Tectonic Traditions in Ancient Chinese Architecture, and Their Development

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Abstract
Archaeological discoveries have enriched our understanding of the tectonic traditions that underlie the evolution of ancient building technologies. In ancient China, the natural environment, in particular local climate and abundant building materials, along with the development of agricultural tools, shaped the unique local architectural types referred to as Jinggan, earth constructions that originated in the north of China, and Ganlan and Chuandou that originated in the south. This paper discusses the origin and evolution of each building type, as well as the process of merging the wood-based frames developed in the south of China with the earth-and-wood frames developed in the north. This new integration enabled an advanced jointing technology connecting wood columns and beams, and resulted in the wooden structural Tailiang method for the synthesis of framed and piled-up structures. We therefore argue that, on the basis of examples of such fusion in China as well as in other east Asian countries, integration was established via a strong vernacular foundation building on architectural tectonic recognition that helps us understand ancient Asian architecture.

Keywords: 'framed' and 'piled-up' structures; tectonic traditions; ancient Chinese architecture; cultural fusion

1. Introduction
Depending on climate, hydrology, geology, agricultural production, and customs, ancient China can be divided into two civilized areas that are geographically differentiated by the Qinling Mountains, the Huai River line, generally regarded as the border between south and north China. In the south, the Hemudu site in Zhejiang provides a good example of civilization, while in the north, Banpo in Xian encompasses the central plain (Zhongyuan). Archaeological evidence tells us that ancient Chinese buildings generally either made of wood or were earth-based. In the southern Hemudu culture, wood was plentiful and was used as a major building material. The inhabitants of this region developed wood-framed structures, the components of which were substantially braced and anchored to one another. In contrast, in the northern Yangshao culture, epitomized by the Banpo site, the major building material was loess. We know that ancient Chinese people in the northern region utilized pounded-earth and pile-up techniques, stacking loess to make the foundations and walls of buildings.

As both northern and southern civilizations later merged into mainstream Chinese culture and flourished on the central plain, building techniques were also merged, mutually influencing one another. However, prior to integration, two major tectonic traditions evolved and developed distinctive construction methods, referred to as 'piled-up' and 'framed' structures, respectively. These traditions developed the use of different frameworks in terms of their combinations of wood with earth as well as the application of wood. Thus, 'piled-up' structures were built so that struts rest on beams via the application of successive tiers of beams and struts, while 'framed' structures were built so that a whole framework was constructed using interlinking longitudinal purlins and sills with transverse tie-beams, cutting through columns. Archaeological discoveries show that both these construction methods exhibited their own sequences of relative and independent development, and mutually affected one another through the process of fusion. Creation and development of this combination of building components is based not only on materials, but also on results from the tectonic tradition produced considering the natural environment and human behavior. Thus, this thesis proves that the tectonic tradition originated from an understanding and rapport between the natural environment and human behavior that laid a firm foundation for producing primitive dwellings before they were later upgraded into wooden frameworks.

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This paper is divided into two sub-sections. The first of these presents a discussion of how the categorization of traditional structures in Chinese architecture has been made by focusing on wood-based structures and ignoring other structural systems, such as earth and wooden buildings. The second section reviews the known excavated remains of primitive dwellings, the historical literature, and previous research findings to show that these can be classified into Yangshao and Hemudu cultures that evolved independently. The first of these cultures created 'piled-up' structures that combined earth and timber, while the second created wood-based 'framed' structures. We further argue that the tectonic traditions developed through fusion of the northern and southern main cultures, and later exerting influence on neighboring cultural spheres. Finally, the third section of this paper discusses the relationship between these two tectonic traditions.

