Mediterranean Archaeology and Archaeometry
2024, 24(3), 1314
ISSN:2241-8121
https://www.maajournal.com/ **Research Article**

The Archaeological Value Excavation and Digital Development of the Liangzhu Site and its Impact on the Urban Culture of the Museum

Hao Ni [1*]

[1] Associate Professor, Department, Shanghai Urban Construction Vocational College, Shanghai, China
* **Corresponding Author:** nhao1229@163.com

Citation: Ni, H. (2024). The Archaeological Value Excavation and Digital Development of the Liangzhu Site and its Impact on the Urban Culture of the Museum. *Mediterranean Archaeology and Archaeometry*, *24*(3), 206–222. 10.5281/zenodo.13626988

ARTICLE INFO

Received: 07 Apr 2024
Accepted: 17 May 2024

ABSTRACT

In order to further explore the impact of digital development and archaeological excavation on the urban development of museums, this paper takes the Liangzhu site as the research object. The artifacts of the site were surveyed and their materials, shapes, connotations, colors, structures, and symmetries were studied. The results show that the jade, ceramics and wood carvings of Liangzhu site are mainly spiritual birds and dragon patterns, mainly streamlined, the colors are mainly blue, yellow and red, black is the background color, and the main dyeing materials are copper sulfate, iron oxide and arsenic oxide. Among them, the texture of jade is round, but contains many impurities, and the ceramic enamel is thicker, between 2~3mm. Jade, ceramics and wood carvings are complex and composite, with reasonable mechanical balance and symmetry of the central axis. Therefore, the Liangzhu site plays an important role in promoting the construction of museum city and digital research, and can provide more information.

Keywords: Liangzhu Site, Archaeological Value, Digital Development, Museum City.

INTRODUCTION

The Liangzhu site is in the Neolithic period (3300~2300 BC), located in the western suburbs of Hangzhou, Zhejiang, China, and is one of the earliest urban sites in Neolithic history, which was discovered in the 30s of the 20th centuries (Allen, Yang, Lin, Zhou & Sheng, 2023; Bin, 2022). The Liangzhu culture was formed in the late Neolithic period in China and was one of the important cultures at that time, with a history of about 5,000 years. The Liangzhu site is one of the important sites of China's prehistoric civilization. The site is extremely vast, with about 10 million square meters of city ruins, and its scale is quite large, which can reflect the prosperity and planning of the ancient city of China. The Liangzhu site is dated to the Neolithic Age (3300~2300 BC), one of the Chinese nation's historical and cultural heritage and is recognized by domestic archaeologists. In the Liangzhu site, many cultural relics have been found, including many stone tools and jade, stone tools, pottery, etc., and at the same time, many tomb remains with research value have been found in the Liangzhu site (Guo, 2023; Larrivé-Bass, 2023). The cultural relics and relics show the life and lifestyle of the Liangzhu culture period and reveal the ecology of social civilization at that time, which provides many precious contents for understanding the initial period of Chinese civilization. First, stone tools. In ancient times, stone tools were very important ritual tools, and at the same time, they also had important symbolic meanings, which could reflect the social system, religious beliefs, and smelting technology level of the time. The stone tools found in the Liangzhu site are one of the most representative cultural relics, and the stone tools include many different shapes, such as tripods, pots, etc., which can show the smelting technology and craftsmanship level of that period, and have great artistic value. Second, jade. Jade is also an important part of Liangzhu culture. Fine jade includes a variety of shapes, such as round, square column, etc. In ancient China, jade was always a sacred cultural relic and a symbol of nobility and purity, so at that time, jade had a very special artistic value and was welcomed. Based on this, it is necessary to deepen the research on the jade artifacts unearthed at the Liangzhu site to better understand and understand the Chinese

jade craftsmanship more than 5,000 years ago. Third, pottery. In ancient Chinese life, pottery was also a very important utensil. Many potteries unearthed in the Liangzhu site are exquisite in appearance and craftsmanship, and they have a variety of different colors, which shows that the people at that time had mastered basic ceramic craftsmanship and were able to use it skillfully (Huan et al., 2022; Z. H. Liu & Chang, 2023). In addition, in the Liangzhu site, many burials remain have been found. The remains of the tombs, including single pit tombs and family graves, vary in type, revealing thoughts on the meaning of life and death in that period and information such as family relationships and social structures at that time. Therefore, the protection and research of Liangzhu ruins and culture has always been a subject of great historical and cultural significance. The stone tool making technology and jade making technology in the Liangzhu site are all famous Liangzhu cultural heritage, which can show that the stone tool production at that time was relatively developed and had a reasonable social organization. The characteristics allow future generations to recognize the smelting and manufacturing technology of the Neolithic Age (3300~2300 BC) and fill the gap in this regard, which is of great practical significance for human beings to explore the origin of Chinese civilization and the Chinese nation. Many stone artifacts, jade, pottery, and tomb cultural relics have been excavated from the Liangzhu site, and the discovery of exquisite cultural relics can reflect the maturity of smelting technology at that time, and reflect the thinking of culture and craftsmanship at that time. Through the study of the cultural relics unearthed at the Liangzhu site, we can deduce the form of social organization and the technical level of stone tool making at that time, and compare and analyze the material and cultural characteristics of different periods, to reveal the historical evolution process and social changes of the Liangzhu site area (Lian et al., 2022; Y. Wang et al., 2022). The Liangzhu site can provide rich historical and cultural background information and important archaeological clues and sources for modern researchers, which can be beneficial to related research in later generations. In addition to its great academic significance, the research results also have practical significance in promoting the understanding of ancient Chinese civilization. Based on this, this paper fully excavates the archaeological value of the Liangzhu site and analyzes the space of its digital development. At the same time, this paper studies its influence on the urban culture of modern museums. It concludes that the unique culture formed on the Liangzhu site has a variety of influences on the culture of modern museum cities, which is mainly reflected in promoting the development of local tourism and enriching the cultural connotation of the city.

