Interpreting heritage canals from the perspective of historical events: a case study of the Hangzhou section of the Grand Canal, China

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Abstract

Taking the Hangzhou section of the Grand Canal in China as a case study, this research develops an approach towards interpreting heritage canals from the perspective of historical events. First, we classified historical events related to the canal into three types. Through historical literature archives and relevant research, architectural works and places that are related to the historical events were identified and located on contemporary maps and were verified by field investigations. Then, we examined the role of the heritage canal in shaping the regional cultural landscape concerning the canal based on a process that evaluated the degree of correlation between the works (constructions) and places and the Grand Canal. Finally, we explored which historic works and places were related to the core values of the canal and how these works and places were joined into a network by interacting with each other during the developmental process.

This approach reveals the mechanisms by which a heritage canal plays a defining role in its related cultural landscape system. With this information, further strategies can be developed regarding the conservation and urban design for heritage canals.

1. Introduction

1.1. Research aims and significance

As the earliest constructed (before the industrial revolution) and longest canal in the world, the Grand Canal in China is famous for its technical innovations and civil engineering scale. This canal runs from northern to southern China, connecting China’s five main river basins, and has an important influence on the urban and rural landscapes.

Previous studies regarding the heritage of areas along the Grand Canal often simply classified these aspects into tangible and intangible heritages or existing and extinct environments, and they lacked accurate quantitative analyses of the historical events and their spatial elements. This study aims to develop an approach towards interpreting heritage canals from a historical event perspective, with significances as follows:

1. Taking a historical event perspective prevents excessive focus on the characteristics of tangible and intangible heritages. Instead, we paid attention to the disappeared sites and existing historical sites that were considered to be less important by linking all types of heritage related to a certain historical event in a narrative method. Through this method, the meaning of a site in relation to the spirit of the Grand Canal could be understood. In a deeper sense, compared to the value of rational spirit within the European tradition, which emphasizes that heritage should be objective and physical (Wu and Fang 2016), this perspective would fit into the traditional culture of East Asia, which cherishes the spirit of place and the intangible value of heritage.

2. According to the Operational Guidelines for the Implementation of the World Heritage Convention issued by UNESCO World Heritage Centre (2019), cultural landscapes are “combined works” that reflect the interactions between humans and nature and have the characteristic of evolving organically. Therefore, by exploring the occurrence and development of historical events, we can obtain a dynamic understanding of the interactions between humans and nature and between the canal and the city. Thus, we can gain further insights into the connotations of “cultural landscape” under the influence of heritage canals.

3. Through a quantitative analysis and geographical location study of the architectural works and places related to historical events, more accurate conservation planning and urban design strategies can be applied.

4. Possible new archaeological discoveries will be incorporated into the classification framework.
of historical events in the future, in accordance with the interpretation of the dynamic relationship between the heritage canal and its related cultural landscape.

(5) The Hangzhou section is a southern section of the Grand Canal. The West Lake, another famous World Heritage cultural landscape, is located close to it. The interaction among the Grand Canal, the West Lake, and the regional water systems is a typical example of the complex and multiple significances of a heritage canal to its related cultural landscape. The approach developed in this study could also be applied to other sections of the Grand Canal because of the similarities of study objects and problems to be solved.

1.2. Background

The Grand Canal was inscribed as a World Heritage Site in 2014. Compared with several other canals that have been inscribed in the World Heritage List (Table 1, data from UNESCO World Heritage Centre 2017), the Grand Canal is distinctive for its Caoyun transportation system (transportation of grain and strategic logistics). The Caoyun system contributed much to establishing a foundation for maintaining the centralization of authority and unity within the multinational country throughout China’s several historical dynasties. The Grand Canal crosses the urban and rural areas of 6 provinces and 2 province-level municipalities in China and has supported the development of many cities throughout history, especially in the regions south of the Yangtze River.

