

Adaptive Reuse of Port Heritage Leads to Urban Waterfront Regeneration: A Proposed Case Study in Zhuzhou City, China

Ling Shen^{a, b}, Asmawan Mohd Sarman^{a*}, Mohamad Ibrahim Bin Mohamad^a, GuoMin Wei^a & Mian Jiang^c

^a Faculty of Engineering, Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia,

^b School of Urban Planning & Environmental Science, Hunan University of Technology,
Zhu Zhou, Hu Nan, China,

^c School of Architecture and Design, Southwest Jiaotong University, China

*Corresponding author: asmawan@ums.edu.my

Received 5 August 2022, Received in revised form 30 September 2022

Accepted 30 October 2022, Available online 30 March 2023

ABSTRACT

Improvements in transportation and logistics have forced many ports lost their functional status even abandoned in the recent globalization context. While these deteriorated port-related area could get revitalization when reusing the port heritage as a catalyst to rebuild the better connection to the city, just as the ideal redevelopment projects worldwide have revealed. They provide ways to identify and conserve the port heritage, especially set a research foundation to explore how to use them for urban economic, social-cultural and environmental sustainability. In this sense, three common perspectives towards adaptive reuse of the port heritage have been introduced, respectively representing as multi-functional creator, adhesive back to the city and environmental-friendly messenger, based on which, practical implementation can be directly performed despite the scale of the port area. Consequently, this approach selects a typical port heritage site (Yong Li dockyard) in Zhuzhou, which is just an average industrial port city in center China, to illustrate that the essential factors extracted from project icons will also work for proceedings with considering their own context. In addition, a visual adaptive reuse plan is proposed, aiming to trigger the urban waterfront regeneration by recreating the port heritage as new roles to increase economy, satisfy residents and improve environment. Additionally, this research might shed lights on other cities with potentials.

Keywords: Port heritage; adaptive reuse; waterfront; regeneration; landscape corridor; Zhuzhou

INTRODUCTION

When entering the post-industrialization era, waterfronts containing huge, abandoned land areas while possessing historical estates at the same time in the heart of urban core were facing with the enormous challenges as well as opportunities (Brown 2009). Prosperity gone with the functional degradation, and environmental issues such as water quality, soil, waste, and noise etc., emerged endlessly causing severe consequences for the health of the residents (Merk 2013), which drove the evacuation off the port area and accelerated the alienation against neighborhood as well. In addition, the one-sided pursuit of land value in the demand for expansion of the inner city has reduced many port heritages as the victims of urbanization.

Luckily, measures and instruments have been applied in the great amount of waterfront redevelopments that took place over the last decades (Breen & Rigby 1996; Hoyle et al. 1994), in which, most of the decayed and scarred port-related sites have been transformed into contemporary places

of consumption (Merk 2013). Those projects provided a new option to increase local economy, an opportunity for recreating the image of a city, and a new perspective that citizens are willing to return to the water's edge with the visceral pleasure and share that pleasure with visitors or tourist (Millspaugh 2001), revealing the significance of port heritage in the redevelopment strategy. Though the influence expanded to developing countries (Erbil & Erbil 2001; Long & Zhang 2022; Wu et al. 2019), the over-reliance in American and Western Europe waterfront model leads both success and failure (Andrade et al. 2020).

Commonly, the development model adopted always depends on the decision-makers' understanding of the potential value of these declining industrial areas (Lu 1998). "Economic recovery" always dominates the policy that seizing the spatial value of the urban waterfront, initially from the land use with the attracting a lower land price, such as cases in Toronto and first phrase in Dockland, England. But economic dominance cannot satisfy venues with their own cultural characteristics and unique landscapes, so that

“cultural revitalization” techniques begin to make all sectors of society more aware of their own respectable historical significances (Gunay & Dokmeci 2012; Sepe 2013), such as projects of Granville Island in Vancouver, South Street in New York or Port of Columbus in Genoa, Italy. Until now, beyond the traditional perspective of historical archaeology, landscape combined with ecological and artificial environment acts as essential to explain a new relationship between large-scale infrastructure sites and urban functions (Loures 2015), drives a new leisure-oriented or green-space-construction strategy that often uses historical associations as a form of brand image (Marshall 2001). With similarity, the notion of Historic Urban Landscape (HUL) contributes to lead a discussion of “creative synthesis” with the city integrating ecological circularization, cultural inheritance and developmental adaptability (Rosa & Palma 2013). Furthermore, in view of the characteristics of river-line-type heritage corridors, many scholars turn to comprehensive ecological and humanistic research ideas for better exploring the inherent relationship between heritages and river for sustainable use of natural and cultural resources in heritage areas (Deng 2011; Qiao 2009; Zhang et al. 2016). However, there are still many ignorance when social and economic confusions determine the fate of port-based cultural heritage, from which, the great inventory is hardly identified with suitable examination and may cause the failure in sustainability for long-term development (Pinder 2003).

In this context, this paper is aimed to ensure the positive influence of port heritage in the waterfront regeneration via sorting out specific measurements from three basic aspects, and constructed as follows: the first section of this paper will explore diverse methods of port heritage reuse based on theory reviews and successful projects, followed by the analysis of how the experience can adapt to the local project. In the second section, the case conceptual design of Yong Li dockyard located in Zhuzhou City (an average industrial city in center China) will be studied as an example to discuss how to apply the updated strategy on the ground.

RESEARCH PROGRESS AND METHODOLOGY ON THE PRESERVATION AND REUSE OF PORT HERITAGE

Back in the 1960's, waterfront redevelopment projects were outlined under the perspective of increasing consciousness on historic infrastructure and it was an expression to against the ‘Modern Movement’ (Jacobs 1992). During the 1980s and 1990s, the successes and failures at the cities’ waterfront attracted more attention because the port-related relics were regarded as a special language of the city and special studies involving landmarks in the port area launched in the context of “heritage of port industrial district” proposed by Jeffery Stinson (Stinson 1992). At the beginning of 21th century, “National Oldest Dock Heritage Area” project was issued by The United States Heritage Regional Organization (USHRO) addressing the urban port heritage area as a significant area where the typical elements of cities collide and merge. After that, scholars are using multi-dimension to document and analyze waterfront redevelopment projects. Recent waterfront master plans and civic visioning reports have increasingly referenced the industrial past of port sites slated for redevelopment, as the overview for New York’s East River Waterfront Esplanade and Piers Project states that, “Traditional esplanade elements have been reinterpreted into unique designs that hearken back to this waterfront’s industrial past” (Sharfman 2017).

