# A Study on the Water Treatment System in the Ancient Chinese Village of Hongcun

Focus on its sustainable and aesthetic values and its value as a model for the modern concept of the sponge city

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AR2A011 Architectural History Thesis

Delft University of Technology

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April 2023

**Abstract**

This thesis takes the ancient Chinese village of Hongcun as the main object of study, focusing on the specific functions and modes of operation of the water treatment system in Hongcun as well as the cultural and social context behind it. And the role of different water treatment methods used in Hongcun is analysed in terms of both sustainable and aesthetic values. This thesis also links the water treatment system of Hongcun with the modern concept of the sponge city, explaining the similarities between the two and using Hongcun as a prototype to provide guidance for the construction of modern sponge cities.

**Introduction**

The ancient villages of southern Anhui in China are part of UNESCO World Heritage. Hongcun, as a representative of these villages, has been studied by scholars in several fields, such as architecture, planning, culture, and hydrology. Among the water-related studies, Hongcun's water forms, water scenery, waterfront gardens, water system planning, water aesthetics and water culture have received extensive attention. Hongcun has a water treatment system built through meticulous planning, which is relatively rare in ancient China. And one of the reasons for Hongcun being listed as a World Heritage Site is that it has this complete ancient water treatment system, which reflects the pursuit of harmony between man and nature, and it has scientific, cultural, and aesthetic values. The village's Moon Marsh, Nanhu Lake and the Ditches are the main components of the water treatment system, which were planned and built at different times in history.

Water treatment is often seen as a separate, purely functional system that relies on infrastructure such as pipes to help reduce water waste and promote water reuse. But the water treatment system in Hongcun gives a different answer, showing that water treatment can be integrated with the natural environment and developed without destroying the ecology. In other words, in developing the village and constructing the water treatment system, Hongcun promotes the integration of the village with the natural environment, allowing the whole village to absorb and store water like a sponge, meeting the requirements for sustainability while creating a beautiful landscape. This is in line with the modern concept of the 'sponge city'. This thesis will therefore focus on how the local inhabitants created an ancient water treatment system to store, purify, infiltrate, and use water in accordance with natural water resources, and how this water treatment system was used to create landscape and aesthetic values while meeting sustainable requirements. In this way, it is shown how the ancient water treatment system of Hongcun can inform the modern concept of the village or city as a 'sponge'.

This thesis adopts a combination of primary and secondary sources, using hydrologic maps from different years and photos of Hongcun as primary sources and other scholars' studies as secondary sources. The sustainable role of the Moon Marsh, Nanhu Lake and Ditches in the overall water treatment system of Hongcun has been analysed by many scholars. Su, Song and Cao (2017) present a general plan of the entire water treatment system in Hongcun, broadly describing the various components of the system. Wang and Fu (2017) analyse the role of Nanhu

Lake in the water treatment system, including flood control, water storage and irrigation. Wang (2008) describes how the ditches transport water to the inhabitants, helping to reduce the pressure of flooding. In addition, Deng and Liu (2018) state that the concept of a sponge city is to enable the city to absorb, infiltrate, store, purify and reuse water on its own. This concept is very similar to the one used to guide the construction of the water treatment system in Hongcun, but the studies on Hongcun are not integrated with the concept of the sponge city and do not provide a model for the creation of modern sponge cities. In terms of aesthetics, Tan (2010) illustrates that the layout of the water system in ancient Huizhou is based on traditional Chinese aesthetic concepts. Zhang (2022) introduces the diverse water landscapes in ancient Huizhou, describing the different forms and functions of the waterscape and the harmony and beauty they produce by integrating with each other. These studies, however, focus on the whole region of ancient Huizhou and do not analyse the ancient Hongcun separately in greater depth.

