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Analysis on the Application and Technology of the Five Elements in Chinese Ancient Buildings

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Abstract:

As an important carrier of human civilization, buildings reflect the scientific thoughts and technological level of the times. The theory of the Five Elements is a summary of the ancient Chinese's cognition of the world; as one of its branches, geomancy has had an important impact on the development of Chinese architecture. Because the formation of the Five Elements Theory mainly involves cognition, thinking and other fields, it will inevitably affect people's psychological recognition of buildings after acting on life and living. This special background makes it necessary for us to understand the five elements Do in-depth research on the specific application of this issue to understand its past objective situation. Due to the rich heritage and distinctive regional characteristics of the ancient buildings in Huizhou, as well as its special emphasis on the five elements, they are representative in terms of the application of the five-element theory; therefore, the research team took the ancient buildings in Huizhou as the target, and explained the application and technology of the five elements in Chinese ancient buildings on the basis of multiple field surveys and sampling, as well as the cross-comparison between the data of building materials and the analysis of the characteristics of the five elements of wood, fire, earth, metal and water. The results show that the specific application of five elements in ancient architecture is based on human psychological activities, and reflects the maximum rationalization of the application of material resources. The five elements of wood, fire, earth, gold and water are used as application materials with different properties, and they are used differently to maximize strengths and avoid weaknesses. , forming a summary of the experience of giving play to the best performance of materials and the best use plan according to local conditions, which meets the needs of Feng Shui and conforms to the idea of green and environmental protection. It is believed that the application of the five elements of ancient Huizhou architecture fully reflects the local construction methods and the level of construction technology at that time. The development of things is inseparable from the real conditions of the times and society, and even more inseparable from the externalization and active role of human psychological activities. It has great scientific value; the pursuit of the unity of man and nature is also highly consistent with the concept of green and sustainable development advocated today, and it still has a great influence on today.

Keywords*: Huizhou, Ancient building, Five elements, Technology, Application.*

I. PREFACE

As a basic human need, buildings have always accompanied the development of human society, occupying an important position in human history; they are the crystallization of human wisdom, thought

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and technology, and fully reflect the transformation and utilization of resources and materials by humans; the evolution of buildings also contains the development of human science and technology, and the embodiment of technology in ancient buildings mainly relies on the extant historical buildings: "Historical building is an important embodiment of human material civilization and spiritual civilization, with rich cultural connotation, artistic value, scientific value and emotional value." [1] Although ancient architecture covers the skills of the times, it mainly relied on manpower for construction and the natural resources for building materials, which was impossible to involve modern high and new technologies. Therefore, the "scientific value" of ancient buildings is mainly embodied in the traditional simple philosophy of the nation, including the rational application of the five substances of wood, fire, earth, metal and water.

While exploring nature and building a society, ancient Chinese people constantly accumulated cognition and summed up experience, and classified the universe into five different physical properties: wood, fire, earth, metal and water, which were called the five elements; their interaction and movement were regarded as the basis of universal operation, forming the Five-element Theory. The Five-element Theory is essentially a simple scientific view of the ancients on the world, whose core idea is that the mutual promotion and restraint between the five elements maintain the balanced development of things and phenomena. One of the branches of the five-elements theory developed into the geomancy later, which became an important idea that affected architecture. When rooted in buildings, which is one of the basic human needs, the Five-element Theory reflects people's practice and application of the technology at that time.