General speaking, the commercial redevelopment plan accelerates public interest into the new-burn business and recreation waterfront place (Edgell et al. 2008). Besides, from major industrial museum to emotionally charged memorials (Ali et al. 2018), cultural waterfront and educational estates are the favourite visiting place possessing features both from traditional and modern cities (Rössler 2006). Instead of condemning the old port-related structures and claiming demolition, the historic waterfront are working hard in conservation and adaptive reuse of port heritage, with a restorative approach aiming to make a richer community and a better city (Gordon 1999), and the strategies rooted in methods below, with the framework representing in figure 1.

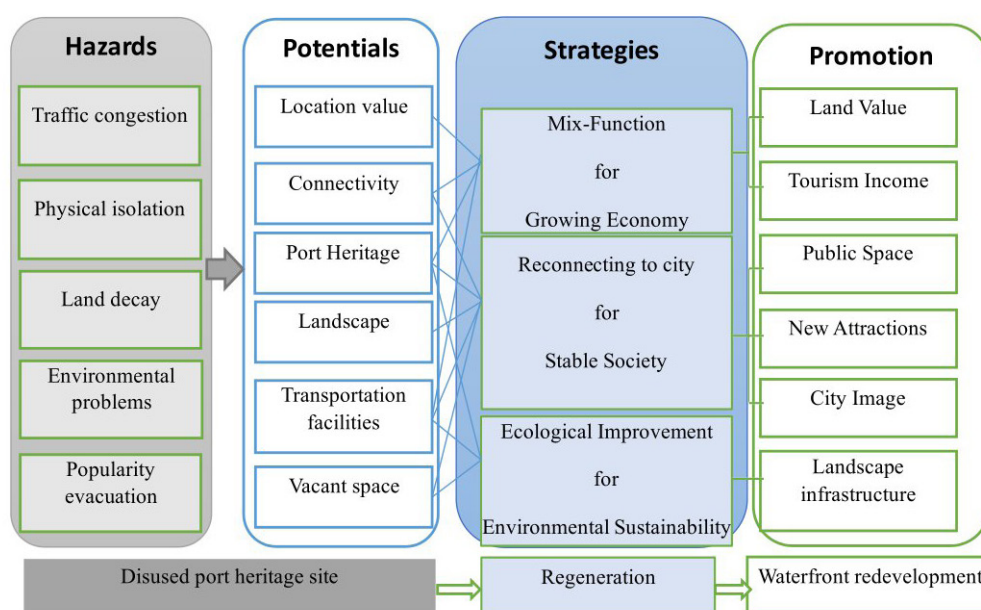


FIGURE 1. The technical framework of regeneration of port heritage leading to urban waterfront redevelopment

MIX-FUNCTIONS FOR ECONOMY REVITALIZATION

Mixed-use development is suggested as a crucial instrument to achieve desirable, energetic and sustainable urban environments (Hoppenbrouwer & Louw 2005), and the regular expression often emphasizes on the diverse usage in one compatible mix (Grant 2002), overcoming regulatory obstacles, mainly from environmental issues, such as noise, or traffic. Whereas, former industries at the water edge left the port-related substantial symbols unadorned, dilapidated, and deserted, seemed inaccessible rather than attractive. On the contrary, this abandoned port area gives city a new chance to transform the large parcels of inexpensive water-edge to be mixed-use growing zones. The proposed offices, museums, shops, galleries, marinas, and especially condominiums and hotels can lead to gentrification though they seem incompatible with industrial remaining look (Gordon 1999; Rössler 2006).

For so many well-known practical examples, morphological diversity and spatial flexibility make the port heritage more potential to perform the mixed-reuse function. In the Inner Harbor plan of Baltimore (1964), which focused on the piers around the harbor basin, Pier Four Power Plant was transformed into a complex with Café, bookstore, and bar, which successfully represented as one of the earliest restorations of a listed National Register of Historic place in the context of a mixed-use waterfront redevelopment. Besides, industrial constructs and warehouses scattered throughout the district of Fell's Point

on the north side of the harbor were shifted on new roles as offices, restaurants, museums and hotels, which contributed on welcoming multiply growing visitors annually and kept illustrating how vivid the heritages can be in the new era as a model for calligraphy. While, in the project of Port Vell in Barcelona (1982), attracting millions visitors per year, old port area has been transformed into an energetic waterfront due to its effective and balanced functional mixture: firstly it carries on the port destiny through transportation facilities, diverse dockyards, and cruise terminal; besides, its former port-related buildings change into new service facilities, like Palau de Mar, the historical warehouse, has been transferred as restaurants, from which visitors can enjoy the leisure time through the sun bathed terraces with full of river beauty; furthermore, Maritime Museum, Aquarium, water sports facilities also have been offered in the original port zone, along with plenty of cultural and recreational events (such as International Boat Show), to share new social responsibility to the city. Moreover, exemplary cases came out one after another, like San Francisco's Waterfront area, which adequately combines its existing port function with recreational activities and restaurant businesses (Port of San Francisco: Waterfront Land Use Plan 2004), with Ferry Building brought vibrant commercial uses and public access to the waterfront, meanwhile, Cape Town's V&A Waterfront also shows how mixed activities based on maritime function, implemented with well-equipped quays of facilities, cafes, and restaurants, can make a unique and

prosperous waterfront (Charlier 2009), shining with water tours and a real industrial activity (working port scenery) that is more active than ever.

Successfully revitalized waterfront cases, in general, have regained a vibrant water-edge as well as a new urban economic growth spot via positioning right mixture of diverse functions. In most projects, the adaptive reuse of port-related heritage redefined the economic value as a replacement for used viable industry by re-attracting people (Merk 2013), which usually includes 1) expanding consumer business

such as retail stores, 2) emphasizing historical and cultural connotation on museums or creative industry, 3) developing recreational and scenic spots, 4) proceeding transportation functions basically for tourism and 5) extending community needs by rendering residential boundary. Based on adaptive reuse of single structure of port heritage extracted from the former waterfront redevelopment projects, there are some principles can be introduced for the new functions and the comparison is sorted out in Table1.