The Operational Guidelines mentioned above define a “heritage canal” as follows: “... The canal may be a monumental work, the defining feature of a linear cultural landscape, or an integral component of a complex cultural landscape”. This explanation reveals the relationship between “heritage canals” and “cultural landscape”, as well as the significance of a “heritage canal” to the “cultural landscape”. For the Grand Canal, first, this canal has various functions, including navigation, flood mitigation and imperial monopoly, which are achieved by the connection of the canal to other water systems (rivers, lakes, etc.) and by the coordination of the canal with urban constructions and facilities. Second, to address the diverse contexts that the canal crosses and adapt to the complex natural and artificial conditions, various technologies have been applied. In addition, different forms and materials were intentionally designed for the Grand Canal to allow for the effective interactions between the canal and these contexts. Third, the Grand Canal created specific cultures and living modes for the people who lived or worked along it. Over time, this canal also caused population aggregation and thus promoted the emergence of a series of new cities and towns. As a large-scale linear spatial element, this canal played and will continue to play a vital role in shaping the cultural landscape of urban and rural areas and be closely linked to all aspects of urban and rural life.

2. Research methods

We used historical literature archives, ancient city drawings and maps to survey and confirm historical events related to the canal. Locations related to these historical events were investigated through quantitative analyses, regardless of whether the historic works (constructions) and places still exist or not. In an article (in Chinese) published by the authors of this article (Rong and Wang 2018), the locations of the historic works and places that are related to the significant historical events were determined. The methodology, historical data and references used for determining the locations were described. All of this information is the research basis of this article. Sections 3.1–3.3 of this article summarize the methodology and some of the main findings of the previous article (Rong and Wang 2018), with more information added. Among previous studies, Professor Wei Chen’s team from the School of Architecture at Southeast University performed a comprehensive survey of the historic cities and

Table 1. Comparisons between the Grand Canal in China and Several Other World Heritage Canals.*

| Name                  | Rideau Canal | Canal du Midi | Pontcysyllte Aqueduct and Canal | The Grand Canal |
|-----------------------|--------------|---------------|--------------------------------|-----------------|
| **Country**           |              |               |                                |                 |
| Construction Time     |              |               |                                |                 |
| Construction Time     | Canada early 19th century | France between 1667 and 1694 | U.K. the end of the 18th century and the start of the 19th century | China from the 5th century BC (constructed in sections, in the 7th century AD perceived as a unified means of communication) |
| Inscription Time      |              |               |                                |                 |
| Inscription Time      | 2007         | 1996          | 2009                           | 2014            |
| Property Area         |              |               |                                |                 |
| Property Area         | 21,454.81 ha | 1,172.00 ha   | 105.00 ha                      | 20,819.11 ha    |
| Inscription for Criteria | (i)(iv) | (i)(ii)(iv)(vi) | (i)(ii)(iv)                   | (i)(ii)(iv)(vi) |
| Length                |              |               |                                |                 |
| Length                | 202 km       | 360 km        | 18 km                          | consists of more than 2,000 km of artificial waterways, inscribed length 1011 km |

*In addition to the canals listed here, the Canal Ring Area of Amsterdam inside Singelgracht (the Netherlands) and Four Lifts on the Canal du Centre and their Environ (Belgium) are inscribed as World Heritage Sites. Other well-known canals can be found in the report “The International Canal Monuments List” issued by the International Committee for the Conservation of the Industrial Heritage (TICCIH).
3. Archives and quantitative analyses of historical events

3.1. Inspection tours of the rulers

Historically, the rulers’ inspection tours along the Grand Canal were ceremonial events of great significance, which the historical records always described in great detail, and the emperors often ordered painters to draw the scenery on the tours. The tours of Emperor Kangxi (reigning 1661–1722) and Emperor Qianlong (reigning 1736–1796) to the south were both very important historical events for the Grand Canal. These tours not only influenced the social, economic and cultural development at that time, but also were closely related to the changes of the forms and the formations of the landscapes in the cities and villages along the canal.

Taking as an example one of the six tours of Emperor Qianlong to the south, the ancient book “The Grand Event of Qianlong’s Tour to the South (南巡盛典)” (Gao et al. 1882) recorded the journey along the Hangzhou section of the Grand Canal during this tour as follows: “[The waterway journey] began from the Camp in Tangqi Town. [Then, the emperor] passed An Bridge after 5 li (a Chinese unit of length for distance measurement whose length changed with dynasties), then Zongguantang Temple after 4 li, Wangjia Village after 4 li, Wujing Ferry after 7 li, Shili Pavilion after 7 li, Xie Village after 2 li, Gongchen Bridge after 6 li, Beixin Tax House after 3 li, Jiangzhang Bridge after 3 li, then changed into landway at Xinmatou Dock after 1 li, entered Wulin City Gate after 6 li, and finally he arrived at his temporary palace after 8 li, with a total travelling distance of 57 li.”

