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Research on urban Village Renewal Design

based on the theory of biophilic urbanism

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摘要

在过去的几十年里，中国的城市化进程加快，城市大兴扩建，城中村这种特殊城市空间应运而生。由于缺乏合理的规划建设，城中村往往积攒了众多城市问题，成为城市的一块病变之地。同时，随着二十大的召开，十四五规划还有健康中国战略的提出，推动中国迈向人与自然和谐共生的现代化是发展的必然选择。然而人居环境恶劣、生态功能缺位的城中村为这一发展前景带来了巨大的挑战。因此，如何通过有效的城中村更新手段化解这些问题成为了重要议题。通过检阅相关文献和案例，可以发现，城中村更新改造的关注点往往是建筑，涉及到城市层面的研究也更多关注于经济与文化领域，与挖掘自然相关更新要素的针对性研究相对较少，需要更多的理论成果来指导更新改造。基于此，本文试图从亲自然城市设计的理念出发，以城中村的公共空间为主要研究对象，试图探索城中村更新如何向着人与自然和谐共生的主题进行，同时将亲自然城市主义理念在城中村的运用作为该理念在中国城市语境下的补充与运用。

本文首先通过文献案例研究，厘清了城中村发展现状以及问题，总结了亲自然城市设计的基本原则并提出了亲自然城市的设计方法，探讨了亲自然城市主义与城中村更新结合的可能性，构建了理论基础。其次，基于亲自然城市理论，针对城中村的现状以及问题，提出了多尺度的改造更新策略，包括在宏观的城市尺度构建亲自然网络，让城中村与城市融合发展；在中观的社区尺度对现有建筑有机拆建，营造更加满足亲自然设计原则的城中村公共空间布局；最后在微观的场地尺度对人切实生存环境进行亲自然更新设计，让人真正与自然融合共生。通过这三个尺度的设计策略为城中村的亲自然更新改造提供完整的设计实施路径。最后，本文以广州沥滘村为对象进行了策略的设计验证，以村内现状、村民需求等为出发点，以前文提出的更新策略为指导，对沥滘村内外的城市公共空间进行了有序的更新改造，以展现沥滘的自然活力为目标，通过三个尺度的更新改造唤起人们对于自然的内在情感，让沥滘成为更加亲自然、宜生活的都市社区。

总而言之，本文期望在中国语境下对亲自然城市理论进行拓展使用，增进其在地化进程，同时也为城中村更新改造提供不同与以往研究角度的具有可实践性的设计参考。

关键词：城中村更新；亲自然设计；城市设计；公共空间

ABSTRACT

In the past few decades, China's urbanization process has accelerated, with cities expanding rapidly and giving rise to a unique urban space known as "urban villages". Due to the lack of proper planning and construction, urban villages often accumulate many urban problems and become a hotbed of urban decay. At the same time, with the convening of the 20th National Congress of the Communist Party of China, the formulation of the 14th Five-Year Plan, and the introduction of the Healthy China strategy, promoting the modernization of China towards harmonious coexistence between humans and nature has become an inevitable choice for development. However, the poor living environment and lack of ecological function in urban villages present huge challenges to this development prospect. Therefore, how to resolve these problems through effective urban village renewal methods has become an important issue. By reviewing relevant literature and cases, it can be found that the focus of urban village renewal is often on buildings, and research at the urban level is more focused on the economic and cultural fields, with relatively less targeted research on exploring natural elements for renewal. Therefore, more theoretical achievements are needed to guide renewal and transformation. Based on this, this paper attempts to explore how urban village renewal can move towards the theme of harmonious coexistence between humans and nature from the perspective of biophilic urban design, taking the public space of urban villages as the main research object. At the same time, the application of biophilic urbanism in urban villages is used as a supplement and application of this concept in the context of Chinese cities.

Firstly, This article clarifies the current situation and problems of urban villages through literature case studies, summarizes the basic principles of biophilic urban design, and proposes the design methods of biophilic cities. It explores the possibility of combining biophilic urbanism with the renewal of urban villages and establishes a theoretical foundation. Secondly, based on the theory of biophilic cities, multi-scale transformation and renewal strategies are proposed for the current situation and problems of urban villages, including the construction of biophilic networks at the macro urban scale to integrate urban villages with the city's development, the organic demolition and construction of existing buildings at the community scale to create a more biophilic public space layout in urban villages, and the biophilic renewal design of the micro-site scale to provide people with a truly integrated and symbiotic natural living environment. Through these three scales of design strategies, a complete design and implementation path for the biophilic renewal and transformation of

urban villages is provided. Finally, this article verifies the design strategies using Lijiao Village in Guangzhou as an example, starting from the current situation and needs of the villagers, and guided by the proposed renewal strategies, the urban public spaces inside and outside Lijiao Village are systematically updated and transformed to showcase the natural vitality of Lijiao, evoke people's innate emotions towards nature through the three-scale renewal, and make Lijiao a more biophilic and livable urban community.

In conclusion, this article aims to expand and localize the theory of biophilic cities in the Chinese context, while providing practical design references with different research perspectives for the renewal and transformation of urban villages.

Keywords: Urban village renewal; Biophilic urbanism; Urban design; Public space.

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Chapter 1 Introduction

1.1 Background of the study

1.1.1 Urban villages have become gathering places for urban issues

The urban villages are deeply embedded within the city but still retain the management and construction systems of villages, leading to their lagging development and the proliferation of numerous problems. With the rapid development of Guangzhou's urban areas, the number of urban villages has also grown rapidly. As the surrounding building density continues to increase, the distance between buildings in urban villages gradually shrinks. Eventually, the urban villages occupy a significant portion of the city and form unique urban landscapes such as "handshake buildings" and "narrow alleys," becoming iconic symbols of the city of Guangzhou. However, as urbanization deepens, the contradictions between urban villages and the cities they are located in become increasingly prominent, and their negative impact on the city's sustainable development and social progress has become more significant. The long-term uncontrolled growth of urban villages has gradually diverged from the development goals of the city in terms of style and management^[1]. The backward development of urban villages may cause a series of chain reactions, such as environmental degradation, social problems, urban management chaos, difficulty in urban renewal, and unreasonable urban planning, which seriously affect the sustainable development of the city and the quality of life of residents. To achieve harmonious urban development, measures must be taken to promote the development of urban villages, such as urban renewal, improving the environment of urban villages, and providing public services. These actions can help to achieve the goal of promoting the harmonious development of the city.