RESEARCH METHODS AND RESULTS

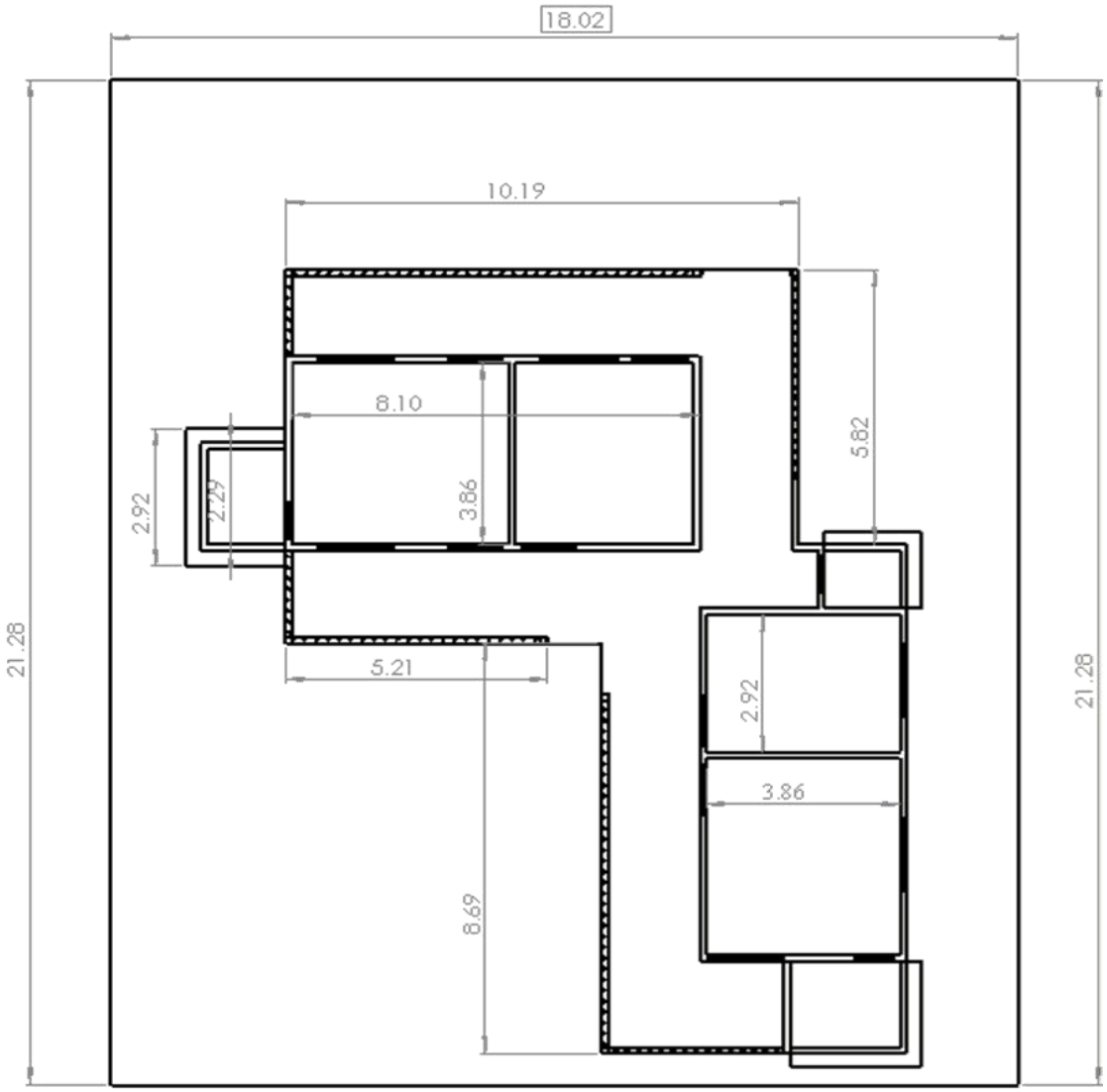
Research Methodology

Taking jade, ceramics and wood carvings as the research objects, 4K scanners (Japan, Panasonic, K300, model, 36 times) and pressure gauges (Guangdong, Dongguan, 10N, matrix 16*16) were used, and the test indicators were shape, dyes, structure, symmetry, materials and cultural connotations. The specimens are public artifacts, and the structures and dyes are literature searches, so the study of artifacts does not involve confidentiality.

Materials and Dyeing of Jade, Ceramics, and Wood Carvings

In this paper, the Liangzhu site is taken as the research object, and the measurement of the excavation site is shown in Figure 1.

Field Survey Photographs



CAD Drawing Picture (Unit: m)

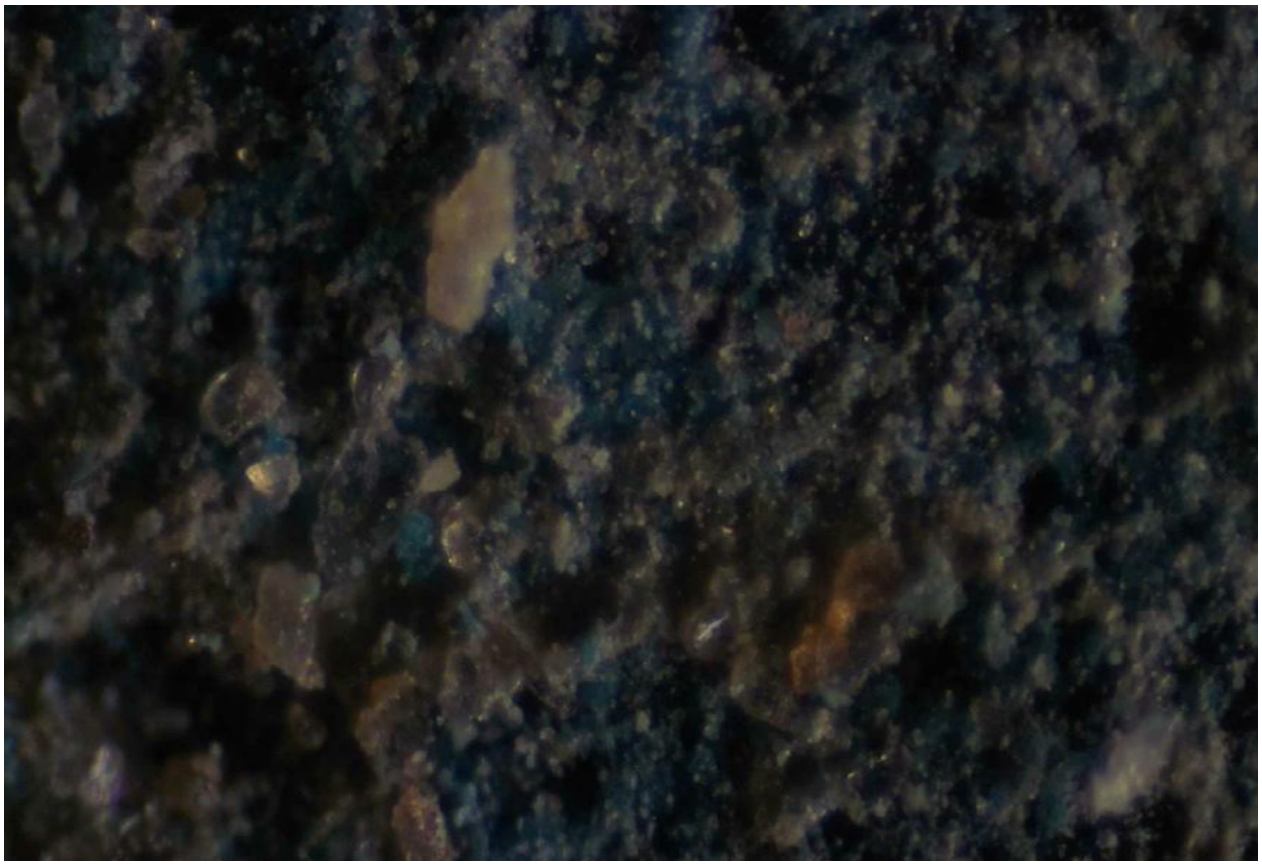
Figure 1. Field Survey of the Liangzhu Site

Comparing the jade, wood carvings and ceramics in the Liangzhu site, and observing their materials and colors, it is found that their colors are single and the materials are relatively common, but the tightness and smoothness of the materials are high, as shown in Table 1.

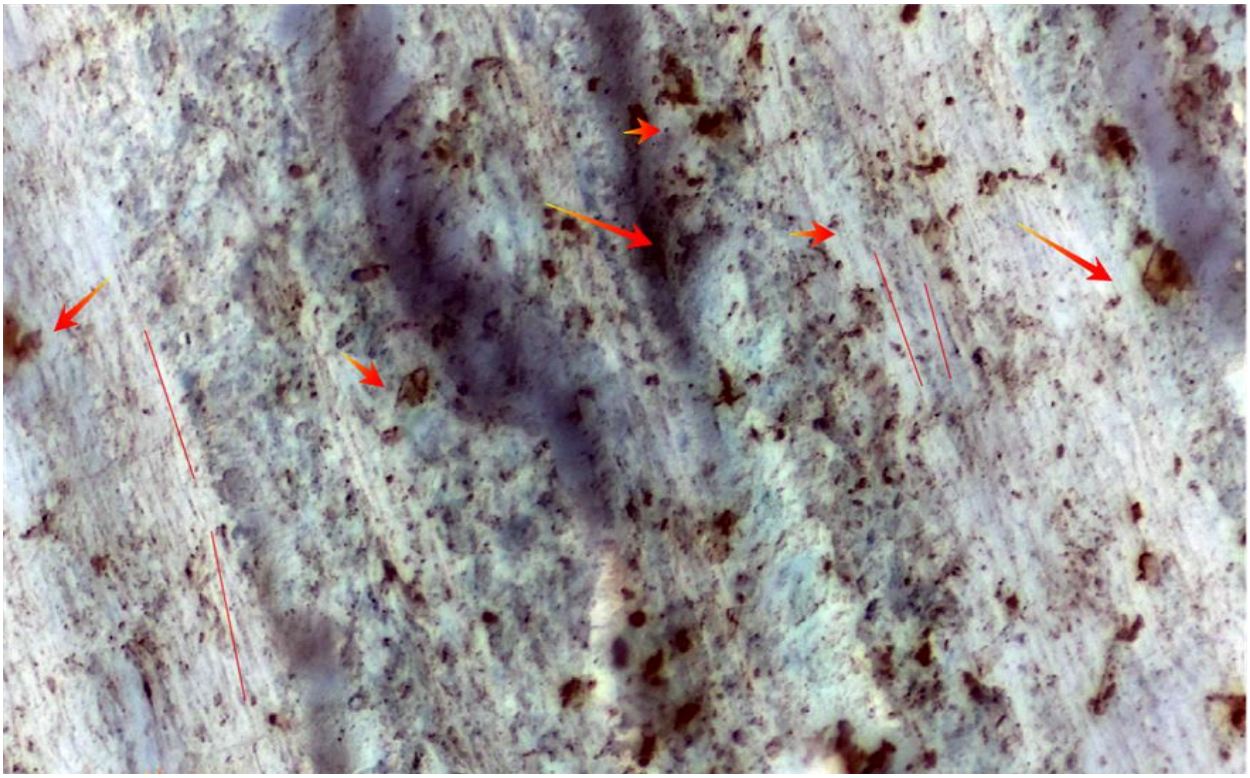
Table 1. Materials of Chinese Objects at the Liangzhu Site

