Composition of water-featured open spaces on Chinese university campuses

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ABSTRACT

Influenced by traditional Chinese natural philosophy and increasing concern for environmental sustainability nowadays, water has been recognized as an embodiment of cultural identity and a desired component of the campus environment in China. This study focuses on the distinctive element, aims to clarify the characteristics of water-featured open spaces on Chinese university campuses, and tries to provide a typological method to define the presentation of water. From the viewpoint of the relationship between water and other spatial elements, 172 cases are investigated in three aspects: adaption to the site, creation of activity space, and scenery formation. Compositional typologies are categorized, and the characteristics of each typology and their relation to regional and historical backgrounds are analyzed and clarified. These characteristics show the evolution and variation of water-featured open spaces on Chinese campuses and demonstrate that water features can create spatial and scenic diversity with a flexible and adjustable relationship with other building and landscape elements. Furthermore, appropriate utilization of water features in the environmental design should be based on a thorough understanding of both cultural and spatial context.

1. Introduction

1.1. Background and aim

Surrounded by trees in the mountain and by the river, natural environment was pursued and valued as an essential component of ancient Chinese Shuyuan (academies, Pic.1), which has been influenced by the traditional thoughts, such as “Harmony between Nature and Humanity” in Taoist philosophy and the Shan-Shui (mountain and water) idea. Such deeply rooted traditional culture has been inherited in the modernization of educational institutes since the late 19th century (Pic.2), and still has a significant impact on today’s Chinese university campuses. To advance both the academic and residential environments on campus, rich natural contexts are desired on the site and considered important factors to the layout of buildings and the landscape in open spaces.

Among various natural features, water is a distinctive one and observed on many campuses in China. Through its reflection and flow, water creates a unique scenery and artistic conception in an open space. It enhances the environmental amenities so students and researchers can enjoy recreational activities, communicate in a relaxed atmosphere, and be inspired. Besides cultural and scenic meanings, water contributes to ecological sustainability through a cooling effect and a river network or wetland system,
Picture 1. Map of Yuelu Shuyuan [書院] (founded in 976, today's Yuelu Campus, Hunan University)

Picture 2. Master plan of Yenching University, 1926 (today’s Yanyuan Campus, Peking University).
showing its great potential to promote the physical environment for education. Therefore, such water-featured open spaces are typical examples representing the characteristics of Chinese campuses, as well as the inheritance and evolvement of traditional culture in contemporary spatial planning and design.

This study focuses on water-featured open spaces on Chinese university campuses, and aims to clarify their spatial composition and characteristics from the viewpoint of the relationship between water and other spatial elements, as well as their relation to regional and historical contexts.

1.2. Review

In previous studies about Chinese university campuses, brief histories of campus morphology (Chen and Ren 2008) and the spatial evolution from the traditional Shuyuan to the university (Wei 2012) were examined. The first author of this study investigated the landscape and its evolution of campuses founded before 1949 in three aspects: site environment, surrounding buildings, and landscape elements (Ping, Fu, and Yasuda 2017; Ping and Yasuda 2017, 2018). Through the above studies, the author recognized that the active use of natural elements is a distinctive characteristic deeply influenced by traditional Chinese culture, although the Beaux-Arts planning style was introduced and widely applied early in modernization. To further discuss the originality of Chinese university campus planning and design, this study focuses on the composition of water-featured open spaces, and tries to provide a typological method to define the presentation of water.

Water features are also considered characteristic landscape elements on campuses worldwide. Wetscape was listed in the campus landscape design taxonomy and discussed in terms of its functions, forms, and features (Dober 2000). The process of improving water environments on a campus in cooperation with the local government was researched (Yamaki and Koshizawa 2005). By comparison, this study focuses on Chinese campuses in a cultural context to explore the characteristics and evolution of physical spaces utilizing water features.

Moreover, in dealing with the loss of cultural identity under globalization, contemporary architectural and urban design related to the traditional culture becomes an issue of concern. For example, museum courtyard space design referred to traditional Chinese gardens (Sun, Wang, and Leng 2019), and sustainable urban design inspired by the Shan-Shui idea (Yang and Hu 2016) were researched to explore and enrich design ideas. With this shared background, this study focuses on water as a significant element embodying traditional culture and featuring the physical environment. It raises the topic of university campus planning, which has been practiced over a century nationwide with mixed Eastern and Western influences, to investigate its evolution in relation to the traditions and variety according to the regional contexts.