1.1.2 Renewal and transformation of urban villages requires approaches

In recent years, the renovation and transformation of urban villages has been put on the agenda and the methods and approaches have become increasingly diverse. However, the

^[1] Xu G L. The problem of "urban villages" in the process of urbanization in China. *Economic and Social Development*, 2008, No.65(05): 155-157.

shortcomings of these approaches have also become increasingly apparent. While the current urban village renovation has promoted the improvement of the urban landscape and the upgrading of public facilities to a certain extent, the lack of controlled large-scale demolition and reconstruction has also created new urban problems, such as the reduction of low-cost land, the exacerbation of the work-life contradiction, the disappearance of historical and cultural heritage, and the destruction of natural landscapes. At the same time, the central government has also put forward strategic transformation requirements for urban planning and construction from top to bottom. In 2017, General Secretary Xi Jinping pointed out during the 'Two Sessions' that 'urban management should be as delicate as embroidery'. In 2018, while inspecting Yongqingfang in Guangzhou, General Secretary Xi Jinping mentioned that urban planning and construction should attach great importance to the protection of historical and cultural heritage, avoid hasty and large-scale demolition and reconstruction, highlight local characteristics, focus on improving living conditions, and make more use of the "embroidery" technique of micro-renovation, emphasising the heritage of civilisation and culture, and making the city leave memories for people to remember their roots^[2]. This shows that the country has already recognised the problems of China's large-scale demolition and reconstruction in urban renewal, especially the erosion of urban historical and cultural heritage and local characteristics caused by the large-scale demolition and reconstruction of urban villages. Therefore, it is now necessary to guide the transformation of the development mode of urban villages in a reasonable way, comprehensively consider urban development needs, economic feasibility and development intensity, explore diverse and organic implementation paths for the renovation and transformation of urban villages, and provide a certain reference for the sustainable development of urban villages throughout the country.

1.1.3 Rich Resources in Urban Villages Lack of Development

Due to historical reasons, China's urban villages often retain resources that have historical, cultural, and ecological value. Firstly, there are architectural cultural resources. Many old buildings are preserved in urban villages, some of which have high historical and cultural

^[2]Miao C S, Qin W C, Shui H R. From Large Scale Demolition to Organic Regeneration: The Transition of Urban Village Development Model in Shenzhen/Miu Chunsheng, Qin Wenchao, Shui Haoran[J]. Planners, 2021(11): 55-62.

value, such as Qing Dynasty residences, modern factories, and worker's villages. They can be developed and utilized for protection, cultural and creative industries, and other purposes. Secondly, there are ecological environment resources. Urban villages often have some resources with ecological value, such as old trees, ancient wells, and natural streams. These resources can be an important part of urban greening and ecological protection and can also be a focus of efforts to improve the living environment. Thirdly, there are cultural activity resources. Urban villages preserve many traditional cultural activities, such as folk culture, craftsmanship, etc. They can be developed and utilized through cultural activities and the establishment of cultural exhibition halls. Finally, there are community cultural resources. Urban villages preserve many community cultures, such as village culture and community festivals. These make the residents of urban villages more cohesive and more willing to participate in the transformation and governance of their communities. Therefore, unlike newly built cities, the historical and ecological resources in urban villages have very rich development value. By protecting and developing these resources, it can not only enhance the vitality and charm of urban villages but also promote the sustainable development of cities.

1.1.4 The development theme of harmonious coexistence

The theme of harmonious coexistence between humans and nature is pervasive in China's development, dating back to ancient cultural and philosophical thought and becoming an important direction for social development today. A millennium ago, the Taoist concept of "the natural way" and the Confucian idea of "the unity of heaven and mankind" proposed this concept. As history develops and society changes, people's understanding and appreciation of nature is constantly deepened and expanded. In modern China, the theme of harmonious coexistence between man and nature has gradually become an important direction for social development. After the founding of the People's Republic of China in 1949, China began to vigorously develop industrialisation, but environmental problems followed. In order to protect the environment, China began to formulate environmental protection laws and policies, establish environmental protection departments, and strengthen environmental supervision and management. After the reform and opening up, China's economy developed rapidly, but it also brought serious environmental pollution problems. To solve the pollution problem, the

Chinese government has taken many measures, such as increasing investment in environmental protection, encouraging enterprises to protect the environment, promoting clean energy, and strengthening penalties for pollution. In 2022, the 20th National Congress of the Communist Party of China was successfully held, and General Secretary Xi Jinping pointed out that in building the modernisation of the harmonious coexistence between man and nature, the protection of urban ecological environment must be given a higher priority. At the same time, the General Office of the Communist Party of China Central Committee and the General Office of the State Council issued the "Opinions on Promoting Green Development in Urban and Rural Construction", actively promoting green development in urban and rural construction and accelerating the implementation of urban renewal policies^[3]. In urban construction, continue to promote urban ecological restoration and functional improvement projects, promote green development in regions and urban agglomerations, and build beautiful cities with harmonious coexistence between man and nature. In various regions, strengthen planning and adaptation to local conditions, improve urban livability through measures such as implementing urban ecological restoration projects, vigorously promoting urban water conservation and improving green travel infrastructure, integrate cities with nature, and enable residents to see mountains and water and remember their homesickness. However, urban villages have become the loopholes in this plan, and there are still significant natural ecological deficiencies.

Designing in harmony with nature was once the norm in human history, but with the progress of modern technology and engineering revolution, people have gradually become disconnected from nature. This is particularly true in urban villages that have abundant natural resources, where people's quality of life can only be sought in the gaps between buildings. The concept of biophilic city emphasizes the use of design techniques that maintain, enhance, and preserve nature in the built environment. This concept is in line with the Chinese philosophy of harmonious modernization development between people and nature. Therefore, this article introduces the concept of biophilic city and explores a new strategy for the organic renewal of urban villages.

^[3] Zhang X H. Introduction to "Opinions on Promoting Green Development in Urban and Rural Construction".[N]. Website of The State Council Information Office, 2021.10.27

1.2 Purpose and significance of the study

1.2.1 Purpose of the study

This paper applies the theory of biophilic urbanism to guide the renewal and transformation of urban villages. Through a comprehensive study, it is hoped to achieve the following goals:

Theoretical optimisation and improvement: Biophilic urbanism has only recently moved from the field of architecture to urban design. Most of the research is still in its infancy, and existing research results, relevant papers and practical projects on biophilic urbanism have mostly been established abroad. It is only in the past two years that it has begun to receive attention in China. Therefore, this article hopes to optimise and improve the theory to make it more suitable for the Chinese context and application environment of urban village renewal.

Propose feasible renewal strategies: Biophilic urban design lacks applicable overall strategies for urban village renewal. Therefore, from the perspective of urban design, multi-scale transformation strategies are proposed, using the large-scale green network of the city to break the barrier between the urban village and the surrounding urban area, updating the street and public space at the community level to improve the living environment of the urban village in various aspects, and using site and building scale transformations to provide biophilic design for daily life in the urban village. Based on biophilic urbanism, a general strategy for the renewal of urban villages will be formed.

Practical design verification of the strategy: After the strategy is proposed, it needs to be applied and studied. Therefore, this paper applies the design strategy to the renewal design of Lijiao Village in Guangzhou, provides a design template for the practical application of the strategy, and verifies its feasibility through practical design.