2. Criticisms of the Traditional Classification of Ancient Wooden Building Structures

Traditionally, ancient Chinese wooden building structures have been classified into three categories: (1) Post beam and tie framework (Chuandou); (2) Well framework (Jinggan), and; (3) Post beam and strut framework (Tailiang). Of these, the first, Chuandou, is comprised of tie-beams and sills that are tied onto columns, while the roof is constructed via direct connections of purlins and columns. The second, Jinggan, consists of horizontally laid logs with interlaced corners, while the third, Tailiang, comprises successive tiers of beams and struts in a transverse direction, cut to the size of the roof. Cross- beams in the Tailiang structure are not mortised into columns, but rest on top of them. This structural classification was established based on work by the first generation of Chinese architectural theorists. For example, Liu classified ancient building structures into three categories, Tailiang, Chuandou, and Jinggan, while Fu discussed three types of wooden structures, Tailiang, Chuandou, and Milliang Pingding (purlin-and-rafter flat roof). However, if emphasis is placed on the description of superficial appearance, these classifications fall short of fully recognizing the origin of each type, the sequence of evolution in each phase, and an understanding of their mutual influences. Indeed, Tailiang must be viewed as distinct compared with the other two categories because this type is based on structural form and architectural features, rather than superficial figuration and style. In addition, because pile constructions (Ganlan) are derived from nesting settlements in overhead trees (the term Chaoju literally refers to a bird nest-like pile dwelling), they could be included as a further type, but are excluded from the classification discussed here as no mention is made of a specific structural form. As discussed above, these classifications also tend to obscure the origins of structural systems, how they have evolved from other original shapes, and the nature of the relationships they have developed with local building styles while they were assembled over the years. Timber-oriented classifications also do not take structural styles grounded in earth, brick, and stone into consideration.

Of these structural systems, Jinggan and Chuandou types exhibit characteristics of an independent structural system. These are also the oldest of the combination methods and typify 'piled-up' and 'framed' structural methods, the most primitive ways to erect a dwelling. In particular, no columns are used in the Jinggan method and walls are built by horizontally piling logs within a square plan. Although this method was used in a large number of regions across ancient China, Jinggan was never mainstream. As the use of wood became more frequent, the Jinggan structure does have an affinity with the later piled-up Diantang style (palace type). Combining the technology of wood-earth construction that was used in central China, this method provides us with a clue that this layered structure was developed first as a post beam and strut framework composed of multi-tiered brackets, beams, and struts laid in a transverse direction. In contrast, the Chuandou style stemmed from stilt dwellings (Ganlan), built with tenon-and-mortise joints. The framework of this structural style includes transverse tie-beams connected into columns, lacking beams and struts. The pillars in this form directly support the roof purlins, the number of pillars is increased, and horizontal tie beam members are mortised directly into, or tenoned through, manifold columns to form an interlocking matrix that inhibits slanting of a somewhat elastic framework. Thus, the weight of the roof is carried directly above the ground by notched pillars, upon which roof purlins rest, and horizontal tie beam components serve to stabilize the structural framework.

These early pile dwellings originated in southeast Asia, and, indeed, Chuandou are still built by minority groups in Yunnan, Guizhou, Guangxi, Hunan, and Sichuan. Such structural forms have been widespread since the Neolithic period, confirmed by archaeological remains from the Hemudu culture as well as building miniatures excavated from tombs in the Han era (206 BCE to 220 CE). Thus, viewed through the lens of tectonic tradition, the Chuandou building type was established using tenon and mortise joints; with wooden beams penetrating columns and crossing bracket arms, this method later formed the basis of the framed structures that later emerged. Indeed, as a result of gradual cultural exchange between localities as well as adaptations based on regional preferences over time, Jinggan and Chuandou were later merged into 'piled-up' and 'framed' structure buildings and eventually evolved into the 'piled-up' Tailiang type and the 'framed' Tailiang type. One point to note, however, is that the archaeological finds reported to date show that this fusion from ancient building types into Tailiang...
started earlier than anticipated by many authors. One archaeological proof is that the jointing methods described from Banpo are similar to those employed in stilt dwellings (Ganlan) known from Sichuan and Yunnan. Although discovered in northern China, these buildings are characterized by the integrated use of advanced wood crafting technologies, including mortise-and-tenon joints, doors and doorframes, coffins, penetrating sticks, and the use of the tongue and groove method for open mortise and tenon.