TABLE 1 Types of functional transformation of industrial installations for port heritage*

Item Category	Morphological classification	Morphological characteristics	New function recommendation
Conventional buildings	Warehouses Conventional factories	Tall and spacious internal spaces, mostly frame structures	Internal exhibition spaces such as museums, art galleries, concert halls, shopping centers, etc.
	Shipbuilding workshops Turbine workshops	Huge steel frames, arches, bent frames, etc., forming a larger internal space	Soho creative industry studios, residences, conferences, entertainment and leisure centers and other flexible and deformable spaces, etc.
	Small and medium-sized buildings (water house, pump house, etc.)	Enclosure and masonry structure	Functionally adaptable auxiliary facility building
	Lighthouse (high tower) chimney	Towering columns, group houses at the base	Landscape signs, indicating symbols, and the base for other purposes
Unconventional buildings (structures)	Wharf, water (ship) gate and surrounding waters Plane hydrophilic space	Raised and sunken platforms, specially defined space	Parks and other leisure places, and external exhibition spaces
	Metal materials (loading equipment, rope ties, exposed steel frames, etc.	With specific shapes.	Display objects, landscape sketches, and installation artworks
	Railroad track	Linear connection channel	Tour trail, visit instruction clues
	Building foundation	Sunken or low sunken space	Rest facilities
	Column net frame	Network shape	Pergola, sketch
	Enclosure wall	Face upright	Landscape wall, construction of climbing equipment

*Morphological classification derives from data (Liu 2016) (Pinder 2003)

Achieving the adaptive mix-functions can be a challenging task, due to the difficulties in financing the project. The land use of port-related district typically including residential, commercial, tourism, recreational functions; yet the municipalities or redevelopment agencies are oftentimes submitted to add residential plans because “low-density” from park or other public space which do not generate the revenue required to cover the cost of buildings or preparation of the sites (Brown 2009). It would be crucial to balance between the functions that help the financing of the project (e. g. residences) and the functions that do not immediately generate sufficient revenues yet are essential for serving to social interests (e. g. leisure or recreational sites). Concerning this matter, conservation and regeneration of port heritage needs a realistic developing

plan for the achievement of the concept in the master plan based on a projection of market demand and of public and private funding sources (Millspaugh 2001).

ADHESIVE FOR RECONNECTING TO THE CITY

A close association between human and water is inherent since the history of civilization whereby most human settlements are located on or near a water body of some type, and urban waterfront is the most frequent accessible spot for people to contact with nature water. As productions representing human’s social and economic activities needed water to push forward and gather the spirit, tradition and culture along with, the port-related waterfront witnesses the leap of human’s wisdom in evolution of technologies covering shipping, logistics, communications, industry, and

trade. Moreover, the port zone is inevitably assimilated into the environment people dreamed to build their picturesque urban waterfront where they can improve the work and accommodation condition in the respect for nature. The port function has degenerated from the site nowadays, though the nature production and shipping requirements evolved over time to accommodate new forms and new technology, where the industrial buildings are constantly becoming obsolete (Bodurow 2003). Nevertheless, the port waterfronts can continue to influence the city, because their heritages live on, e.g. in urban form (Merk 2013). The remains may rare to be preserved intact, yet, a dock space, a maintenance ladder, a plant gate, a gantry crane or an equipment can stand enough to inspire a sense of cultural or historic identity and connection to the former scenes. This link has been strong in history and continues to be enhanced in many emerging economies.

Revitalization of a city's waterfront is often tied directly to the revitalization of a city's downtown, and vice versa (Ryckbost 2005), which also reflects the change in social values, that is, the change from the value of pursuing economic benefits in the industrialization period to the sustainable development concept in the post-industrialization period (Remesar & Costa 2004). Whereas, the public space construction of the waterfront rejuvenation embodies the spirit of "people-oriented" urban cohesion, from which, the waterfront area, so close to the water surface with a wide view, can be a good place for tourism, exercise and other outdoor activities, and it is also the most potential target under the background of scarce land in the inner city. Because the rise in water quality after the relocation of industries and docks and the effectiveness of water environmental governance, the clean water has gradually made "near water" an attraction again-citizens gathering on the waterfront for diverse purposes will inevitably lead to an increase in "popularity", following which, commercial opportunities will also arise, and finally the interaction between the waterfront area and the surrounding area will be closer then gradually merged and prospered.

Most of the successful waterfront development projects begin with a master plan--not only guides the implementation process towards the project's initial goal, but it also provides a common ground where different actors from the city (e. g. private and public sector, different local authorities) can agree upon. A master plan considering social connection to city is recommended that with blended values of both old and new structures and uses, the desired concept can be expressed from three simple patterns, 1) offering public access and space to and enjoyment of water, 2) with circulation extending from the old city, 3) and integrating the water as well as the surrounding land into the design landscape (Millspaugh 2001). A successful waterfront development agency relies on an incremental approach to design, a high degree of political autonomy, and the related ability to move quickly and flexibly to time individual development projects with market cycles (Brown 2009). All these aims are to re-create a flexible new waterfront area,

an open space that can incorporate urban context, residents' emotions, and port culture.

In addition, in the strategic concept, attention should be paid to the combination of material and spirit, architecture and environment, history and future. To achieve that, protecting the city skyline is an important part of the historical preservation and renewal of historical buildings at the urban level (Tibbalds 2005) and making symbiosis, which has been widely used in the areas of urban evolution mechanism (Liu 2003) and urban sustainable development (Zhang 2004), is a strategy to integrate port heritage with nature and society.

NEW FORM FOR ENVIRONMENTAL SUSTAINABILITY

"Industrial sites are daunting reminders of humanity's dual capacity for destruction and creation that engenders both nuisances and progress." (Bodurow 2003), and the environmental degradation of the industrial sites often serves as an early catalyst of redevelopment for properties located on the sides of polluted waterways (Bruttomesso 2001). Pressure from environmentalists, environmental legislation and local residents force all sectors of society to be concern about the environmental issues of land and water, furthermore, port heritages are facing continued challenges related to environmental and economic sustainability, so that careful assessment and the implementation of detailed cleanup programmes involving the removal, remediation or sequestration of contaminated soils and groundwater are standard prerequisites to redevelopment. Generally, ensuring the environmental sustainability for port heritage hinges on "3C" strategies: 1) Controlling the environment by site cleanup of water body and industrial land; 2) Conserving resources by reusing existing structures and improving urban infrastructure already existing; 3) Constructing landscape by integrating nature sources and artificial elements. When the conditions of waterways and industries has improved, more developers would saw the attraction of urban waterfronts, which also formed the trend for widespread remediation practice for waterfront brownfields. Take the US for example, under the program of Brownfields Revitalization and Environmental Restoration Act of 2001 as well as Environmental Protection Agency funds, waterfront brownfields in Brooklyn, Pittsburgh, Richmond, Memphis, Cincinnati, and Los Angeles all underwent remediation and redevelopment which also inspired numerous smaller municipalities (Roshi 2003). Despite that brownfield redevelopment schemes often fall limited in creating diverse environments and cause possibility in losing sites' rich material culture, awareness should be taken that the brownfield remediation has not only become increasingly complex but also called for new approaches to restoring and integrating these sites into the urban fabric (Kirkwood & Hough 2001).