1.2.2 Significance of the study

Theoretical significance: The lack of research on biophilic urbanism in China has led to the underutilisation of this theory, which could have been beneficial to improving people's lives. This paper proposes biophilic urban design principles by studying existing theories at both Chinese and foreign levels, and also collates and classifies design elements, proposes

corresponding design strategies for each element, and organises them into a set of biophilic urban design patterns, which can serve as a reference for future related research in China.

Practical significance: The problem of urban villages has hindered the development of modernisation in Chinese cities and requires feasible strategies for renewal. Based on the research on biophilic urbanism, this theory can bring many benefits to urban villages, such as improving environmental quality, raising living standards, increasing social activities and promoting sustainable development. This paper proposes multi-scale design strategies and their implementation methods, and applies them to the renewal design of Lijiao Village. It attempts to find a new model for the renewal of urban villages in China, and provides a research direction and conclusion for the localised development of biophilic urbanism in China.

1.3 Definition of relevant concepts

1.3.1 Biophilia

Biophilia refers to the connection between humans and nature, where natural elements are integrated into our built environment, designs, and lifestyles. This is a concept that recognizes the inherent need of humans to connect with the natural world, and suggests that incorporating natural elements can improve our physical and mental health, creativity, productivity, and overall well-being. Biophilic design principles can be applied in various fields, such as architecture, interior design, urban planning, and landscape beautification, to create spaces that establish a deeper connection with nature.

1.3.2 Biophilic urbanism

Biophilic urbanism is an approach to urban design and planning that seeks to integrate nature and natural systems into the urban built environment. It is based on the idea that humans have an innate connection to nature and that incorporating natural elements into urban spaces can improve well-being, increase biodiversity and create more sustainable and resilient communities. Biophilic urbanism can take many forms, from urban forests and ecological parks, to community gardens and streetscapes, to green roofs and walls on buildings,

incorporating natural features such as waterways and natural light through a range of design techniques. The aim of biophilic urbanism is to promote a better understanding of people's place in the natural world by reconnecting people with nature and creating more liveable, healthy and sustainable cities. It is an important approach to addressing many of the environmental and social challenges facing today's cities.

1.3.3 Urban Village

Urban village refer to illegal communities in the central areas of cities, typically consisting of numerous small residential buildings and accommodating a large number of migrants. They are also known as "floating population settlements" or "urban slums," among other names. In China, urban villages usually refer to residential areas with poor planning, illegal construction, chaotic management, and poor environmental conditions. The formation of urban villages is closely related to China's urbanization process and economic development. Due to the acceleration of urbanization and the continuous increase in land prices in the city center, many migrant workers or new residents can only choose to live on the outskirts or in urban villages. These populations often lack housing security and public services, and their living environment and sanitation conditions are relatively poor. In China, urban villages have become one of the key issues in urban management and land use. The government attempts to address the problems of urban villages and improve the living standards of migrants through urban renewal, demolition and reconstruction, and other measures. Urban village renovation work typically includes land acquisition, house demolition, infrastructure improvement, and housing renewal. At the same time, the government also encourages private capital to participate in urban village renovation to improve efficiency and quality.

1.4 Research content and methods

1.4.1 Research content

This article conducts an in-depth study of the overall transformation of urban villages through the 'biophilia' design approach, which promotes interaction between humans and nature. The overall research approach is as follows: First, identify the problem based on an analysis of the

current status and reasons for the problems in China's urban villages and urban development, and show the background and feasibility of the research topic. Second, analyse the problem and propose the "biophilia" theory, explaining the development background, core ideas and specific practices of the theory in urban construction, and analysing the benefits and coupling possibilities it brings to urban village renewal. Third, solve the problem by applying the theory, propose a biophilic urbanism-based concept and strategy for urban village renewal. Finally, apply the "biophilia" strategy to specific renewal projects by integrating it with the real situation of LiJiao Village in Guangzhou. The article is divided into six chapters, with the specific contents as follows:

Chapter One, Introduction. This chapter mainly expounds the research background, the problems encountered in current urban village renewal and future development trends, combined with domestic and international research dynamics, proposes the research purpose, significance, research methods, and framework, giving a basic understanding of the entire article.

Chapter Two, Review of Relevant Theories. This chapter introduces the biophilic urban theory and the process of China's urban village transformation, summarizes the design principles and patterns of biophilic city, analyzes the applicability and development potential of biophilic urbanism in urban village renewal through specific analyses of two cities' biophilic designs, and extracts applicable measures and methods.

Chapter Three, Urban village renewal strategies guided by biophilic urbanism. Combining the theory mentioned above and excellent domestic and foreign cases, this chapter explores the unique application of "biophilia" in the specific environment of urban villages and proposes corresponding strategies at the macro-meso-micro levels, forming design guidelines suitable for urban village renewal.

Chapter Four, Analysis of the Lijiao area. This chapter briefly analyzes the urban context of LiJiao, evaluates the existing upper-level planning based on LiJiao's basic situation, proposes areas for improvement, introduces the biophilic urbanism concept, and conducts research on LiJiao's biophilic elements for subsequent design.

Chapter Five, Strategic use of biophilic urban design--the case of Lijiao. Based on the specific analysis of LiJiao, this chapter applies the biophilic urbanism design to LiJiao at different

levels according to the previously proposed design strategy, verifies the feasibility of the research and provides a template for the design strategy.

Chapter Six, Conclusion and Outlook. This chapter summarizes the research content of the article, points out the shortcomings of the research, and looks forward to the future development of biophilic urbanism in China and more diversified urban village renewal methods.

1.4.2 Research Object

The main research object of this paper is the urban village renewal in the Greater Bay Area of Guangdong, Hong Kong, and Macau. The Greater Bay Area refers to a metropolitan area consisting of nine cities including Guangzhou, Shenzhen, Foshan, Dongguan, Huizhou (excluding Longmen), Zhongshan, Zhuhai, Jiangmen, and Zhaoqing (Sihui and downtown area), as well as Hong Kong and Macau, forming the urban agglomeration (Fig.1-1). It is the fourth largest bay area in the world after the New York Bay Area, San Francisco Bay Area, and Tokyo Bay Area, and an important spatial carrier for China to build a world-class city cluster and participate in global competition. However, the Greater Bay Area has experienced a rapid process of urbanization, with an influx of population into cities, posing huge challenges to housing demand. Due to limited land resources, lagging urban planning, and other reasons, some low-income residents can only live in the peripheral areas or urban villages in the city center. Urban villages in the Greater Bay Area occupy a significant portion of the urban space, with a much higher proportion than other Chinese cities, making them a typical representation. Therefore, studying urban villages is particularly suitable for exploring this region.

1.4.3 Research Methods

(1) Literature Review

By studying literature materials related to the theory of biophilic design and the guidance of biophilic urban design in various countries, the existing research trends are grasped, and the current achievements and existing problems are summarized to provide a foundation for further research and clarify the research direction of this topic.

(2) Case Study

In this study, classic biophilic design practices in developed countries such as Europe and America and the latest practices in neighboring Asian countries in implementing biophilic design were obtained through the internet, and key cases were sorted out in terms of background, design strategy, project highlights, and reflections. The aim was to find biophilic urban design patterns that can be scientifically and reasonably applied in high-density urban contexts.

