WATERSCAPES: THE CULTURAL HERITAGE FOR SUSTAINABLE DEVELOPMENT IN THE URBAN STRUCTURE OF HUE CITY IN VIETNAM

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Abstract - For many years, waterscapes have used as indispensable architectural elements in urban design like Amsterdam, Venice, etc. Similarly, from 1802 to 1945, the integration of water into the layout of Hue city exemplified sustainable urban planning. Additionally, Feng Shui method positions water as a crucial component Hue city which represents a unique harmony between humans and nature, reflecting Eastern philosophical ideas and traditional Vietnamese architecture. The waterway model was seamlessly integrated with the waterscape and monuments, establishing the unique identity for the local ecosystem. In recent decades, Hue's waterscape has undergone considerable change due to urbanization, environmental pollution, flooding, and disruption of water flow. These factors have altered the characteristics of traditional waterscape and negatively affected the previous concept of water system. Identifying the characteristics and values of the traditional water network is as cultural heritage to preserve and promote a sustainable model that adapts with local environmental self-regulating technology.

Key words - Waterscape; Identity; Feng Shui; Hue city; Sustainability.

1. Introduction

For a long time, people have used the water as an indispensable element for life such as drinking, washing, main transportation and mental element, their needs were interesting in the urban environment with the enhancement in living conditions and enjoying the art so that the water in urban planning had attracted more attention, and the living spaces with water elements have become more popular. This longstanding interest in water is evident in the way civilizations historically established their settlements near rivers, streams, lakes, lagoons, and other water resources [1].

The water has been the basic element in urban planning of Venice, Amsterdam, Suzhou... Water is used to create the specific identity of the local places (Figure 1 and 2). The visual form and function of the water is interesting in their planning. They relate to the movements, form and models of water and its endless transformation from sources to the sea [1]. Water is also an important element that can be related in the landscape design and it is a unique material in terms of landscape design [2]. The water element in open spaces has a relevant value because of its aesthetic value, sensory stimulant, social function and psychological benefits for landscape architects, environmental designers, and for the community [3]. The various concepts and practices related to waterscapes from Vietnam, Thailand, Cambodia, and Indonesia, with the majority at the Southeast Asian Geography Association (SEAGA, http://www.seaga.info/) 2014 [4]. Cultural differences, climatic and topographic conditions have been the elements which have diversified the use of water. The use of water elements in design and urban planning has evolved over time, influenced by various cultures that have impacted one another. This influence continues today, with new trends sustaining and reshaping these traditional styles [1].

Figure 1. *Waterscape in Venice, Italy (source: the author)*

Figure 2. *Waterscape in Amsterdam, Netherlands (source: the author)*

In Hue city of Vietnam, waterscape was applied as an indispensable element for urban design by the Nguyen Dynasty. During the period of urban construction from 1802 to 1945, the integration of water elements with Hue city served as an exemplary model of sustainable urban planning. Furthermore, Feng Shui method emphasizes the importance of water as a vital component in urban design. For instance, the waterscape of Hue city embodies a unique unification of human and nature, reflecting Eastern philosophical ideas and traditional Vietnamese architecture [5]. The waterway model was seamlessly integrated with monuments and the surrounding waterscape, contributing to the unique identity of the local ecological system. While numerous studies have explored

the influence of Vietnamese researchers, as well as scholars from Japan, Italy, and France, there has not yet been a full assessment of the role of water and the value of waterscapes within the urban structures established by earlier generations. Additionally, the significance of the integration of urban design with natural water elements have not been identified.

2. Materials and method

2.1. Ecological method

Hue's urban planning effectively utilized natural resources and the tropical climate to develop a proper living environment. It is important to understand the formation of the Hue Citadel, ideas and geography's condition behind its construction. The urban structure is closely tied to the local topography and water resources. Ecological technology is properly adapted to local geography, wind and water. The ecological value derived from system features of the urban structure, functions and components of the ecosystem.