In general, although many scholars have studied the water treatment system in Hongcun, there is still a lack of analysis on how to adapt the environment to meet the needs of water treatment and how to balance the development of the village with the use of natural resources. At the same time, existing studies have focused more on the sustainable contribution of the water treatment system in Hongcun, ignoring its aesthetic role, and have not systematically analysed the water treatment system from both perspectives. In addition, although there have been studies on the use of water in houses and dwellings, for example, Zhao (2019) examines how water was introduced into dwellings to facilitate daily water use and create an aesthetic experience, but research on water treatment systems has focused more on water holding area and ditches, without integrating the houses into the overall water treatment planning of Hongcun. Finally, there are many similarities between the way the water treatment system in Hongcun operates and the concept of the sponge city. Specifically, in ancient China, there was an idea of keeping humans and nature in harmony and using water according to local conditions. It is similar to the modern concept of the sponge city, which means preserving the natural environment so that the city itself can meet the needs of water storage, purification, infiltration and use (Li et al., 2022). At the same time, the overall development of Hongcun has purposefully controlled the way in which the village is developed and the intensity of development, reducing the disturbance to the natural environment. However, the discussion on Hongcun and sponge cities lacks some comparative and systematic analysis to link the two together and provide a model for modern water treatment.

This thesis is a social science study of water treatment systems based on ancient Chinese social backgrounds and cultural concepts and serves as an example of the modern concept of the sponge city. The thesis, after the introduction, is divided into three more chapters as follows.

Chapter 1 (Environmental-social-cultural context) introduces the historical and cultural context of ancient China, showing the social influences and ideas that guided the villagers of Hongcun to choose a well-planned and environmentally integrated approach to the construction of the village's water treatment system.

Chapter 2 (Specific water treatment methods) discusses how the two water holding areas and

ditches functioned as water storage and purification, bringing vitality and aesthetic value to the village. And it also examines the ways in which villagers live with water in the dwellings, and how water creates sustainable value and aesthetic experience for inhabitants.

Chapter 3 (Sponge city) specifically describes the modern concept of the sponge city, illustrates some of the conditions that need to be met to create a sponge city, and compares these requirements with the effectiveness and advantages of the ancient water treatment system in Hongcun, showing the reasons why it can be a model for modern water treatment.

At the end of the thesis, there will be a conclusion that summarises all the analyses above. It will conclude some of the characteristics of a water treatment system that could be used as a model for the sponge city concept and draw out some of the cultural and theoretical knowledge that can help in the implementation of the sponge city concept from the example of Hongcun.

## Chapter 1

### Environmental-Social-Cultural Context

The water treatment system in Hongcun was initially created because of environmental and social factors. The flooding and the expansion of the village's population and arable land area were the main reasons why the local villagers began to establish a water treatment system. Prior to 1276 AD, there was a Xixi stream flowing from north-west to south-east, situated to the south of where Hongcun was located at the time, but a huge flash flood in 1276 AD changed the direction of the stream to north-south, leaving the original channel dry and abandoned (Wang, 2008). At the same time, Hongcun grew southwards as the population expanded, gradually occupying the southern part of the area, including the original stream channel. From 1403 AD onwards, local villagers began to plan and build a water treatment system for Hongcun, transforming the former Xixi stream channel into ditches, extending a natural well and naming it Moon Marsh (Figure 1). Over the next two hundred years, Hongcun suffered flash floods, which blocked the ditches with mud and sand and washed away many houses. At the same time, according to Wang (2008), with the expansion of the population, the Moon Marsh was no longer able to meet the villagers' water needs and the farmland in the south lacked a waterway for irrigation. The villagers, therefore, decided to rebuild and expand the ditches for flood control and irrigation, and to construct the Nanhu Lake on the south side of Hongcun to meet the need for water storage. It was only in 1610 AD that the southern part of the ditches and the Nanhu Lake were finally completed, and since then the water treatment system in Hongcun has been constructed and has been in use until today (Figure 2). In conclusion, on the one hand, the topography of Hongcun is high in the north and low in the south, with abundant precipitation, making it prone to flooding, while at the same time, the increase in population and arable land area in Hongcun means an increase in water demand. These two factors make it necessary to build a well-designed water treatment system in order to maintain daily life.