(3) Analysis and Deduction

Analyze the basic theoretical foundation of biophilic design and the current situation of the transformation of urban villages in China and summarize the possibility of combining the two. Through on-site investigation of the Lijiao urban village in Guangzhou, the current problems are clarified, and the biophilic design mode suitable for urban villages is analyzed and deduced. A framework for the design of urban village renewal under the biophilic design background is proposed, including design principles, design strategies, and implementation paths.

(4) Exemplification and Application

Using the Lijiao village in Guangzhou as an example, the biophilic design strategies obtained through research were used to guide practice and provide a detailed planning and design example for the public space of urban villages.

1.5 Research framework

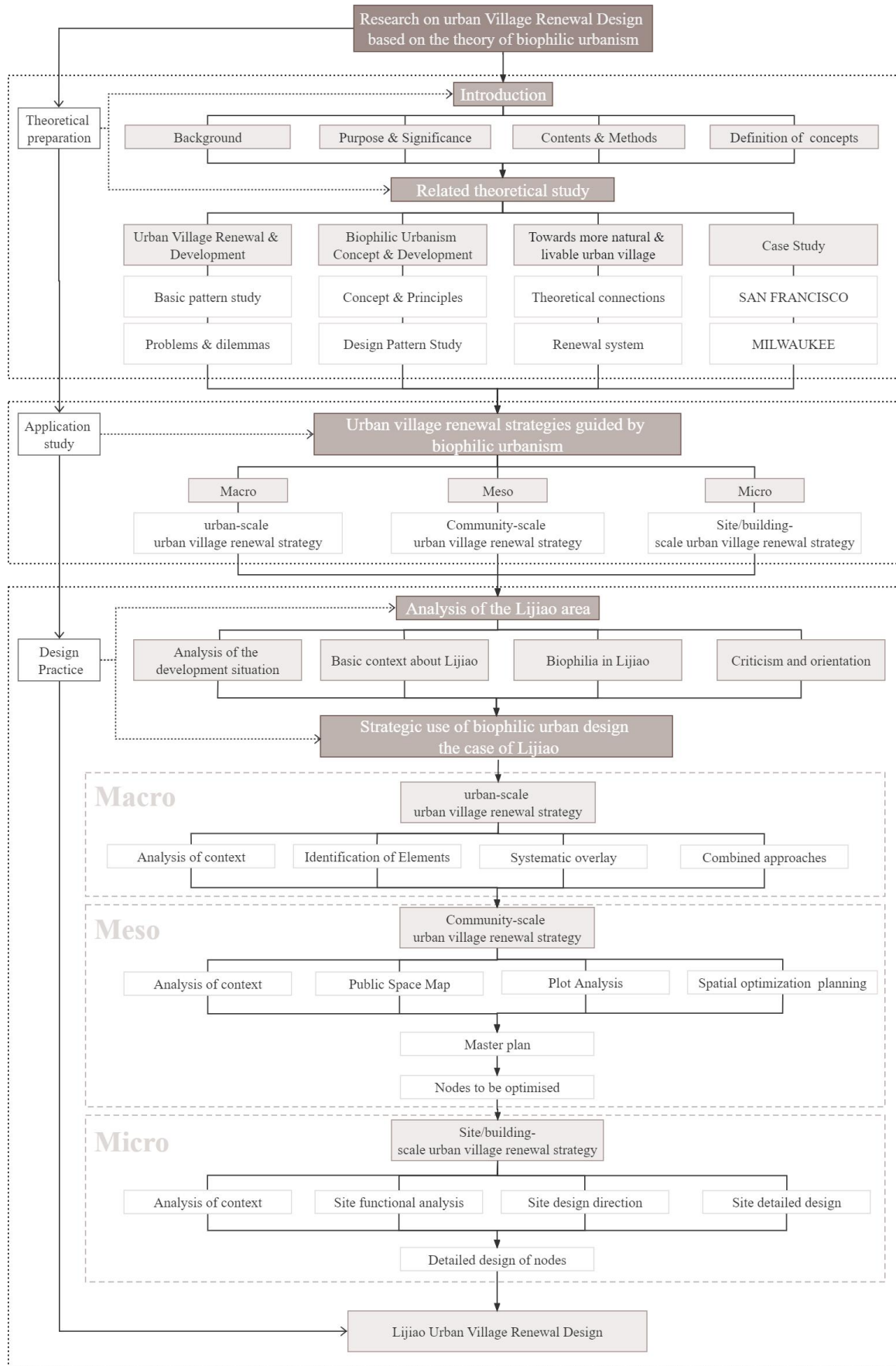


Fig 1-1 Research framework

Chapter 2 Literature review and theoretical research

2.1 Research on Development and Renewal of Chinese Urban Villages

2.1.1 Formation and Development of Urban Villages

2.1.1.1 Formation of Urban Villages

Urban villages in China have a long history, and the fundamental reason for their existence is due to the rapid urban development since the reform and opening up. However, the deeper reasons are worth exploring. As a product of China's urban-rural dual system, urban villages have distinct Chinese characteristics and have attracted widespread attention from the government, industry, and academia^[4]. In mainstream research, the formation of urban villages is mainly attributed to two factors. On the one hand, macro-level factors are emphasized, arguing that the "profit-seeking" land requisition by local governments during urban expansion is the catalyst for the formation of urban villages, and the underlying urban-rural dual system is the fundamental reason for their existence^[5]. This is because urban planning has failed to keep up with the rapid urban expansion, and in some areas, where rural collective ownership is still in practice, urban construction has already surrounded them, resulting in a dual structure of urban and rural areas. For example, in Guangzhou, since the 1980s, the planned area has increased by nearly double, and areas such as Shipai Village, Tangxia Village, Lijiao Village, and Yuan Village, which were once rural areas on the outskirts of Guangzhou, have now become part of the city. On the other hand, from a micro-level perspective, it is believed that the spatial production of urban villages is the result of the collective efforts of multiple social forces, involving government, enterprises, collective organizations, original villagers, and migrant populations^[6]. These forces operate in the absence of government supervision, through collective economic games, market demand stimulation, and the impact of migrant populations, among others. The formation of urban villages is the result of the joint action of these two factors.

^[4] Li P L. Great Changes: The End of the Village -- Urban Village Studies[J]. Chinese social sciences, 2002, (01): 168-179+209.

^[5] Ma H. An analysis of the urban sociological perspective of Shenzhen urban Village Reconstruction [J] Urban planning, 2007, 31(1): 26-32.

^[6] Zhang J X, Zhao W. An analysis of the development of urban village in dual regulation environment and its significance [J] .Urban planning, 2007, 31(1): 63-67.