2.2. Feng Shui method

The distinctive character of ancient Vietnamese cities was rooted in Eastern philosophy. Utilizing available natural elements, Feng Shui method was carefully applied in selecting locations, orientations, and the overall layout of the city. This approach was based on in three core principles: the Yin and Yang theory, the Three Elements theory (Heaven, Earth, and Human), and the Five Elements theory (Metal, Wood, Water, Fire, Earth). Feng Shui methodology includes concepts such as the "front Screen", "back Pillow", "left Azure Dragon", and "right White Tiger", emphasizing the importance of water and the Ming-Tang element. It also reflected the philosophy of Universal Changes, in which the city oriented to the south and arranged according to the Five Elements: placing the emperor's palace at the center, temples and tombs to the west, and markets to the east. The Hue Citadel serves as a notable example of the application of Feng Shui principles in urban planning.

2.3. Field survey method

The survey data collection - which includes measurements, archival research, and interviews - aims to observe changes in the water system and ecological structure of Hue's landscapes after 1945, in 1968, and throughout the renovation period beginning in 1986. Additionally, materials from Waseda University (Japan), Polytechnic University of Marche (Italy), the Hue Monuments Conservation Center, and the Faculty of Architecture at Hue University of Sciences provide insights into the structure of natural ecosystems, mountain systems, water systems, and local community activities.

3. Results and discussion

3.1. Water elements with the history of the Hue Citadel's formation

The construction and completion period of Hue Citadel from 1802 to 1883: it was designed as a defensive rampart in the style of Western military architecture, while the two inner walls - the Imperial City and the Forbidden City - were constructed following ancient Oriental architectural traditions. During this period, a network of rivers, defensive moats, and lakes was also established within the Citadel. Feng Shui method was tightly applied to the direction, location, and layout of the buildings, emphasizing the integration of water elements. This relationship of water significantly shaped with the urban morphology, contributing to the unique identity of the Citadel (Figure 3 and 4).

Figure 3. *Map of the water system of Hue city in Nguyen Dynasty (source: Dong Khanh dia du chi)*

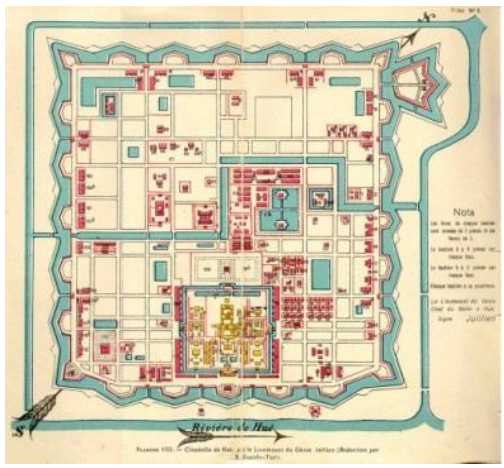

Figure 4. *The water circulation system of Hue Citadel in the colonial period [6]*

The colonial domination period from 1884 to 1945: traditional architecture in Hue underwent a transformation that combined local styles with Western materials and construction techniques. Under French protectorate rule, a new urban landscape emerged alongside the traditional areas in the northern part of Huong River, and characterized by garden villas in the south. These villas were designed to complement traditional architectural forms while adapting to Hue's tropical climate, achieving a harmonious blend of function and style. Huong River was the main part to connect the north and the south of the city. The waterscape of Huong basin created specific landscape of Hue city.

3.2. The situation of surface water use in Hue Citadel

In recent decades, urbanization, population growth, and land encroachment have significantly impacted the areas surrounding the defensive moats, lakes, and Ngu Ha River within Hue. Survey data indicates that residents engage in a wide range of activities within these spaces, including exercising, walking, resting, agricultural practices, livestock raising, buying and selling goods, festivals, and tourism. This diverse array of human activities has become an integral part of daily life for the community, as these areas serve not only as living spaces but also as sources of income. However, these activities have adversely affected the water system and local heritage. Encroachments have led to the cultivation of vegetables, littering, and even the construction of structures that interfere with historical sites (Figure 5). The discharge of domestic waste and various activities have severely polluted the moats, leading to significant environmental degradation and detracting from the visual aesthetics of the urban landscape. These issues have contributed to the overall pollution of the water system. Additionally, ongoing construction and damming in the area have caused the moat's water levels to decrease and created blockages that disrupt the Citadel's water management functions. This encroachment by residents has further damaged the traditional landscape structure, negatively impacting both the water system and the integrity of the Citadel. The Figure 6 shows functional layers' analysis in Hue Citadel.