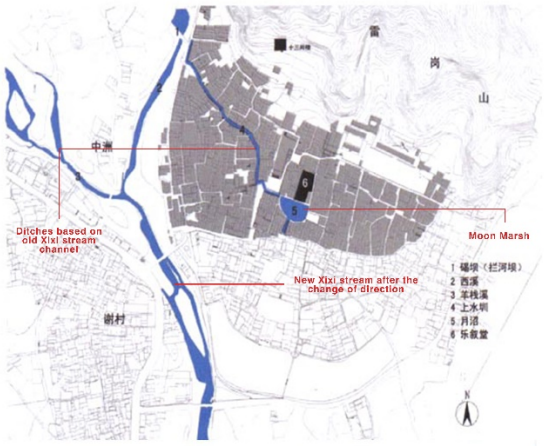


Fig. 1: Hydrologic map of Hongcun from 1403 to 1610 AD.

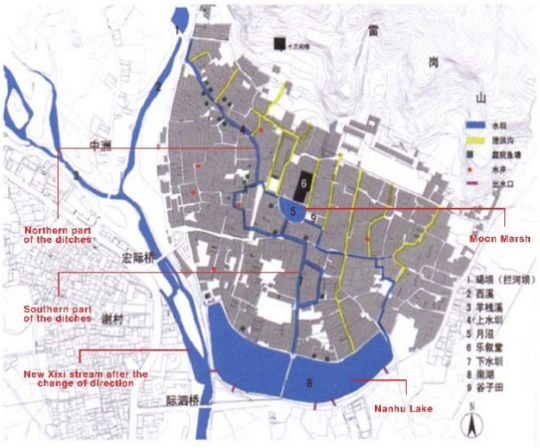


Fig. 2: Hydrologic map of Hongcun after 1610 AD.

The construction of the water treatment system in Hongcun required unified planning and meticulous arrangements, all of which were made possible by the cultural background of the clan system. In China, a clan is a group of people who share a common ancestor, the same surname and who live together. A clan may form a community in which people help each other, share common ancestral rituals or festivals to strengthen connections and work together to protect common property (Lv, 1929). In Hongcun, for example, the villagers' main surname is Wang, and together they build a Wang clan. Based on the traditional social culture of ancient China, the individual people of Hongcun were usually dependent on the clan for the source and distribution of their property, and because of this, the clan would have more power and wealth than the individual and would be used to promote the development of Hongcun. The construction of the entire water treatment system required a large amount of money, which was difficult for individuals to achieve, but the clan could mobilise the proceeds from the clan fields and clan property and raise funds in the form of a joint contribution from each family. At the same time, in ancient times, the construction of water treatment systems required a large investment in manpower, and it was under the unified dispatch of the clan that the villagers of Hongcun were able to work in an orderly and continuous manner over two hundred years. The Wang clan is a large clan with a population of over a thousand people, with ten branches in total, each with a leader. There was a clear division of labour and cooperation between the various branches. For example, during the Qing dynasty, Hongcun carried out a project to remove silt from the entire water treatment system. The clansmen of the second branch were responsible for the dredging of the ditches and the clansmen of the fourth branch were responsible for the dredging of the Moon Marsh (Wang, 2008). In short, the ancient Chinese clan system ensured that the construction of the water treatment system could be carried out continuously over two hundred years, bringing all the villagers together and dividing the work between them to complete this meticulously planned large-scale water treatment project.