Type	Material	Dye	Craft	Remark
Jade	Jade, which contains many impurities, contains iron oxide, ferric oxide	Calcium carbonate, carbon, iron oxide, evergreen powder, copper sulfate	Grinding, polishing, engraving	The depth of the carving is 1~2cm, and it is polished with stone and sheepskin
Woodcarving	Elm, pine			
Ceramics	Clay, feldspar, kaolin			

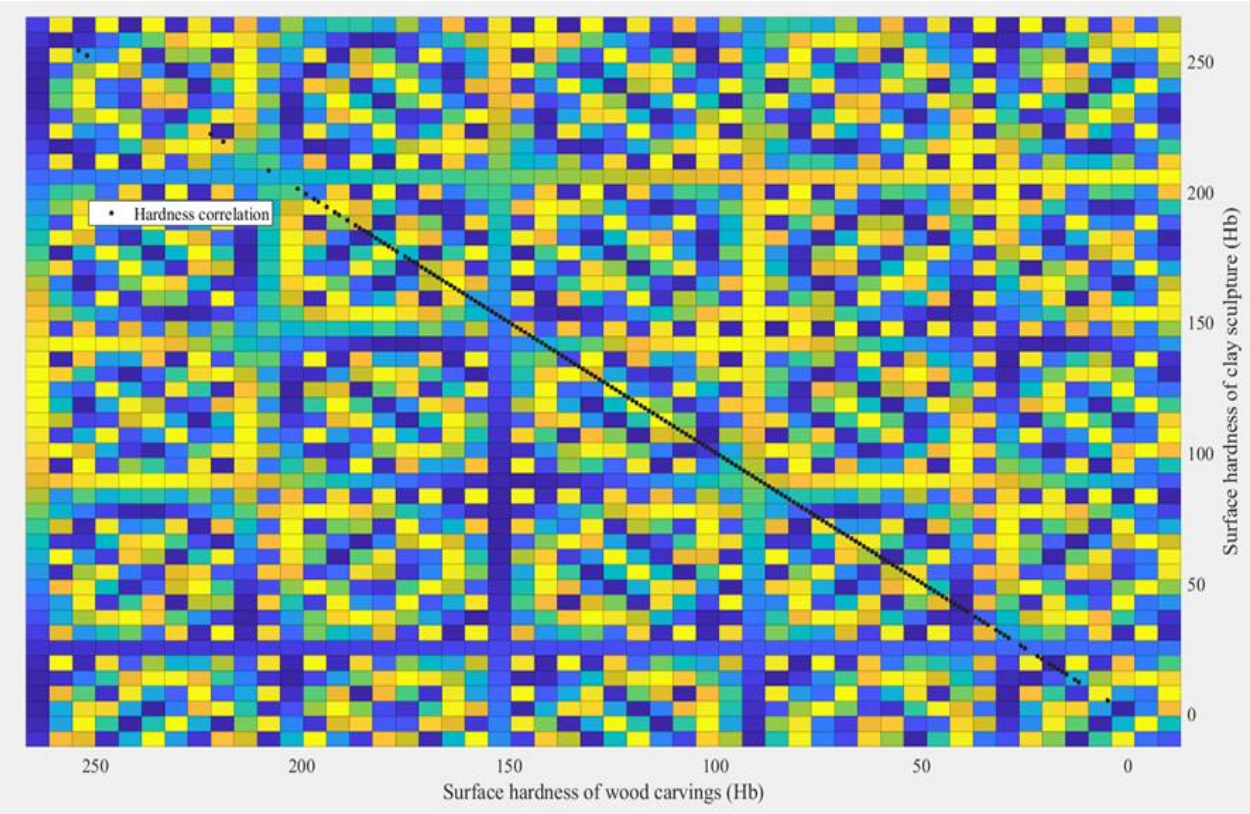
According to the content in Table 1, the Chinese materials of the Liangzhu site are single, which are commonly used materials, such as clay, feldspar, kaolin, etc., and are simply polished and polished. However, the diversity of cultural relics and the composition of dye materials have an important supporting role in excavating cultural relics in the Neolithic Age (3300~2300 BC). The historical development trajectory of Liangzhu culture can be roughly divided into three stages: the initial stage (2800~2500 BC). In the early days of the development of the Liangzhu site, the villages in the site were basically small-scale, and they generally lived by hunting and fishing. Many potteries unearthed from the site is basically handmade, with a simple structure and a single aesthetic taste. Middle stage (2500~2200 BC). The Liangzhu culture at this stage has developed rapidly, and the social organization has developed to a certain degree of complexity, which can be seen from the increase (or expansion) of the scale and number of its sites, and the number of cities and settlements within the Liangzhu culture has increased during this stage (Z. H. Liu, 2023; H. Y. Wang et al., 2024). Agricultural production has also been further developed, especially stone tool production, which is basically dominated by jade production, with exquisite shapes, and has reached a certain degree of development. Late stage (2200~2000 BC). During this period, the Liangzhu culture reached its heyday. During this period, the Liangzhu site was very complete, with a large scale and complex structure, which shows that the social organization and political structure at that time were mature. Obviously, the Liangzhu site is not only a residential area, but also contains various other functions, such as religious sacrifices and handicrafts. At that time, handicraft technology became an artistic pastime and cultural transaction, and the production of various pottery and jade was able to meet the needs of life and aesthetics. Fourth, the period of decline and extinction (2000~1800 BC). During this period, the Liangzhu culture gradually declined, and eventually disappeared into the long river of history. The specific reasons are complex, and may include changes in the natural environment, intensifying internal social contradictions, and mutual integration with other Chinese groups. From the cultural heritage of the Liangzhu site, many related imprints have been found, which have a profound and long-lasting impact on the later Neolithic culture. Many scholars believe that some religious beliefs, symbols, and forms of social organization in the Liangzhu culture have profoundly impacted the protection, inheritance and development of the later Neolithic history and culture. At present, the Liangzhu site has been inscribed on the World Heritage List, which also shows that the international community has fully recognized the Liangzhu culture and its contribution to human history. The observation of the surface material of the cultural relics is shown in Figure 2.



Terracotta Interior



Wood Carved Surface



Hardness Correlation between Wood Carving and Clay Sculpture

Figure 2. Surface Observation of Clay and Wood Carvings

As can be seen from Figure 2, the pottery has large grains, containing large particles such as quartz, clay, and evergreen, and the surface of the wood carving contains a large amount of oil and oil. The surface of the pottery is intact and free of scratches, mainly made of clay sculpture after firing, and many polishing marks have been found in the wood carving, and the traces are consistent with the wood grain. This shows that the cultural relics of the Liangzhu site are simple to make, but a simple clay and wood carving culture has been formed. The discovery of the Liangzhu site studies the development of Liangzhu culture from multiple perspectives, such as the development of Neolithic cities and culture, agriculture, and stone tool making.According to the hardness observation of the cultural relics unearthed in the site, there is a commonality between the hardness of woodcarving and ceramics, and the results are shown in Table 2.

Table 2. Commonality Analysis of Hardness of Woodcut and Clay in Excavated Cultural Relics