2.1.1.2 Development of Urban Villages

(1) Nascent Period: Before 1978, this period was when rural areas began to shift towards urbanization around cities. In order to promote urbanization, the government expropriated rural land and some of it was transferred, which made it difficult for Chinese people who originally engaged in farming activities to continue doing so. To make a living, some villagers began to engage in commercial activities. At this time, there was still a clear division between rural and urban areas in China. The population composition of villages was mostly made up of local people who had lived there for generations. The population density of villages was low and the buildings were scattered throughout the village.

(2) Development period: From around 1978 to 2010, during this stage, urban villages began to form rapidly. China entered a period of rapid urbanization and expansion, with the government implementing compensated land use policies. As a result, the process of urban sprawl and suburbanization accelerated, and large amounts of land on the outskirts of cities were expropriated, with original rural settlements being surrounded or incorporated into urban development areas^[7]. During this period, China's level of urbanization increased rapidly and became a major miracle in China's development. However, due to the rapid pace of development without long-term planning and corresponding strategies to address the issues, the expansion of urban land and the near disappearance of farmland resulted in the original small villages being surrounded by urban construction, with a large influx of migrant populations, resulting in the unique phenomenon of urban villages.

(3) Transformation stage: After China's urbanization process stabilized, people began to focus on the problem of urban villages. As early as 2003, the Third Plenum of the 16th Party Congress proposed the scientific development concept of "putting people first and establishing a comprehensive, coordinated, and sustainable" approach. Under the influence of the times and theoretical trends, academia began to discuss the goals, subjects, and paths of urban village renewal and governance. Subsequently, Guangzhou launched the "Three Olds" transformation work, which focused more on improving the material level of the transformation. After the 18th Party Congress of the Communist Party of China, the country

^[7] Wei L H, Yan X P. The Formation and evolution of Urban Informal Immigrant Settlements in China's economically developed Areas -- "Urban Villages" -- A case study of Zhucheng City in the Pearl River Delta[J]. Journal of Management World, 2005(08):48-57.

proposed a new urbanization development strategy that puts people first, and the concept of high-quality development centered on the people took root in people's minds, which opened up a new era of urban and rural planning and construction^[8]. It was required to take "putting people first" and focusing on people's livelihoods as the fundamental starting point of the new urbanization work. Under the continuous modeling and practice of domestic scholars, research on urban village transformation has become more comprehensive and systematic.

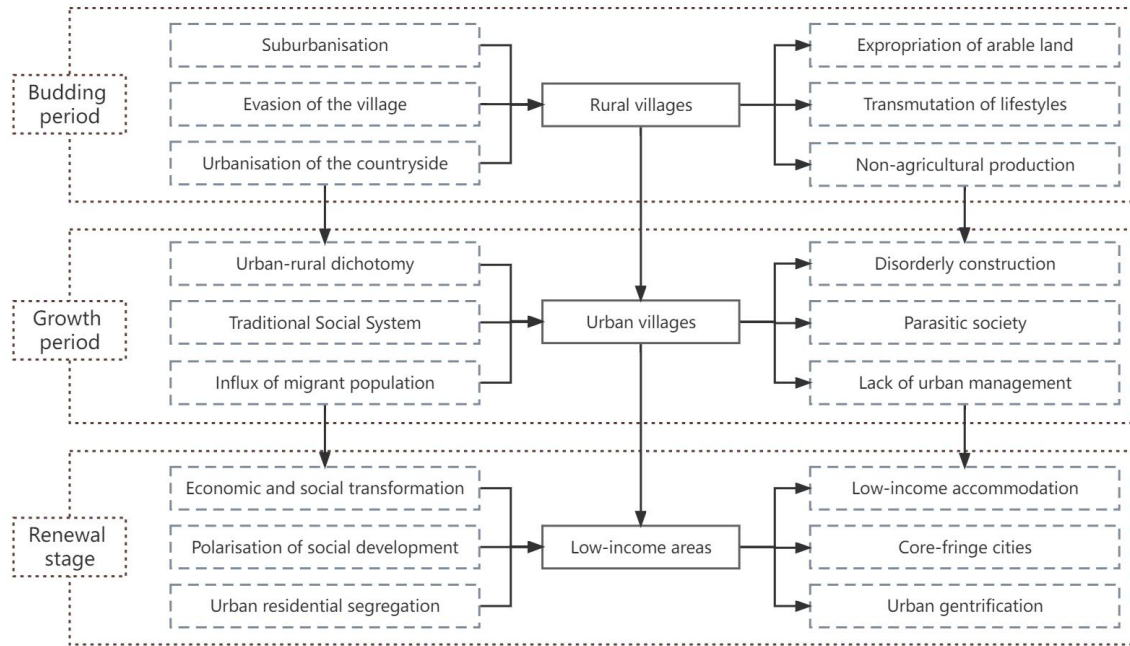


Fig 2-1 Urban Village Formation and Growth

Source: Author repainted

2.1.2 Study on the Basic Model of Urban Village Renewal

Based on the existing practices of urban village renewal, there are mainly two ways: one is demolition and reconstruction, and the other is renovation and improvement.

(1) Demolition and Reconstruction This form mainly appeared from 2003 to 2008. At that time, urban villages were still considered as "social and economic collapse zones" that were "not suitable for the city"^[7]. Moreover, the city's available land for development was already limited, so the way of renewal through demolition and reconstruction could indeed solve the problem of urban land supply, effectively improve the value of land use, improve local urban transportation, and rationalize the functional configuration of urban areas. There were mainly

^[8] Wan C W, Long X R. Review and Prospect of Urban Village Renewal Research in China: Literature Analysis Based on Major Journals of Urban Planning[J]. Journal of Human Settlements in West China, 2022, 37(1): 78-86.

three types of renewal models during this period: government-led, developer-led, and village collective-led. Due to being in the early stages, the urban village renewal models during this period had significant limitations, mainly manifested in: first, influenced by the theory of growth machines and other trends of thought, the research on governance often ignored new urban residents renting in urban villages and even had views that encouraged gentrification. It was precisely because of the neglect of new urban residents that research during this period often viewed urban villages as a cancer of the city, ignoring the positive role of urban villages. Second, in terms of research scale, most research severed the connection between urban villages and the city, and the research perspective was limited to the urban village itself, ignoring the organic connection between urban villages and the city^[9].

Table 2-1 Three main modes of participation in urban village renewal

Source: Author repainted

	Government-led approach	Developer-led approach	Village collective-led approach
Approach	The government completes land acquisition and pre-development, then through bidding, auction, and grant to developers to complete the construction	Government and market players cooperate and bring in market capital to achieve transformation	Under the guidance of the government, village collectives and villagers raise their own funds and resettle themselves. Complete the renovation by themselves
Benefits	Short transition period and simple operation; protection of public interest and order; policy support from the government	The developer is well-financed and experienced, which can relieve the pressure of government funding and reduce the involvement of public authority	No financial input from the government; villagers change from passive to active and become more motivated; higher collective income for the village
Weaknesses	Limited financial resources of the government, difficult to balance the demolition and resettlement into, this villagers passive participation	Gentrification, which is detrimental to the public interest; breakthrough of the control regulations, high plot ratio; villagers' interests are ignored. Resistance	Difficult to raise funds for renovation; difficult for village collectives to have organisational capacity; different compensation standards among villages, causing imbalance among villagers
Availability	Used when the government has strong financial capacity	Used when the government has limited financial resources and the village has insufficient funding capacity	Used when the collective economy is well-developed and has strong financing capacity and the village is small

^[9] Zhang L Z, Ye Y M. Forty Years of Urban Village Redevelopment and Governance Evolution and Prospect of Academic Thoughts[J]. Urban planning, 2022, 46(05):103-114.