Taking all these lines of evidence into account, it is clear that Taillang was not a spontaneous creation but rather a convergence of two ancient vernacular building types. Developed much later than either Chuandou or Jinggan, Tailiang is an advanced structure with greater loading capacity but can only be completed using posts, beams, and struts.

3. The Origins of Different Tectonic Traditions

When humans began to build their own shelters, their primary building materials were soil, stone, and wood. Because the most convenient materials for construction were soil and wood, early forms of shelter were predominantly either burrows or nests. The Yi Jing (Zhouyi), one of the most famous Confucian classic documents, mentions nest dwellings, as "in the past when rulers did not have royal palaces or royal chambers (Gongshi) they at that time lived in caves (Xueju) in winter and in nest dwellings (Chaoju) in summer." It is also written that "people lived in caves and stayed in fields at that time, and later on they were replaced by the Gongshi (palaces or houses) type, putting a ridgepole at the top and rafters (and eaves) below for protection against the wind and rain. The cover (roof) might be derived from the Dazhuang." Later, Han Feizi also wrote that "people were few and animals were many in the past, and they never beat the animals. Thus holy men (Youchaoshi) built nest dwellings (Chaoju meaning bird nest-like pile houses) to avoid the harmful animals." The Mengzi also notes that "building shelters in trees or piles where the land is low, and constructing caves where the land is high." Given these discussions in the literature of ancient architecture, we can conclude that two types of primitive dwellings were initially present, 'cave-type' and 'nest-type' (Figs.1., 2.). Later, a new building type referred to as Gongshi evolved, used for the central buildings of royal palaces by pre-Han ruling powers. Another classic Confucian document, Mozi, refers to another building type constructed on "high rammed earth platforms with timber frames or upon even floors supported by a lot of piles or columns with tenon-and-mortise joints to avoid excessive moisture."

These differences also demonstrate that regional housing types were structured by adaptations in agricultural techniques during the pre-historic era that correspond to changes in climate. Initiation of agriculture during the Neolithic Revolution triggered an increase in productivity. Thus, the inhabitants of different regions used environmental advantages to develop distinct building forms in accordance with their own characteristic construction methods. On the basis of productivity methods, Chen Wei has argued that most archaeological reports are consistent in that Chinese regions can be differentiated into south and north, two distinctive areas of civilization divided geographically by a line that runs from the Qinling Mountains to the Huai River in eastern China, between the Yangtze and Yellow rivers. Thus, in general, the Huai River and the Qinling Mountains are regarded as the line dividing the north and south of China. Although both the Hemudu culture, representative of southern China, and the Banpo culture, representative of northern China, formed the same social structures based on matriarchal society, there are clear differences on either side of this line in the features of buildings that can be related to variation in climate, hydrology, soil, vegetation, agricultural production, and local customs.

The northern and southern regions of China are also divided by the rice cultivation line: northern regions mostly produced wheat and millet, while southern regions produced rice. The map used here is taken from the U.S. Central Intelligence Agency (http://commons.wikimedia.org/) (Fig.3.). Although Shi recognized this classification method and noted that the "division of cultural districts in the early period has not an absolute geographical boundary," he also argued that "a cultural division between Neolithic and pre-Neolithic time
periods was mainly focused on the north and south in China." Shi categorized these cultural areas into three subdivisions. Firstly, on the plateau in the upper reaches of the Yellow River, the Yangshao culture grew millet and provided a sphere of activity for the ancient Qiangrong. Secondly, in the midstream and downstream areas of the Yangtze River and along its east coast, the Dawenkou and Chingliangang cultures encompassed lands used for rice farming, and were areas of activity for the ancient Yiliao (or Yue). Thirdly, inhabitants of the high and cold northern desert and grasslands utilized fine stone tools, and so this region was an archetypal area for hunting, gathering, and ranching, the zone of activity for the ancient Hudingrong. This third culture is also referred to as Hongshan, and it thrived in the territories including the Liaoxi and Liaodong peninsulas and the fertile upper and lower valleys of the Liao River. Although Hongshan culture had a similar social structure to its counterparts in the regions of the Yangtze and Yellow rivers, stone was used as a building material, especially to construct round and square stone platforms as ceremonial centers and symbols of fertility and procreation.