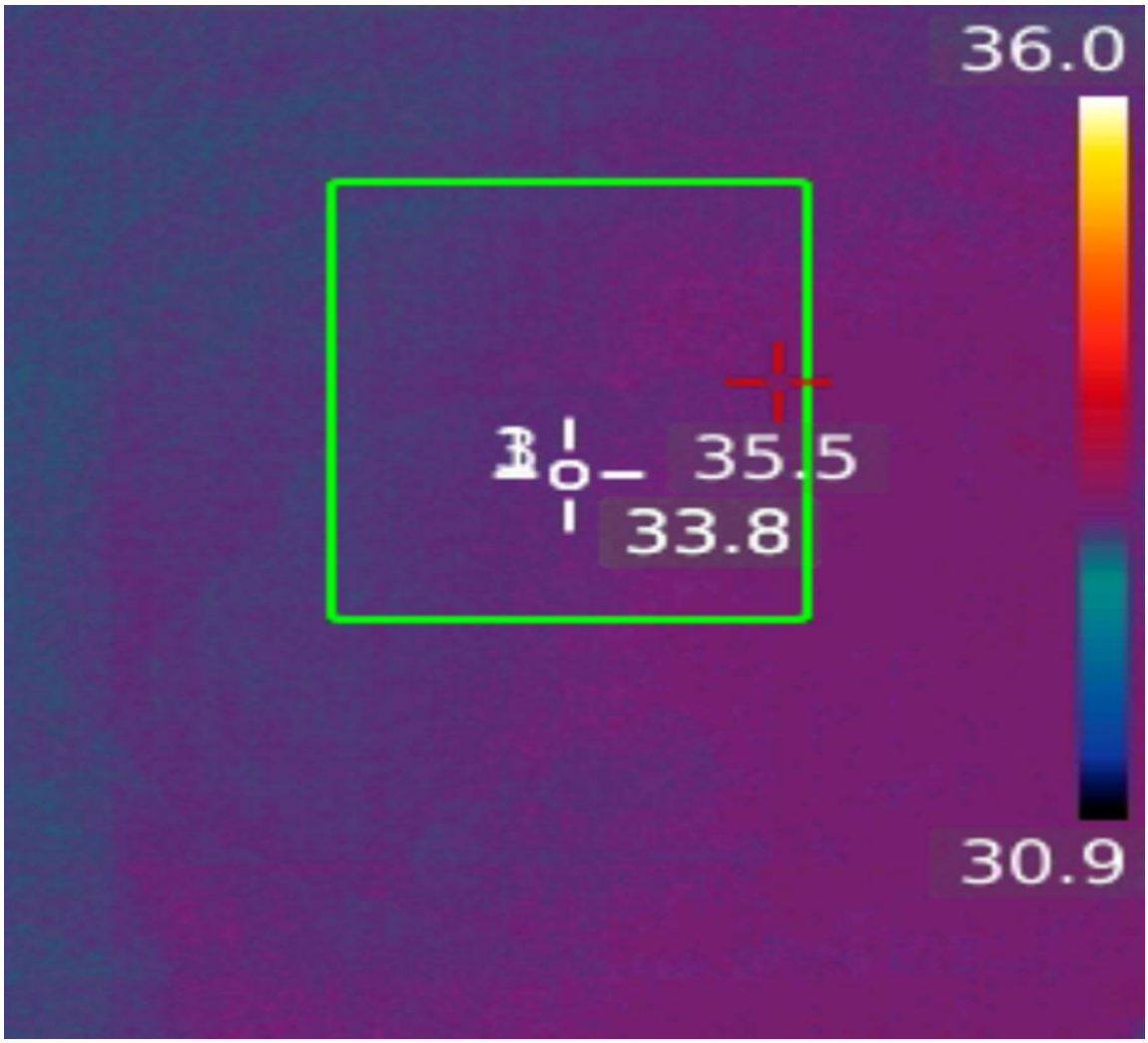
Features	Cultural Relic	Regression Coefficients	Error	Differences	Universality
Generality	Woodcut	0.995	1.261	0.789	0.453
	Kaolin	0.177	0.510	0.346	0.738
	Average value	1.294	1.405	-0.921	0.384

It can be seen from Table 2 that the hardness of woodcut and clay is higher than the average, indicating that the tooth decay of the unearthed cultural relics is mainly gold, silver and silk. The error of woodcut is large, indicating that the corrosion resistance of woodcut is poor. However, the prevalence of woodcuts and clay is strong, indicating that the clay and woodcuts unearthed in the site have regional characteristics. The Liangzhu site is one of the important sites of the late Neolithic period (2800~2300 BC), and its layout can show that the society at that time was relatively developed, with certain smelting and mining technology (Y. Liu & Shi, 2022; Wu, Wang, Zhang, & Ge, 2022). In the Liangzhu site, many different structures have been found, such as city walls, palaces,

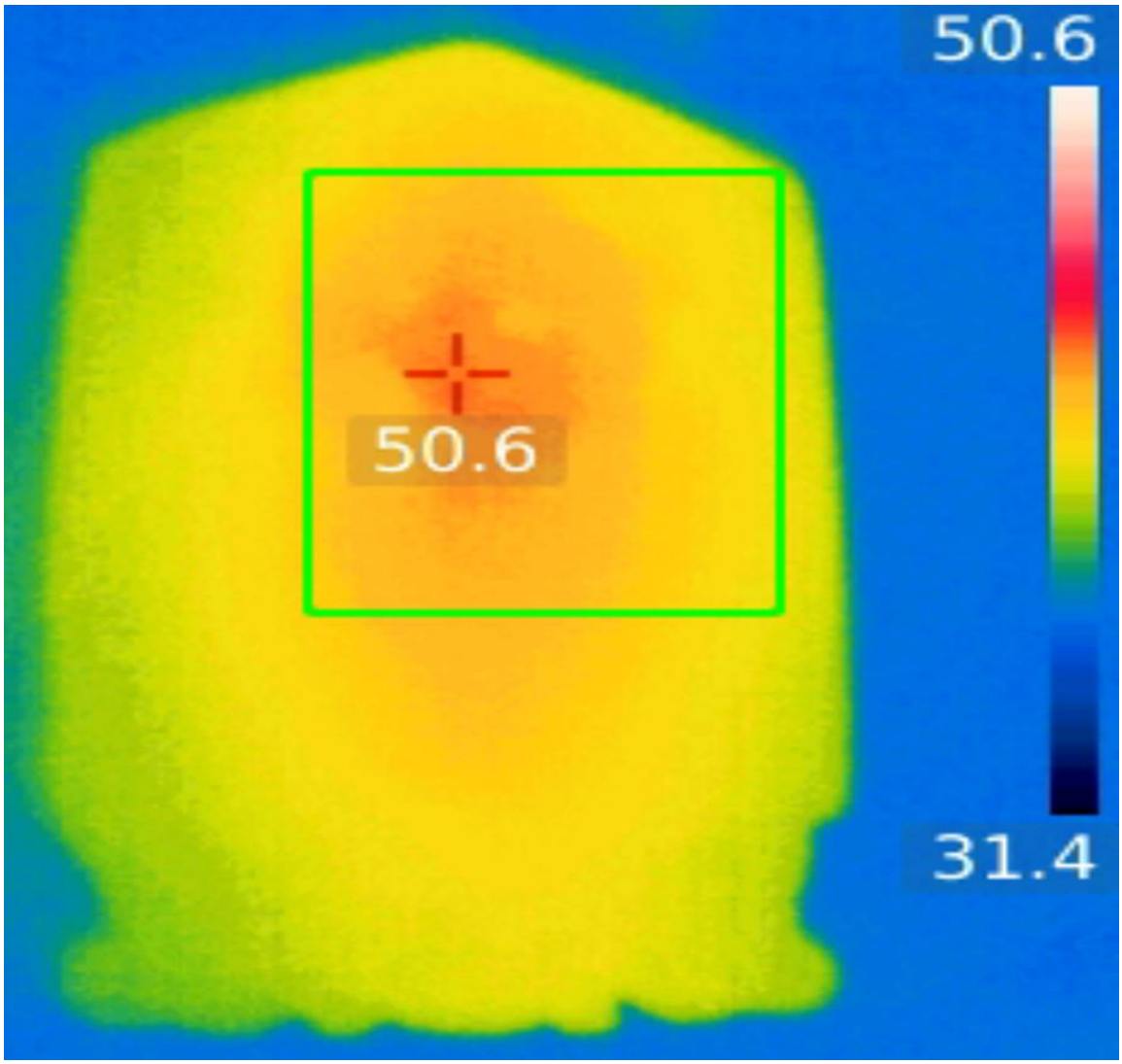
and architectural ruins, which can show that the Liangzhu site is large in scale, has a certain social organization ability, and can reflect the social culture, political center, and administrative level of the time. The Liangzhu culture has always been an important part, which can be seen from the integrity of the preservation of the Liangzhu site and the grandeur of its scale. At the same time, it has certain connections and exchanges with other ancient Chinese cultures, such as Longshan culture or Yangshao culture (Long, 2022; Xiao, Shang, Xu, Jia, & Xiao, 2023). By studying the cultural relics unearthed at the Liangzhu site and comparing them in detail, we can reveal the cultural exchange and integration of the Neolithic Age (3300~2300 BC). Many stone objects unearthed in the Liangzhu site, such as agricultural tools and pottery, can reflect the development level of agricultural production and stone tool production during the development period of Liangzhu culture. From the formation of agricultural production technology at that time, its scale, and development, the urban population at that time relied mainly on agricultural activities to ensure sufficient livelihood, and stone tool making technology was one of the main production supports at that time.