(2) Comprehensive renovation: With the proposal of the "three-old renovation" project and the new urbanization strategy, the increasing number of problems caused by large-scale demolition and construction has led academia to reflect on the tendency of solely pursuing spatial and economic goals. More inclusive and diversified renewal objectives have been proposed, based on which the model of comprehensive renovation has been put forward. Comprehensive renovation involves rectifying illegal constructions while retaining most of the buildings in urban villages. It focuses on the transformation of local areas and key elements, controls the construction of new buildings, decorates the overall facade and appropriately tidies up the interior of the urban villages. The biggest feature of this form is that the amount of renovation work is small, and the funding required is not high, which makes the process relatively smooth. However, the problems of this approach have gradually emerged. Firstly, due to the small demand, the funding for this kind of renovation is almost entirely provided by the government. According to previous legal regulations, collective rural land can only be used for commercial development after being requisitioned and turned into state-owned land. Since on-site renovation does not involve land requisition, it is difficult for social capital to participate, and the government's financial burden is too high, which may lead to the interruption or low quality of the renovation. Secondly, many on-site renovations lack useful theoretical guidance, resulting in low effectiveness and short duration. Xiao Junyao and others proved that under the current on-site renovation model, due to the lack of commercial capital, the rented houses after renovation are still operated by original residents, resulting in the fast restoration of the urban village to a crowded, dirty, and chaotic state^[10]. Finally, the current focus of comprehensive urban renewal is generally on optimizing integrated governance, which generally does not involve the construction of supporting facilities or changes in building functions. It is difficult to play a role in increasing public space, industrial transformation or upgrading, and it is impossible to enable urban villages to have substantial development in the city.

^[10] Xiao J Y,Zhang X Y,Li Z G.Patterns and Evolution Mechanism of Urban Village Redevelopment in Shenzhen City from the "Administrative Absorption" Perspective[J].Urban and Environmental Studies,2019,No.21(03):72-82.

2.1.3 Urban villages fallen into a predicament of unsustainable development

After years of exploration and practical verification, it can be found that existing renewal models, whether through demolition and reconstruction or comprehensive improvement, adopt a thorough negation attitude towards the apparent disorder of urban villages, and advocate for large-scale demolition and reconstruction. The formulation and implementation of planning mostly consider short-term goals within the term of government management departments, while ignoring the actual situation of urban villages and the long-term development of the displaced farmers^[11]. In summary, the biggest dilemma of the existing renewal model is its lack of sustainability, which prevents the healthy development of urban villages. In addition, the spatial and social forms of urban villages in China have basically taken shape. Whether it is the model of demolition and reconstruction or comprehensive improvement, it can no longer meet people's increasing demand for a better quality of life. Various issues need to be addressed during this period, such as how to promote the urbanization of farmers, solve the housing problems of migrant populations, improve the quality of urban environmental space, eliminate institutional and mechanism obstacles, pursue connotative development, and promote the integrated development of urban and rural areas. Under the current era background, the renewal of urban villages has become an important means to promote the overall development of cities. It emphasizes systematic renewal, innovation in theory, institutional mechanisms and technology. Many scholars and local governments are actively introducing and applying various new theories, attempting to solve the problem of urban villages.

2.1.5 Summary

Urban villages in China are facing a dilemma - either facing the threat of collective demolition or stagnation in development due to the exploration of more appropriate renewal methods. Large-scale demolition and reconstruction, though once a popular approach to urban renewal, is no longer sustainable due to the significant human, material, and financial resources it consumes. There is an urgent need for alternative renewal methods that are not

^[11]Cheng D L. Research on the Scientific Development of UrbanVillage in China—In Perspective of Land-Losing Farmers' Sustainable Livelihoods[J]. Urban Development Studies,2008,15(3):68-79.

only cost-effective but also sustainable in the long run.

However, despite the numerous renewal methods available, most of them primarily focus on economic development or cultural shaping rather than creating a more livable natural environment for the residents within the village or developing a more sustainable urban village community. As a result, research on these aspects has been limited.

Therefore, this article aims to introduce the concept of biophilic urbanism into the design of urban village renewal, which emphasizes the harmonious relationship between urbanization and the natural environment, leading to a more sustainable and livable urban village community. This approach entails preserving existing buildings, promoting the use of renewable energy, integrating green spaces, and improving the overall living conditions for the residents.

2.2 Study of the Biophilic Urban Theory

2.2.1 Review of the biophilic Theory

2.2.1.1 Overview of Biophilic Theory in West Countries

(1) Emergence phase

In 1964, American social psychologist Erich Seligmann Fromm first used the term "biophilia" in his book "The Heart of Man," and explained it as "a psychological tendency that is attracted to all living and energetic things," which marked the beginning of the pro-nature theory. In 1984, Harvard biologist Edward Wilson's book "Biophilia" was published, which popularized the concept^[12]. An important historical milestone occurred in 1993 when Edward Wilson and Yale environmental psychologist Stephen Kellert jointly proposed the Biophilia Hypothesis. In the book, the authors emphasized the necessity of nature as one of the necessary conditions through an explanation of human evolution, pointing out the ecological degradation and species loss caused by the modern lifestyle lacking connection with nature due to technological and economic progress, which causes irreversible damage to human genetic wisdom development^[13]. This sparked a wave of exploration into the benefits of nature in various disciplines such as environmental science, sociology, medicine, and economics in the

^[12] Wilson E O. Biophilia: The Human Bond with Other Species[M]. Cambridge, MA: Harvard University Press,1984.

^[13]Kellert, S. and Wilson, E. O., eds. The Biophilia Hypothesis[M]. Washington, DC: Island Press,1993.

1990s. After many scholars conducted research, the positive effects of nature were validated from multiple perspectives and received recognition from various fields. Architects and urban planners realized that if they could incorporate the many positive effects of nature into the urban environment, it would undoubtedly be an important measure beneficial to human survival and development. Therefore, academia began to explore methods of designing artificial environments that could fully utilize the benefits of nature.

(2) Establishment phase

In 2008, as one of the pioneers of biophilic design, Stephen R. Kellert first proposed the concept of incorporating human pro-nature tendencies into architectural environmental design, which aims to provide biophilic experiences for people in buildings through design, and pointed out specific guidelines for the dimensions, elements, and attributes of biophilic design to construct urban environments. In the same year, the book "Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life" was published, which officially named and defined biophilic design as the creation of artificial environments that can support and revive human biophilic tendencies by drawing experiences from nature and recreating, utilizing, simulating, and extracting nature^[14].

