The ancient bridges over the Jue River near the Han Chang’an City

Xi’an Municipal Institute of Cultural Heritage Conservation and Archaeology

Abstract

In 2006 through 2007, Xi’an Municipal Institute of Cultural Heritage Conservation and Archaeology excavated two ancient bridges crossing the old course of Jue River 400m to the west of the southwest corner of the Han Chang’an City. The ancient bridge no. 1 was better preserved, of which 160 bridge piles lining in five east-west rows were excavated; these bridge piles were high and straightly standing, and were almost on their original positions. The alignments and the charring degrees of the bridge piles reflected that this bridge had been built for twice. Ancient bridge no. 2, which was also crossing the same ancient river course, was about 90m to the west of no. 1. It was poorly preserved, only the root parts of the wooden bridge piles were found, in total 32 bridge piles in five rows were uncovered. This bridge located about 400m outside the southwest corner of the Han Chang’an City was just between the capital city and Jianzhang Palace of the Western Han Dynasty; to its southeast were the sites of the Altars of the Soil and Grains, the Mingtang (Hall of Enlightenment) and Biyong (circular moat surrounding the Mingtang) of the Western Han Dynasty and the Nine Temples of Wang Mang’s Xin Dynasty, to its south across the Jue River was the imperial Shanglin Park. The special location of this bridge and the large amounts of building materials of high-ranking architecture unearthed nearby it implied that this bridge would be an imperial court-used bridge on the way from the capital city to Shanglin Park across the Jue River. The discovery of these bridges is significantly meaningful for the researches on the capital planning, traffic and communication and the changes of the water environment nearby Chang’an City of the Han Dynasty.

Keywords: Bridges–archaeology–Han Dynasty; Xi’an City (Shaanxi Province)–geography–history

A brief introduction of the site

From February to May 2006, archaeologists from the Xi’an Municipal Institute of Cultural Heritage Conservation and Archaeology excavated an ancient wooden bridge 400m to the west of the southwest corner of the Western Han Chang’an City. The bridge across the old course of Jue River is located 200m to the northeast of Wanzi Village on the west bank of the Zao River. It is located in the Sanqiao Town of Xi’an City, to the east of Jianzhang Rd. and south of the Longhai Railway. The site is about 13km to the downtown of Xi’an City (Figures 1 and 2).

The bridge was buried by silt from the old course of the Zao River. Archaeologists set up nine excavation grids 10m × 10m each, from which 160 wood piles lined up in five rows were recovered, all of which stayed in their original positions. The site is numbered as the Jue River ancient bridge no. 1 (Figures 3 and 4).

The stratigraphy of the site can be divided into 11 layers. Except for Layer 1 which is the surface soil, the remaining layers alternate between sand and silt deposits. The depths from the surface to the riverbed are

Figure 1 The location of the ancient bridges in relation to the Han Chang’an City.
9 to 10m. The five rows of the piles are arranged in an east-west direction. The distances between the rows are 4.2 to 5.7m. The diameters of the piles are 0.3 to 0.56m and their heights above the riverbed are 0.3 to 2.7m, most of which are between 1.5 to 2.5m.

Each row consists of several sets of piles, and each set has one to three piles (Figure 5). The sets form pillars resembling modern bridge piers. The piles are distinguished in two groups: burned and unburned. The burned piles are on the southern side of each row, charred with only the lower trunk remaining. The relatively well preserved piles on the northern side of each row were unaffected by fire, solid and tall, and yellowish brown in color.

It is quite clear that the bridge had been burned and rebuilt after the fire. The burned piles are part of the original bridge, usually assembled together with two to three piles for each set. The distances between the sets are 0.5 to 1.1m. The remaining heights of the 119 burned piles are from 0.3 to 2.1m, and they are 0.3 to 0.45m in diameter.

The piles used for the bridge reconstruction are larger in size. The piles are placed north to the original ones. Unlike the original sets of piles, the replacements are in most cases a single lumber. Only a few sets contain two lumbers. The diameters of the 41 replacements are from 0.44 to 0.56m, most of which are 0.5m. The remaining heights are 1.85 to 2.6m. Although many of the piles have lost their upper section, several of them have tenon joints preserved on the top. The new piles are in better condition. From south to north, each row has different numbers of piles from the other: the first row has 12 piles (Figure 6), the second row 15 piles, the third row six piles, the fourth row four piles, and the fifth row two piles. The distance between each pile is about 1.2m (Figure 7).

In order to understand the construction techniques, archaeologists dug two sectioning trenches (TG1 and TG2).

TG1 is laid on the east end of the first row running in a north-south

Figure 2 The full-view of the ancient bridge sites.
① Ancient bridge no. 1; ② Ancient bridge no. 2; ③ The new course of Zao River; ④ The southwestern corner of the Han Chang’an City; ⑤ The elevated West 3rd Ring Road; ⑥ Longhai Railway.

Figure 3 The plan of the ancient bridge no. 1 (the digits are the numbers of the piles).
direction. It is 3.7m long, 1.5m wide and 3.3m deep. The two piles found in the trench are numbered I:1 and I:2 (see Figures 8 and 9; the Roman numerals represent the row numbers and the Arabic numerals are for pile numbers).