1.3. Study objects and methodology

In this study, water-featured open space is defined as open space containing visible water features in the form of ponds, lakes, rivers, etc. on or adjacent to the campus. Based on this definition, 172 cases (Table 1) are collected as study objects from 356 campuses of 137 well-known and leading universities listed in “Double First Class Universities”.

Campus maps or plans, photographs, and related histories and information are collected based on the literature review, field research, and online map service. Buildings and landscape elements related to water-featured open spaces, as well as the representative open spaces faced by the main buildings are extracted and illustrated in the analysis map (Figure 1 left).

Referring to the ideal environment of Shuyuan and design principles of traditional Chinese gardens influenced by the Shan-Shui idea, three aspects are considered important for investigating water-featured open spaces on campus: adaption to the site, creation of activity space, and scenery formation. Based on these three aspects, this study is developed as follows: First, the campus’ region, founding period, and size are sorted as related background factors (Ch. 2). Second, adaption to the site is examined by the source, shape and layout of the water feature (Ch. 3). Third, creation of activity space is examined by the relationship between water-featured and other open spaces (Ch. 4). Fourth, scenery formation is examined by the relationship between water features and other building or landscape elements (Ch. 5). Fifth, compositional typologies are categorized based on the two essential roles of water features in open spaces, and the characteristics of each typology and comparison of them according to region, founding period, size, and cultural context are analyzed and clarified (Ch. 6, Figure 1 right).

Water features: ponds, lakes, rivers, canals etc. are judged as water features in this study. However, those with strong function definitions, such as classical fountain as a sculpture and swimming pool as a sport facility, are not counted in the study objects.

Double First Class Universities: short of “World First Class University and First Class Academic Discipline Construction”, is a plan to develop higher educational institutes conceived by the China government in 2015. Schools sponsored by the plan are considered well-known and leading in China. 137 universities listed in the plan published in 2017 are research objects of the first stage of this study.

Campus maps and related documents were collected from HP of each university, university/public libraries and CNKI (China National Knowledge Infrastructure). Current situations were confirmed by the field research on 41 campuses in 2015, satellite photos, and street view on Baidu Maps and Tencent Maps.
Table 1. List of case studies.

| No.  | University Name                  | City          | Sig. Pattern |
|------|----------------------------------|---------------|--------------|
| 1    | Beijing Normal University        | Beijing       | Beijing       |
| 2    | Capital Normal University         | Beijing       | Beijing       |
| 3    | Capital Normal University         | Beijing       | Beijing       |
| 4    | Capital Normal University         | Beijing       | Beijing       |
| 5    | Capital Normal University         | Beijing       | Beijing       |
| 6    | Capital Normal University         | Beijing       | Beijing       |
| 7    | Capital Normal University         | Beijing       | Beijing       |
| 8    | Capital Normal University         | Beijing       | Beijing       |
| 9    | Capital Normal University         | Beijing       | Beijing       |
| 10   | Capital Normal University         | Beijing       | Beijing       |
| 11   | Capital Normal University         | Beijing       | Beijing       |
| 12   | Capital Normal University         | Beijing       | Beijing       |
| 13   | Capital Normal University         | Beijing       | Beijing       |
| 14   | Capital Normal University         | Beijing       | Beijing       |
| 15   | Capital Normal University         | Beijing       | Beijing       |
| 16   | Capital Normal University         | Beijing       | Beijing       |

Study flow

2. Background factors
- region
- founding period
- size of the campus

3. Adaption to the site
- source
- shape and layout of the water feature

4. Creation of activity space
- relation to open space, etc.

5. Scenery formation
- relation to buildings, etc.

6. Composition of water-featured open spaces

Chapter 2 Region of the campus
- Finding period of the campus
- Size of the campus

Chapter 3 Source of the water
- to preserve the original state
- part of the historical imperial garden

Chapter 4 Shape & layout of the water
- in both zones, along the site boundary
- Outdoor activity spaces related to the water

Chapter 5 Relation to the main building/gate
- on the axis (in the front yard), between the buildings
- Approach to forming the monumentally scenic (Fig. 10): symmetrical shape, element layouts (pavilion & island)
- Scenery formed by the water (Fig. 11): contrast between monumental & casual scenery

Figure 1. Analysis example.