One of the most distinctive geographical features of the Yellow River basin is loess-covered land, the region where dry land farming was first developed in the central part of China. The development of buildings in this area is closely connected with the material characteristics of loess; this environment enabled the development of the unique tectonic tradition based on the superposition method of earth layers to erect walls. Thus, for above ground construction, the 'piled-up' system uses superimposed components to secure stability. This method of construction employs not only an earth structure, but a combination of earth and wood, this being the key prehistoric traditions around Taihu Lake, most ritual buildings, including the exquisite jade burial tombs of nobles, were built on high rammed-earth platforms. For example, as the Mojiao Mountain Fortress, located between Liangzhu and Pingyao townships, three rammed-earth platforms, supposed to be the foundations for grand palaces, were situated in a triangle. Yaojiadun comprised three settlement groups making up nine discrete dwelling precincts along a south-north axis and symmetrical east-west placement on sandstone building foundations. In addition, a few dwellings in the Liangzhu culture were also built above mounds. As well as pile dwellings from other periods, underground and semi-underground dwellings in northern areas coexisted at the same time, but utilized different wall materials including bamboo strips and mud plaster. These houses were either leveled, or recessed, into the ground, and evidence the use of numerous construction methods to flatten land. This was done on a base of burned red soil, paved with black ash and yellow soil, and pounded to make firm foundations before being completed by the installation of woven reed mats. In the Yellow River basin, inhabitants partly dug into the loess soil.

At this time, a very efficient building structure was developed that comprises three parts, a platform, columns and beams, and a roof. At the Xiaojia Wuji site in the Qujialing period, one building labeled F15 shows the use of unburnt earth walls in timber

4. The Cultural Fusion between Timber Frameworks and Earth Construction

It is notable is that cultural exchanges developed between the northern Yangshao and southern Songze cultures (Fig.4.). As a result of the influx of the rammed-earth technique using piled-up earthwork from northern China, construction emerged from the Songze culture after Hemudu. Artificially piled-up pounded-earth platforms have been discovered at Nanhu Lake in Jiaxing, Zhejiang, and the same platform type existed in the Yangshao culture. This podium comprised an overall square-shaped structure constructed by stacking different colors of earth. In late Songze culture, rammed-earth walls were also used in cities, while in the Liangzhu culture, which developed from Songze and was one of the key prehistoric cultures around Taihu Lake, most ritual buildings, including the exquisite jade burial tombs of nobles, were built on high rammed-earth platforms. For example, as the Mojiao Mountain Fortress, located between Liangzhu and Pingyao townships, three rammed-earth platforms, supposed to be the foundations for grand palaces, were situated in a triangle. Yaojiadun comprised three settlement groups making up nine discrete dwelling precincts along a south-north axis and symmetrical east-west placement on sandstone building foundations. In addition, a few dwellings in the Liangzhu culture were also built above mounds. As well as pile dwellings from other periods, underground and semi-underground dwellings in northern areas coexisted at the same time, but utilized different wall materials including bamboo strips and mud plaster. These houses were either leveled, or recessed, into the ground, and evidence the use of numerous construction methods to flatten land. This was done on a base of burned red soil, paved with black ash and yellow soil, and pounded to make firm foundations before being completed by the installation of woven reed mats. In the Yellow River basin, inhabitants partly dug into the loess soil.

At this time, a very efficient building structure was developed that comprises three parts, a platform, columns and beams, and a roof. At the Xiaojia Wuji site in the Qujialing period, one building labeled F15 shows the use of unburnt earth walls in timber
columns and a wooden framework with pillars and beams. (Figs.5., 6.), while in the northern area of this site a framed structure (labeled F1) with a column-and-beam system was employed to support load-bearing structures. Similar timber-framed buildings with column-and-beam systems for load-bearing have been excavated at the F24 and F25 sites at Banpo in Xian (Figs.7., 8.). It is clear that, as a result of mutual influences, earth-and-wood composite structures existed in both northern and southern regions at this time, and that appropriate and ingenious methods were used for their construction depending on the local conditions and geographic environment. In addition to early primitive dwellings, pile dwellings were present in the south and underground dwellings were used in the north. However, these types began to lose their originality via the cultural mixing of building construction between the two regions in the early Neolithic period, although local construction methods and evidence of tectonic development were retained.