(3) Development Stage

After 2010, biophilic design gradually expanded from the architectural dimension to the urban and landscape dimensions. In 2010, Amjad Almusaed proposed the concept of biophilic architecture in "Biophilic and Bioclimatic Architecture: Analytical Therapy for the Next Generation of Passive Sustainable Architecture," which is one of the most promising ideas in sustainable architecture. The aim of biophilic architecture is to create environmentally friendly and energy-efficient living environments through effective management of natural resources. In 2011, Timothy Beatley integrated biophilic design into urban planning in his book "Biophilic Cities: Integrating Nature into Urban Design and Planning," proposing the concept of biophilic cities and their basic elements, providing examples of biophilic cities around the world, analyzing the design of urban landscapes and buildings, and suggesting research directions for future eco-cities and emerging practices^[15]. In 2015, Stephen R. Kellert

^[14] Kellert S R, Heerwagen J H, Martin L. Ed. Biophilic Design, The Theory, Science, and Practice of Bringing Buildings to Life [M]. Hoboken, NJ: Wiley, 2008.

^[15] Beatley T. Biophilic Cities: Integrating Nature into Urban Design and Planning [M]. Su Y, Zhang Z, Bai Y. Beijing: China

and Elizabeth F. Calabrese introduced three forms and 24 attributes of biophilic design in "The Practice of Biophilic Design," namely Direct Experience of Nature, Indirect Experience of Nature, and Experience of Space and Place. Stephen R. Kellert also provided more detailed supplementary explanations of biophilic design in his 2018 book "Nature by Design: The Practice of Biophilic Design."^[16] In 2015, Joe Clancy and Catie Ryan studied the application of biophilic design to landscape design, and in their book "14 Patterns of Biophilic Design," they mentioned 14 application patterns and believed that these experiential patterns have broad application prospects and can be applied to projects of any scale to enhance health and well-being^[17]. So far, international research on biophilic design and biophilic urbanism has covered many aspects, such as the refinement of design elements, the construction of design frameworks and evaluation systems, urban construction practice and promotion of human health and well-being, and has developed in more directions.

2.2.1.2 The development of Biophilic Theory in China

In recent years, biophilic theory has been researched and developed in China, which mainly focuses on three aspects:

(1) Theoretical research: In 2021, Wang and Mei traced the historical development of biophilic design abroad in their paper "Research on Biophilic Design: Theory, Methodology, and Development Trends," using iconic research achievements as nodes to outline the origins, establishment, and expansion of biophilic design research. Through a detailed discussion of theoretical evolution, methodological changes, and practical applications in different stages of development, they summarized the basic concept and universal methods of biophilic design and proposed inspirations for biophilic design in China's urban spaces, with the aim of providing theoretical basis for related research^[18]. Ma and Chen, et al used the concept of biophilic as a new perspective and analyzed the connotation of biophilic and biophilic aesthetics cognition, and the empirical research on the promotion of environmental preferences through biophilic. They explored the targeted construction methods of

Architecture and Building Press, 2019.

^[16] KELLERT.S .R. Nature by Design: The Practice of Biophilic Design[M]. Yale: Yale University Press, 2015.

^[17] BROWNING. W, RYAN .C, CLANCY .J. 14 Patterns of Biophilic Design[M]. New York: Terrapin Bright Green LLC, 2014.

^[18] Wang S Q, Mei H Y. Research on Biophilic Design: Theory, Methodology, and Development Trends[J]. landscape architecture, 2021, 28(02): 83-89.

life-oriented landscape space that embodies biophilic cognition through three contents: design points, planning scenes, and life visions, in order to provide useful references for biophilic-oriented landscape space planning and design^[19]. In 2022, Yue et al. conducted a knowledge map analysis of biophilic design theory and the research progress of biophilic architecture design and its health benefits by using the Web of Science database and CiteSpace knowledge mapping software in their paper "Knowledge Map Analysis of Biophilic Architecture Design and Its Health Benefits." They provided references for the design and theoretical research of healthy buildings based on a biophilic perspective^[20].

(2) Health and wellness field: Due to the unique characteristics of the health and wellness industry, the healing power of nature was confirmed in research many years ago, making it the earliest adopter of the biophilic design concept in China. In 2008, Chao and Liu used this concept to guide the design of a hospital building. In 2012, Liu and Li analyzed the inspiration of biophilic design on rehabilitation landscapes, focusing on the positive effects of four abstract natural features on human health and the guidance they provide for spatial design^[21]. From 2018 to 2019, Zhang, Zhang, Fan, and others applied this concept to rehabilitation research in community parks. Zhang and Jiang explored its application in hospital environments, indicating that this concept can endow hospital spaces with meaningful natural attributes and promote health^[22]. Shang and Lin suggested that color design in biophilic design can be helpful for medical spaces^[23].

(3) Architectural planning field: In 2016, Ye and Yu proposed the biophilic design model for high-density urban environments and its influencing factors in their article "Biophilic Design Model in High-Density Cities." They explained the previous biological concepts and features and tried to demonstrate the feasibility of its development through relevant cases^[24]. Huang and Zhang analyzed the biophilic design concept reflected in classical Chinese gardens in

^[19] Ma Y H, Chen X, Zhu J, et al Study on the Method of Constructing Biophilic Urban Nature—Based on the Analysis of Biophilic Aesthetics Cognition and Its Landscape Space Carriers[J]. Chinese Landscape Architecture, 2021, 37(07): 77-82.

^[20] Yue M, Zhang X S, Zhang J J. Knowledge Map Analysis of Biophilic Architecture Design and Its Health Benefits[J]. South Architecture, 2022, No. 217(11): 12-20.

^[21] Liu B X, Li S H. Analysis on Healing Landscape Design Based on Neuroscience Research[J]. Chinese Landscape Architecture, 2012, 28(11): 47-51.

^[22] Zhang S S, Jiang L. Study on biophilic design of hospital space environment for health promotion[J]. WORLD ARCHITECTURE, 2020, No. 362(08): 126-129+141.

^[23] Shang H F, Ling M Q, Wang C S. Research on color design of medical space based on biophilic theory[J]. Industrial engineering design, 2020, 2(03): 61-66.

^[24] Ye S W, Yu W J. Biophilic Design Model in High-Density Cities[J]. Housing Industry, 2016(05): 26-30.