Furthermore, due to the proximity to water bodies, waterfront areas with port heritage are often threatened by natural disasters such as floods, severe tides even climate change, so the development projects must seriously study

the possible impact on the tidal flood or the flood discharge capacity of water. For instance, the approach of different heights of waterfront terraces should be adopted, and the flood control dike should be treated with diversified cross-sections to avoid blocking the public's water-water approach. Like in the case of Pier Head (Liverpool, UK), where the water level is a few meters below the ground level of the public area, the designer conceived the shoreline space of the entire dock area as a gradually folded plane, which can be folded like a sheet of beautiful folded paper reach to the river. This project uses a pragmatic approach to unify a public space of 16,000 square meters, which not only conforms to the historical trend of local land reclamation, but also perfectly blends with the needs of the site through an exquisite and firm method (James & Peng 2009). Natural phenomena presents additional challenges to conserving or reusing port heritage, though these historic structures located within floodways are often exempted from some of local regulations, considerations should be given to mitigation measures that can reduce the impacts of future flooding (FEMA 2008) and integrating to the enhancement for the infrastructure and landscape of the urban waterfront.

Nowadays, the core content of the landscape design of the waterfront area is the process of "humanizing" the natural elements of the waterfront area (Loures 2015). Through the organization and composition of the intermediary landscape of the waterfront area, the macroscopic "landscape background" extends into the microscopic people with the living environment. However, we should realize that the urban waterfront not only belongs to humans, but also the animals and plants that live on the sites, the necessary ecological environment for the habitat of whom should be considered and maintained, in addition, a protected and promoted green corridors should be created integrating scattered used port-related industries to form a linear eco-friendly waterfront (Voghera & Giudice 2019; Zhu 2007). After all, the "humanization" of the waterfront redevelopment is based on the premise of respecting the unique natural laws of the water-adjacent area, taking the nature landscape as the forerunner and pursuing its ecological, economic, and social benefits as the core after emerging it into the overall urban landscape design, so that

the activities of respecting nature and people achieve a unified and harmonious state (Rosa & Palma 2013).

RESULT WITH CASE STUDY OF YONG LI DOCKYARD IN ZHUZHOU

HISTORICAL EVOLUTION OF THE YONG LI DOCKYARD AREA

Zhuzhou is an important industrial town in central China, and was once one of the eight provincial-level leading port city. Before the rise of railways and highways, Zhuzhou relied on the unique water transportation conditions of the Xiang River to build ports for developing commerce and industry. The Zhuzhou section of the Xiang River has a total length of 88 kilometers and has bred more than 40 large and small shipping terminals within the urban area. Among them, the Yong Li dockyard has become the best witness of the urban port industry due to its superior water conditions and moderate land location, as figure 2 illustrated.

The Yong Li dockyard plot is a very historic riverfront in Zhuzhou. From the beginning of the last century, the original site was only a small granite wharf that served wooden ships carrying several loads of goods, as accelerated by the rapid development of industry afterwards, it turned into a thousand-ton port, ranking among the best in the province. But both the transfer of the regional economic structure and the decline of inland port transportation resulted in the gradual decay of the Yong Li dockyard that at the end of 2008, it entered a semi-stop state and was officially closed finally in 2012, leaving only part of the infrastructure and equipment waiting lonely on the riverside. A successful port never holds a lonely historical story. Operated on December 17, 1956, the Zhuzhou Ramie Textile Mill in the port area, as China's first all-round ramie textile enterprise integrating scientific research, spinning, weaving, printing and dyeing and the only production base and bamboo fiber textile research base in the country at that time, is also a testimony to the historical development of Zhuzhou's industrial civilization. Faced with cruel market competition and changes in consumption trends in the new era, The Ramie Textile Mill has gradually receded from its glory and returned to loneliness and plainness.

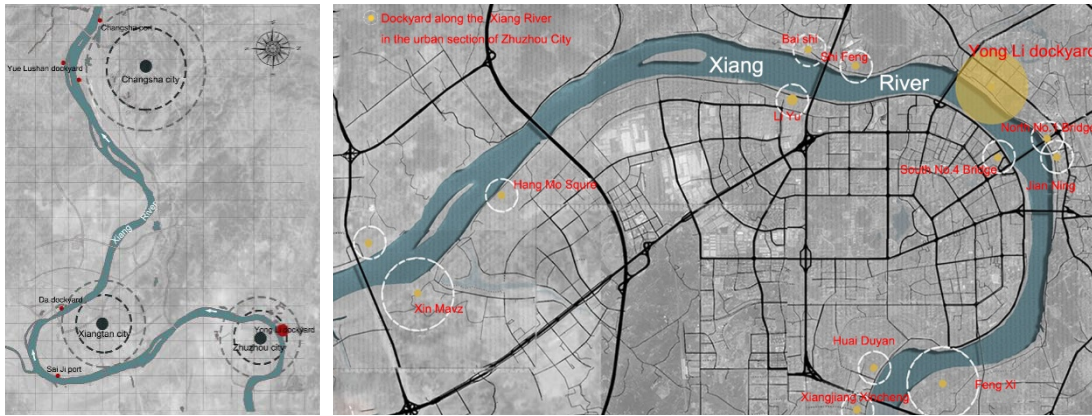


FIGURE 2. Location of case study named Yong Li dockyard and Distribution of dockyards along the Xiang riverside in the urban section of Zhuzhou



FIGURE 3. Current situation of Yong Li dockyard (Partly from document *Join together to protect the homeland*, 2019)

Figure 3 expressed that the abandoned dockyard has been left as a “decent space” for the city. Firstly, the area standing on the water edge is filled with decadent constructions and desolate facilities, the urban landscape space around which is of poor quality and affects the spatial quality of the residential communities adjacent to. Besides, not only the port site is abandoned, so do the old port-related factories nearby, which often causes urban problems such as destitute, sanitation, traffic jams, and so on.