Members of the Hemudu culture utilized both agriculture and hunting, and in order to adapt to wetland environments including marshes, rivers, and lakes, they built pile dwellings for protection from inundation and damp. Indeed, judging from the large number of wooden utensils unearthed at the Hemudu site, wood crafting technology was used more frequently in this culture than by the primitive society at Banpo in the Yellow River valley. Inhabitants at Hemudu produced wooden instruments and utensils, including plows, paddles, bowls, mallets, and sticks with spinning wheels. These wooden utensils incorporate fine ornamentation, representing the unique social and cultural characteristics of Hemudu inhabitants. At the same time, however, ceramic industry at Hemudu remained primitive, evidenced by the fact that the pottery from this site has thick walls, and irregular shapes and surfaces. In contrast, the ceramic industry at Banpo was more delicate as earthenware bowls and pot-like cooking utensils with round-mouths and three hollow-legs were used in daily life.

Hemudu inhabitants had also developed a number of refined ways of dealing with wood, while the people at Banpo were much more proficient in ceramic technology. As a result, in terms of techniques for timber-framed building constructions, tenon-and-mortise joint methods were well-developed at Hemudu, while the F1 site at Banpo shows instead the use of joints tied with rope. Although it is hard to judge based on partial and fragmentary archaeological remains,
it is nevertheless possible to infer that the original inhabitants of the Yangshao period probably utilized just small amounts of wood in building dwellings. Hemudu inhabitants, in contrast, lived in a region with abundant wood resources and so employed more timber-framed components than their counterparts in the Yellow River Basin. The abundant availability of wood as a building material had a considerable impact on the development of construction methods in southern China (Figs.9., 10.). During the Liangzhu period, between 5,000 BCE and 4,000 BCE, the formation of early kingdoms and population growth increased demand for large-scale and grandiose buildings. To meet this new demand, old pile dwellings were no longer constructed and the development of timber-framed and earth-and-wood structures can be closely connected to the dissemination of agricultural techniques. The systematic change in productive economy from fishing, gathering and hunting to agriculture was a revolution in the Neolithic period.

As part of the process of political and economic development, commerce via roads and rivers and territorial occupation through wars resulted in various technical fusions between earth and timber building techniques. Consequently, the timber-based framed system and the earth-and-wood piled-up system were gradually merged to create a single unified building technology. In terms of tectonic traditions, two different cultures co-existed at this time. The first of these, Hemudu, initially used the timber framework building method and affected the framed structure used by carpenters, while the second, Yangshao, developed the use of wood and earth that influenced the development of piled-up structures.

5. The Influence of Building Materials and Tools on the Fusion of Building Technology

Advanced technology first found at the Hemudu site in southern China (the origin of the Liangzhu and Majibang cultures) was later exported to the Yangshao culture in the north (influenced by the Peiligang and Cishan cultures). Thus, wooden frameworks developed in the Hemudu culture gradually overwhelmed the existing building methods of the Cishan, and the inhabitants of northern China incorporated timber framework buildings with tenon-and-mortise joints, integrating them with existing earth construction. For example, during the Yangshao period, this combined approach led to the development of buildings with wattle-daub walls, built by placing mud inside pockets in the timber frame. Walls in this type of dwelling were made using upright poles interlaced with vines or small sticks while mud mixed with straw and grass was plastered over them to create a solid construction.