The Structure and Balance of the Liangzhu Site

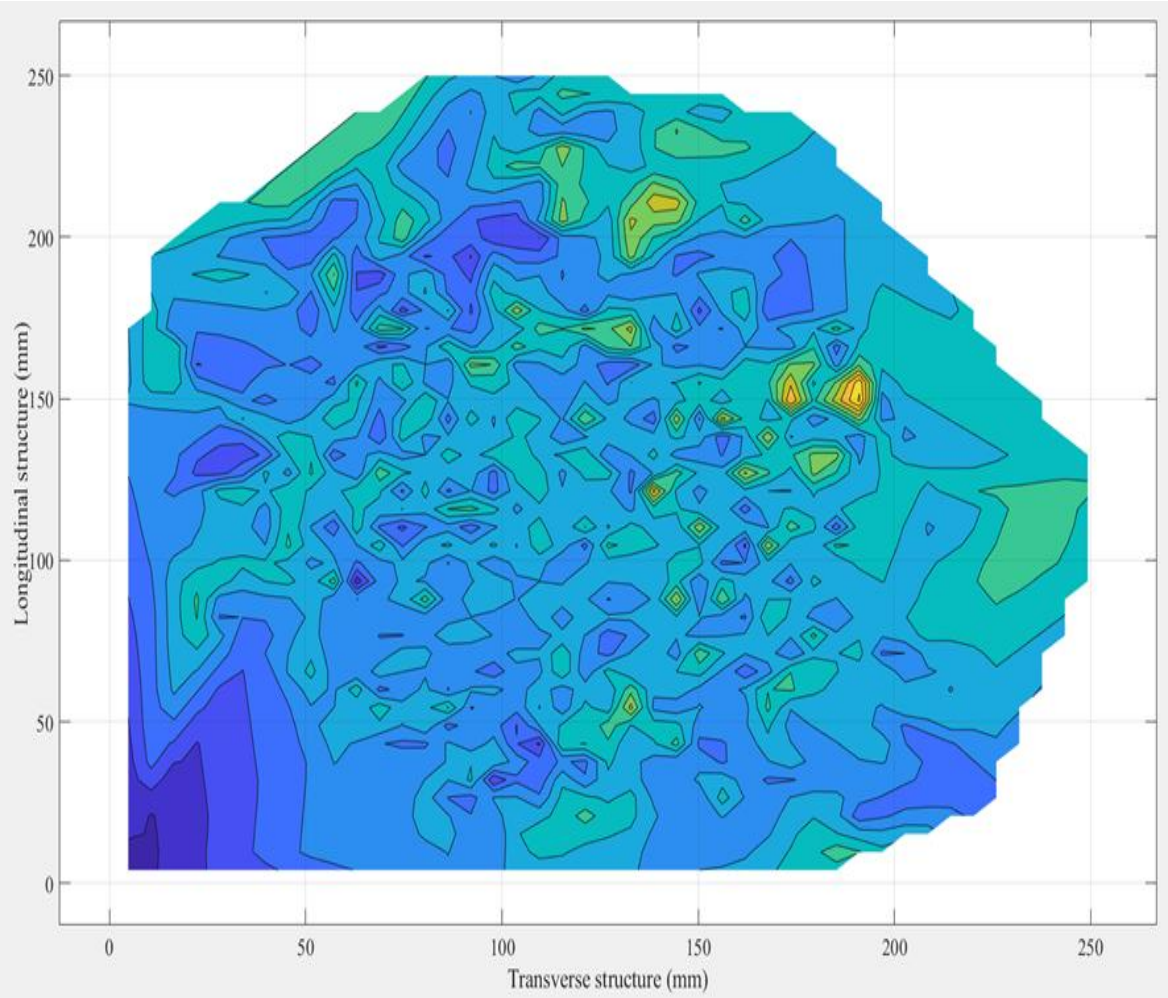
Comparing the jade and clay cultural relics unearthed in the Liangzhu site, the structure and balance of the jade and clay cultural relics unearthed in the Liangzhu site were analyzed by infrared scanning equipment, and the results are shown in Figure 3.



Woodcarving



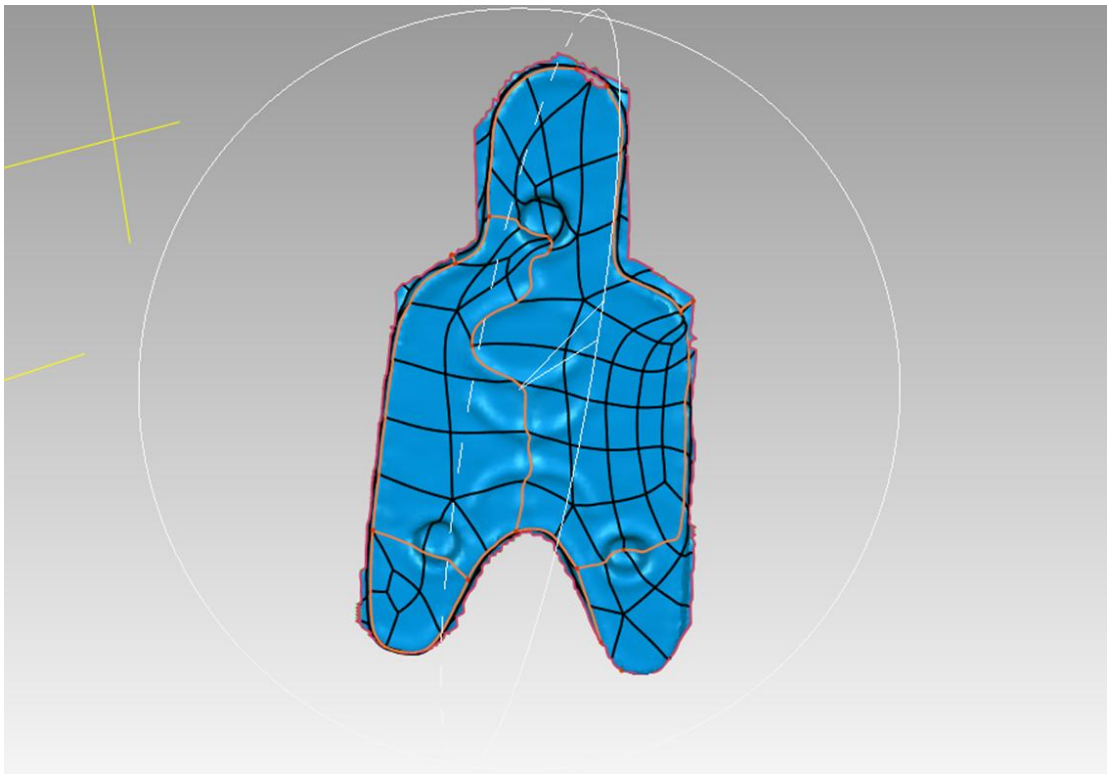
Jade



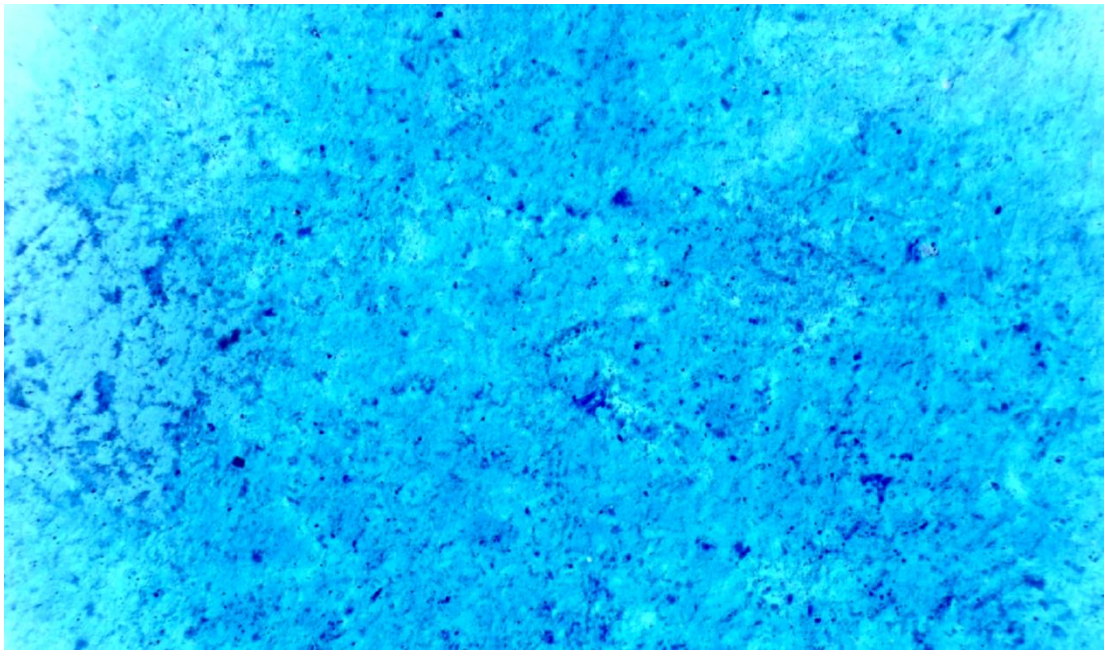
Structural Balance of Jade and Wood Carvings

Figure 3. Scans of Wood Carvings and Jade

As can be seen from the contents of Figure 3, the scanning results of wood carvings and jade artifacts show that the color of the middle part is darker, indicating that its density and specific heat capacity are higher, so the absorption of infrared waves is larger. Therefore, in the Neolithic period (3300~2300 BC), wood carving and jade production was based on the center of gravity, polishing and production (H. M. Wang et al., 2023; Zhang, Zheng, Wang, & Meadows, 2022). It can be indirectly seen that the jade and wood carvings in the Neolithic Age are axisymmetric in the center of gravity. Three-dimensional scanning also confirmed that the symmetry is symmetrical with the central axis, as shown in Figure 4.