URBAN WATERFRONT REGENERATION DESIGN STRATEGY FOR YONG LI DOCKYARD

The abandoned dockyard and adjacent urban space have much potential for redevelopment, as reviews on waterfront revitalization cases have addressed that we need put economic, social and environmental factors all together to schedule a master plan reconnecting to the city, based on which the specialized strategies of how historical port-

related structures and facilities can be transferred for tourism and commercial purposes, vacant space between heritage sites for recreational public space or landscape. The detailed procedure goes as follows.

BUILDING CORRIDOR-LIKE LANDSCAPE FOR URBAN PLANNING

Yong li dockyard is located at the urban waterfront area of east Zhuzhou, covering about 1.1 square kilometers with the boundary from Xinhua West Road to Honggang Road in the north-south direction (2.5 kilometers) and about 500 meters long from the east waterline to Jianshe Middle Road in the east-west direction. According to the current distribution of urban functions and long-term control regulations, the waterfront area can be roughly divided into three sections: financial business, green ecology and leisure entertainment. Among them, the strong industrial atmosphere of the Yong Li dockyard makes it become the core component to forming the urban facade along the river, like Figure 4 displays.

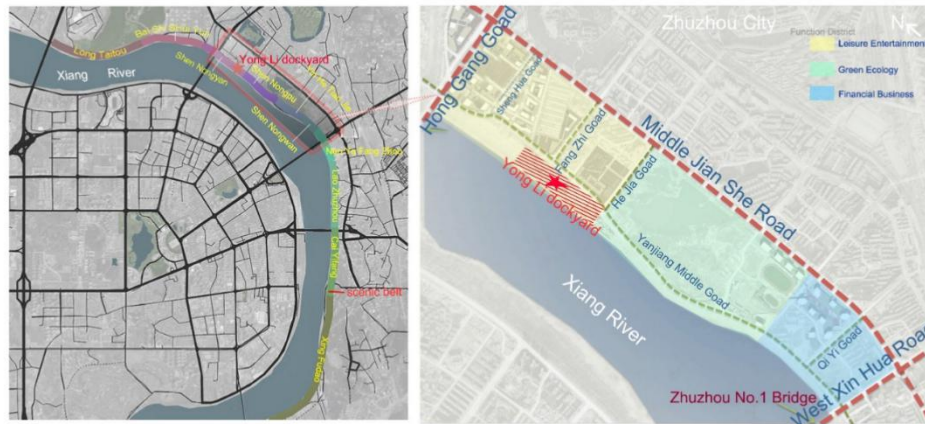


FIGURE 4. Function district and Riverside Scenic Belt in the east urban waterfront of Zhuzhou

Relying on linear open spaces to build high-quality ecological corridors can alleviate and compensate for the loss and fragmentation of habitats, which is particularly important for the fragile and sensitive urban waterfront (Steelman & Hess 2009). As early as 2010, urban planners and decision makers have realized the symbiotic relationship between the city and the river as well as the significance of the image of the waterfront on both sides of the Xiang River to urban development, so they issued and implemented projects of the Riverside Scenic Belt (Zhuzhou section) with the hope of striving to “integrate the Xiang River into the city and let the city embrace the Xiang River”. The project based on ecological management and flood control, attempts to construct a landscape framework of “one river, two banks and ten sceneries”, fully shows the distinctive urban personality, explores the secluded local context, portrays the historical imprints of different ages, and creates a distinctive, open and inclusive Zhuzhou urban culture, finally, connects with sections in Changsha and Xiangtan cities to be an integration.

This scenic belt in figure 4 is like a corridor that organizes the development node of the urban waterfront, and it is also another interpretation of the greenway in the heritage corridor in the corridor space system. It connects the separated riverside facades of the old urban districts in the form of landscape infrastructure, providing a guarantee and opportunity for port heritage protection from the macro perspective of urban design and the direction of sustainable development.

MAKING SYMBIOSIS AND INSTIGATION FOR WATERFRONT DEVELOPMENT

Preserving historical areas in urban blocks—areas that contain urban historical characteristics and landscape imagery in terms of nature and humanistic environment, and reflect the diversity of social life and culture—dominates the trend in the conservation of the contemporary traditional culture. The historical area including the port area is a living testimony to the history of the city, and the preservation

of the whole area makes it more fully reflect the integrity and continuity of historical culture than a single building. Historical areas do not necessarily include individual buildings with high artistic value, the preserved houses, streets, squares, trees, water flow, etc. constitute an overall environment implying historical scenes of human life in the past.

The regeneration of the port heritage needs to radiate to other heritage units in the area through landscape extension, road guidance, and cultural dissemination so that people can realize the complementarity between different heritage units, and then form the intergrowth and reciprocal symbiosis of different units within the city. Symbiosis units at different levels will also be influenced by layer-by-layer instigation. The actions perform as figure 5 can reveal that, the first layer of symbiosis unit will be formed between the Yong Li dockyard heritage monomers and the site. After expanding to the periphery, it will form a second layer of symbiosis unit combination with the Ramie Textile Mill area, and then it is towed by the Xiang River Scenic Belt extending to the waterfront area of east Zhuzhou in order to form the third layer of symbiosis unit. Eventually, the rejuvenation of the waterfront becomes a new driving point for urban development and a return to the new texture of the city without losing its historical context.

Public space in port heritage area can work as a lubricant and glue to change the weakness of lacking close contact and communication with other parts of the city. It can also work with scenic belt as supplement to serve the large- and medium-sized heritage sites and shared recreation space with residential communities. As a former industrial city in the center of China, Zhuzhou City lacked public space for citizens to spend their leisure time. By creating a series of urban public space as functional nodes along the waterfront, accompanied with redesigning a variety of trails for walking and biking and increasing different types of green space, the public space system where urban public activities take place will contribute to the efficient reconnection between the waterfront and the city with explanation of figure 5.

