

## Stilt style Architecture in Southern China based on the evolution of Stilt style architecture and modern architectural techniques

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**Abstract:** In the summer of 1972, with a loud noise, one of the Pruitt-Igoe house in St. Louis collapsed. "Modern architecture is dead," said Jenks. This community used to be the medal of rational architectural design, but its losers began to make people reflect on the modern architecture and internationalism that have been born for half a century. People began to pay more attention to the characteristic buildings in different regions, which gave birth to the evolution of modernism such as new regionalism. However, in today's China, Southeast Asian countries, their very distinctive stilt style architectures are currently ignored and dying in the fast wave of modernization and construction. To resist this process, this paper will try to discuss the possibility of combining this traditional architectural form with modern residential demand from the analysis of modern new technologies and materials applied in some new stilt style buildings, and put forward some ideas for improvement through the analysis of its new possibilities. We first review the history of Stilt style architecture, which can help us better understand why this unique form of architecture appears and the relationship between architectural form and its geographical environment. After that, we went to look for ideas in some new column buildings built by modern architects. After that, we also discussed what contribution stilt style architecture can make to this process in the environment of gradual differentiation of modern architecture. The following conclusions are drawn: Through the combination of new technology, new materials and construction methods, stilt style architecture can obtain stronger vitality and move from regional architectural form to the world. And hopefully, this article can explore some possible combination ways of stilt style residence and modern architecture, the problems they can solve, and how can this guide the integration of modern architecture and local architectural traditions.

### 1. Introduction

. Faculty of Environment and Resource Studies, Mahidol University has called into question some past theories about the 'stilt house'. Most academic research projects have studied stilt houses based on two types of flood: inundation and coastal flooding. The study of pillar houses in flash floods is very limited. This research investigated whether the main structure of a stilt house could withstand strong water current to determine the suitability of the stilt house for flash flood sites. The study explored the physical appearance of stilt houses in five flash flood areas in Thailand. They also did another research investigating whether the main structure of a stilt house could withstand strong water current to determine the suitability of the stilt house for flash flood sites, which focus mainly on several existing cases [1,2].

In Zhuming Liu's investigation into stilt buildings, he has shown that there are new possibilities for stilt building. The purpose of the thesis lies in exploring the new possibilities of the stilt building in dealing with two sustainability problems caused by urban development: the Lack of Public Greening in Prosperous, High-density Areas, and the Continuous Sprawl of Private Housing in Suburbs [3].

William L. Tilson have developed a new method for stilt house, he have described and analyzed the stilt style buildings of the Tujia people (an ethnic group living in mainland China), a distinctive

building style unique to them, from the perspectives of site selection, spatial layout, construction techniques, and cultural inheritance. The cluster of stilt style buildings (Diaojiang Lou in Mandarin Pinyin) in the Pengjia Village (meaning most of the villagers share the surname of Peng) is presented as a case study in this paper. The paper makes a case for their preservation as authentic carriers of the Tujia people's cultural history, which is quickly disappearing due to development pressures. Three preservation strategies are discussed to meet this preservation goal [4].

From the case in which Japanese studio Unemori Architects has completed a house in the city of Takaoka that is raised 70 centimeters above the ground on concrete stilts to protect it from flooding and heavy snow. We can see the potential of stilt style architecture to solve new landscape problems as we are building architectures in more and more precipitous conditions [5].

And in the interview with interior designer Michael Lauw about a recently completed residential project in Surabaya, Indonesia, for which he combined traditional Menadonese stilt house vernacular with contemporary interior elements, we can see the combination of local culture and new techniques, as well as the bright future they bring to stilt style architecture [6].

We can also see the cultural and nature-initiated roots of stilt style architecture and the urgent need to sustain them through Guo and Cong's study of the phenomenon that vernacular houses in rural villages are rapidly disappearing, raising questions about the loss of material and cultural heritage, while their replacement or alteration poses questions of appropriateness and sustainability. This area has received much less attention and this thesis aims to address this lacunae. Also we can draw similar conclusions from another study on the stilt style architecture design of De'ang Nationality In Yunnan Province [7,8].