I:1. The upper part of the lumber has no bark left, revealed the hard wood of yellow color with several vertical cracks. Tree bark remains are found on the lower part of the lumber, preserved due to the deposit condition (it was buried deep in the riverbed). The total height of the pile is 5.35m, and the submerged part is 3.3m. The cross section of the submerged part is round in the upper section (0.5m in diameter), becomes hexagonal at 0.9m deep. From 2m deep downward, it changes into a conical shape. This pile was used for reconstruction after the fire.

I:2. This lumber 5m tall was used for the original construction. It has a conical top which was burned to its core. The submerged part is 3.3m tall (and 1.7m above the riverbed), 0.4m in diameter. It has a conical shape at 2m deep downward measured from
Figure 6 The first row of the bridge piles of the ancient bridge no. 1 (NW-SE).

Figure 7 The elevations of the five rows of the bridge piles of the ancient bridge no. 1.

Figure 8 The plan and western section of TG1.
1. The riverbed; 2. The coarse sand layer; 3. The sandy soil layer.

Figure 9 The first and the second rows of the bridge piles (NE-SW; the rectangular pit on the left is TG1).
the surface of the riverbed. Some bark remains were found at 1.25m tall and below.

TG2 is on the southern part of the first row. It is 3.4m long from east to west, 1.4m wide from north to south and 0.87m deep in its western section, and 3m deep in the eastern section. Three charred piles are found in TG2 with burned upper part. These piles were parts of the original construction (Figures 10–12).

I:22: the lumber is 0.39m in diameter and 4.58m in height. The submerged section is 3m.
I:24: the lumber is 0.37m in diameter and 3.55m in height. The submerged section is 3m.
I:27: the lumber is 0.28m in diameter and 1.57m in length. The submerged part is 0.87m.

The sectioning trenches show that the depth of the submerged section is not caused by the constructions of the two different periods, but the lumber sizes. The thicker the lumber, the deeper they are buried in the riverbed. The submerged part of the lumber is in different cross-section shapes–dodecagonal, octagonal and hexagonal–with the number of sides reduced toward the end, all turning into a sharp conical point. The existing heights of the piles are 5 to 7m.

Most of the excavated wooden artifacts are wooden piles, but a few are other building materials used for the bridge.

I:33: the dodecagonal cross-section of the bottom part of the charred pile shows clear fire marks, it is for sure the building material of the original bridge. The remaining height is 1.02m and 0.38m in diameter (Figure 13:1).
I:32: the pile has a cross-shaped notch on the top, which is the mortise for a tenon. The perimeter is 1.37m with 0.48m in diameter. The height above the riverbed surface is 2.37m. It was used for the reconstruction (Figure 13:3).
IV:13: this building part has a groove (mortise) on its thicker end. Based on the trapezoidal shape of the groove, this lumber was estimated to be used as a girder and connected to a vertical component. No burned trace is found, thus it was a building part for the reconstruction. The remaining length is 1.76m and it is 0.2m in diameter (Figures 13:2 and 14).
Unearthed artifacts

The 972 artifacts found in the riverbed are pottery, bronze, iron, and stone objects. Among them, 830 pieces are pottery building materials, including flat and cylindrical roof tiles, drainage pipes, bricks with tongues and notches and tile-ends (Figures 15–22). The tile-ends are decorated with the characters “Shanglin 上林” and “Yannian 延年 (longevity)” as well as cloud patterns. Among them, an intact large ridge tile (T1:5) measuring 68.5cm long and 25.6cm wide (Figures 15:2 and 20) is found. The 58 bronze objects are coins, rings and a coin mold (T2:2). The rectangular mold was used for casting daquan wushi coins. The mold has 21 coin cavities in four rows and a runner in the middle. The mold is 19.5cm long, 16cm wide and 1.3cm thick (Figures 23 and 24). There are 70
Figure 17  Cylindrical roof tile of Type B (T1:7).

Figure 18  Cylindrical roof tile of Type C (T4:2).

Figure 19  Flat roof tile (T2:11).

Figure 20  Ridge tile (T1:5).

Figure 21  Tile-end with cloud pattern of Type B (T1:1).

Figure 22  Tile-end with “yannian (longevity)” inscription in lishu style (T2:5).
Conclusion