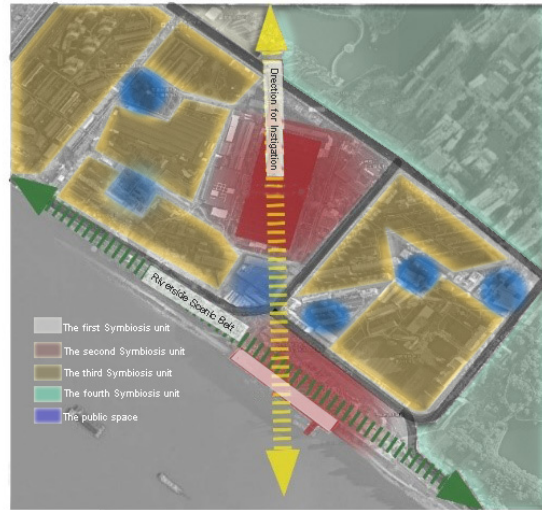


FIGURE 5. Symbiosis and instigation system in waterfront development

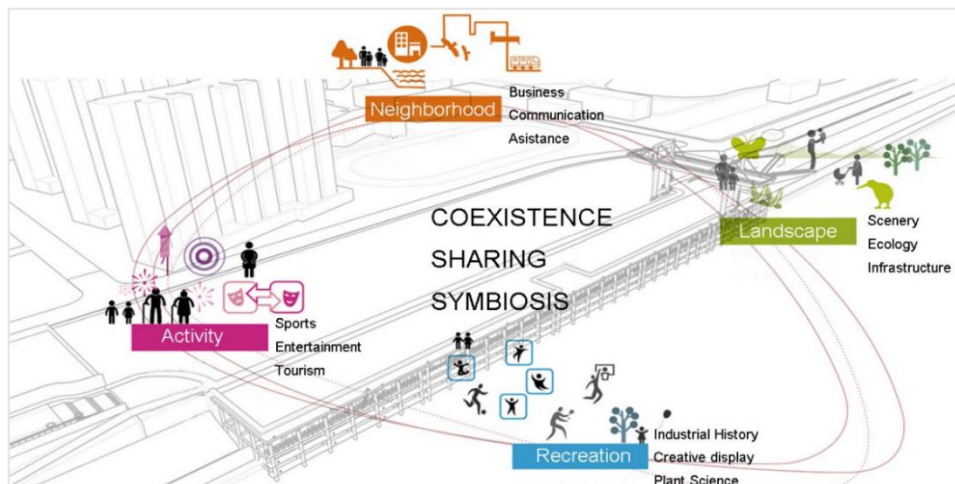


FIGURE 6. Multifunctional positioning in Yong Li dockyard

REGENERATING PORT HERITAGE WITH MULTIPLE FUNCTIONS

Popular port-related heritage regeneration strategies are inseparable from the themes such as commercializing the location of being close to water (marina, fisheries, aquariums etc.), to transform the characteristics of port activities into tourist attractions (travel destination or travel method), or making the most of historical constructions (museums, recreation architectures etc.) with organized mega events to attract people and tourism, etc., all of which involved in capitalizing on port heritage into a source of urban growth in the process of stylization.

Considering Zhuzhou’s overall positioning for the function of the urban waterfront, the Yong Li dockyard, located at the entertainment and leisure sector, determines the functional direction of the reuse of the heritage unit, but it is inevitable that the multi-function principle needs to be followed in figure 6. The regeneration of port heritage can be selected and implemented according to the type of reuse of industrial heritage buildings/structures mentioned

in Table1. The focus of the single-unit design is to use reasonable transformation and new construction combined with the creation of environmental space to make the port heritage area a destination for civic activities and leisure.

The most representative monomers in the Yong Li dockyard heritage are the truss-framed wharf and the gantry crane. The truss-framed wharf can be converted into an exhibition and leisure space by using the conventional frame space. A rectangular frame with a full vertical pile frame structure, including a total of 180 square columns, was originally divided into three parts, and the upper part has a clear height of six meters, the middle height is almost four meters, and the figure at the bottom section is about one-third of the middle one, which can be reserved for flood control and naturally integrated into the urban infrastructure due to the height of the water rise from July to August each year, the 1.3-meter area at the bottom. While the whole frame can use the upper part of rich space to flexibly set up the new structure generally dividing it into two relatively independent spaces as the front part of figure.7 displayed.



FIGURE 7. Transformation proposed for Yong Li dockyard and the new skyline

The gantry crane, which also has the characteristics of a wharf, has a commanding height that affects the skyline of the city along the river. We can consider using it to build a new image of the site together with the new functional buildings on the site, or use its iconic image to set up a square space to create a transitional landscape facility connecting other heritage units. In figure 7, the similarity or contrast of materials, colors, and shapes can be used in processing methods to reflect the design concept and to make the heritage buildings glow with new brilliance.

One of the major features of the Ramie Textile Mill plot is that the industrial plants are full of characteristics of the textile industry, which can be used to form urban new public spaces that can bring the vitality of the urban historical context and the sense of urban belonging to the waterfront space. At the same time, together with the construction of waterfront apartments, hotels, businesses and other public buildings in the area, it provides appropriate indoor public space and semi-open space for citizens leisure and recreational activities, which complements the outdoor waterfront activities.

For the entire leisure area, adding a variety of cross-heights, including connecting corridors, overhead and outdoor corridors will make the entire space rich and practical. In addition, such structures can also become a part of the auxiliary traffic space, helping to make fire compartments as well as meet the evacuation requirements.

DISCUSSION

From the points of previous literatures and case application, preservation and reuse strategy of port heritage has mainly focused on three main aspects of economy, society (community), and environment, each of which embodies different values and expects new form of continuation.

Firstly, economic benefit is the core value that determines the goal, the process and the scale of the regeneration of the port heritage. Industrial building facilities such as factories, warehouses, docks or railway stations have ample space full of functional conversion possibilities, which costs lower

and needs less amount of demolition when comparing with new constructions. As a tourism destination, the port heritage site has huge economic significance that need to be tapped. At the same time, the mix-function economic development strategy has allowed the value of the land in the old port area to continue to increase with the process of regeneration, by which, large number of employment opportunities will also be provided, which is indispensable for contribution of relieving unemployment pressure and promoting consumption growth. Multi-use of Yong Li's truss-framed wharf could be an actually new incubator for recessionary economy, through cultural- and recreational-oriented transforming goals with the free space around.