3D Scanning



The Results of a Reverse Scan of the Inside of the Jade

Figure 4. Analysis of the Construction Surface

Through the analysis of the structural surface in Figure 4, it is found that the structure of the jade is symmetrical, and the upper and lower and left and right sides show a symmetrical relationship. Moreover, the figure's center of gravity is in a spherical center of gravity, so it belongs to an axisymmetric figure. The digital development of Liangzhu site culture will be conducive to the protection and inheritance of Liangzhu culture. To help better recognize and understand the Liangzhu culture, this can be achieved by developing the digitization of the Liangzhu site. Virtual reality technology can be used to reproduce the urban planning and architectural structure of the Liangzhu culture at that time (Yu & Mei, 2024; Zheng et al., 2023). The use of virtual roaming

technology allows users to immerse themselves in the Liangzhu ruins, explore the streets, palaces, city walls, etc. of the ancient city of Liangzhu culture, so that people can better know and understand the social life and civilization achievements of Liangzhu at that time. Secondly, a digital model was established to show various details such as the layout of the Liangzhu site. Relevant personnel can combine historical documents and archaeological data to improve the digital model, and show the scientific and advanced nature of the urban planning of the Liangzhu culture at that time, to understand the civilization characteristics of the Liangzhu site directly. Comparing the mechanical structure of the Chinese objects at the Liangzhu site, it is found that the symmetry comparison is reasonable, and the results are shown in Table 3.

Table 3. The Center of Gravity of the Artefacts

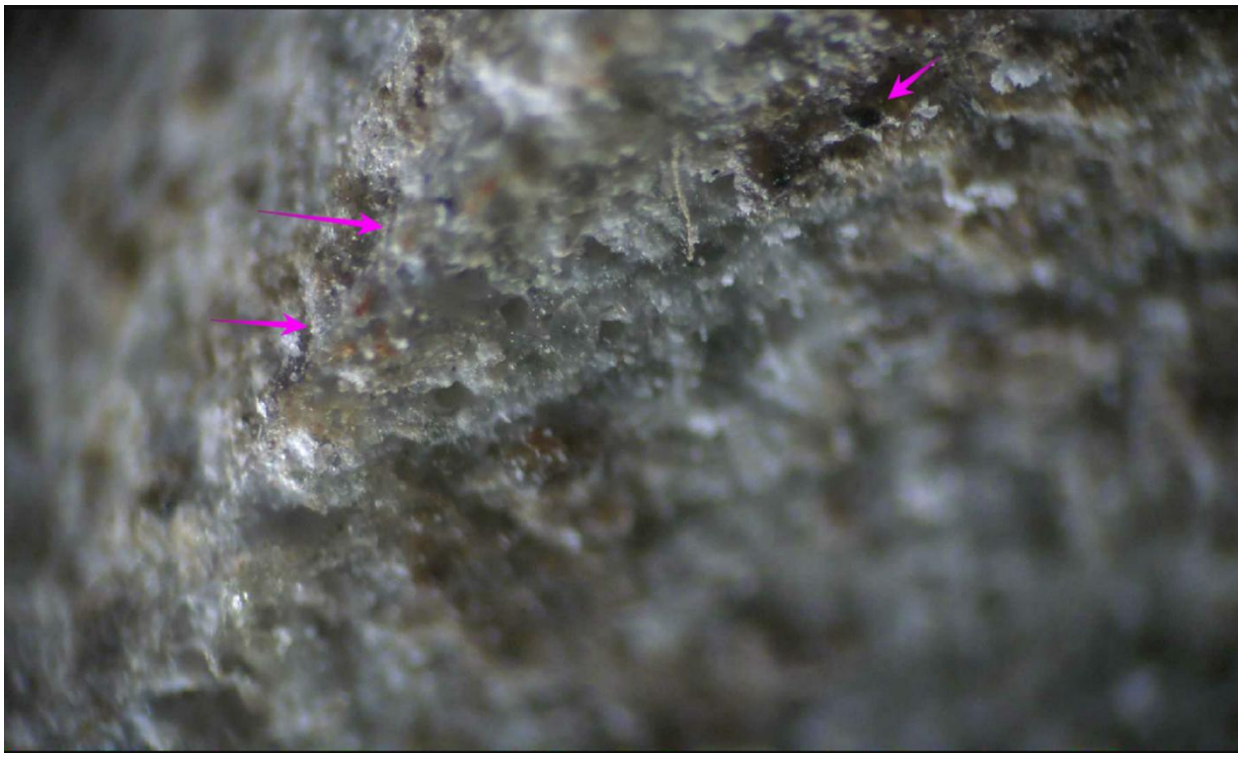
Type	Front and Rear Center of Gravity	Upper and Lower Center of Gravity	Control
Jade	1/2	3/4	1/2
Woodcarving	1/2	3/4	1/2
Ceramics	1/2	3/4	1/2

The rough calculation in Table 3 shows that the center of gravity of the Chinese objects at the Liangzhu site is within a reasonable range and is axisymmetric structure, so the overall center of gravity is at the center of the sphere. When digitizing the Chinese objects of the Liangzhu site, it is necessary to pay attention to its center of gravity. Digital technology quantifies the cultural relics in the Liangzhu site, collects the images, production skills, and related information of various stone artifacts unearthed from the Liangzhu site, and forms a digital Liangzhu stone device, for example, deeply understand and understand the stone tool production process and design style in the Liangzhu culture. In addition, the clay unearthed from the Liangzhu site can measure the enamel thickness and main material of the clay, form digital content, record relevant text introductions, video materials, etc., and better reflect the connotation of the cultural relics (such as stone tools, etc.) unearthed at the Liangzhu site, and understand their historical value, production technology, ornamental style.

Observation of the Enamel of Excavated Vessels

Compared with the corrosion resistance of the artifacts unearthed at the Liangzhu site, it is found that the surface layer of the vessels is covered with a large amount of enamel, indicating that in the Neolithic Age (3300~2300 BC), the clay has developed in the direction of porcelain, and the thickness of the surface enamel is 2~3mm, as shown in Figure 5.

Black Pottery



White Pottery

Figure 5. Enamel of Vessels Excavated from the Liangzhu Site

Through the surface test in Figure 5, it is found that there is a thick enamel on the surface of the pottery at the Liangzhu site, which is mainly fired at high temperature, indicating that the firing temperature reached 100~150° in the Neolithic Age (3300~2300 BC), which proves that its smelting technology has been greatly improved and provides a foundation for the arrival of the Bronze Age. The digital development of clay ware in the Liangzhu site can include the digital presentation of the urban civilization of the Liangzhu site, and VR technology can be used to reproduce the urban civilization of the Liangzhu site. For example, a more realistic virtual scene of the ancient city of Liangzhu civilization can be created using VR technology, including streets and buildings. Based on the observed values, smoothness analysis was performed, and the specific results are shown in Table 4.

Table 4. Surface Smoothness of Clay

Location	Lower	Outside	Bottom	Upper Portion	Medial	Average Value
	1 point	2 points	3 points	4 points	5 points	
White pottery	22.2%	22.2%	22.2%	22.2%	11.1%	2.778
Black pottery	11.1%	0.0%	44.4%	22.2%	22.2%	3.444
Average value	11.1%	22.2%	22.2%	22.2%	22.2%	3.222

It can be seen from Table 4 that although the surface smoothness of the clay is high, the emphasis is different, the smoothness of the inner and upper parts is high, while the smoothness of the outer and lower parts is low, indicating that the clay attaches great importance to practicality. In addition, the smoothness of white pottery is higher than that of black pottery, indicating that porcelain has been detached from practicality, and gradually meets the needs of sacrifices and celebrations, and develops to a high level.

