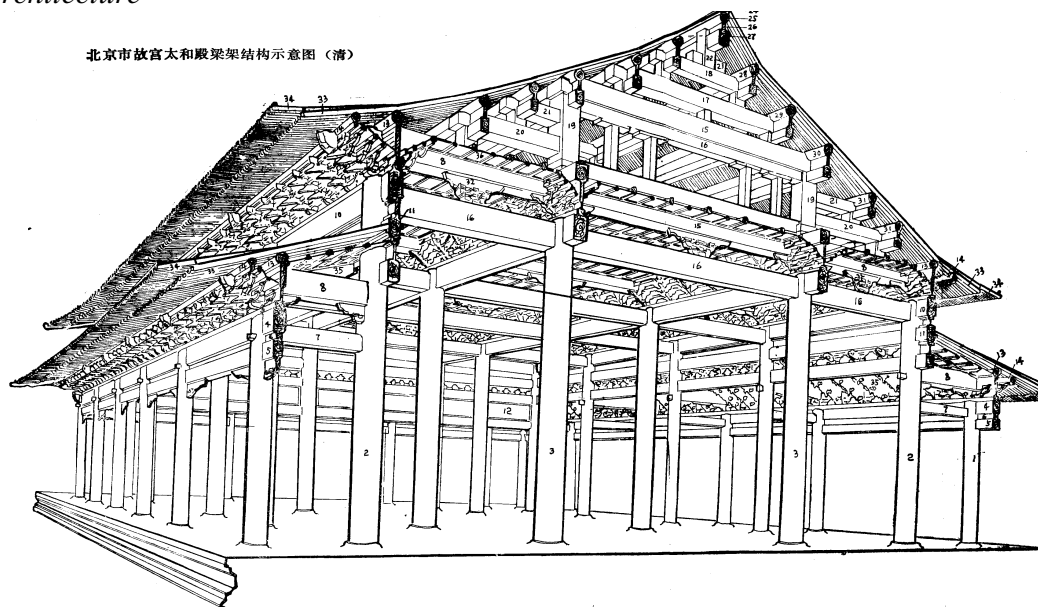
Background: Wooden Structured Architecture in Chinese Civilization

Wooden structured architecture has become the most popular and important system of Chinese architecture, which covered whether in the most areas of China, no matter the North or the South, formal or vernacular. From this point of view, we always have seen that wooden structured architecture is the major system in Chinese architectural culture along the recorded history of Chinese civilization.

The main system of Chinese wooden architecture is the wooden framed structure system. It has been described many times in the Modern Architecture, as “organic”; “skeleton and skin”; also many modern architects in the West were fascinated by it, since they found there has been strong logic related between Modern Architecture and the ancient architectural contributions of East Asia.

Since the end of 19 Century, the Chinese wooden structured architecture has been continuously interpreted firstly by Western late on Chinese architectural historians. However, those interpretations had been really confined in a stylistic view. Nowadays, more and more architects noticed that if a defined architectural culture developed not along the stylistic evolution, it should be still based upon the tectonic evolution. Chinese wooden architecture can be better interpreted with tectonic view, and it demonstrated a relatively fair way. (Fig.1)

Figure 1. *The Wooden Framed Structure System in Chinese Traditional Architecture*