Figure 1. Analysis example.
For example, the Yanyuan Campus of Peking University was founded in suburban Beijing in 1921\(^5\) based on the Qing Dynasty imperial garden with a complex network of lakes and streams. These water features are retained and connected with natural open spaces full of greenery and undulating topography in the north of the campus, distinguished from the artificial one in the east constructed since the 1950s. The waterway in the front yard was shaped straight and symmetrical to the West Gate and administrative building, forming a monumental approach, while the Weiming Lake and other streams are kept in a natural artistic conception. The utilization of water features is mixed with the western Beaux-Arts style and Chinese garden aesthetics.

2. Region, founding period, and size of the campus

The campus location is divided into seven regions according to the climatic and geographic conditions, and 48% of the researched cases were observed with water-featured open spaces. Campuses located in the South, East, and Southwest (areas with dense river-lake networks and abundant precipitation) tend to contain water features in open spaces, while fewer cases are observed in arid regions like the Northwest and North (Figure 2).

The founding year of the campus is divided into four periods according to the historical and social background. Period I (pre-1949) is the beginning of modernization in China; the modern higher education system was introduced, and traditional academies were superseded by universities. Period II (1950-77) is from the establishment of the People’s Republic of China until the Cultural Revolution, and the Soviet influence\(^6\) is reflected on many campus plans in the early 1950s. In Period II (1978-99), universities recovered and developed in the background of Chinese economic reform. And in Period IV (2000-19), with China experiencing further socioeconomic growth, the popularization of higher education and global competition stimulated the development of higher education. Most of the study cases were founded during two construction booms of campuses: Periods II and IV (Figure 3).

Campuses are sorted into five sizes for further comparative analysis. Most of the cases are M-L-size covering 50-200 ha, while new campuses founded in Periods II and IV tend to be larger to meet the demand of the increasing number of university students, occupying 68% of the L-XL-size cases (Figure 4).

![Map of the university campuses with water-featured open spaces.](image)

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\(^5\)Yanyuan Campus was founded by Yenching University in 1921. Peking University moved in since 1952.

\(^6\)Soviet influence: Soviet-type economic system was introduced in early 1950s after the establishment of P.R. China. Under the Soviet influence, universities experienced nationwide reorganization of colleges and departments, and the Main Building of Moscow State University was of a symbolic image imitated by many campuses.
3. Source, shape, and layout of the water feature

Influenced by the traditional Shuyuan, site selection and planning adaption to the site context are recognized as essential (Yang 2002) on Chinese university campuses. As the initial inspiration and resource for campus planning and design, the source of the water feature is investigated through its relation to the site context, such as rivers, lakes, seas, topography or garden remains. Active use of the existing site conditions are observed in nearly 80% of the cases in various forms: preservation of the original state of the water on site, the reshaping of the water based on context (such as broadening the river into a pond), connection to the surrounding river network to draw water, and use of lowland topography to impound or drain water. In the cases without water-related context, artificial ponds are dug and the earth is sometimes used to build a hill, which is a practice similarly applied in traditional Chinese gardens (Figure 5).

Based on the site context, the water feature’s shape and layout both form the basic frame and characterize related open spaces, interacting with the configuration of the campus and the arrangement of buildings. The shapes are sorted into point, plane, line, and their combination. The layout is categorized as single, scattered, combined, or contiguous. In more than half of the cases, the water features range from vast lake surfaces to narrow streams, creating numerous environments varying from place to place. Furthermore, combinations of plane and line shapes such as rivers and ponds connected to each other, land surrounded by the water, and waterways crossed and netted together bring about more diverse forms and integrated systems of water features (Figure 6).