Secondly, the historical port area, with unique history, is always the place bound with cultural heritage and resource conditions, implying the connection between the architectural remains and the city center. Understanding and reconstructing the context of the old port area according to the spirit of the place, followed by the refining process from concrete to abstract will achieve a qualitative leap for explaining how port influence the city, moreover, building the waterfront scenery of the old port area under the master plan can demonstrate the fashion and prosperity of modern urban life. Based on the renewal of the port heritage, the redevelopment of the port sector can be instigated to rebuild the city center. For further social consequence, every single port-related construction will be the driving force for the development of the city, that is architecture instigates places, place instigates districts, district instigates city, finally forming a linear development framework. The gantry crane acts as a symbol to add glorious for the skyline of Zhuzhou' urban section, maintaining the port's character and reflecting unique culture of Yong Li dockyard with other facilities.

At last, the linear green/landscape space can be used as a link to connect the environment of the port area and carry out the overall design, just as the greenway in the heritage corridor, playing a role in the unite structure of the entire heritage resources. Just as the Riverside Scenic Belt on both sides of the Xiangjiang River in Zhuzhou, it was the fully consideration of ecological aspects such as pollution control and waste utilization, climate, greening, and water surface

transformation design, which will eventually become the core component of the urban waterfront landscape infrastructure. Furthermore, it acts as a bridge between scattered heritage sites, and a green sponge that re-infiltrates from the water area to the city through the port area, which softens the city while establishing a harmonious integration of people, nature, society and culture, and eventually will make the city more dynamic and attractive.

CONCLUSION

Urban waterfront with abandoned port-related historical remains is a negative space for many port cities, affecting the surrounding areas in adverse ways from aspects of economy, society and environment. However, this situation has been gradually changing by many large-scale waterfront redevelopment projects globally since the 60's of last century, which experienced the modes shift from the economic-oriented, culture-led to environmental-reconstruction due to the constantly changing needs of urban development cities. Besides, more attention has been paid on values of port heritage which plays a significant role in the present and future-plan for waterfront development.

Three common strategies for conservation and regeneration of port heritage have been identified from physical transformation for multi-function, interaction creation for rebind to the city, and reintegration of landscape infrastructure for sustainability. It has been proved that different targeted strategies will have certain positive effects on urban waterfront and surrounding community even the city covering the sides of the improvement of city image, the opportunities for land value-enhancement, the increase in tourism income, and so on. However, each transformation strategy is limited for actual performance. Facing diverse actual challenges, we should consider the method to reconstruct them into specific techniques by the consideration of more applicability in different cases to integrate the positive effects all together. A building complex can display its different functions and show different types in different periods, and each function shares the same space in each period. From the morning exercises in the morning, to the market in the day, to the evening public leisure and performance, we show the characteristics of all-weather mixed use. The landscape presented in each time period changes dynamically with the subject. In the long run, periodic spatial transformation helps to form a dynamically evolving fusion landscape.

Under the context of urban waterfront regeneration worldwide, most researches emphasize on the physical transformation either for economic benefit or historical significance and limited in discussion on its environment renewal priority. In fact, nature and artificial landscape recourses has become increasingly important in contemporary cities that they can be converted to infrastructures for what urban development needs- mobility and connectivity. Urban waterfront renewal could account for the port heritages,

considering their prime location, historical value, economic applicability and environmental compatibility. This paper enriches the content of urban waterfront revitalization from the perspective of port heritage regeneration by adopting landscape corridor which contributes to integrating multi-effectiveness. The Yong Li Dockyard as a typical port heritage in east Zhuzhou waterfront is taken as an example to prove the feasibility of the theory, from which, it is acknowledged that the practice of reusing port heritage, to every scale of port city, has potentials in urban waterfront redevelopment and consciousness for the urban planning and design for landscape corridor could be a suitable way.

ACKNOWLEDGEMENT/FUND

The authors would like to thank the Innovation and Entrepreneurship Training Program General Project of Human Province under the grant 2022-NO.3581, the Postgraduate Assistance Scheme, under the grant UMS(UMS/PASCA8.4/700-10/2) and the Research Foundation of Education Bureau of Human Province, China under the grant Grant No.20B177

DECLARATION OF COMPETING INTEREST

None

REFERENCE

- Ali, K., Arezou, S., Sapura, M., Mu'azu, A., Hamidah, A., Nurul, M. D. & Majid, K. 2018. A sustainable historic waterfront revitalization decision support tool for attracting tourists. *Sustainability* 10(2): 215.
- Andrade, M. J., Costa, J. P. & Blasco López, J. 2020. 3DPortCityMeasure: Methodology for the comparative study of good practices in Port-City integration. *Sustainability* 12(3): 880. <https://www.mdpi.com/2071-1050/12/3/880>.
- Bodurow, C. C. 2003. A vehicle for conserving and interpreting our recent industrial heritage. *The George Wright Forum* 20(2): 68-88.
- Breen, A. & Rigby, D. 1996. *The new waterfront : a worldwide urban success story*. The new waterfront : A worldwide urban success story.
- Brown, P. H. 2009. *America's Waterfront Tevival: Port Authorities and Urban Redevelopment*. University of Pennsylvania Press.
- Bruttomesso, R. 2001. Complexity on the urban waterfront. In *Waterfront in Post-industrial Cities*. New York: Spon Press.
- Charlier, J. 2009. The port life cycle model and waterfront redevelopment: The case of the Victoria and Alfred waterfront in Cape Town. *Portus Year* 9(n.17).
- Deng, J. 2011. Research on the construction of the three gorges of the Yangtze River heritage corridor [Doctoral dissertation, Chongqing University of Technology]. China National Knowledge Infrastructure (CNKI). <http://172.16.38.55/kcms/detail/detail.aspx?recid=&FileName=1012280094.nh&DbName=CMFDLAST2012&DbCode=CMFD&uid=akhnZzROZjcvdGRnV0VibGZaVjV1NmFoWTJkZDZlZXkKSms5ZWlsZWdlUjBMcUxC>