Tectonic Approach: Reinterpretation of Chinese Wooden Architecture

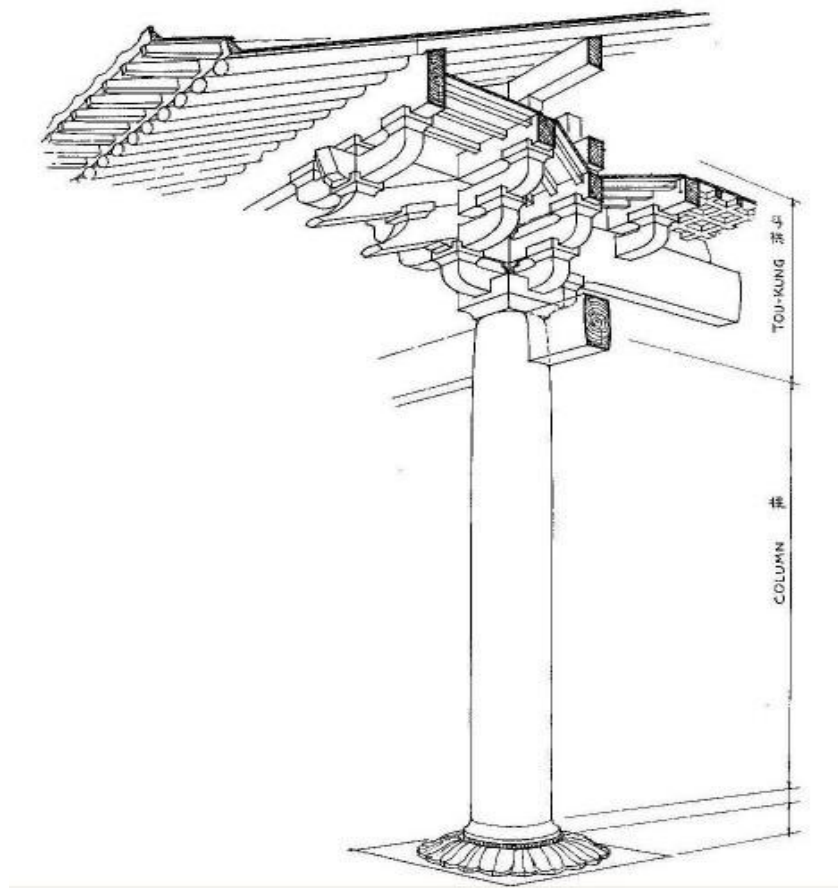
To have the tectonic view in architecture however, for the most architects, would means “a certain expressivity arising from the statical resistance of constructional form in such a way that the resultant expression could not be

accounted for in terms of structure and construction alone”¹, the technical process of construction should be anyway essential. It followed the step of defined material, and the step of certain way of construction, then the step of to gain the structure form.

There have been too much interesting traditional types of wooden architecture in China; many other architectural researches had done with all those different types with functional classifications.

As in a classical building in the West, the elevation of a Chinese temple would be defined as three parts with “Platform or Stylobate”, “Middle part” as well as “Roof part”. The most famous of Liang Sicheng’s definitions concerning Chinese architecture is probably “The Chinese Order” (Fig.2). We can clearly see that different parts present a tectonic relationship. If we focus on the part of “Dougong”, we can better understand the logic relationship between form and construction skills.

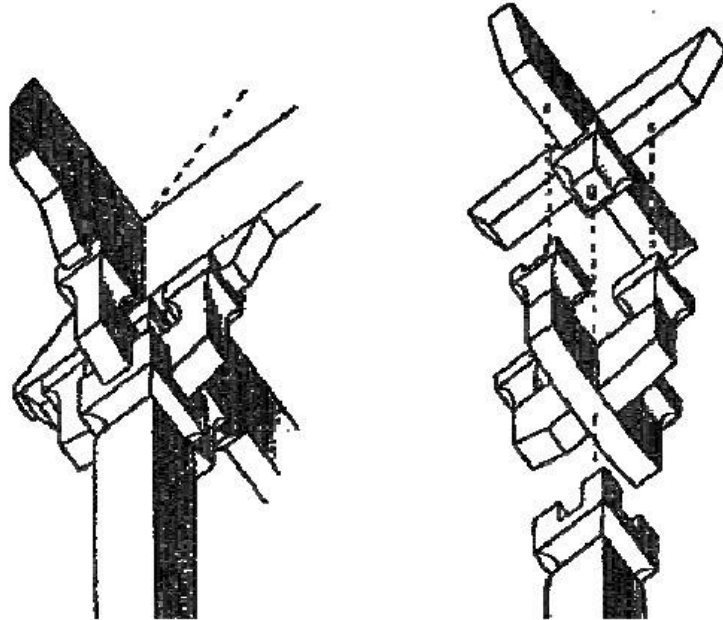
Figure 2. *"The Chinese Order"*



¹Eduard F. Sekler: “Structure, Construction and Tectonics” Connection: Visual Arts at Harvard (March 1965). Cited from Kenneth Frampton: “Studies in Tectonic Culture, The poetics of Construction in Nineteenth and Twentieth Century Architecture”, The MIT Press, Cambridge, 1995.P.19

Dougong is part of the network of wooden supports essential to the timber frame structure of traditional Chinese building because the walls in these structures are not load-bearing. (Fig.3)

Figure 3. A lesson from Auguster Choise (1841-1909): “*Histoire de L’Architecture*” 1899, Paris