The planning of the water treatment system in Hongcun is based on the Chinese traditional theory of Feng Shui. Feng Shui originated from the cult of nature and topography, and in ancient Huizhou, Feng Shui was believed by many people and spread widely, and people would guide their lives according to it (Liu, 2007). In Feng Shui, it is believed that "Qi" makes up everything and is the origin of everything. A village should preferably be situated on low ground, with its back to the

mountains and its face to the water, so that it is conducive to the gathering of “Qi” and the development of the village (Yao, 2021). Because the northern side of Hongcun leans on the Leigang Mountain, when the water treatment system was planned, the Nanhu Lake was placed in the southernmost part of the village. This means that all the houses are between Nanhu Lake and Leigang Mountain, which means that they can all have their backs on the mountain and face the water. Secondly, in Feng Shui, it is believed that every substance is divided into Yin and Yang attributes, and that only by combining Yin and Yang can things be developed in a favourable way. In Feng Shui, river water is considered to be "Yang", while underground water is considered to be "Yin", so the ditches in Hongcun were built to bring the "Yang" river water into the village, balancing the " Yin" underground water in the village (Wang, 2008). At the same time, in Feng Shui theory there is the concept of the 'Five Elements', which states that everything in the world belongs to five different properties, namely, metal, wood, water, fire and earth. Hongcun is considered to be of the 'fire' nature and by introducing water into the village through ditches, the 'fire' nature can be effectively suppressed and a balance achieved. This idea of bringing water in to suppress fire was based on the Feng Shui theory in ancient China, but in the scientific perspective of modern society, there is also another interpretation, which is that bringing water into the village would help to stop fires from occurring. In short, the doctrine of Feng Shui played a part in the planning of water treatment systems in ancient Hongcun, and many proposals were determined from a reverence for Feng Shui.

## Chapter 2

### Specific Water Treatment Methods

There are two main water holding areas in Hongcun, the Moon Marsh and Nanhu Lake, which are located in two different locations in the village and therefore have different functions in the daily life of the village. The Moon Marsh is located in the centre of the village and is relatively upstream in the water treatment system, therefore, the water in the Moon Marsh is clean and is used as a source of water for the daily life of the inhabitants. At the same time, the Moon Marsh is surrounded by houses and is close to them, so the water is also used to prevent fires (Figure 3). Because of the protection of the Moon Marsh, the houses around it have not been exposed to fire for hundreds of years and the wooden structure of the buildings has been preserved as a result (Su, Song and Cao, 2017). In addition, because of its central position in the village, it was a natural place for villagers to gather and interact and had a social aspect. In contrast, Nanhu Lake, located at the southernmost end of the village, is the most downstream body of water in the entire water treatment system of Hongcun, where domestic wastewater is discharged into the lake and the water is less clean and therefore used for fish farming and lotus root farming (Figure 4). The organisms in the lake form a small ecosystem that helps to purify the water, allowing it to be used to irrigate the farmland. Nanhu Lake helps to treat domestic wastewater while generating income for the villagers from agricultural produce (Ma, 2005). At the same time, Nanhu Lake is also used to increase the water storage capacity to resist flash floods, as the village is situated high in the north and low in the south and at the foot of the mountains, which are often subject to rain and flash floods. In addition, from an aesthetic point of view, both water holding areas show the calm beauty of water (Lu, 2005). The clear surface of the water reflects

the surrounding trees, buildings, sky, and clouds like a mirror, allowing the space to expand. And when facing the water, people and nature are integrated, creating an atmosphere of peace and tranquillity and a sense of spiritual cleansing.

Fig. 3: The Moon Marsh and the surrounding buildings.

Fig. 4: The Nanhu Lake and the aquatic plants in it.