And Gabriel Muñoz Moreno (MDes '17) and Santiago Serna Gonzalez (MDes '17) present a possible future for stilt style architectures to form a kind of tribe or city above water Their design "Sovereignty on Stilts" exemplifies this phenomenon by showing how the displacement of native communities in Latin-American Pacific coasts has occurred for centuries [9].

And at last, we also searched several details and history of stilt style architecture from Wikipedia [10].

Stilt style architecture is one of the important architectural forms in south of the Yangtze River in China since the Neolithic Age. It was first discovered in Hemudu. It is obviously different from the semi-crypt houses of the same period in the north.

This architectural form is suitable for those living in rainy areas and is popular in central and western Guangxi, southeastern Yunnan, southwestern Guizhou and northern Vietnam. The moisture-proof principle of stilt style architecture is to make the house and ground segregation, besides, still have the effect that uses space effectively, one room multi-purpose. Living forms are closely related to the lifestyles and natural economic conditions of all nationalities. Southern tribes live in houses similar to nests, two-story buildings of bamboo and wood structure. Cattle, pigs and other livestock are raised in the lower layer, and people live in the upper layer. In this way, they can also avoid all kinds of ferocious beasts, insects and snakes.

Modern stilt style architecture is mainly distributed throughout Xishuangbanna and Southeast Asia. Stilt style architecture houses are made of bamboo and wood, wood as the house frame, bamboo as purlins, rafters, floors, walls, stairs, etc. The connection of each component is tied with tenon and tenon or bamboo strips, and the roof is tied with straw row or hanging tiles. The houses are connected by paths.

With the acceleration of modernization, stilt style architecture disappearing at an alarming rate. Some are even in the danger of dying out due to the lost of certain construction techniques. For example, the stilted buildings of the Tujia people, according to Kui Zhao, William L. Tilson, Dan Zhu from Huazhong University of Science and Technology. In China, there are few stilt style architecture, so the stilt style architecture in Guangnan area are very precious, and these inherited national cultural heritage condenses the profound complex of ethnic groups. Today, living houses have moved towards modern houses, which are made of brick and stone or reinforced concrete, but some of the structures still retain the basic characteristics of the railings.

And with the development of modern society and the acceleration of the pace of urban life, people are more and more advocating individual and free-living conditions, and have higher requirements for the independence and privacy of living. They pursue beautiful environment, fresh air and sufficient sunshine, and have a strong desire to return to nature. In this case, traditional residential buildings begin to develop into modern residential buildings. For example, gray space in modern residential buildings is inspired by the stilt style architecture of dong nationality. Therefore, how to embody the characteristics of traditional architectural space in modern architectural space, meet the psychological needs of people associated with the natural environment, enrich people's spiritual experience, and promote the development of space design toward a more humane and personalized direction is the main theme of our research.

The gray space of traditional Dong folk houses is not only rich in forms and functions, but also contains profound cultural connotations, which is representative of stilt style architecture in southwest China. Gray space is not only a common architectural space in the daily life of Dong people, but also rooted in the environment of stilt style architectural culture, and has a vital impact on their life today. Through the detailed analysis of the gray space form of Dong nationality stilt style architecture, we can further explore the artistic characteristics of stilt style architectural culture and the essence of space design, deepen our understanding of the gray space of traditional Dong residential buildings, and provide beneficial design inspiration for our contemporary residential buildings.

This paper will try to discuss the possibility of combining this traditional architectural form with modern residential demand from the analysis of modern new technologies and materials applied in some new stilt style buildings, and put forward some ideas for improvement through the analysis of data.