Multiple interlocking bracket sets are formed by placing a large wooden block (dou) on a column to provide a solid base for the bow-shaped brackets (gong) that support the beam or another gong above it. The function of dougong is to provide increased support for the weight of the horizontal beams that span the vertical columns or pillars by transferring the weight on horizontal beams over a larger area to the vertical columns. This process can be repeated many times, and rise many stories. Adding multiple sets of interlocking brackets or dougong reduces the amount of strain on the horizontal beams when transferring their weight to a column. Multiple dougong also allows structures to be elastic and to withstand damage from earthquakes.(Fig.4,5)

Figure 4. *The Dougong in Fogong Temple Shakyata, Shanxi*



Figure 5. *The Dougong in Datong Shanhua Temple*



Wooden Arched Bridge in Southeast of China

This special type of wooden arched bridge delivered very unusual form, which has been attractive for many bridge engineers and architects eventually tourists. However, the interest was introduced from the ancient arched bridge, “Rainbow Bridge”, a significant bridge in the Capital City of Song Dynasty (AD 960-1127). It was a beautiful type wooden bridge in the history, had been widely existed and still can be seen in Japan today but, in China it is only the subject presented on the famous ancient painting “Along the River During the Qing-ming Festival” by Zhang Zheduan. Many historical researches have done for this disappeared well-known bridge in Chinese history, so that when the wooden arched bridge has been found in its location of the South of Zhejiang and North of Fujian provinces, the most scholars recognized it as the remained relics of “Rainbow Bridge” from Song Dynasty. In the reality, the wooden arched bridge located in The Southeast region of China is not same as the “Rainbow Bridge” in its construction, however they have similar structure meaning.

The bridge looked a nice form with complicated organization and sophisticate construction. Such kind of unusual type of traditional construction often to be recognized as a brilliant creation of design in the history, many historical studies for this kind of subjects just based on this recognition. While we don’t believe it could be directly created by any person in history, it should be the subject with traditional and regional wooden tectonic feature, obey the ruler of vernacular constructions to develop along the natural way. Sort of speaking, additive development, no body could be the creator or inventor.

Therefore, it would be much more meaningful to apply a typological study to analysis its development, other than to try to dig out the first builder or designer (Fig.6,7).

Figure 6. *“Rainbow Bridge” from “Along the River During the Qing-ming Festival”*

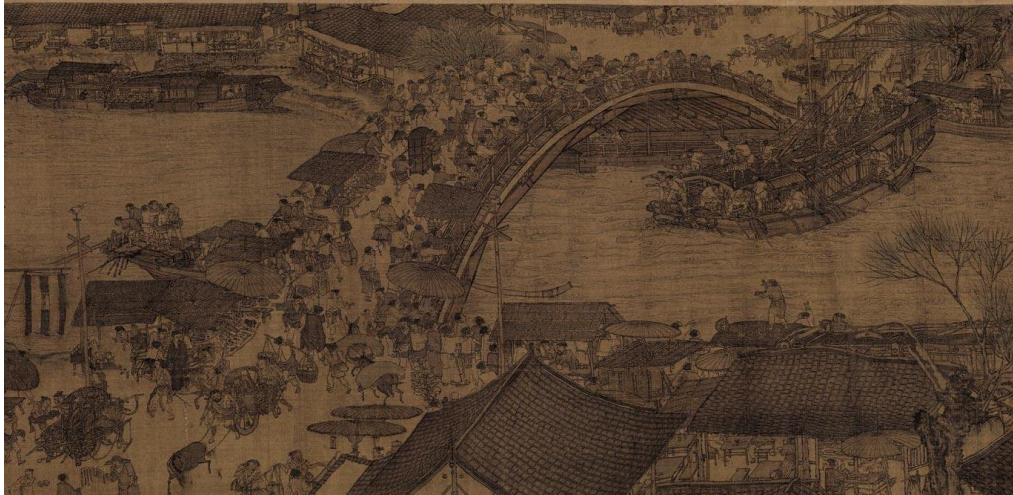


Figure 7. *Wooden arched Bridge in Zhejiang Province*



Application Case: The Design of Qiqiaoweng Wooden Pavilions

Our selection again was based upon tectonic consideration, so the standards for our selection are more related to the clear technical definition, less architectural expression. Nevertheless, we believe that applying the

tectonic view into our architectural studies, would never reduce the expressivity of those wooden constructions, which remained to be as the quality of architecture.