The location, width, and slope of the ditches in Hongcun have been carefully designed to achieve sustainable values, while the flowing water in the ditches also brings a unique aesthetic value. Firstly, the north-western part of the ditches is connected to the Xixi stream, bringing natural water resources into the village ditches. The ditches are not directly connected to the Xixi stream, but rather the connection has been planned and designed. At the beginning of the ditches, 30 metres of the ditches are built parallel to the Xixi stream to buffer the water flowing into the ditches so that during times of high precipitation, the water from the Xixi stream does not overwhelm the beginning part of the ditches (Lu, 2005). Secondly, the topography of the village is generally high in the north and low in the south, and the water in the ditches relies on this difference in topography to transport water from the north to the south of the village. The width and slope of the ditches, therefore, need to be carefully controlled to ensure that the water will not be prevented from flowing continuously by too little slope or too wide ditches. For example, the part of the ditches that connect to the Xixi stream is wider than the rest of the ditches because the water is flowing at a higher velocity when it first enters the ditches, and this part of the ditches needs to be able to carry more water (Lu, 2005). At the same time, the constant flow of water and the sound of rushing water brings a sense of vitality to the village (Figure 5), as in ancient Chinese traditional culture, water is the source of life and flowing water carries a sense of vitality. The combination of movement and stillness in a tranquil village with flowing water also brings an experience of beauty (Liu, 2007). The ditches in Hongcun have existed for hundreds of years and the water in them has flowed for hundreds of years. The flow of water symbolises the passage of time and triggers people's imagination about time and space. In short, the ditches in Hongcun form a network of water for transporting water, allowing the distance between the inhabitants and the water source to be reduced, which facilitates the daily life of the inhabitants. The flowing water also provides the villagers with visual and aural aesthetic pleasure.

Fig. 5: Flowing water in ditches.

Hongcun is located in Huizhou, and one of the characteristics of Huizhou houses is that there is a courtyard in the middle of the house, which serves the functions of lighting, ventilation and drainage (Zhao, 2019). As most Huizhou houses have sloping roofs, rainwater flows along the eaves into the courtyard and is discharged through the drains in the courtyard. The rainwater flows over the eaves and forms a kind of rain curtain, providing the interior of the house with a beautiful view (Figure 6), which is also very common in Hongcun. More particularly, in Hongcun, as ditches carry water to all parts of the village and residents can easily access it, people will tend to dig ponds in their courtyards, bring the water from the ditches into the ponds and build pavilions around them. Fish can be kept in the pond and trees can be planted around the pond to create a garden full of nature inside the residence. For example, according to Liu (2007), there is a pavilion in the courtyard of a residence called Deyi Tang, which is attached to a pond where people can sit with their friends, watch fish, sip tea and chat (Figure 7). The pond, the pavilion, the swimming fish, and the plants together form a beautiful landscape, bringing the natural scenery into the building and bringing an aesthetic experience to people's daily lives. In addition, several measures were used to ensure that the water introduced into the courtyard could flow continuously without becoming stagnant. For example, in a house called Chengzhi Tang, the pond in the courtyard is divided into two parts with a height difference, with the slightly higher part connected to the water inlet and the slightly lower part to the water outlet. The water from the pond connected to the inlet is used as water for daily life, while the pond connected to the outlet is used for aquatic plants and fish. At the same time, both the inlet and outlet are equipped with water filters to prevent waste from entering the village's entire water system.

Fig. 6: The pitched roof and the rain curtain.

Fig. 7: The pavilion and pond in Deyi Tang.

## Chapter 3

## Sponge City

In 2012, the concept of the sponge city was first introduced in China to help solve the urban drainage problems arising from urban development. The definition of a sponge city is that the city can act like a sponge and be 'resilient' in the face of environmental changes and natural disasters, capable of coping with the effects of flooding (Li et al., 2022). The specific requirements of the concept of the sponge city can be discussed in terms of technical, social and cultural aspects. In terms of the technical aspect, it is necessary to create a water treatment system that

integrates with the environment and satisfies the functions of water absorption, storage, and reuse. Regarding the social aspect, in the process of urban development, attention needs to be paid to controlling the intensity of urban development and protecting the original ecosystem. In the cultural aspect, people are expected to transform from a concept of conquering nature to respecting nature.