Among the extant ancient buildings in China, the ones in Huizhou are rich in heritage and diverse in types, and become world-famous for their unique composition and distinctive regional characteristics, such as the famous Ma Tau Wall buildings and earth buildings. According to statistics on some villages in Yixian County, Huizhou in the past three years, the extant ancient buildings of Ming and Qing Dynasties include: more than 200 buildings in Xidi, 137 buildings in Hongcun, more than 300 buildings in Pingshan, more than 100 buildings in Guanlu, more than 300 buildings in Nanping, and more than 200 buildings in Lucun. Such a huge number of ancient buildings in one county indicates the huge scale of the entire Huizhou area. At the same time, geomancy prevailed in the ancient Huizhou, and a complete theoretical system had been formed in the Ming Dynasty; the ancient buildings in Huizhou were particularly affected by it, and they were highly representative in the application of the Five-element Theory. Therefore, on the basis of multiple field surveys and statistics, this paper analyzes the application of the five elements and the embodiment of technology by the Chinese ancient buildings with the ancient buildings in Huizhou as a case.

II. WOOD ELEMENT

In the Five-element Theory, wood refers to all trees and plants in nature. Wood generates fire, corresponding to the East. The sunrise in the east brings light that needed by the growth of trees, so it implies hope. The fruits of plants can not only be used as seeds, but are also mostly edible, such as grains, etc., which are the staple food of human beings, so it implies life and reproduction. In addition, plants produce a large amount of oxygen under photosynthesis, which stabilizes the oxygen ratio on the earth. It

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can be seen that the wood element has a close relationship with humans.

The wood element is frequently applied to Chinese ancient buildings: the main supporting structure is made of thick wood, such as "stand columns, crescent beams, and curved arches" [2]. For example, Xuzhi Hall in Nanping County, Yixian County (Fig 1. The pictures in this paper are all drawn by the author) has more than 50 thick wooden pillars, reflecting the wood's properties of bending, straightness, elasticity and strength; the furnishing components made of wood, such as bucket arches, diagonal braces, sparrow braces, doors, windows, corridors, stairs, panel walls, pendant, etc., reflect the plasticity of wood; the decorative substrates made of wood, such as the couplets, plaques, strip screens, apron boards, window guards, and carvings and drawings, reflect the fusion of wood and other materials; there are also various furniture materials related to architecture, such as traditional square tables, long narrow tables, armchairs, bed cover sheets, wardrobes, etc., which are also made of wood, reflecting the health performance of wood.

Fig 1: Cross-section of the wooden structure of Xuzhi Hall

The extensive use of the wood element in Chinese ancient buildings reflects the inherent scientific principles. First of all, it is determined by the local resource conditions: Huizhou is located in a mountainous area, where there were abundant giant trees but few land resources in ancient times, resulting in high costs of brick kilns; therefore, for the sake of convenience, wood was the first choice, which reflected its practicality. Secondly, it is required by building decoration: to show the local culture, especially the financial resources, buildings in Huizhou are decorated as luxuriously as possible in the form of carving and drawing. The most operable decorative substrate is wood; therefore, wood carving and wood drawing become the main method of decoration for ancient buildings. Moreover, buildings and greening are inseparable; the ancient buildings in Huizhou are full of various plants, creating an ecological environment close to nature; the luxuriant plants indicate vitality and prosperity; at the same time, it satisfies the desire to retain water and wealth, which is conducive to physical and mental health.

"In Chinese philosophy, wood is a symbol of endless life, reincarnation, and immortality; therefore, the building system based on wood structure has continued for thousands of years... More importantly, as an architectural style, it embodies the ancients' plain philosophical concept and their simple ecological awareness in the history of living." [3] The application of wood in Chinese ancient buildings well explain this point.

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III. FIRE ELEMENT

In the Five-element Theory, fire generates earth, corresponding to the South. Fire is Yang, which is hot and symbolizes warmth and heat; the flame jumps and flashes, which implies rising upward; the fire is light, which expels darkness, and implies hope and light.