4. Outdoor activity spaces related to the water feature

According to traditional Chinese educational thought, relaxing and enjoying oneself are as important as learning and thinking (Xueji (Record on the Subject of Education)/Liji (Book of Rites), ancient China, 3rd century B.C.). Therefore, creating outdoor activity spaces to enrich campus life is one of the key functions of water features. First, the position of the water feature is considered to be related to the activities and users. Water features in the academic zone are used more during the daytime for breaks or collective activities by students and researchers, while those in the residential zone or between the two zones are usually related to after-class activities and shared with neighborhoods throughout the day. In over half of the cases, water features are observed in both zones to accommodate various activities and people (Figure 7).

| Social background | Higher education | Period | Case |
|-------------------|------------------|--------|------|
| 1901-95: Self-Strengthening Movement | 1901-95 foundation of new academy | I | 1-95 |
| 1911: Xinhai Revolution | 1905: abolition of imperial examination system | II | 1905-1911 |
| 1949: establishment of the People’s Republic of China | 1949: nationalization of private universities | III | 1949-1952 |
| 1956-66: Cultural Revolution | 1956-66: stop of National Higher Education Entrance Examination | IV | 1956-66 |
| 1978: Chinese economic reform | 1978: Project 211 | V | 1978-1989 |
| 1990s: rapid socio-economic growth | 1999: comprehensification of university, raising of enrollment rate | VI | 1990s |
| 2000s: globalization | 2001: Double First Class University Plan | VII | 2000-2010 |

Figure 3. Historical background and founding period of the campus (172 cases).

Figure 4. Size of the campus (172 cases).

Figure 5. Source of the water feature.

Figure 6. Shape and layout of the water feature.
5. Scenery related to the water feature

According to the design principles of traditional Chinese gardens, scenery formation is a core concept in organizing landscape and building elements (Tong 1984). Therefore, forming campus scenery is another significant role of water features. Characterization of scenery can be described as monumental or casual, and monumental scenery refers to the scene related to landmark elements such as main buildings and gates. The presentation of water features in the scenery can be observed by their relation to these elements. First, positional relationships are classified as the water feature being on the axis in front of the gate, in the front yard, or between the buildings; in front of the main building without an axis; or away from the main building (Figure 9).

Second, two approaches to forming monumental scenery by the water feature were defined. The “geometrical approach” refers to the precisely symmetrical shape and vertical angle of the water feature on the axis to form ordered and grandiose scenery, and is often applied in the Beaux-Arts planning style. The “organic approach” refers to water features in organic shapes which still emphasize the main building through landscape element layouts such as bridge and pavilion on the axis, water encircling or semi-encircling the main building, or the enlarged water surface in front of the main building, all of which are more flexible and natural ways to arrange water features and found in the traditional Chinese gardens (Figure 10).

Based on the definitions above, cases are observed and categorized into three types of scenery formed by water features: Geometrical approaches are applied in specific areas, forming a strong contrast between monumental and casual scenery on campus (Type 1). Monumental and casual scenery integrated in organic approaches form a continuous sequence of changing scenes (Type 2). Water features form only casual scenery without distinct relation to the main building or gate (Type 3). Half of the cases are Type 2, which shows the tendency of using the water feature’s flexibility to create various characteristics of scenery in harmony with each other (Figure 11).

6. Compositional typology and characteristics of water-featured open spaces on campus

6.1. Compositional typologies of water-featured open spaces

Based on the essential roles of water features in the open spaces of campuses, cases are categorized into nine

Figure 7. Position of the water on campus.

Figure 8. Outdoor activity spaces related to the water feature.

Figure 9. Positional relationship of water feature and the main building/gate.

Figure 10. Approach to forming monumental scenery by the water feature.

Figure 11. Scenery formed by the water feature.
compositional typologies by combinations of outdoor activity spaces and scenery related to water features (Figure 12).

In the case of water-featured open spaces as a part of multiple outdoor activity spaces scattered across campus, those forming a contrast between (A1: 10) or integration of (A2: 18) monumental and casual scenery are fewer than those forming only casual scenery (A3: 29). Nearly 93% of these cases are in simple point/line-shapes or scattered layouts. Water features are completely or partially artificially excavated in half of the cases.