The concept of the sponge city requires a city to be able to build a water treatment system based on natural conditions that satisfy the functions of water absorption, storage, infiltration, purification, and reuse, constituting a good water cycle and enabling a good ecological environment to be built in the city (Deng and Liu, 2018). Firstly, the construction of ditches and the use of stone slabs as road material were used in Hongcun to improve the overall water absorption and permeability of the village. On the one hand, the ditches that are scattered throughout the village not only serve the function of transporting water to each household but also help to hold the rainwater and fulfil their function as drainage pipes for the village in order to prevent flooding from occurring. At the same time, the roads in Hongcun are paved with stone slabs with gaps existing between them, and these gaps naturally improve the permeability of the ground and reduce the accumulation of water on the ground (Deng and Liu, 2018). The ground in modern cities, by contrast, lacks the ability of water infiltration and is very prone to ponding during heavy rainfall. The sponge city concept, therefore, requires modern cities to protect the original water ecology while using permeable materials to pave the ground, hence enhancing the water permeability of the urban ground. Secondly, in terms of improving the reuse of water, most of the homes in Hongcun have courtyards which are used as a tool for rainwater collection and utilisation (Deng and Liu, 2018). The courtyards in the houses not only help to reduce drainage problems due to high rainfall but also achieve sustainable use of water resources. In contrast, the reuse of water in modern cities relies on water treatment plants rather than all residents and does not result in the universal reuse of water resources. The sponge city concept, therefore, requires that the reuse of water in modern cities should be focused on the household or individual to improve the overall water reuse capacity of the city. Finally, the villagers in Hongcun built Nanhu Lake to resist heavy rainfall and flooding, and aquatic plants and fish were put in it to build a better ecosystem. This not only improves the village's water storage and flood resistance but also helps to build a comfortable living environment, leaving the village in an atmosphere of harmony and tranquillity, bringing an aesthetic experience. This is very similar to the concept of the sponge city, which requires that more wetlands should be present in the city to create a good ecological environment. This helps to improve the city's ability to cope with changing natural conditions and creates a living environment close to nature and full of beautiful scenery for its inhabitants.

In the process of urban development, people need to protect the original ecosystem, use the natural environment wisely and control the intensity of urban development so that the city can be 'resilient' (Wu et al., 2016). In other words, cities cannot be developed at the expense of destroying the natural water environment. In modern urban planning and expansion, environmental factors are often not the primary consideration, leading to the destruction of the environment. In terms of living in harmony with the environment, Hongcun is a positive case in point. During the centuries-long process of village development, Hongcun also experienced an

expansion of its population and the village needed to undergo new planning. The ditches in the village were built on the site of a disused river, and the later expansion of the ditches followed the flow of the water without too much human interference. The moon marsh was built on the site of a natural well, which meant that the original water resources were fully utilised. The expansion of the village also follows the north-high and south-low topography and the direction of natural water flow. The fact that the water treatment system in Hongcun has survived for hundreds of years without being damaged or abandoned is closely linked to these nature-based measures. Both the case of Hongcun and the concept of the sponge city illustrate the need to maintain a sustainable relationship between humans and the natural ecosystem while pursuing the development of a village or city (Wu et al., 2016).

In the concept of the sponge city, people are requested to change the concept of transforming nature and conquering it, to learn to respect and follow nature, and to pursue the harmonious coexistence of man, water, and nature (Fang, Cheng and Yu, 2017). In modern society, with the development of technology, people have developed a feeling that they are above nature, which has led to people ignoring nature when treating water and forcing the use of technology to solve problems, eventually leading to a series of problems such as urban water logging, water pollution and water shortages. In ancient China, however, the situation was quite different. In ancient Chinese philosophy, there was a theory of natural cosmology, which included a notion called 'Tianrenheyi', meaning that heaven, earth, nature, and man be regarded as a whole (Weber, 2005). People, therefore, consider themselves to be closely connected to nature and respect it, and treat it as if it were their own body. For example, the villagers of Hongcun insisted on the protection of the natural environment during the construction of the water treatment system, which demonstrates the respect and reverence people had for nature in ancient China. In ancient times, people lacked advanced technology and relied on natural conditions, but were still able to create a sustainable water treatment system to meet their daily needs and maintain a balance between village development and the ecological environment. This success was due to the people's respect for nature in their thinking. However, this traditional Chinese thinking has declined under the impact of modern technology, and people are more inclined to pursue profit than to respect the natural environment. The rise of the concept of the sponge city is a reminder that some valuable ancient traditional ideas should not be forgotten.