In the practical application of Chinese ancient buildings, fire and heat are also reflected in the wisdom of the ancients. Huizhou is located at the junction of China's north and south; although it is not as cold as the north, it is still necessary to consider heating issues in winter. Sunshine is the most convenient, and therefore most doors and windows of the halls face south, which is conducive to increasing the brightness and temperature. In addition, some ancient buildings also used fire energy in the design of kitchen hearths, and channels and flues were set inside. The channels were connected to other rooms; when it's cold, heat energy was conveyed to other rooms to increase the room temperature by removing the pre-set partitions of the channel; the flues were built against walls or reserved inside walls, and the flue gas also heated the walls and increased the temperature of the room when discharged to the upper smoke vents. Compared with the northern pits that have "high carbon consumption and high economic cost, and cannot be combined with cooking" [4], the heating mode of ancient buildings in Huizhou is more practical.

In addition, in awe of fire, the ancient buildings in Huizhou paid attention to the control of fire, manifested as the design of firewalls. The buildings in Huizhou are mainly made of wood, which is easy to catch fire. To prevent the fire from spreading and affecting the neighborhood, the gable is built as a screen form towering over the roof; meanwhile, to achieve a visual effect, the gable is stacked with ladder pattern along two sloped roofs, with a sense of rhythm; the shape of each step of the gable wall resembles a horse head, it is called Ma Tau (horse head) Wall (see Fig 1); since its original purpose is to prevent fire, it's also called a firewall. The firewall can make the residences relatively independent, which has the anti-theft and fire-proof functions; it can also make the living space more comfortable, which has the function of sheltering wind and rain, preventing heat and cooling down. In view of the unique and important functions of the firewall, it has become one of the unique characteristics of the ancient buildings in Huizhou, constituting the famous "Ma Tau Wall building".

The use and control of fire by the ancient buildings in Huizhou has effectively improved the defects caused by the humidity in the local mountainous areas, and enhanced the quality of life.

IV. EARTH ELEMENT

Earth generates metal, corresponding to the central position. The earth breeds and bears all things in the world, which can resist water, cover fire, and breed trees, and is the most basic among the five elements. The ancient buildings in Huizhou applied the earth in a very primitive way; for example, the extant ancient buildings in Yangchan Village, Huizhou are called earth buildings, whose walls are built directly with rammed earth; the walls on four sides enclose the building, and there are multiple holes with different sizes on the wall, which are scaffolded by wood or stone and transformed into doors and windows. The upper

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frame of the wall is made of wood and sealed as the roof. Since the earth wall may collapse after getting wet, gabled roof, a roof form conducive to sheltering from wind and rain, is mostly adopted, which surpasses the eaves by 1 meter in the front and back, and by about 0.3-0.5 meters at left and right [5] to prevent rainwater from splashing on the wall as much as possible; at the same time, to prevent the lower part of the wall from being affected by water, the lowermost layer of the buildings is mostly made of stone.

The use of earth, mud and other raw materials by the ancient buildings in Huizhou contains scientific thoughts. First of all, earth is a low-cost, sustainable and durable building material, which is extremely convenient to obtain in local areas; in ancient times, the rough mountain roads made it inconvenient to transport, while local raw materials such as earth and stone were practical and affordable. Secondly, the earth is flexible, and the combination of earth and mud can create various shapes; the thickness of the wall can be controlled freely, and the doors and windows are also easy to open. Furthermore, the outermost layer of the earth wall is sealed with mud, mixed with local rice straw to strengthen the bonding force of the earth, increase the tensile strength of the rammed earth, and prevent the wall from expanding and cracking; the wall is sealed flat with mud, which also forms a certain surface tension to prevent local scattering.

In addition, as a building material, the earth is green, non-toxic, and very healthy, and will not have too much impact on the surrounding native natural environment; it also avoids the generation of a large number of carbon footprints and is closer to the construction concept of “natural buildings”. As the main load-bearing system of the buildings, the rammed earth wall is not only strong and practical, anti-termite and fireproof, but is also airtight. It can create the effect of a passive solar house: the earth wall has a large heat capacity, absorbs and stores heat from sunlight, and can provide heating in winter, providing excellent thermal insulation; at the same time, the soil wall also has good thermal performance, keeping the house cool in summer.