To accurately locate all the places recorded here, our study (Rong and Wang 2018) used two methods to mutually compare and check these places. The first calculated locations were based on the historical data and Chinese historical measurement system. “The Grand Event of Qianlong’s Tour to the South” used in our study was completed in 1882. The length unit “li” at that time could be concluded to be 576 m (Chen 1966). According to this determination, we calculated all of the distances between each site recorded, and the results are shown in Table 2 (Rong and Wang 2018). The second method was to fix the places with accurate locations on a contemporary map, including the Camp in Tangqi Town, the Hangzhou Prefecture Palace and the Gongchen Bridge (it still exists and is currently protected as a cultural relic unit), and then discern the other locations by calculation. We measured the distances between the Camp in Tangqi Town and the Gongchen Bridge, and between the Gongchen Bridge and the Hangzhou Prefecture Palace. Since they were recorded in the ancient book as 36 li and 21 li, the length for one “li” could be calculated. The results of these two methods were proven to be identical. Therefore, we obtained the locations of the places recorded in “The Grand Event of Qianlong’s

Table 2. Distances between Each Site along the Hangzhou Section of the Grand Canal during Qianlong’s Tour to the South (calculated according to the studies of the Chinese historical measurement system (576 m per li)).

| Name                  | Distance (km) | Current Situation |
|-----------------------|---------------|-------------------|
| Camp in Tangqi Town   | 2.880         | a)                |
| An Bridge             | 2.880         | b)                |
| Zongguantang Temple   | 2.304         | c)                |
| Wangjia Village       | 4.032         | d)                |
| Wujing Ferry          | 4.032         | b)                |
| Shili Pavilion        | 1.152         | d)                |
| Xie Village           | 3.456         | d)                |
| Gongchen Bridge       | 1.728         | e)                |
| Beixin Tax House      | 1.728         | d)                |
| Jiangzhang Bridge     | 0.576         | d)                |
| Xinmatou Dock         | 3.456         | b)                |
| Wulin City Gate       | 4.608         | a)                |
| Prefecture Palace     |               |                   |

a) The ancient site is occupied by modern buildings. b) Disappeared. c) Only the name is retained. d) The name is retained, and the site could be found. e) The construction exists and is well preserved.
Tour to the South” as shown in Figure 1 (Rong and Wang 2018).

3.2. Emergence of functional urban works and places along the Grand Canal

As the main linear structural element of Hangzhou City, the canal connects a series of landscapes and has shaped the landscape of the city. Many of the architectural works and places that emerged during the development of the city were related to the canal, such as markets, gardens, residential zones, city gates, etc.

Through archives, ancient texts (Table 3), related studies (Ren 2002; Chen et al. 2012; Cai 2012), ancient atlases and modern maps, we classified into six types all the 115 works and places from the Sui Dynasty (581–619 AD) to the Republic of China (1912–1949) with discernible historical locations.¹ The six types are the following: city gates and city walls; ancestor worship places, altars and temples; government offices, schools and military camps; officials’ mansions, markets and entertainment places (Wazi); gardens and other landscapes; and barns, working fields and warehouses.

Although most of these works and places no longer exist, they constituted the historical structure of the cultural landscape along this section of the Grand Canal. Additionally, there were many historic paths that emerged along the canal. We located all of these works, places and paths that could be discerned on a contemporary map as shown in Figure 2² (Rong and Wang 2018).

3.3. Events related to water conservancy projects

The historical fundamental functions of a canal were flood prevention, water supply, irrigation, and transportation, among others. Historically, people have usually opened new rivers or diverted the canal to adjust the Grand Canal’s connections to the West Lake and the Qiantang River or other regional water systems.

Dating back to earlier times, the Shangtang River, an inland river within the city, was kept in use during the Sui

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¹Because of the number of works and places involved, only those whose historical locations have been discerned in this study are listed in Table 4. More works and places will be added in future studies.