Users can complete a virtual tour by wearing VR equipment or simulating it on a computer, so they can feel like they are in the Liangzhu ruins. In the virtual reality scene, users can enter the interior of the buildings of the ancient city of Liangzhu, such as palaces, city walls, altars, etc., and interact with the virtual local people. At the same time, users can also experience the "stone tool-making process" in the virtual scene, and watch how ancient craftsmen made stone tools, to understand the process technology and production methods of the ancient civilization of Liangzhu. For example, users can also participate in the daily activities of the Liangzhu site, such as watching the celebrations of the ancient city, participating in market transactions, and participating in farming

activities. Using this virtual interactive experience, users can better understand the urban life and social organization form of the ancient civilization of Liangzhu, and through the establishment of a digital model, the structure of the clay in the Liangzhu site and the layout in the site can be displayed. For example, 3D modeling software can be used to create a detailed digital model to show the distribution of clay, jade, and stone tools in the Liangzhu site. Observe the central area, altar area, residential area, palace group and other parts of the Liangzhu site from different perspectives, and understand each part's spatial relationship and functional distribution. For example, the digital model can also be used to show the design and operation of the Liangzhu site to the audience. For example, users can watch the operation of virtualized water canals, dams, and other facilities, and understand the actual role of the facilities. In this way, virtual reality technology and digital models can be used to show the appearance of the Liangzhu site.Through the above analysis, the regression analysis of woodcuts, clay and jade unearthed in the site was carried out to find out the main aspects of digital construction and provide support for the construction of the museum city, as shown in Table 5.

Table 5. Regression Analysis of Excavated Woodcuts, Clay and Jade and the Digital City

Variable		Project	Affect the Intensity	Links between Cultural Relics	Long-Term Impact Intensity	Weight	Degree of Integration
Argument	Jade	Hardness	0.320	0.241	0.278	3	Moderate disorder
		Equilibrium	0.710	0.473	0.579	6	Barely fused
	Kaolin	hardness	0.814	0.010	0.090	1	Extreme dysregulation
		equilibrium	0.356	0.137	0.220	3	Moderate disorder
	Woodcut	hardness	0.335	0.555	0.431	5	On the verge of disorder
		equilibrium	0.651	0.127	0.288	3	Moderate disorder
Covariates	Digitization	Smoothness	0.687	0.990	0.825	9	Good integration
		structure	0.755	0.963	0.853	9	Good integration
		Material	0.922	0.766	0.840	9	Good integration
Dependent Variable = Museum City							

As can be seen from Table 5, the main archaeological contents of jade, clay and woodcut are hardness and balance, and the integration effect is poor in the process of integration with the museum city. However, with the help of digital covariates, there is a good convergence and smoothness, structure and material are the main aspects of digitalization. Therefore, hardness, balance, material, smoothness, material and structure are the contents of archaeological research, and they are also the technologies of digital development to promote the construction and development of museum cities.

DISCUSSION

The Impact of the Digitization of the Liangzhu Site on the Urban Culture of the Museum

Enhance the Interactivity of the Liangzhu Site

Local governments can design a special jade page and a special app section to introduce the large number of jade artifacts unearthed at the Liangzhu site to the public. Through the high-definition image display of the form and ornamentation of jade artifacts, you can understand the details, and according to the corresponding textual description, you can understand their historical background and cultural significance. To allow users to experience the fun of interactive experience better, the platform can combine interactive elements to provide relevant experience functions. For example, it allows users to click and drag images to interact with jade easily and helps them understand the details of various aspects of jade and its place in ancient society. Specifically, it can be done: first, design a special page of Liangzhu jade culture, apply APP, and then display many Liangzhu jade cultural relics for the audience, and through a clear layout, to display various jade artifacts in various periods of

the development of Liangzhu culture, and divide them into different viewing areas. Users can easily click through to a specific display area to learn more about the jade artifacts unearthed at each Liangzhu site. Secondly, high-definition display. On the special page or APP section, there needs to be many high-definition images, videos, etc., to show the shape and ornamental details of the unearthed jade, and allow users to zoom in and out of the image to observe every detail of the jade. Based on this, users can experience the fun of immersive experience and learn about the carving process and artistic style of Liangzhu jade. For example, a specific jade image, then drag and zoom the image to understand its ornamental details, symbolism, etc. Then, you can also make some text descriptions in the jade special page or APP section, with text, to introduce the information of each jade unearthed at the Liangzhu site, such as its historical background and cultural significance, its status at that time, etc. In this way, users only need to read the relevant information to better understand the craftsmanship and culture of Liangzhu jade and the cultural connotation behind each piece of jade. For example, for a certain piece of jade, providing information about its unearthed background and possible uses, as well as its impact on the social life and culture and belief system of the time, can deepen the impression of the audience and allow the audience to appreciate the artistic charm and historical and cultural connotation of the Liangzhu culture more deeply and its jade works. At the same time, it can also show the cultural heritage of the museum city and help promote the academic level of related fields. Based on this, the relevant personnel can actively promote the cultural activities of the Liangzhu site in the museum city, to enhance the interest in the protection and inheritance of local history and culture, and arouse their active attention. For example, this may inspire them to start focusing on the scientific protection and rational use of the Liangzhu site and its various excavated cultural relics. For example, through this way of education and popularization, the public will truly know and understand the historical value and spirit behind the Liangzhu site. Especially for the younger generation, the Liangzhu site and its culture will enhance their awareness of participation in historical and cultural preservation work. Based on this, the development of the digitization of Liangzhu culture can better introduce the aesthetic value and historical value of various cultural relics unearthed from the Liangzhu site to the public, and help understand the level of craftsmanship, production information, and cultural content at that time. At the same time, it can also increase users' participation and enthusiasm for learning, better introduce ancient Chinese civilization to the public, and be conducive to the protection and inheritance of ancient Chinese civilization heritage.

Promote the Development of Tourism in Museum Cities

Liangzhu site is in the western suburbs of Hangzhou City, Zhejiang Province, is one of the important sites of ancient Chinese civilization, as a famous historical site, it contains a profound historical and cultural heritage, therefore, attracting many tourists to visit, which provides great energy for the development of the local tourism industry, and is of great significance to revitalize the local tourism ecology. At the same time, the large number of tourists attracted by the Liangzhu site will also have a variety of needs, such as catering needs, accommodation needs, etc. Based on this, all walks of life in the scenic area will be driven by this, forming a good prosperity situation and promoting local tourism development. In addition, tourism requires the participation of many practitioners, and the discovery of the Liangzhu site can create local jobs, promote the further development of Chinese commerce, and promote the growth of the local economy. The Liangzhu site has shown a strong sense of planning and organization, and the functional divisions of various functional areas, such as the palace and sacrificial areas, are extremely clear. This kind of urban space design can reflect the social organization structure and space utilization of the Liangzhu site, and there has been a very rational thinking and design. This can influence the culture of modern museum cities, including urban planning. For example, modern museum cities can provide more scientific and reasonable spatial planning and layout for various cultural facilities such as museums and cultural centers by drawing on this planning idea. At the same time, planners of museum cities can also draw on this idea to rationally plan cultural facilities in the city, such as museums and public libraries, art studios, and other public leisure areas. Based on this, it is possible to ensure that each functional area can meet the specific needs of different groups of people and achieve the requirements of harmonious coexistence, to enhance the functionality and aesthetics of the urban space. The appearance of many architectural ruins and structures in the Liangzhu site can indicate that the architecture of the late Neolithic period (2800~2300 BC) has formed an independent style and has a certain technical level. The ancient architectural style can provide new inspiration for the prosperity and development of the museum's urban culture, and serve as its reference object. The designers can integrate some ancient architectural elements of the Liangzhu site into their own buildings, so as to make the cultural facilities of the museum city more historical and unique, and more importantly, the protection and inheritance of the Liangzhu site will attract more people to travel to the local area, and then promote the continuous extension and expansion of the tourism industry, so that the local economy can always maintain a certain vitality in the long-term development, and promote the local economic structure to diversify the development direction. Archaeological institutions can create a dedicated virtual exhibition app or website to present important discoveries about rituals and religious beliefs at the Liangzhu site. For example, the rituals and

religious ceremonies of the time can be displayed in different forms such as texts, pictures, and videos, to deepen the audience's understanding and knowledge of the Liangzhu culture at that time. Design online games or simulation experience functions, and set up some courses and lectures on the religious culture, etiquette, and customs of the Liangzhu site on the APP or web page to help understand the important status and significance of religious beliefs, etiquette, and customs in the society at that time. Based on this, the inheritance and protection of the relevant culture of the Liangzhu site will be better implemented, and at the same time, the precious cultural relics, and related cultural contents of the Liangzhu site can also be effectively publicized.