- Edgell, D. L., Allen, M. D., Smith, G. & Swanson, J. R. 2008. Chapter 4 - Tourism as a commercial and economic activity. In D. L. Edgell, M. D. Allen, G. Smith, & J. R. Swanson (Eds.), *Tourism Policy and Planning* (pp. 97-139). Butterworth-Heinemann. DOI:<https://doi.org/10.1016/B978-0-7506-8557-3.50009-7>
- Erbil, A. O. & Erbil, T. 2001. Redevelopment of Karaköy Harbor, Istanbul: Need for a new planning approach in the midst of change. *18*(3): 185-192.
- National flood insurance program: Floodplain Management Bulletin Historic Structures 467 2 (2008).
- Gordon, D. L. A. 1999. Implementing urban waterfront redevelopment in an historic context: a case study of the The Boston Naval Shipyard. *Ocean & Coastal Management* 42(10): 909-931. [https://doi.org/10.1016/S0964-5691\(99\)00054-X](https://doi.org/10.1016/S0964-5691(99)00054-X).
- Grant, J. 2002. Mixed use in theory and practice: Canadian experience with implementing a planning principle. *Journal of the American Planning Association* 68(1): 71-84.
- Gunay, Z. & Dokmeci, V. 2012. Culture-led regeneration of Istanbul waterfront: Golden Horn Cultural Valley Project. *Cities* 29(4): 213-222.
- Hoppenbrouwer, E. & Louw, E. 2005. Mixed-use development: Theory and practice in Amsterdam's Eastern Docklands. *European Planning Studies*.
- Hoyle, B. S., Pinder, D. & Husain, M. S. 1994. *Revitalising the waterfront: International dimensions of dockland redevelopment*. John Wiley & Sons.
- Jacobs, J. 1992. *The Death and Life of Great American Cities*. Vintage Books.
- James, S. H. & Peng, L. 2009. Pier Head Public Realm and Canal Link, Liverpool, England, UK. *Landscape Architecture* (02): 71-75.
- The Red News. 2019. Join together to protect the homeland. Retrieved 22th July from <https://bbs.rednet.cn/forum.php?mod=viewthread&tid=48112169>
- Kirkwood, N. & Hough, M. 2001. Manufactured sites : rethinking the post-industrial landscape. *Landscape Architecture* 91(11): 92-93.
- Liu, R. Z. 2003. *The evolution mechanism and integration of the development of dense urban areas*. Economic Science Press.
- Long, Y. & Zhang, E. 2022. Multidimensional data-based city images: Cultural reactivation of waterfront industrial heritage design in Shanghai. *Data Augmented Design* 73-91.
- Loures, L. 2015. Post-industrial landscapes as drivers for urban redevelopment: Public versus expert perspectives towards the benefits and barriers of the reuse of post-industrial sites in urban areas. *Habitat International* 45: 72-81. DOI:<https://doi.org/10.1016/j.habitatint.2014.06.028>.
- Lu, S. M. 1998. The development of foreign terminal industrial areas. *Shanghai City Planning*, 2.
- Marshall, R. 2001. *Waterfronts in post-industrial cities*. Spon Press.
- Merk, O. 2013. The competitiveness of global port-cities: Synthesis report. *OECD Regional Development Working Papers*.
- Millspaugh, M. 2001. *Waterfronts as catalysts for city renewal, Waterfronts in Post-Industrial Cities*. London: Spon Press.
- Pinder, D. 2003. Seaport decline and cultural heritage sustainability issues in the UK coastal zone. *Journal of Cultural Heritage* 4(1): 35-47.
- Port of San Francisco: Waterfront Land Use Plan*. 2004. Retrieved from <http://providenceworkingwaterfront.org/index.php/blog/>.
- Qiao, D. 2009. Establishment research of Lijiang heritage corridor [Master's thesis, Guilin University of Technology].
- Remesar, A. & Costa, J. P. 2004. Multifunctional land use in the renewal of harbour areas: patterns of physical distribution of the urban functions. In A. Remesar (Ed.), *on the waterfront*. Publications Universitat de Barcelona/Polis Research Centre: Barcelona, Spain.
- Rosa, F. D. & Palma, M. 2013. Historic urban landscape approach and port cities regeneration: Naples between identity and outlook. *Sustainability* 5(10): 4268-4287.
- Roshi, P. 2003. *Riverfront Brownfield Redevelopment*. Retrieved 30th October from <http://www.planning.org/thecommissioner/2003/win.htm>.
- Rössler, M. 2006. World Heritage cultural landscapes: A UNESCO flagship programme 1992 – 2006. *Landscape Research* 31(4): 333-353. DOI:<https://doi.org/10.1080/01426390601004210>.
- Ryckbost, P. 2005. *Redeveloping urban waterfront property*. Retrieved April 20 from <http://www.umich.edu/~econdev/waterfronts/>.
- Sepe, M. 2013. Urban history and cultural resources in urban regeneration: a case of creative waterfront renewal. *Planning Perspectives* 28(4): 595-613. DOI:<https://doi.org/10.1080/02665433.2013.774539>.
- Sharfman, J. 2017. Troubled waters. Developing a new approach to maritime and underwater cultural heritage management in Sub-Saharan Africa. [Doctoral dissertation, Leiden University]. <https://scholarlypublications.universiteitleiden.nl/handle/1887/59501>.
- Stelman, T. A. & Hess, G. R. 2009. Effective protection of open space: does planning matter? *Environ Manage* 44(1): 93-104. DOI:<https://doi.org/10.1007/s00267-009-9272-1>.
- Stinson, J. 1992. The port industrial district. *Canadian Architect* 137(10): 30.
- Tibbalds, F. 2005. *Building an Affinity City-Improving the Public Environment of Towns*. Beijing-Intellectual Property Publishing House-China Water & Power Press.
- Voghera, A. & Giudice, B. 2019. Evaluating and planning green infrastructure: A strategic perspective for sustainability and resilience. *Sustainability* 11(10). DOI:<https://doi.org/10.3390/su11102726>.
- Wu, J., Chen, X. & Chen, S. 2019. Temporal characteristics of waterfronts in Wuhan city and people's behavioral preferences based on social media data. *Sustainability* 11(22). DOI:<https://doi.org/10.3390/su11226308>.
- Zhang, D., Wang, H. & Cao, X. 2016. Review of Heritage Corridor Research in China. *Urban Development Studies* 23(05): 70-75.
- Zhang, X. 2004. Research on urban sustainable development based on symbiosis theory [Doctoral dissertation, Northeast Agricultural University].
- Zhu, Q. 2007. Industrial Heritage Corridor Construction of the Jiangnan Part of the Great Canal [Doctoral Dissertations, Peking University].