²The ancient atlases and measured drawings were mostly from (Hangzhou Archives 2006) and (Que 2000). Only the works, places and rivers whose historical locations have been discerned in this study are shown in Figures 2, 3 and 7.
Table 3. Main Historical Texts Used in This Study.

| Type               | Name                          |
|--------------------|-------------------------------|
| Local Chronicles   | Qian Dao Lin An Zhi          |
|                    | Chen You Lin An Zhi          |
|                    | Xiao Chun Lin An Zhi         |
| Official History Records | Jiu Tang Shu                 |
|                    | Xin Tang Shu                 |
|                    | Song Shi                     |
|                    | Yuan Shi                     |
|                    | Ming Shi                     |
|                    | Qing Shi Gao                 |
| Others             | Zi Zhi Tong Jian             |
|                    | Gu Jin Yu Shu Ji Cheng       |
|                    | Hang Zhou Fu Zhi             |
|                    | Yuan Feng Ji Yu Zhi          |
|                    | Meng Liang Lu                |
|                    | Hong Xue Yin Yuan Tu Ji      |
|                    | Hu Shu Xiao Zhi              |

Dynasty, while a new water channel (that later became the Qinghu River in the Song Dynasty) was excavated on the east of the West Lake. Qinghu River was an important connection between the West Lake and the Grand Canal in history. In the Tang Dynasty (618–907 AD), three channels, namely, the Waisha River, the Zhongsha River and the Lisha River, were excavated to stop the tides of the Qiantang River. They later became the Maoshan River, the Yanqiao River and the Shi River, respectively. Then, the Grand Canal was diverted, and water from the West Lake was introduced into the Qinghu River to provide water for the Shangtang River. New water channels were excavated in the Wuyue Kingdom period (907–978 AD). In the Northern Song Dynasty (960–1127 AD), the Yunyan River was excavated. The Beiguan River was excavated in the Yuan Dynasty (1271–1368 AD) (Xu 2007). Additionally, the Desheng Dam separated the West Lake and the Grand Canal. In the Ming (1368–1644 AD) and Qing (1644–1912 AD) Dynasties, the canal generally remained in the former layout, and the Heng River was newly excavated (Chen 2015).

By using historical geographical texts, such as “The Records of Scenic Sites across the Country (Yu Di Ji Sheng)” (Wang, 1227) and related studies (Xu 2007; Chen et al. 2012), we listed important constructions and rivers related to water conservancy events (Table 4) and located those with discernible historical locations, as shown in Figure 3³ (Rong and Wang 2018).

### 3.4. Long-existing activities of local residents

During its development, the Grand Canal has always been closely related to all aspects of the lives of the local residents along it. Some characteristic folk activities of local residents, of which some have become customs, are shown in Table 5 and Figure 4. Some of these activities are held once a year at a fixed time, while others do not have a fixed time.

Parts of these activities have clear origin places or fixed occurrence places. They can be located on a contemporary map as supplements to the historical events mentioned in Sections 3.1–3.3. However, some activities, such as the folk operas and dance performances, can be held at different sites. Therefore, not all of the locations indicated in Figure 4 are the only places where these activities originated or currently occur.

The long-existing activities of local residents are crucial for understanding the living culture and folk culture along the Grand Canal. In addition, some of these activities are also helpful in comprehending the historical events mentioned in Sections 3.1–3.3.

### 4. Field investigation and element extraction

According to our field investigation, there were 75 historic works and places currently existing along the canal (Figure 5). We classified them into 21 types according to their functions (Table 6). Since not all of the 75 works and places had a relation to the canal, we examined their current situations in a field investigation, including the construction type, authenticity, integrity, preservation status, whether the sites were occupied or not, etc. There were 3 from the ruler’s inspection tour and 1 from the functional urban works that were found in the locations that we inferred, which verifies the validity of our research method in Section 3. For the other 71, through literature research, we analyzed the construction time, historic value, and the main events during their developmental processes (Figure 6) and sought to examine whether the canal played a role in their emergence and development. As a result, 34 of the sites

Table 4. Historic Constructions and Rivers along the Grand Canal Related to Historical Water Conservancy Events (Partial).