## **2. Mechanism**

We first look for ideas in some new stilt style buildings built by modern architects. Unfortunately, at present, we have not found a good case in the birthplace of China's traditional stilt style buildings. This may be because China is in a period of rapid development. All cities are concerned about how to improve the modernization of cities and build pure antique villages. But few people seriously think about the combination of modern technology and traditional forms. Another reason may be that China's land property rights lead to the scarcity of private single family houses. In contrast, we have found many relevant cases in Southeast Asia. We found "Chau Doc house" designed by Mishizawa architect and "Ban Loy LOM" designed by Thailand Pods' architects. These are two modern dry railing buildings built in the 21st century. They better reflect what we want to achieve, that is, to bring stilt style architecture into contemporary life. Among them, "Chau Doc house" is located near Ho Chi Minh City, Vietnam, in a village where many stilts have to be built due to floods all year round. "Chau Doc house" can adjust the window size according to the amount of sunlight and natural wind by replacing the wall with floor mounted rotating metal windows. And replace all indoor solid walls with movable partitions to create a larger continuous space. At the same time, there are some solid fair faced concrete walls inside. The application of these new technologies makes many shortcomings of the local stilt style buildings: the ceiling is too low and there is no thermal insulation layer, the window is too small to meet the natural ventilation, and so on. At the same time, it also solves the most important problem, that is, the instability of stilt style buildings under the traditional construction technology and materials. At the same time, the building well corresponds to the architectural form here and pays tribute to the context here. After entering the main house, you can find that this space is interspersed with cement columns and wooden beams. The traditional frame structure is obvious, and the light shed through the translucent roof shading material makes the atmosphere of this space dim, which is the traditional living environment of the local area. Another important place is that a large number of local plants are introduced into the building. The introduction of this natural element makes the building integrated with the local environment, which is another important feature brought by the permeability of traditional stilt style buildings. Therefore, people living in this village all year round will not feel the same sense of separation as if they moved to other places. The other "ban loy LOM" achieves the

owner's needs for different spaces through the application of different materials. The whole building adopts a split layout, and the rooms on the foundation are independent, which makes the building not too abrupt even if it is alone on the flat ground, because it looks like other villages common in this land, rather than a single huge volume. This is also respect for the local context. It selects the thick material of brick and stone on the outer wall of a more private room such as the living room and bedroom to protect the owner's privacy, and uses a mesh steel structure in the place where the Buddha statues are worshipped, so as to achieve the realm of interaction with nature as mentioned in the Buddhist scriptures. What's more interesting is that the height of its suspender has also been adjusted to the height of parking. This is the combination of modern needs and traditional forms, which reflects the natural evolution of a technology in history. Just as organisms in nature gradually evolve with environmental changes, architecture is also evolving with people's needs. For example, the wooden frame structure in ancient China has obtained new development due to the new reinforced concrete. In the last century, with the industrial revolution entering the construction industry, the first is the rapid modernization of the whole construction industry in the first half of the 20th century. Different architectural theories mixed together to solve new problems in life and society, resulting in modernism, followed by the reflection on the internationalism formed by this rapid modernization in the second half of the 20th century. At the same time, other construction technologies have made similar progress, such as Chinese traditional frame technology and wood frame technology, which have been reborn in the new wave of technology. Architects all over the world found that internationalist architecture invaded all places without considering the local geographical characteristics and context. On the contrary, the regional buildings that fit the local context in thousands of years of history were abandoned in this process. This is the beginning of the trend of postmodernism. In this wave, the traditional architecture in various regions has been re valued and developed, which is what we want to do. We also believe that with the development of regionalization, the application of new architectural technology is gradually going deep into the category of traditional houses omitted in the process of architectural modernization in the last century, which is the result we want to achieve in this paper.

### **3. Result**

New materials and new construction method meet the requirements of 6R design. Reuse, Reduce, Recycle, Renew, Regenerate, Revalue at the same time maintain the cultural inheritance of stilt style architecture, so that the national architectural culture can be inherited.