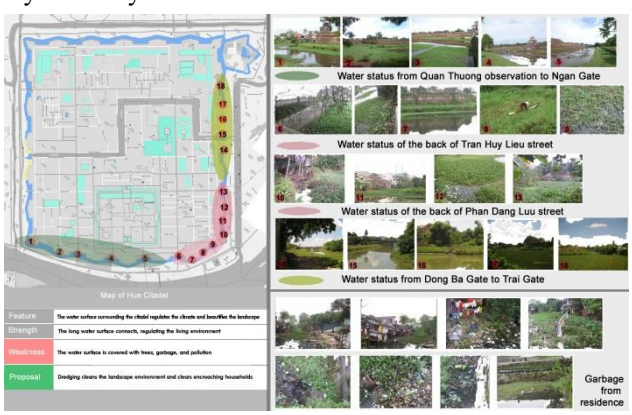

Figure 5. *The situation of water surface use around Citadel and defensive moat in 2016 (source: the author)*

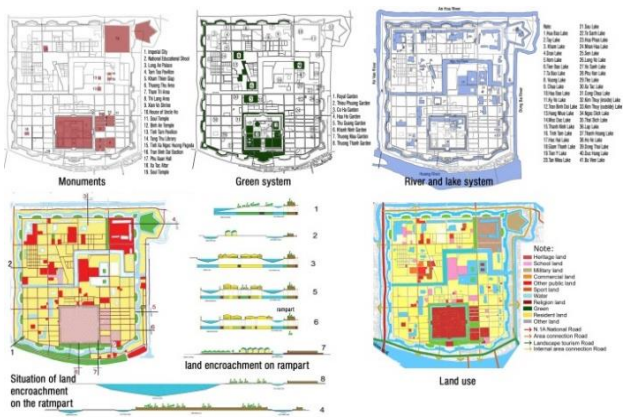

Figure 6. *The spatial layers and water encroachment in Hue Citadel (source: the author)*

The project of relocating residents and clearing land in area 1 of Thuong Thanh, Eo Bau in the Citadel and defensive water's moat phase 1 (2019-2021) contributes to solving the problem of people's livelihood and gradually restoring the image of Hue Citadel and the water system. Promoting the value of heritage within the contemporary context is a priority for both the government and local communities. However, urban expansion on Huong River to the south, with numerous new development projects, has often overlooked ground level considerations. This oversight has contributed to recent flooding in the city, highlighting the need for a balanced approach that integrates heritage conservation with sustainable urban planning (Figure 7). Additionally, the activities of local residents and natural disasters contribute to significant changes in the area. The Huong River's basin has a gentle slope and experiences concentrated rainfall, resulting in a high frequency of flooding events. Hue city is particularly vulnerable to flooding. Data from the Kim Long station over a 27-year period (1977-2003) indicates that there were 33 flood events in which water levels exceeded 3.0 meters (with Le Loi Street, along the river, at 3.2 meters). Of these, 10 events reached levels over 4.0 meters, and 5 events surpassed 4.5 meters. These events are detailed in Table 1, which shows their monthly distribution.

Table 1. *The data of flood events monthly in Huong River from 1977 to 2003 [7]*

Month / Floods	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
h>3.0 m	0	0	0	0	1	1	0	1	**5**	**14**	**10**	1
h>4.0 m	0	0	0	0	1	0	0	0	**1**	**6**	**2**	0
h>4.5 m	0	0	0	0	0	0	0	0	**0**	**4**	**1**	0

Over time, the water system and land use within the Citadel have undergone significant changes due to historical, natural, and human influences. These alterations have impacted the original functions of the area, adversely affecting the lives of residents and complicating the preservation of cultural heritage in the region.