**Conclusion**

In conclusion, this thesis focuses on the ancient water treatment system in Hongcun, analysing its creation and its role in sustainability and aesthetics in the context of the village's social, cultural and environmental background, and explains how it can be used as an ancient template for the modern concept of the sponge city. Hongcun has a functional and well-preserved water treatment system that is still in use today, which is due to the collaborative efforts of several generations of villagers, taking into account nature and the environment. The water treatment system in Hongcun has a number of different ways of treating water, including water holding areas, ditches and the use of water in homes. In terms of sustainability, these water treatment methods are capable of absorbing, infiltrating, storing, purifying, and reusing water, helping to prevent flooding and minimise the risk of water shortage. In terms of aesthetics, these different methods offer a

variety of aesthetic experiences. The calm beauty of water, the beauty of the vitality of water, and the beauty of the scenery created by water together with architecture, plants and pavilions, can all be experienced in Hongcun. Each type of water treatment has its characteristics, which are interlinked and together form a complete water treatment system in Hongcun, meeting the needs of the villagers in their daily lives while achieving an improvement in the village environment.

The sponge city is an emerging modern concept in China used to guide the planning and construction of cities, designed to help solve the problems of drainage, water logging, water scarcity and water pollution that cities are currently facing. This modern concept has many similarities to the traditional concept of designing water treatment systems in ancient China. The water treatment system in Hongcun is one of the few that has been preserved to this day, so Hongcun can be seen as a model for the modern concept of the sponge city, and one can learn some of the methods and ideas from this ancient water treatment system and apply them to the treatment of water resources in modern cities. In general, it is about using Hongcun as an example to learn how to control the intensity of urban development and create a water treatment system that meets the needs of everyday life and is integrated with nature, while preserving the original ecological environment. The example of Hongcun shows that in ancient China there was an idea of 'man living in harmony with nature and using water in accordance with local conditions'. In the same way, the modern concept of the sponge city is an attempt to awaken the idea of respecting and protecting nature in people's minds in order to raise the possibility of cities becoming as resilient as sponges and to enable the city itself to meet the needs of water storage, purification, infiltration, and reuse.

**References**


Deng, R. & Liu, C. (2018) '徽州古村落水系对现代海绵城市的借鉴' [Ancient village water systems in Huizhou with lessons for modern sponge cities], *辽宁科技学院学报 (Journal of Liaoning Institute of Science and Technology)*, 20(2), April, pp. 27-29.

Fang, Q., Cheng, P. & Yu, H. (2017) '徽州古村落水利用对海绵城市建设的启示' [The enlightenment of water utilization in Huizhou ancient villages to sponge urban construction], *太原学院学报 (Journal of Taiyuan Institute)*, 35(2), June, pp. 20-23.

Li, J., Gong, D., Mo, L. & Ma, X. (2022) '城市健康水循环视角下海绵城市因地制宜建设的思考' [Reflections on the localized construction of sponge cities from the perspective of healthy urban water cycle], *中国给水排水 (China Water & Wastewater)*, 38(12), June, pp. 94-99.

Liu, Y. (2007) '水脉宏村——安徽宏村水文化探析' [The water arteries of Hongcun —— The exploration on water culture of Hongcun in Anhui], *湖南师范大学 (Hunan Normal University)*, March.

Lu, H. (2005) '徽州古村落水系形态设计的审美特色——黟县宏村水环境探析' [Aesthetic characteristics of water system form design of the ancient villages in Huizhou —— Analysis of the water environment of Hongcun in Yixian], *华中建筑 (Huazhong Architecture)*, 23, April, pp. 144-146.