The Qiqiaoweng Park is a wetland park opened in 2008 in Nanjing, located in the southeast of the city on a peninsula which is the intersection of Qinhuai River and Food Shipping River and was named after a seven-hole stone bridge of the Ming Dynasty. Three wooden pavilions located on the artificial island in the western of the park. The whole region is with diverse vegetation, lush reedy, dense trees which is very sensitivity in terms of ecology. The main function of the wooden pavilions is providing visitors with a place for rest and watching habitat activities of a variety of birds on the opposite island at the same time.(Fig.8)

Figure 8. *The site plan of Qiqiaoweng wooden pavilion*



According to the relationship with the surrounding environment, three wood pavilions find their own positions on the island. The intersection of the two rivers can be seen from the platform outstretched from the No.1 Pavilion; and the old Qiqiaoong bridge can be perspectived from the opening place of the No.2 Pavilion; a 12-meter- high tower which has the best viewpoint of overlooking the view of the park and the surrounding flora and fauna was designed in the No.3 Pavilion .(Fig.9,10)

Figure 9. *The Pavilion NO.1*



Figure 10. *The Pavilion NO.2*



Material of the three pavilions is strictly confined to wood (Except for the foundation and the tower stem of NO.3 Pavilion, all three pavilions are made of wood), Matinsons company of Sweden provided good quality Glulam made of boreal coniferous wood for the project. The Laugier Elder's shelter is the prototype of the three wooden pavilions. The structure itself encloses and percepts the space and the materials. Construction and space show as one in the most direct way. Material, shape and the connecting method of components reveal in the real way, without shelter, imitation, frills, and additional weird thing and indulge.(Fig.11.12)

Figure 11. *The Pavilion NO.3*



Figure 12. *The interior of the Pavilion NO.1*



Space generated from the section and in order to maximize the retention of the ecological surface, the main structure of the three wood pavilions was lifted from the ground. The design of section started from the regular heptagonal with a side length of 2m, which was the base-face to generate the form. According to the locations of the three wood pavilions, different paths were designed to guide the movement of the base-face of the heptagon to form body

and space. Heptagon turned in the process of moving to produce a gradual change of rhythm and the rhythm of the turning in the depth of the space.

The main body of wood pavilions is consisted of three heptagon cylinder of different turning directions. Four basic frameworks erect at the start, end and two turning surfaces. The longitudinal members are connected dislocatedly between the two basic frameworks in both front and back parts, but the middle parts are connected correspondingly. So in both front and back parts the cylinder space are turned.

12 consecutive turning framework of heptagon are inserted in and equally divide these two turning but crossed longitudinal space; 9 framework equally divided the the middle part. Those linear components gradually turn at both surface and section to achieve continuity by interruption and form the interface and space in the rhythm of gradual change. In order to enhance the stability of the heptagonal architecture, connecting the midpoint of each side to get shorter sides and forming inside heptagon. Two groups(inside and outside) frameworks support each other, not only enhance the overall stiffness, but also make the body and space to show richer and more delicate sense of rhythm . (Fig.13, 14)

Figure 13. *The interior of the Pavilion NO.2*



Figure 14. *The interior of the Pavilion NO.3*



The tower of No. 3 pavilion also is generated by continuous turning of the regular heptagon in vertical direction. For every rise of 2.4 meters, the plane of heptagon architecture turning of 25.7° and the side length narrow 10cm. Mesh structure is weaved for the tower by the oblique structure connecting heptagon dislocatedly, and scaly wood blinds attached to which to form the surface of tower, performing the Motif of turning in the vertical stack. For every rise of 2.4 meters of inside spiral staircase a platform protrudes out to provide different perspectives of the surrounding scenery. (Fig.15, 16)