In addition, earth buildings also embody a simple design concept and the aesthetic pursuit of the ancients. In addition to the overall design of the buildings, to prevent the wall from being cracked due to uneven force, most of the windows are staggered and opened on the building facade; the basic symmetrical layout on both sides with the gate as the axis presents shows a sense of beauty between the window and the wall, and takes into account the architectural principles of practicality, sturdiness and beauty.

V. METAL ELEMENT

The metal element refers to metals and hard minerals. Metal generates water, corresponding to the West. Metals are smelted, for example, iron is smelted from ore and steel from iron; the “alchemy” that has prevailed for a long time promotes the generation of modern chemistry to a certain extent; therefore, evolution and smelting are its directivity. These characteristics also show that metal is suitable for manufacturing construction products of different shapes.

Limited to the dependence on manpower of ancient metal smelting technology, “Chinese ancient metal buildings mostly existed in temples and courtyards, as luxury buildings”, [6] so the metal cannot be used in

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ancient buildings as widely as it is now, and it is only reflected in some aspects.

Among the ancient buildings in Huizhou, it is common to install metal knockers on the gates; some have metal animal head decorations, and some gates have metal overlays, such as the gate of Chengzhi Hall in Hongcun, Yixian County, which gives full play to the metal's firmness and abrasive resistance, as well as the sound similar to a doorbell when the metal collide with other things. In addition, the fish (also called dragon fish) decorated on the eaves of the gate tower or door cover has two long whiskers, which is also made of metal, and is modified to act as a lightning arrester. Some precious architectural woodcarvings and couplets are coated with gold powder, such as the couplets of Lvfu Hall in Xidi, which not only show wealth, but also protect the wood from rot or damage by worms. In addition, some mercantile families also build "Shang-character shaped gates" [7], such as the main gate of Chengzhi Hall, and paint them with gold powder, which satisfies the psychology of combining business and gold, and implies wealth.

The above applications of the metal element shows that the ancients realized its characteristics. On the one hand, metal is destructive, so weapons are mostly made of metal, which is also extended to war, and spears made of metal is a symbol of war; on the other hand, it is also protective, for example, armors are mostly made of metal; in ancient times, conditional city gates were mostly made of metal, and the "metal" in many words implies impregnability; metal is also long-lasting, which is conducive to long-term storage. Therefore, metal is chosen for gates. In addition, metal is not easy to burn and can be used for fire prevention, for example, coating gold powder on wood carvings and fish made of metal materials imply this meaning.

In addition, the application of metal is also embodied in geomancy. The formation of buildings in Huizhou is inseparable from the prosperity and support of Huizhou merchants. To facilitate business, ancient buildings in Huizhou paid special attention to site selection and direction, most of which were built "near the mountain and by the river, balancing Yin and Yang". According to the guiding ideology that in the "Five-element Theory, metal corresponds to business, fire corresponds to the South, and the fire counters gold, which is ominous" [8], the gates shall not face the south, and mostly face the north, or deviate by ten degrees east or west from true south. In fact, this makes sense in science. Limited by mountainous conditions, buildings in Huizhou mostly occupy a small and dense area; according to the local custom, when men go into business or official careers, they need to have their own houses; therefore, the spatial form is dominated by single houses, and there are few big houses; the ancient Huizhou area was rainy and humid, and the mountains affected the air flow, a deviation to east or west avoided the taboo of the gate and the inner door in a straight line, which ensured air circulation and was also conducive to "gathering air and mental aura".

VI. WATER ELEMENT

As the source of life, the importance of water is self-evident. Water generates wood, corresponding to the North; water flows downhill and cools down. In the Jin Dynasty, Guo Pu said that "in geomancy, obtaining water is the most important, followed by gathering air" [9], which indicate that the core content of

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geomancy is the survey of water.