Lv, S. (1929) '中国宗族制度小史' [A short history of the Chinese clan system], *中山书局 (Zhongshan Press)*.

Ma, L. (2005) '宏村古水系在居住环境水体造景上的优越性' [The superiority of the ancient water system of Hongcun in creating a water body in a residential environment], *东南大学学报 (Journal of Southeast University)*, 7, December, pp. 195-198.

Su, M., Song, X. & Cao, H. (2017) '宏村古水系工程研究', [Hongcun ancient water system engineering study], *攀枝花学院学报 (Journal of Panzhihua College)*, 34(5), September, pp. 18-22.

Tan, F. (2010) '论徽州古村落中水系视觉传达的审美文化价值及其在当代设计中的应用' [Research on the ancient Huizhou river visual communication in the aesthetic and cultural value], *安徽工程大学 (Anhui Polytechnic University)*, (6), June.

Wang, H. (2008) '宏村水系的规划与规划控制机制', [Water system planning and its control mechanism of Hongcun], *华中建筑 (Huazhong Architecture)*, 26, December, pp. 224-228.

Wang, L. & Fu, L. (2017) '徽州古村落水口园林研究——以宏村南湖为例' [A study on the garden of Huizhou ancient village———Nanhu Lake in Hongcun], *福建建筑 (Fujian Architecture & Construction)*, 230(8).

Weber, R. (2005) Oneness and particularity in Chinese natural cosmology: The notion tianrenheyi. *Asian Philosophy*. 15(2), pp. 191–205.

Wu, D. et al. (2016) '中国特色海绵城市的新兴趋势与实践研究' [New trends and practical research on the sponge cities with Chinese characteristics], *中国软科学 (China Soft Science)*, (1), January, pp. 79-97.

Yao, Z. (2021) '基于风水文化视角下的徽州村镇空间基因识别研究' [Study on space gene identification of Huizhou villages and towns from the perspective of Fengshui culture], *东南大学 (Southeast University)*, May.

Zhang, M. (2022) '徽州传统聚落水系景观空间营造秩序研究' [Research on the order of water landscape space construction in Huizhou traditional settlements], *安徽建筑大学 (Anhui Jianzhu University)*, May.

Zhao, Z. (2019) '徽州古民居庭院景观的生态性启示' [Ecological insights into the courtyard landscape of ancient Huizhou houses], *长沙大学学报 (Journal of Changsha University)*, 33(4), July, pp. 118-121.

**Illustrations**

Fig. 1 and 2: Wang, H. (2008) '宏村水系的规划与规划控制机制', [Water System Planning and Its Control Mechanism of Hong Village], *华中建筑 (Huazhong Architecture)*, 26, December, pp. 224-228.

Fig. 3: Su, M., Song, X. & Cao, H. (2017) '宏村古水系工程研究', [Hongcun ancient water system engineering study], *攀枝花学院学报 (Journal of Panzhihua College)*, 34(5), September, pp. 18-22.

Fig. 4: Wang, H. (2008) '宏村水系的规划与规划控制机制', [Water System Planning and Its Control Mechanism of Hong Village], *华中建筑 (Huazhong Architecture)*, 26, December, pp. 224-228.

Fig. 5: Lu, H. (2005) '徽州古村落水系形态设计的审美特色——黟县宏村水环境探析' [Aesthetic characteristics of water system form design of the ancient villages in Huizhou —— analysis of the water environment of Hongcun in Yixian], *华中建筑 (Huazhong Architecture)*, 23, April, pp. 144-146.

Fig. 6: The pitched roof and the rain curtain (2020) [Online image]. Available from: https://www.sohu.com/a/395754610_617491 (Accessed: 15 April 2023).

Fig. 7: Liu, Y. (2007) '水脉宏村——安徽宏村水文化探析' [The water arteries of Hongcun —— The exploration on water culture of Hongcun in Anhui], *湖南师范大学 (Hunan Normal University)*, March.