For example, the Xingqing Campus of Xi’an Jiaotong University (No.162, A1) was built in 1955 in the Soviet style and based on the orthogonal grid system of Xi’an city, with a strong axis formed by a sequence of symmetrical buildings and gates. Two ponds in regular shape emphasize the monumental scenery on the axis, while another with free curved outline is spotted in the greenery out of the axis. Two cases illustrate the varying presentation of organic-shaped ponds: on the Suiyuan Campus of Nanjing Normal University (No.70, A2), which was planned in combining the Beaux-Arts style and Forbidden City style in 1923, water at the...
foot of the hill with a pavilion on the axis suggests a mild monumentality, while on the Xueyuan Road Campus, Beihang University (No.21, A3), the pond in the grove between the academic and residential zones represents only in a leisurely atmosphere.

In the case of water features as one of the centers and contiguous with other outdoor activity spaces on campus, cases producing contrasting monumental and casual scenery (B1: 9) are comparable in number to A1, those integrating various scenery (B2: 26) account for more than half, and those without monumental scenery formed by water features (B3: 16) account for fewer cases than A3. Cases in B1 tend to be in a scattered configuration (6/9), while B2 and B3 cases are observed in a variety, including plane-shape (15), scattered layout (12), and combined/contiguous layout (13).

For example, the Kangle Campus of Sun Yat-sen University (No.125, B1) used to be a Christian university built in 1918. The main axis was formed to face the river with traditional Chinese style buildings and Beaux-Arts style lawns and ponds of geometric shape, while four ponds with freehanded outlines are scattered in the residential zone, creating disparate characteristics of open spaces and scenery in different places. The Qinghuayuan Campus of Tsinghua University (No.17, B2) inherits

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*Kangle Campus was founded by Lingnan University in 1918. Sun Yat-sen University moved in since 1952.*
the imperial garden remains and integrates naturally shaped water in the monumental scenery. The island encircled by water is crossed by the axis and serves as a natural foreground to a set of buildings built since the 1920s, in contrast to the artificial plaza in front of the Soviet style main building built in the 1950s. Compared to this, another case of irregularly shaped water serves as a backyard on the Shapingba A Campus of Chongqing University (No.143, B3). Located in the "mountain city", water is impounded in the lowland and surrounded by buildings arranged flexibly along the contours.

In the case of water features as a network or the center connecting most of the outdoor activity spaces, almost all of them involve water features composing monumental scenery, some by contrasting with casual scenery (C1: 21), and many more by integrating the two (C2: 42), which may be considered the most representative typology. By contrast, water features forming only casual scenery in spite of the spread on campus (C3: 1) is minor among the total cases. A hybrid of plane- and line-shaped water features are found in 85% of the cases, and most of them are sourced from the site context (57/65).

For example, on the Beiyangyuan Campus of Tianjin University (No.32, C1), planned as a new campus in 2013, water is considered an embodiment of cultural inheritance of the old campus (No.31) with lakes and rivers, with a strong composition of two rings encircling the entire campus and the central area. The monumental scenery is emphasized by the main axis crossing the water vertically. Compared to the geometrical approach, the Zijingang Campus of Zhejiang University (No.92, C2), planned as a new campus since 2000, keeps the natural shapes of water. Located in a typical context of the water town Jiangnan with a dense water network, water is regarded as a cultural motif of the university and the region. Two lakes serve as centers of areas constructed in two phases, promoting the significance of the main buildings through the enlarged water surfaces and surrounding water. Connections with numerous waterways winding throughout the campus create a network overlapping with other landscape elements. Planned since 2001, the Xiangshan Campus of China Academy of Art (No.93, C3) is a unique example reflecting the inspiration taken from traditional Shan-Shui painting and applied to campus planning. Existing rivers and ponds at the foot of the hill are all retained. Buildings are arranged flexibly to create changing views and experiences related to the natural contexts.

6.2. Characteristics related to region, founding period and size of the campus

Characteristics of water-featured open spaces are further discussed by examining the distribution of cases in relation to the campus’s region, founding period, and size (Figure 13).