1. The history of the Zao and Jue Rivers.

The bridge was found in the old course of the Zao 漢 River, which was the lower reach of the ancient Jue River. In the “Wei River” entry of his Shuijing zhu (Commentary on the Water classic), Li Daoyuan of the Northern Wei Dynasty mentioned the Jue River, saying that “the Jue 漢 River is the Jue 漢 River.” The Jue 漢 River passed by the western side of the Chang’ an city wall, flowed north and split into two rivers to the east of the Fengque (Phoenix gate towers). One of the confluents continued on its northeast course along the western city wall and joined the Wei River. The other also joined the Wei River via a different course. It passed through the Jianzhang Palace, the east of the Shennin and the Jian Terraces and flowed northward into the Wei River. These two courses coincided with the present Zao and Jue 漢 Rivers. The Jue 漢 River was once a major tributaries of the Wei River, but joined the Feng 漳 River after a major shift in the river system in the Wei River valley and became a secondary tributary of the Wei River. According to two local gazetteers, Xianning Chang‘ an liang xian xu zhi 咸 宁长安两县续志 (the supplementary gazetteer of the Xianning and Chang’an Counties) and Xi’an Shi shui li zhi 西安市水利志 (Treatises on the hydraulic engineering of Xi’an City), the lower reach of the Jue 漢 River was widened during the Tang Dynasty (618-907 CE) for timber transportation from the Qinling mountains. The Ming government also utilized the Jue 漢 River as the water source of the Tongji Canal. The lower reach of the Jue 漢 River was converted twice as a canal, known as the “Cao (ts’ao)” is pronounced as “zao (tsao)” in the local dialect; thus, the former “Cao” (artificial waterway) became today’s Zao 漢 River.

2. The date and nature of the bridge.

Most artifacts found at the bridge site are dated to the Western Han except a few Neolithic items washed down in the silt. No artifact later than the Wang Mang’s Xin Dynasty (Wang Mang Interregnum, 8–23 CE) was found. Most of the unearthed coins are wuzhu coins of the Han Dynasty, and the coins of earlier periods are not found. The latest coins are the daquan wushi of the Wang Mang Interregnum. In addition to the diagnostic artifacts, historical literatures provide further hints on the date of the bridge. In the later part of the 2nd century BCE, during the reign of Emperor Wu of the Western Han, the government opened the Kunming Lake and transformed the waterways south of Chang’an City substantially. Based on this evidence, our assumption is that the bridge was built during the Emperor Wu’s time, and abandoned during the Wang Mang Interregnum.

The bridge is located 400m from the southwest corner of Chang’an City of Western Han, facing directly to the...
east gate of the Jianzhang Palace 1km away to the north, where archaeologists earlier found the remains of the double Fengque (phoenix gate towers). Archaeological data show that between the double gate towers built abreast on the east and west, there was a road running in a north-south direction, whose extension directly went through this bridge. This bridge was thus located at a crossroads of the Jiangzhang Palace, the Chang’an City and the ritual architectural complex in the southern suburb of Chang’an. From either the Jianzhang Palace or the city, one could get to the Shanglin imperial park by crossing the bridge. The bridge was likely reserved exclusively for the imperial family.

3. The structure and the scale of the bridge.

The 160 bridge piles in five rows were arranged in a west-east direction, along the old course of the Jue River, which was flowing northward to the west of the Chang’an City but made a z-turn at present-day Wanzi Village and formed a short west-east course. The bridge was just built at this section of the river. The Jue River ancient bridge and two other ancient bridges found at Shahe River of Xianyang are extremely alike. Such bridges are constructed by piling sets of lumbers into the riverbed, and tied them up with horizontal girders. The mortises found on the wooden piles and girders indicate such configuration. The surface of the bridge was likely laid with planks, and on each side with erected railings. The remaining colors on the stone grinder indicate that the wooden-structured bridge was likely painted. Bridge towers probably existed on each end of the bridge, since such structures were an essential part of a Han palace gate. The large amount roof tiles, bricks, and tile-ends found at the bridge site are undoubtedly building materials from the bridge towers.

The range of the bridge revealed by the excavation is about 28m wide from the east to the west, and 22m long from north to south. This represents only the southeast section of the bridge. No pile is found further to the east and south, suggesting that this was the margin of the bridge site. But on the west and north of the bridge remains, more piles are found. Due to the position of the 3rd Ring Road and the Longhai Railway, further excavation in this direction was halted. However, surveys of the site confirm that the original width of the bridge is over 48m. The length of the bridge was at least 100m since the existing riverbed today is about 70m. The size of the bridge is larger than any known bridge on the Wei River during the Han and Tang Dynasties; further research is needed for the identification of other possible buildings on the bridge.

4. The identification of the timbers used for the bridge.

At the beginning, we gathered four wood samples for the Institute of Archaeology, CASS to identify. The result showed that they were Platycladus (Platycladus orientalis), oak, phoebe zhennan and Chinese lacquer tree (Toxicodendron vernicifluum). Northwest Forest University further identified 30 wood samples and figured out that they belonged to six genera of six families, which are Abies sp. of Pinaceae Family, Phoebe spp. of Lauraceae Family, Catalpa spp. (Catalpa ovata) of Bignoniaceae Family, Oriental white oak (Sect. primus) of Quercus Genus of Fagaceae Family, Chinese Toon (Toona sinensis) of Toona Genus of Meliaceae Family and elm (Ulmus sp.) of Ulmaceae Family. These species are similar to those of the wooden piles found at the Shahe bridge remains in Xianyang (Duan 1990 and Shaanxi 1992) and the roof beams of the Terracotta Army pits in Emperor Qinshihuang’s Mausoleum. These are local timbers that grew in the Qinling and Bashan Mountains.

References


Postscript

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