This tectonic tradition, related to the development of ancient building technologies, was also deeply influenced by crafting tools. For example, during the late Neolithic period, this tradition was rooted in the development of agriculture, and the primary building tools used in this early phase were mostly developed initially for harvesting. Archaeological finds clearly reveal the presence of two regional lineages in the development of building tools, wood crafted in the south and polished stone in the north. Of these, wood technology was used more frequently in the Hemudu culture than in the Banpo culture to the north, while the harvesting tools utilized by the Hemudu comprised small polished stones, bones, and wooden tools including rectangular stones and ceramic blade knives. A variety of tools for fine craftsmanship were used for timber-framed building construction, and demonstrate the finesse and elegance of the Hemudu culture. Numerous bones and butterfly-like wooden tools used for rice farming have been collected, for example. The former were used for dredging paddy fields, while the latter were used to flatten muddy fields. Indeed, Hemudu bone tools are amongst the most distinctive features of these Neolithic sites; these tools were used for producing the chisels, needles, awls, arrows, whistles, and sickles that were required for crafting timber-framed and earth-reinforced walls. Archaeological finds clearly reveal the presence of two regional lineages in the development of building tools, wood crafted in the south and polished stone in the north.

Excavations at the early archaeological sites at Banpo (e.g., F37, F21, F41) show that harvesting spades, used for digging and shoveling earth, were also used for building semi-underground caves or dwellings, and later for digging holes for columns (Figs.11., 12.). Axes were also used for chopping wood, setting columns in holes, and tapering the bases of piles. Finds show that the industry that used loess and stone as building materials was highly advanced, and that development, especially in the Yangshao culture, can be linked to the adoption of timber-framed and earth-reinforced walls. In these cases, joints were tied with rope and finished with rattan and kudzu, and there were significant changes in construction methods via the combination of...
earth and wood (Tumu) as principal building materials at this time. Rammed-earth constructions, which affected the tectonic traditions of 'piled-up' structures, appeared around this time in northern and southern China. Timber-framed earthen buildings set directly on the ground, an influence of the Hemudu culture, are seen at Banpo and near the Chang River, while the timber-framed buildings built on the ground at Hemudu were merged with rammed-earth platforms and mud walls to create frameworks. Two building types from the Majiabang culture have been excavated at the Hemudu site, remains at Xiangcapeohe that belong to pile construction, and those at Meiyan, Majiabang, and Qucheng that can be regarded as on-the-ground dwellings with vertical wood-skeleton mud walls made of hard soil layers and with columns placed in pits. In the late Songze culture, artificially piled-soil units at the Nanhuhong site are overall square structures, uniquely constructed by piling up different colored earth layers. Rammed-earth walls and constructions are also seen at this site. Indeed, most of the principal buildings, including tombs, that have been excavated around the Yangtze River were built using timber framed structures on rammed-earth platforms. As noted above, two different kinds of wood-and-earth construction are seen at Xiaojia Wuji, built by the Qujialing culture near the Chang River. Of these, timber-framed walls fastened by bamboo strips and plastered with mud were uncovered at the F1 site, while timber-framed column-and-beam walls that incorporate unburnt earthenware bricks were found at the F15 site (Figs. 5, 6).

Regarding the construction techniques used for timber-framed buildings, while the Hemudu had developed methods utilizing mortise-and-tenon joints, the Banpo made more use of joints tied with rope (Figs. 9, 10). While framed structures that utilized tenon-and-mortise joints gradually migrated from southern to northern areas, including Henan and Hebei, competition between tenon-and-mortise joints and methods involving winding-up rope came to an end in dominance of the latter. Indeed, the prevalence of tenon-and-mortise jointing technology indicates a preference for wooden structures at this time, due mainly to their superior structural stability. The ascendancy of this approach over rope-tying is a direct result of the tools developed for rice farming in the south. In the Yangshao culture, fused constructions appeared in the form of combinations of walls and platform foundations with piled-up rammed-earth, followed by wattle and daub constructions where walls were constructed using a timber skeleton. In contrast, wooden-framed structures with a post, beam, and tie framework for columns and roofs with earth-pounded foundation platforms were imported from the Hemudu culture. Over time, preference for wooden constructions increased as walled cities were established and unified kingdoms emerged subsequent to the Longshan culture. The technological integration of earth-oriented construction with timber-framed structures was the result of evolution building on the tectonic tradition of 'piled-up' and 'framed' structures, as well as their cultural assimilation.