The big flood of Hue Citadel in 1999 (source: internet)

The flood of Hue city in 2022 (source: Tran Thien)

Figure 7. *The flood in Hue city*

3.3. Identification of the water elements of Hue city

Hue city in the overall structure of territory. It is structured within a diverse geographical context that includes various elements characteristic of a tropical climate. It features a mountain range to the west, varied topography, and plains rich with rivers, lakes, and diverse ecosystems. To the east, there are marine systems, lagoons, and sand dunes (figures 10 and 12). The city has been designed as an urban center that closely integrates with its natural conditions, aiming to create a model of sustainable development.

Ecological structure of Hue Citadel. The Citadel is strategically positioned along the Huong River, providing convenient water transportation and benefiting from the protective surrounding mountains. The Citadel is organized in layers, comprising the Imperial City, the Forbidden City, and the outer Citadel. The Huong River serves as the primary transportation route, while its natural and artificial branches act as secondary pathways that delineate the inner territories of the Citadel. These river branches flow through the Citadel, interlinking with over forty lakes and green spaces, thereby forming a rich ecological landscape. This system not only supports self-regulating water flow but also provides vital habitats for local residents and wildlife, enhancing the overall environmental quality of the area.

Historical records reveal that in early 1687, Phu Xuan village was selected as the site for the capital of Annam. The urban planning was guided by the principle of "using the nearby Ngu Binh Mountain as a "Screen" and involved constructing walls, building a palace, and excavating a large lake in front" [8]. Feng Shui principles were rigorously applied to determine the location, orientation, and layout of the city. This methodology included concepts such as the "front Screen", "back Pillow", "left Azure Dragon", and "right White Tiger", along with considerations for water surfaces and the Ming-Tang element, all in alignment with the philosophy of Universal Changes, which emphasized positioning in the north and facing south (Figure 8 and 9).

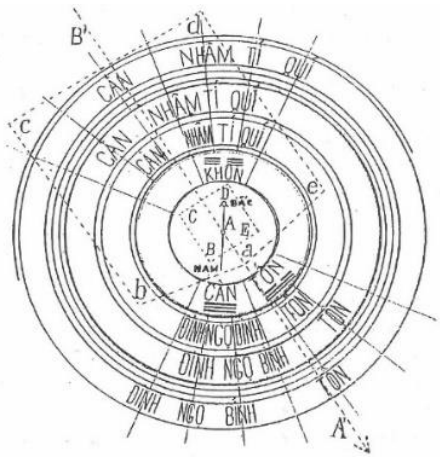

Figure 8. *Compass for the direction choice [9]*

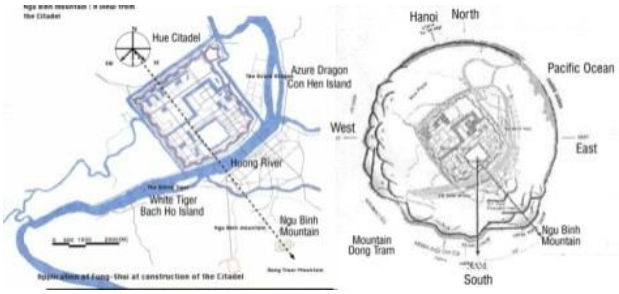

Figure 9. *The major axis and relationship with surrounding natural elements in Hue Citadel [10]*

Water system. The water system in Hue could be divided two kinds, as follows:

Table 2. *The kinds of water in the Hue city [1]*

Category	Source	Signification	Type
Still water	from rain, people activity	Open space Meaning full Focus	Lake Pond
Active water	from mountain though the city to lagoons	Orienting Edging Continuality	Waterfall Stream River Lagoon Sea

The water system of Hue Citadel functions as a diverse ecosystem that is vital for environmental protection, water regulation, and the overall waterscape of the area. Key components of this system include the defensive river, defensive moat, Ngu Ha River, and a network of lakes (figures 10 and 11). The canals and lakes, originally excavated to strengthen the citadel, were historically interconnected with Huong River. Currently, efforts are underway to restore these waterways, aiming to reinstate their ecological functions and enhance the Citadel's landscape.