The ancient buildings in Huizhou regard water as soul and vitality, and they pay particular attention to the application of water, which is mainly reflected in the design of water gathering and diversion. The first is the design of water gathering, which is mainly realized through the patio. Patio, as an inward-looking construction method, is one of the most notable features of the ancient buildings in Huizhou. In the cultural concept in Huizhou, water is wealth; the patio gathers rainwater from the roof and flows into the water storage area or drainage area of the courtyard to create the momentum of "gathering water in the yard", implying that the wealth from all places gathers in the courtyard like the water flowing from the roof; the patio integrates humans with wind, rain and other natural phenomena, which embodies the ancients' yearning for "the unity of nature and man"; it can also naturally cool down through rain, etc., to form a micro-climate of buildings, and create a geomantic layout of "gathering air and mental aura". To highlight this concept, many buildings are designed with multiple patios; for example, Chengzhi Hall in Hongcun has 6 patios (see Fig 2). However, these geomantic ideas are still based on practicality and scientificity: men in Huizhou went out for business all the year round, only their families were left at home; under the influence of the old feudal society, for the sake of safety, people built high walls and small windows on the side facing the street, resulting in unsatisfactory indoor lighting; therefore, the long and narrow patio satisfied the lighting needs of the building, and could also bring natural ventilation, which was conducive to drainage in the rainy season; the water stored in the patio could also be used for firefighting.

Fig 2: Schematic diagram of the patio of Chengzhi Hall in Hongcun ("○" indicates the load-bearing wooden pillars)

The second is the design of water diversion, which is mainly realized through the canal. Due to regional reasons, except for a few houses where wells could be constructed, many families in the ancient Huizhou had to fetch water manually; due to the row upon row of buildings in Huizhou and the narrow and deep lanes, it was difficult to achieve large-scale water transportation; nearby water diversion or storage became the most convenient way to use water; a water channel was built in front of the door to lead mountain spring water or stream water, which could be used for washing, etc.; a pool was dug in the courtyard to lead the water in waterways and store it, becoming a small pond (left corner in Fig 2), and some became fish ponds; the ponds also had water outlets to make the water in the ponds flow. When the waterways reached a certain scale and were connected into a network, the entire building complex formed a canal, which solved the daily water use and prevention of fires in ancient times (now it is only for

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washing, no longer drinking), and also maintained the local warm and humid climate. Building complexes in Hongcun, Xidi, and Pingshan in southern Anhui are all models of water diversion and water use; Hongcun, in particular, is praised as "the ingenious workmanship" [10], which fully demonstrates the scientific and technological wisdom of the ancients.

VII. CONCLUSION

The development of things is inseparable from the actual conditions of the times and society. The application of wood, fire, earth, metal, water in Chinese ancient buildings fully reflects the rationality and scientificity of the time and place; the innovation of architectural ideas is combined with the application of construction methods, embodying the level of technology contained in the buildings. The ancient buildings in Huizhou are surrounded by water and green plants, which meets the requests of geomancy as well as the green building ideas. Some of the effects created are still excellent scientific and technological demonstration cases, which is why they can achieve an important position and prominent reputation today, such as the water system in ancient buildings in Huizhou, etc.; the architectural concepts adopted still have great scientific values, such as the concept of "natural buildings" to protect the environment and live in harmony with nature, which has been rapidly reviving in England, Wales, North America and other countries, especially in Oregon. In addition, some traditional architectural techniques still have strong cultural charm and influence today; for example, when "Li Ziqi, the propagator of traditional Chinese culture", made the "bread kiln", she took a healthy method of mixing earth and straw, showing the traditional architectural culture and simple technological ideas in ancient China.

The historical facts that Chinese ancient buildings were built based on the five elements and derived from the five elements have proved its foresight and scientificity: the harmony between man and nature pursued is highly consistent with the green and sustainable development concept advocated today. The existence of a large number of ancient buildings also illustrates its value and significance: regional cultural thoughts and human survival needs complement each other, reflecting the integration of the five elements in ancient buildings and the application of technology.

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