Enrich the Cultural Connotation of the Museum City

The Liangzhu site has a profound cultural connotation and is very iconic, and there are many attractions in its interior, each of which can be used as a cultural business card of the museum city. The Liangzhu site can influence the cultural image of the museum city and improve its cultural attractiveness. In this way, the rich cultural connotation of the Liangzhu site, the excellent content of scenic spots, and a variety of historical and cultural elements can be used to promote the development of the museum city, promote the further prosperity of its cultural undertakings, and promote the overall development of the museum city. For example, the public can directly contact and understand the ancient Chinese civilization by holding exhibitions or educational activities on the culture of the Liangzhu site, and enrich the cultural content and cultural connotation of the museum city through the effective integration of historical relics and cultural elements with the culture of the museum city. At the same time, through the display of relevant cultural relics collections, the excellent traditional culture of the Chinese nation will be promoted, and the Liangzhu culture will be understood, recognized, and recognized from the spiritual level, and the heritage of ancient Chinese civilization will be inherited. Specifically, all parties can provide diversified and multi-level cultural experience activities through the display of stoneware, jade, pottery, and other cultural relics in the Liangzhu site. For example, thematic exhibitions and lectures combined with digitalization, virtual interactive experiences, etc. The holding of events can not only enhance the cultural charm and attractiveness of the museum city. Innovations in decorative elements. Many architectural relics and structures have been unearthed at the Liangzhu site, which shows the degree of understanding of architectural design and construction technology at that time, reflecting that there was already a certain degree of architectural design wisdom at that time. At the same time, the remains of ancient buildings are home to a lot of unique decorative arts. Based on this, modern designers or architects can use this as an inspiration to incorporate ancient decorative elements into the cultural facilities of the museum city when designing them. In this way, it is possible to create unique spaces with a more historical and cultural atmosphere, promote innovation and development in modern architectural design and decoration, and fourthly, integrate sustainable development and the environment. In the Liangzhu site, you can understand the construction technology and the use of materials at that time through some of the site contents. At the same time, it was found that at that time, great attention was paid to the protection of the natural environment and the concept of sustainable development. Based on this, designers can focus on introducing some relevant elements when designing cultural facilities or museums in museum cities. In this way, the Liangzhu culture can be better developed. For example, designers can use passive energy-saving technologies, such as natural lighting and ventilation, and choose greener materials to integrate into their own designs, to reflect the museum city's cultural atmosphere and its emphasis on the natural environment and ecological environmental protection. At the same time, it can also promote the public's understanding of the history of early human civilization and enhance the public's sense of cultural identity. In addition, as one of the historical and cultural heritages of China, the display of exhibits and academic research activities of Liangzhu site can provide an important impetus for the cultural development of the museum city, and provide valuable information for the historical and cultural research of scholars at home and abroad. Research can not only show the value of the Liangzhu civilization.

CONCLUSION

As a representative site of the Neolithic Age (3300~2300 BC), the Liangzhu site has an essential impact on archaeological excavation, digital development, and the development of museum urban culture. In this paper, with the help of modern scanning equipment and mechanical measurement equipment, the Liangzhu site was measured. The following results were obtained: the Liangzhu site was mainly unearthed wood carvings, clay, and jade, etc., and its materials were mainly elm, mahogany, kaolin, ever-greenstone, clay and other common materials, and the internal structure was strong, and the center of gravity was spherical, so the mechanical stability was good. The dyeing materials are common iron oxide, calcium oxide and carbon. Many scratches on the surface of jade and wood carvings indicate that they have been polished for the second time in the later period. In addition, jade and clay materials are impure and contain many impurities, but there is a thick enamel on the surface of the clay, indicating that in the Neolithic Age, the smelting foundation has been established, and the

temperature has reached 100~150 °. Based on the summary of the research results and digital analysis, it is concluded that the protection and inheritance of the Zhu site can affect the cultural development of the museum city, such as its urban planning and cultural integration, architectural style design, sustainable development strategy, etc., to provide valuable experience and inspiration for the continuous prosperity and development of the museum city. This study has some shortcomings, mainly because it is difficult to obtain sample data and there is little relevant literature, so it is necessary to increase the relevant research efforts in the later stage.

CONFLICT OF INTEREST

No conflict of interest was reported by the author.

REFERENCES

Allen, E., Yang, J. D., Lin, S., Zhou, Y. J., & Sheng, P. F.(2023). A new post-Liangzhu Lower Yangtze culture: The early bronze age Tiaotou and Pishan sites. *Antiquity*, *97*(392). doi: 10.15184/aqy.2023.16

Bin, L. (2022) .Liangzhu and centennial archaeology: The underestimated neolithic age in China. *Frontiers of History in China*, *17*(2), 247-266. doi: 10.3868/s020-011-022-0010-5

Guo, J. H. (2023). Liangzhu cultural heritage speaks to the world. Hangzhou narratives and practices of sustainable urban development. *Cultura-International Journal of Philosophy of Culture and Axiology*, *20*(1), 177-187. doi: 10.3726/CUL012023.0014

Huan, X. J., Zhang, J. P., Zhuang, Y. J., Fan, C., Wang, N. Y., Ji, X., . . . Lu, H. Y. (2022). Intensification of rice farming and its environmental consequences recorded in a Liangzhu reservoir, China. *Quaternary International*, *619*, 39-45. doi: 10.1016/j.quaint.2022.01.012

Larrivé-Bass, S. (2023). Jade for bones in Hongshan craftsmanship: Human anatomy as the genesis of a prehistoric style. *Arts*, *12*(5). doi: 10.3390/arts12050206

Lian, H. R., Egüez, N., Chen, M. H., Yan, K. K., Wang, Y. L., Wang, N. Y., . . . French, C. (2023). Life near the water: Geoarchaeological investigation of site formation processes and occupation patterns at the near-bank mound of Liangzhu City, China. *Geoarchaeology*, *38*(3), 268-292. doi: 10.1002/gea.21928

Liu, Y., & Shi, Z. J. (2022). Combined geophysical surveys using a novel approach to characterize ancient burnt soils: A field experiment at Liangzhu city site in Hangzhou, China. *Catena*, *216*, 106394. doi: 10.1016/j.catena.2022.106394

Liu, Z. H. (2023). Regeneration of Liangzhu culture: Multimedia exhibition, simulated restoration, innovative cultural products, nearby area integration, virtual reality and augmented reality. *Humanities & Social Sciences Communications*, *10*(1). doi: 10.1057/s41599-023-01865-x

Liu, Z. H., & Chang, J. A. (2023). When the whole-nation system meets cultural heritage in China. *International Journal of Cultural Policy, 2023*, 1-14. doi: 10.1080/10286632.2023.2249488

Long, T. W. (2022). Contrasting developments of the cultural complexes South and North of Hangzhou Bay, Eastern China, controlled by coastal environmental changes. *Quaternary International*, *623*, 94-100. doi: 10.1016/j.quaint.2021.10.014

Wang, H. M., Jiang, F., Chen, Y. L., Liu, S. H., Hu, W. F., Zhao, . . . Sun, Q. L. (2023). Unveiling the mid-holocene coastal hydrological changes and their impacts on neolithic cultures along the South Hangzhou Bay of Eastern China. *Quaternary International*, *658*, 36-47. doi: 10.1016/j.quaint.2023.04.010

Wang, H. Y., Jin, Y. L., Li, K., Liu, Y., Liao, M. N., & Ni, J. (2024). Human-activity modified vegetation composition at Hangzhou Bay, Zhejiang Province, China over the last 10,000 years. *Palaeogeography, Palaeoclimatology, Palaeoecology*, *636*, 111984. doi: 10.1016/j.palaeo.2023.111984

Wang, Y., Huang, W. J., Han, Y. Q., Huang, X. D., Wang, C., Ma, K. X., . . . Pan, J. (2022). Microbial diversity of archaeological ruins of Liangzhu city and its correlation with environmental factors. *International Biodeterioration & Biodegradation*, *175*, 105501. doi: 10.1016/j.ibiod.2022.105501

Wu, Y. Y., Wang, C., Zhang, Z. Y., & Ge, Y. (2022). Subsistence, environment, and society in the Taihu lake area during the neolithic era from a dietary perspective. *Land*, *11*(8), 1229. doi: 10.3390/land11081229

Xiao, J. Y., Shang, Z. Y., Xu, J. H., Jia, X., & Xiao, S. J. (2023). The neolithic culture and paleogeographic environment evolution in the Eastern Jianghuai area. *Land*, *12*(1), 156. doi: 10.3390/land12010156

Yu, H., & Mei, J. Y. (2024). Dance improvisation as an embodied encounter with heritage site: A case in the archaeological ruins of Liangzhu. *International Journal of Heritage Studies*, *30*(5), 597-611. doi: 10.1080/13527258.2024.2323534

Zhang, W. T., Zheng, T. T., Wang, Z. H., & Meadows, M. E. (2022). Reconstruction of coastal flooding processes and human response at the end of the Liangzhu culture, East China. *Quaternary Science Reviews*, *293*, 107705. doi: 10.1016/j.quascirev.2022.107705

Zheng, T. T., Lei, S., Wang, Z. H., Li, W. J., Mei, S. W., Wang, J. H., & Meadows, M. E. (2023). Prehistoric sea-salt manufacture as an adaptation strategy to coastal flooding in East China. *Quaternary Science Reviews*, *302*, 107966. doi: 10.1016/j.quascirev.2023.107966