Figure 10. *The water system flows from mountains and mountains through urban areas to lagoons and the sea (source: the author)*

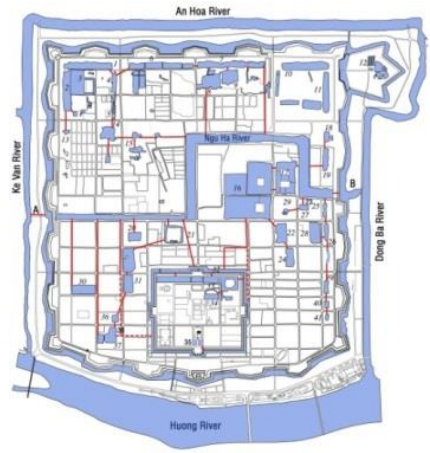

Figure 11. *Map of connection of the lakes in Hue Citadel (source: the author)*

3.4. The waterscape system in Hue Citadel and the lesson for preservation and sustainable development planning

The ecological local technology of self-regulating water flow. The lakes and river system in Hue Citadel

were designed to facilitate self-regulating waterway, serving as an ecological technology that enhances the environment. The waterscape represents a unique integration of human elements and nature, creating a harmonious model that unites waterways with monuments and landscapes, thereby shaping the local ecological identity. This process has resulted in an urban morphology that respects the region's architectural heritage while offering a development model, adapting with traditional features and the local climate. Ultimately, this approach exemplifies a sustainable urban development model that balances environmental, cultural, and aesthetic considerations. The river system and lakes were designed to maintain a self-regulating water flow. This water management system is similar to a form of local ecological technology aimed at protecting the water environment. The waterscape of Hue city represents a unique integration of nature and human. The waterway design integrates seamlessly with local monuments and landscapes, contributing to the identity of the ecological system. This approach has led to an urban layout that reflects local architectural characteristics while promoting sustainable development that respects traditional elements and the tropical climate of the region (Figure 12-15).

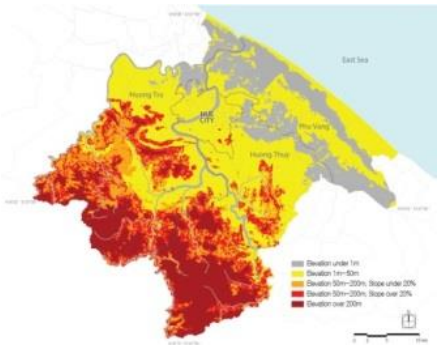

Figure 12. *Topographic map of Hue city [11]*

Figure 13. *Topographic section from west to east illustrating the water system's control for environmental self-regulation (source: the author)*

Figure 14. *The connection of the lakes to river and lagoon of Hue Citadel in Nguyen Dynasty [6]*

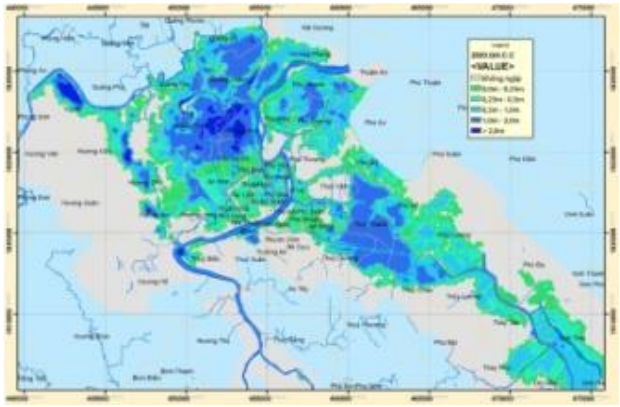

Figure 15. *The flood map of Hue (case study of the regulation without water reservoir) [12]*

Waterscape for city's structure. Water has always maintained its place as one of the most important design elements in urban planning from the past to present. Water has been used for different purposes for symbolic, visual and auditory features. Each feature of water gives life for a different application and space usage in landscape design. The movement and silence factors always give the effect of design related to water.