| Type                  | Name of Constructions and Rivers                                                                 |
|-----------------------|---------------------------------------------------------------------------------------------------|
| Grand Canal-West Lake Connections | City Watergate (name unknown, connecting place with Qinghu River), Connecting place with Qinghu River (name unknown), etc. |
| Grand Canal-Inland River Connections | Tiantong City Watergate, City Watergate (name unknown, on the northwest corner of the city wall), Connecting place of the Grand Canal with one inland river (name unknown), Yuhang City Gate, etc. |
| Grand Canal-Qiantang River Connections | Longshan Lock (constructed in the Ng-Yuih Kingdom period, reconstructed in the Northern Song Dynasty), Zhangting Courier Station (established in the Tang Dynasty, there was the Zhejiang Lock in the Ng-Yuih Kingdom period, reconstructed in the Northern Song Dynasty), etc. |
| Inland Rivers         | Qinghu River, Yanqiao River, Xiao River, Maoshan River, Caishi River (excavated in the Ng-Yuih Kingdom period), Tiesha River (excavated in the Tang Dynasty), etc. |

³Since some constructions related to water conservancy projects, such as the Desheng Dam, are listed in Section 4, they are not listed in Table 4 and Figure 3.
were confirmed to be related to the canal and were accordingly added to the three types of historical events discussed in Section 3.

5. Evaluation of the correlation degree between the works and places related to historical events and the Grand Canal

In Section 3, we studied the locations of historic architectural works and places from the perspective of historical events; then, we verified the sites and added them to the results based on the field investigation introduced in Section 4. After removing the repeated results, we finally obtained 170 historic works and places and 6 rivers with historical locations that could be inferred, including surviving and non-existent sites, as shown in Figure 7 (Rong and Wang 2018). We developed a five-indicator model to examine the correlation degree between these sites and the Grand Canal, namely, Embeddedness, Support, Connection, Adaptation, and Identification (Figure 8).

Embeddedness (E) refers to the relationships between the emergence of these historic works and places and the canal or the canal culture. Support (S) refers to the promoting role that the canal played in the development of these works and places. Connection (C) refers to the current relationships between them. Adaptation (A) refers to the adaptability of these works and places to the changes brought about by the canal. Identification (I) refers to whether the relationships between them could be identified quickly and effectively, regarding function or activity.

The rules for evaluation and parts of the evaluation process are shown in Figure 9. Through this evaluation model, we could obtain a straight-forward understanding of the importance and relevancy of the works and places from a historical event perspective and how the canal shaped the cultural landscapes. The formula of this model is

$$D = (E \ast S + S \ast C + C \ast A + A \ast I + I \ast E) \ast K$$

$D$: The correlation degree of a certain historic work or place to the canal.

$K$: A constant quantity, $K = \frac{\sin \pi}{\pi}$.

Based on this calculation, value $D$ can reflect the importance of a specific historic work or place to the Grand Canal. In conservation planning and urban design for the Grand Canal, more attention should be paid to historic works or places with a higher value of $D$. Additionally, the shape centre in each radar map
Figure 8 reveals the main way in which a historic work or place correlates with the canal. The average correlation degree in each historical period can be calculated by the following formula:

$$\bar{D} = \frac{\sum D_i}{n} \quad (i = 1, 2, \ldots, n)$$

$\bar{D}$: The average correlation degree of the historic works and places to the canal in each historical period.

$D_i$: The correlation degree of each historic work or place to the canal.

A higher value of $\bar{D}$ indicates that the construction activities during a certain historical period had a closer relationship with the canal. The value $\bar{D}$ changes with the value of $n$, which is influenced by the research process of historical events. Obviously, more studies on historical events lead to a more accurate value of $\bar{D}$.

In this case study, through the calculations related to the 170 historic works and places mentioned above, we found that compared with other historical periods, the works built in the Qing Dynasty, the Republic of China and the Southern Song Dynasty had higher correlation degrees to the Grand Canal. The values of $\bar{D}$ in these historical periods were 606, 618 and 654 respectively, while the values for the others were under 560.

6. Conclusion

Canals always have large spatial and temporal scales, running through and linking different urban and rural areas. Issues related to canals are often complicated; however, the functions of canals tend to be consistent. From a historical event perspective, we developed a classification approach to address the complexity and
unity of canals. This approach also made it possible to comprehensively understand the values that a heritage canal has and why the canal plays a vital role in shaping cultural landscapes and forming the city pattern.