Formwork was used to cast the concrete floor during construction preparation. Through the whole ground leveling, do slope, waterproof coating and brush to prevent dust curing agent, in order to achieve drainage, moisture-proof effect. Cement mortar is used to build column foundation, and embedded parts are made on the column foundation to prepare for the connection of galvanized steel long columns in the later period. In remote villages, ground anchor structure should be used as building support system. The ground anchor system is connected with the vertical and horizontal galvanized steel plate by prefabricated components -- flannel pile to achieve the support of the whole house, which can effectively shorten the construction time and reduce the construction cost. The ground anchor structure system can protect the ground plants by overhead. It is conducive to the protection of the ecological environment.

In the stage of building the roof foundation, the 6R performance of bamboo fiber composite material or the heavy steel coated wood plastic composite material is used as the structural material of the dry-railing building to make the architectural frame. Bamboo-based fiber composite material is the fiber separation and recombination of bamboo, so that the fiber bundle distribution is consistent in the fixed cross section area, so as to have high strength performance.

### **4. Conclusion**

In addition to solving the problem of humidity, the stilt style building can also solve a series of other possible problems such as height difference and snow. Therefore, we can see that more and more

stilt style buildings are applied in different scenes. This is also a good phenomenon, which shows that the technology has not been swallowed up in the wave of architectural modernization, but is embracing this process and making itself a part of architectural modernization. They turn themselves into part of this wave, making this technology no longer a single building only to solve problems in a certain area. Many technologies have experienced this process and gained new life, such as China's frame technology, well dry wood frame structure and so on. They have transcended the limitations of their own region, spread to other places and joined the technical system of modern architecture. There are many such cases now, such as the Mediaterra House built on the mountain with large elevation difference and the "highland house" built in the area with perennial snow. Both are stilt style structures, with the bottom overhead above the natural surface. They adopt this form, perhaps not the same as when this kind of building appeared, in order to protect the building from the interference of the local harsh natural environment. But they have a certain purpose in this form, more or less to solve certain problems. This may be a functional problem or a morphological problem. For example, the exhibition center of Dayi agricultural science bas we found is one of the cases in which architects choose stilt style architecture for morphological aesthetics and building a flying look. But doesn't this prove that this form can solve the problems faced by modern architects? What's more, in some areas where there was no such architectural form, stilt style architecture may be introduced, so as to turn it into a new local architectural form bearing the context. They all adopt the form of hanging feet at the bottom in contact with the natural ground to support them. This either allows them to solve the problem of height difference, or gives them a sense of levitation, or allows them to avoid the problems caused by snow for homeowners. Or according to Nakhon of Mahidol University mentioned in one of his passage studying on such aspect, stilt style architecture are widely used in many areas to resist two types of flood: inundation and coastal flooding. They all solve the natural problems through this technology. At the same time, they simplify the structure of the feet through the form of hanging feet, create the permeability effect of the bottom, and give the building a sense of suspension.

As for those stilt style buildings that have little to do with the local natural environment, we don't think they are abrupt and strange. As we know, architecture is not invariable, but constantly updates itself with the progress of the times. They have proved that they can still optimize our lives in modern cities, like solving the problem like the lack of public greening. Isn't this the embodiment of this process?

At the same time, in addition to being able to adapt to different harsh environments, the portability of the stilt style structure also makes it easy to transport, which makes these buildings more suitable for construction in inaccessible areas. For example, Futuro pod in the last century, as a radical attempt to assemble houses, also adopted a similar structure. It adopts an improved hanging foot structure on the supporting foot because it was originally expected to be transported by helicopter, but finally failed due to cost reasons. However, this attempt in the 1970s can still make us think in the 21st century: in today's increasingly mature wave of building assembly, what form can the hanging foot participate in? All the above cases and data tell us that stilt style architecture will not and should not die in the wave of architectural modernization. On the contrary, through the combination with new technology, new materials and construction methods, it can obtain stronger vitality and move from regional architectural forms to the world. This is one of the goals that postmodernism has been committed to since the last century. Many architectural technologies have found their place in modern architecture through this process. We hope the same can be done for stilt style buildings.

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