Regarding the regional location of campuses, A1-A3 (especially A3) are found more in the Northeast, Northwest, and North, most of which is arid and where water is seldom in the site context. In the case of B1-B3, B1 and B2 are observed in the South and North, and B3 in the Northwest, showing different intentions to involve water features in the monumental scene composition. C1–C3 are found more in the East, Southwest, and South, where water features in various states are abundant and favored natural components in the campus design. Among these, the East is a notable area covered with dense water networks and known for its culture of traditional gardens. Thus, water features are used actively and broadly as a theme in the landscape of many campuses in this area.
Regarding the founding period of campuses, cases founded in Period I tend to apply A2 and B1, organizing water features to form monumental scenery. Influenced by Eastern and Western culture, the utilization of water is portrayed with a mixed characterization. The geometric approach is considered influenced by the Beaux-Arts planning style, and the respect for nature to be inherited from the traditional Chinese Shuyuan. Campuses founded in Period II tend to apply A3, with limited use of water features in open spaces, and a weak effect on emphasizing grandiose main buildings, which serve as dominant images of campuses constructed under the Soviet influence. Those founded in Period II show the increasing share of C1-C3, which suggests a trend of expanding the use of water features in open spaces, as landscape is once again regarded to be as important as buildings in the early stage of campus planning. In Period IV, cases of C1-C3 continue to increase and become the majority, showing the rising interest in composing open spaces with the dominant theme of water. Under the background of globalization, not only is water considered a physical landscape element, but it is also imbued with Chinese university traditions and cultural symbology.

Regarding campus sizes, it is found that the larger the campus is, water-featured open spaces are composed more as a network or center to connect other spaces (C1-C3). Further, water features tend to be coordinated in monumental scenery on larger campuses. Geometric approaches (A1, B1, and C1) are pursued relatively more in XL-size campuses, and organic approaches (A2, B2, and C2) more so in L-size campuses. Despite being different sizes, campuses founded in earlier time cluster in A1-A3, and those founded recently cluster in C1-C3, suggesting stronger relationship with founding period than with campus size.

A1 and C3 are the most diametrically opposed typologies. A1 uses water partially in artificial and natural ways to enhance the monumentality of the main axis and the relaxed atmosphere in other areas, which can be considered to be influenced partly by the Western planning style and partly by the traditional Chinese garden. By contrast, C3 arranges all buildings along the natural context without a strong axis or center, which is a kind of interpretation of the cavalier perspective of Shan-Shui paintings.

A3 and C1 are another pair of opposing typologies. A3 embeds water features in a small scale as a complement to the ideal natural environment and is usually applied in the arid areas. On the other hand, C1 has water features on the entire campus, while emphasizing the academic centers with geometric approaches. Eastern and Western planning styles are combined in the water-feature-based landscape design.

B2 and C2 are two typical typologies with the greatest number of cases. Organic approaches are flexibly applied to integrate the two kinds of scenery, which can be considered an active use of water design techniques in traditional Chinese gardens. More cases of B2 were founded in Periods I and II, while most of C2 in Period IV. Such a shift indicates that water-featured open spaces tend to dominate the center of or expand throughout campuses founded recently, and then again in large rather than small campuses founded in the early periods. It indicates the spatial practice of the Shan-Shui idea shifting from imitating the traditional private garden in a small scale to drawing a broad landscape as a conception and framework of the entire campus.

6.3. Characteristics related to the cultural context

Based on the findings above, typical typologies are raised to expound the characteristics related to the cultural context (Figure 14).

7. Conclusion and discussion

Characteristics of water-featured open spaces on 172 Chinese university campuses were investigated through the relationship with other spatial elements in three aspects: adaption to the site, creation of activity space, and scenery formation. Nine compositional typologies were established based on the essential roles of water
features in open spaces. Characteristics of activity spaces and scenery formed by water features vary in the shape and layout due to the site context, region, founding period, and size of the campus. Interpretation of the traditional Shan-Shui idea and Shuyuan vary in scale and the extent of synthesis with Western influence. These characteristics show the evolution and variation of water-featured open spaces on Chinese campuses, and demonstrate that water features can create spatial and scenic diversity with a flexible and adjustable relation to other building and landscape elements.

Nevertheless, it should be noted that “Harmony between Nature and Humanity” cannot be limited to formal terms. To avoid misuse and simple duplication of cultural imagery, the essence of cultural identity and traditional thoughts should be further discussed and truly understood. Cultural and environmental contexts should be both considered and responded to in the design. Based on this study, typical cases of each typology are worth focusing on in future studies, in which the integrated strategies of campus master plans related to water-features, including spatial, cultural, and ecological ideas, can be explored by interviewing master architects and campus management offices.

Disclosure statement

No potential conflict of interest was reported by the authors.

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