1. Through the historical records of rulers’ inspection tours, we found the places where the ruler entered the city, where he stopped, etc. These places were also key landmarks in urban and rural spaces at that time. These locations further influenced the development of urban spaces and the shaping of the urban landscapes through intentional plans. Additionally, the drawings that recorded the tours showed the landscapes in a wide variety of contexts during the ruler’s travel, including the mountains and woods far away from the Grand Canal. No matter who paid attention to such landscapes, the ruler or the painters, these drawings revealed the sight-line and other connections between the canal and its natural and built environments. In other words, it is the continuous interaction between the canal and its natural and built environments that contributes to a holistic landscape pattern.

2. Through the historical events related to the emergence of functional urban architectural works and places, we learned that the Grand Canal directly affected the early urban forms and urban growth of Hangzhou City. Due to the transportation function of the canal, the manufacturing, warehousing, commerce and trade of the city gathered along it. These activities changed with the transformations of the canal, and affected the quantity and distribution of the residential, educational, administrative, religious, recreational, defensive and other works and places, thus determining the appearance of the city. The canal had a profound impact on the shaping of the landscapes along it. Furthermore, the canal is often considered to be a type of cultural identity by the local people.

3. Similarly, the water conservancy-related functions of the canal may be effectively based on the network formed by the Grand Canal, the West Lake, the Qiantang River and the inland rivers. This network as a whole had already been noted in ancient times. For instance, the historical drawing “Full View of the Grand Canal in the Qing Dynasty (Qing Dai Da Yun He Quan Tu)” (Hangzhou...
Figure 5. Currently Existing Historic Works and Places along the Grand Canal.

Table 6. Classification of the Currently Existing Historic Works and Places along the Grand Canal.

| Type | Bridge | Dock | Lock | Dam | Towpath | Well | Tablet |
|------|--------|------|------|-----|---------|------|--------|
| Typical Plane | ![Bridge](image) | ![Dock](image) | ![Lock](image) | ![Dam](image) | ![Towpath](image) | ![Well](image) | ![Tablet](image) |
| Type | Tax House | Temple | Pagoda | Christian Architecture | Residence | Warehouse | Camp |
| Typical Plane | ![Tax House](image) | ![Temple](image) | ![Pagoda](image) | ![Christian Architecture](image) | ![Residence](image) | ![Warehouse](image) | ![Camp](image) |
| Type | Factory | Garden | Museum | Gymnasium | Hospital | Commercial House | School |
| Typical Plane | ![Factory](image) | ![Garden](image) | ![Museum](image) | ![Gymnasium](image) | ![Hospital](image) | ![Commercial House](image) | ![School](image) |
Archives 2013) clearly showed the relationships in this network. During historical periods, city managers changed the water system pattern for different reasons, which can be seen as interactive activities between humans and the land, nature and culture in a specific geographical setting. Above this water network, various types of works, such as bridges, docks, locks, dams and towpaths, were gradually designed and built, which formed unique landscapes.

A large quantity of historical data was involved in this study. This article used only certain typical examples for the explanations of each type of historical event. For instance, similar to Emperor Qianlong, Emperor Kangxi also made inspection tours. These events were considered in the study but not mentioned here. In addition, the three types of historical events in this article are a classification method for this case. In other cases, there can be other classification approaches. This does not influence the framework and methodology of this article.

This study developed an approach from a perspective of historical events to interpret a heritage canal (Figure 10). Thus, we achieved a detailed, comprehensive and dynamic understanding of the role that the
heritage canal played in shaping the cultural landscape. Moreover, from the quantitative model developed, the correlation degree between the historic works and places and the canal could be assessed. Thus, we can learn which historic works and places are related to the canal’s core values, including flood prevention, water supply, irrigation, and transportation, and which works and places are related to the non-core values, such as landscaping, and how these works and places became associated in a network by interacting with one another during historical events; we can also learn the key elements in this developmental process. Through this approach, suggestions can be given for the conservation and urban design of the heritage canal and for studies related to cultural landscapes, especially in the Asian context.

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