The waterscape, along with the visual form and function of water, is applied in urban planning. It reflects the movement, shape, and patterns of water and its continuous transformation from source to sea. Water is used to enhance the visual quality of the space in designs [1] (Figure 16 and 17).

Figure 16. *Waterscape of Hue Citadel and Huong River (source: the author)*

Figure 17. *Waterscape of defensive moat (source: the author)*

Rural-urban continuum in the structure of urban planning. The range of land use characters, from the rural to the pre-urban to the urban are very important in urban planning to scope the flood and food security in Hue. Because of this general nature, the application to a waterscape framework becomes relevant to provide land use and urban design.

Historically, the soft engineering ways were effectively employed to preserve and protect Hue Citadel, while hard engineering ways tended to be costly and often required additional infrastructure. This approach allowed for the maintenance of rice paddies, farmland, and rural villages nestled among the mountains, plains, the Citadel, and the coast, helping to balance water levels across the entire territory. Such a strategy created a vital buffer zone around the monuments and heritage sites [5, 13]. This adaptive approach has been sustainable over the long term, with local communities' living in this environment for centuries. Hue city's inland location has historically made it more resilient to flooding. The original urban model likely enabled residents to effectively cope with natural disasters. Agricultural lands and landscapes on the outskirts acted as natural flood plains, facilitating water collection, while wetlands served as natural sponges, absorbing excess water outside the city center. In the past, residents living in lagoon areas constructed temporary shelters that allowed for quick recovery after disasters, demonstrating a strong connection between local practices and environmental resilience (Figure 18).

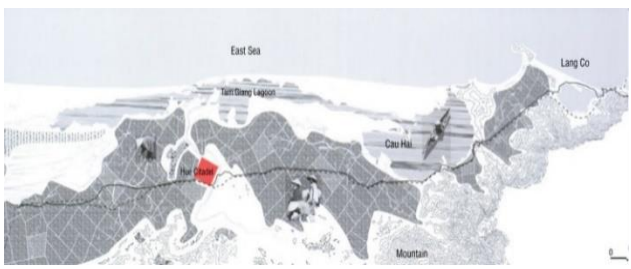

Figure 18. *A proposal of water production and urban agriculture [13]*

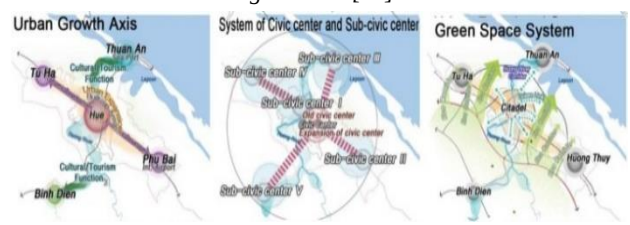

Figure 19. *Idea of urban center and satellite cities for Hue [11]*

Similarly, the KOICA project for the Modification of Hue city's Masterplan 2030 and Vision 2050 embraces this concept (Figure 19). By promoting adaptive living in response to challenging water elements, this initiative aims to establish a sustainable development model for the future. This approach focuses on integrating environmental resilience with urban planning, ensuring that the community can thrive while effectively managing water resources.

4. Conclusion

Over time, the waterscape and water systems of Hue city have demonstrated their significance through various transformations in structure, scale, and urban morphology. Understanding the identity of the water's urban form and its historic waterscape value is crucial. The water systems and waterscape of the Nguyen Dynasty have proven to be invaluable. This paper proposes a new approach that leverages traditional water systems and waterscape models to preserve and enhance the ecological values of Hue city, aiming for sustainable development.

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