Figure 15. *The plan and section drawings of the Pavilion NO.2*

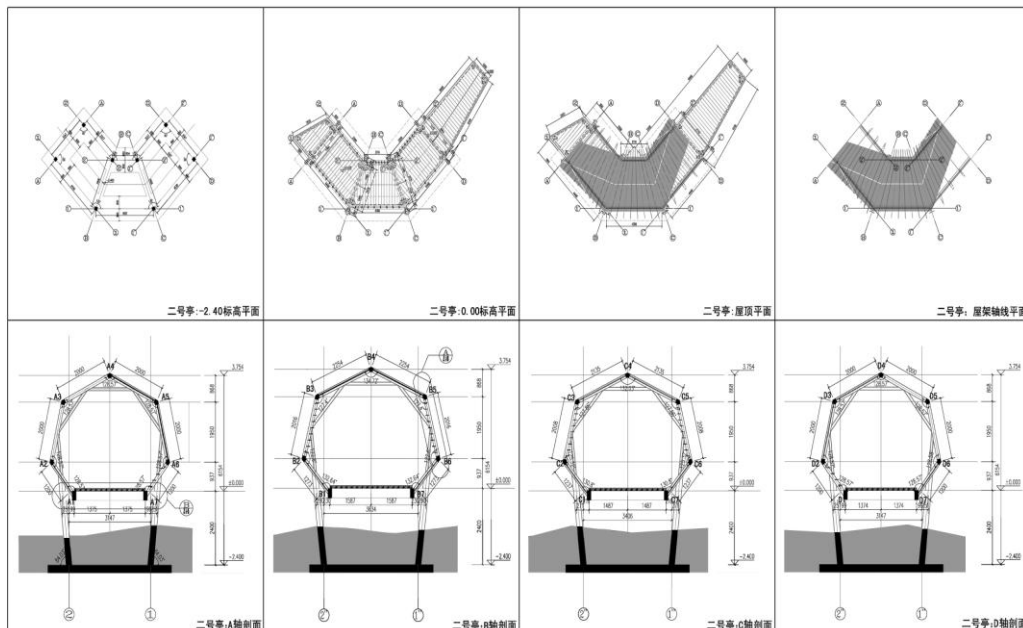
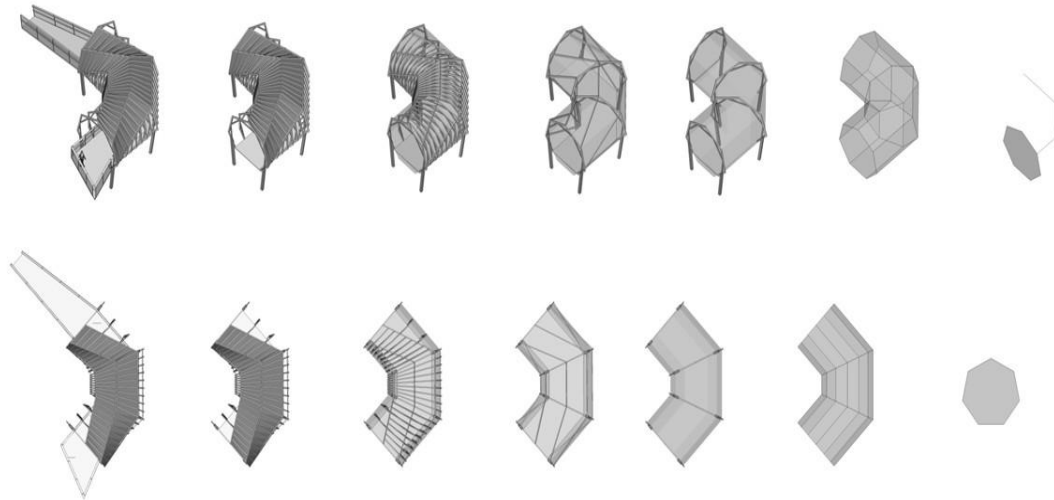


Figure 16. *The form generation process of the Pavilion NO.2*



The gradual turning of the linear component becomes the form motif of wood pavilions in Qiqiaoweng Park. These linear wooden components first is structure propping up the space and that materials, structure and construction were revealed completely as well as structure forming space because they reached continuity in interruption and wrapped up its interior that sometimes open and sometimes close. The linear is the most candid expression of wood, in history for almost all mature and state-of-the-art wood-framed systems, its frameworks are all formed by linear components. Elegant proportion, components of warm texture and their precise connection create unique qualities of the wood construction whose most attractive performance is the logic and rendering display of materials, construction and space. This is the characteristic of wood and the handwriting by wood in space.

Conclusion

With the rich tradition of wooden tectonic culture, Chinese architecture can and should be interpreted in new way and to help the fairly understanding of spirit in Chinese culture. It will be followed and fit the development of wood engineering in the World, based upon the ecological and sustainable theories. Our study is actually a trying to demonstrate the possibility to depart from the traditional stylistic studies confined by classicism; to explore the logic in Chinese wooden tectonic culture. With this new approach, it might allow us however there is long way to go for more necessary studies should be taken, to merge the Chinese wooden tectonic culture with the international trend of wooden engineering and architecture.

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