As a consequence, new building types emerged that corresponded with tectonic incorporation. The Examples include massive rammed-earth and high-platform structures built on a grand scale and illustrated in the historical literature, including Yiji, Zhouyi, and Han Feizi. Such buildings have been discovered at archaeological sites that date back to the early Bronze period (between the 21st century BCE and the 5th century BCE). One huge raised platform, more than ten meters long and one meter high, with pillar bases was excavated in the late Shang walled city at Zhengzhou, in Henan Province.

6. Conclusion: Tectonic Traditions of 'Piled-up' and 'Framed' Wooden Structures

It is the case that a single building can be interpreted and classified in many different ways, on the basis of the figurative features of the whole or on the eclectic style of components, for example bracket sets, roofs, and columns. Although classification can also be done on the basis of the abstract philosophical context that lies behind superficial features, ancient architecture must be interpreted in more comprehensive ways via an understanding of tectonic traditions and their historical context. Indeed, to better understand ancient Chinese architecture, Zhang Siqing insisted that dialectic tectonic traditions should be emphasized that evolved by embracing the unique local natural and cultural environment. In addition to the 'piled-up' log cabin (Jinggan) and the through-joined Chaandou systems, Tailiang also incorporated features from earth-timber (Tumu) constructions. Grounded in local adaptation, Tailiang can be divided into two branch types enhanced by the Tailiang type and emphasizing a 'piled-up' system as well as the Tailiang type which incorporates a framed system. This categorization, on the basis of the tectonic traditions of 'piled-up' and 'framed' structures, is useful

Fig.11. Building F21, a Semi-subterranean Dwelling at the Early Banpo Site

Fig.12. Building F37, a Semi-subterranean Dwelling at the Early Banpo Site
for understanding the genetic characteristics of ancient Chinese architecture that has a variety of vernacular roots. The possibility remains that the 'piled-up' Taliang structure evolved from Jingga into Tuma, while the 'framed' Taliang could have evolved from Galan into Chuandou, or vice versa. Thus, buildings in different Chinese Great Encyclopedia: Archaeology, Wuhan: Hubei, 1966. As well as reciprocal influence between southern and northern regions. The evidence presented here reveals two tectonic traditions, a northern earth-wood structure and a southern wood-framed structure that gradually integrated and merged into one over time. As the advantages of both 'piled-up' and 'framed' wooden structures became dominant, they later influenced the tectonic traditions of other east Asian countries. We believe that the application of tectonic traditions in a historical context greatly augments our understanding of the mostly unknown evolution and development of ancient architecture in non-western civilizations. It is inevitable that there are fl aws in this research caused by a lack of well-established theories. Thus, this study should be viewed as one of many efforts to suggest an alternative approach to our understanding of ancient Asian architecture. A more detailed survey should be conducted in future research to compile a database of existing ancient buildings that combine various mixtures of the two known tectonic traditions.

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Notes


2. The word 'tectonic' originates from Greek, where 'tekton' was a building master or a carpenter, resembling 'technic,' which means technology or the art of making, or 'the techne of carpentry.' While 'techne' indicates art or craft in all fields, tectonics implies the art of carpentry. Thus, tectonic implicates the art of architectural construction joining of form elements to a unity. K. Frampton (1995), Studies in Tectonic Culture, Cambridge, MA: MIT Press, pp.3-4.

3. Ibid., pp.549-558.


6. In a few proofs, one also should note the long rows of rooms found in the archaeological sites of the Yangshao culture distributed in Henan; engraved tablets of clan settlements in the Hebei culture (about 4000 BCE to 3000 BCE); and tribal cemeteries of the Majiayao culture found near Liuan village at Qinghai. C. Zhang (2003) “Changjiang Zhongxiayoudiqushiqian Juluo yanjiu,” Wenwu, p.150.


8. Liyu in the Juan 9 of the Yi Yi.

9. Xici xia in the Chapter 2 of the Zhouyi.

10. Wudu in the Juan 49 of the Han Feizi.

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