"Analysis of Biophilic Design Pattern in Jangnan Classical Gardens" and suggested that when applying the biophilic design model in landscape design, more attention should be paid to the user's experience^[25]. In 2018 and 2022, Lei and others published two articles, "BIOPHILIC URBANISM: AN IMPETUS FOR GREEN HUMANITIES-- A Review and Synthesis of Biophilia" and "Health and Low-Carbon Design Practices for Urban Living Environment Optimizatio- Reshaping the Natural Environment in Urban Renewal," confirming that this concept can be organically combined with the construction of China's green humanistic system, analyzing the design strategies for reshaping public spaces in urban renewal, and exploring practical techniques for optimizing urban living environments, health, and low-carbon practices. They provided design strategy references and a biophilic low-carbon design evaluation indicator framework for designers^{[26][27]}. Xi and Qin , in their article "Biophilic Design based on the Theory of Biophilia:A Case Study of Parkroyal on Pickering," discussed the specific principles of biophilic design based on the concept of biophilic affinity and used Pickering Hotel as a case study^[28].

2.2.1.3 Summary

Based on the research on the theory of biophilic, it can be concluded that biophilia, as a psychological term, has triggered numerous discussions.Initially applied to the design of architectural environments, this concept has gradually developed to include interior spaces and landscape environments.A large body of research consistently confirms the significant role that biophilic design plays in promoting human physical and mental health.Subsequently, many scholars have extended the principles of biophilic design and theories of psychological evolution from the micro-level to the macro-level of urban design, leading to the emergence of biophilic urbanism.However, due to the late start of research on biophilic design in China, domestic scholars have focused mainly on the initial stage of architectural environments and

^[25] Huang Y,Zhang J X.Analysis of Biophilic Design Pattern in Jangnan Classical Gardens[J].Journal of Chinese Urban Forestry,2016,14(04):55-58.

^[26] Lei Q H.Health and Low-Carbon Design Practices for Urban Living Environment Optimizatio- Reshaping the Natural Environment in Urban Renewal[J].WORLD ARCHITECTURE REVIEW, 2022 , 37(04) : 56-63.

^[27] Lei Q H,Liu S Y,Zhang Z D. BIOPHILIC URBANISM: AN IMPETUS FOR GREEN HUMANITIES -- A Review and Synthesis of Biophilia[C]//China Society of Urban Sciences, Guangdong Provincial Department of Housing and Urban-Rural Development, Zhuhai Municipal People's Government, Sino-US Green Fund, Green Building and Energy Conservation Committee of China Society of Urban Sciences.Proceedings of the 2018 International Green Building and Building Energy Efficiency Conference.,2018:344-348.

^[28] Xi T Y,Qin H,Yu W L,et al.Biophilic Design based on the Theory of Biophilia:A Case Study of Parkroyal on Pickering[J].Architecture & Culture,2021(02):93-94.

rehabilitative aspects, with little theoretical research on how biophilic design can be applied to urban design, and a lack of feasible practices addressing specific urban issues. This article aims to explore the potential application of biophilic design in the context of urban village renewal, which could contribute to the diversified development of biophilic urbanism in China, making it one of the research significances of this paper.

2.2.2 The Core Concepts and Principles of Biophilic Urbanism

2.2.2.1 Biophilic Design

Biophilic design is based on human biophilia, the innate desire to connect with nature, with a core value of putting people first and focusing on the relationship between humans and nature. It aims to improve urban public environments and enhance the quality of users' health by incorporating certain design techniques that prioritize the user experience. The core belief of the biophilic urbanism movement is that city dwellers need to interact with the natural world daily and even hourly, as a fundamental element of happy, healthy, and meaningful living. Nature is not merely an optional design element or a secluded preservation area; it should be integrated into the spaces and places where people spend most of their time, including homes, offices, communities, and even entire cities.

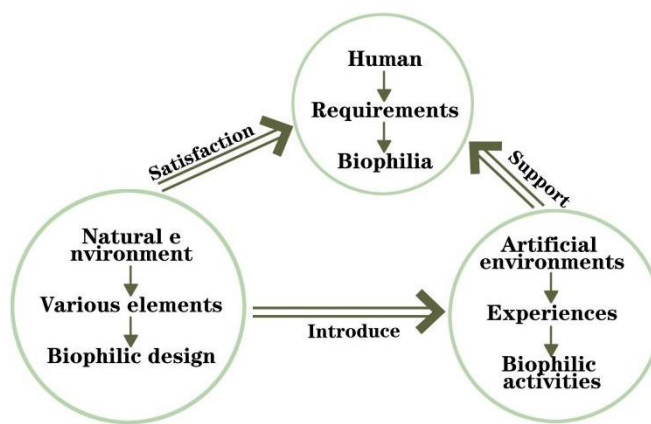


Fig 2-2 Theoretical model of biophilic design

2.2.2.2 Principles of Biophilic Urbanism

(1) What is biophilic urban design?

Beatley defines it simply as "biophilia on an urban scale" in his book "Biophilic Cities: Integrating Nature into Urban Design and Planning". Biophilic urbanism is a relatively new

term, which can also be explained as "the principle of using natural features as functional design elements, especially in buildings"^[29]. It is also described as a way of "bringing nature to our doorstep"^[30] by intentionally designing outdoor activities to reconnect people with animals and plants. So, what is biophilic urban design? The goal of biophilic urban design is twofold. First, it aims to create healthy, attractive, and interconnected urban natural environments, such as by using green corridors, green belts, constructing urban "living buildings" networks with vegetated walls and roofs, and utilizing rivers as potential locations for new habitats and biodiversity hotspots^[15]. The second goal is human development. Biophilic urban design uses natural education facilities to design infrastructure in a way that encourages interaction with nature, while involving curiosity at all ages in natural environments to achieve holistic human development. To achieve meaningful and beneficial biophilic urban design, Kellert once proposed some design principles: 1-The experience of nature in the built environment should be repeated, continuous, and enduring; 2-The design should consider human adaptation to nature, comply with human evolution mechanisms, and promote people's health and well-being; 3-Design should use people's attachment to specific ecological and cultural environments and places; 3- Positive interactions between humans and nature should be created; 4-Create an interconnected and integrated environment where various design forms complement nature^[31].

(2) Design principle

Based on Kellert's biophilic design principles, the following fundamental principles can be proposed for use in biophilic city design. The key principles include the following five main points: Nature-centered; Integrated view of urban nature; Multi-level, multi-scale design; Equitable and diverse public participation; Positive display of local distinctiveness. Following this, each principle is explained and illustrated with relevant examples.

^[29] Reeve A., Desha S., Hargroves C, et al. A Basis for Inquiry into Policy Consideration for Increasing the Application of Biophilic Urbanism[C]. In S. Rauch, G. Morrison, S. Norra, N. Schleicher, et al. Urban Environment: Proceedings of the 11th Urban Environment Symposium (UES). Springer, Germany, pp. 143-151.

^[30] Newman P, Hargroves K, Desha C. Can biophilic urbanism deliver strong economic and social benefits in cities? An economic and policy investigation into the increased use of natural elements in urban design[Z]. Sustainable Built Environment National Research Centre (SBE nrc), Curtin University and Queensland University of Technology, Australia, 2012, 5.

^[31] Kellert S. Biophilic urbanism: the potential to transform[J]. Smart and sustainable built environment, 2016, 5(1):4-8.

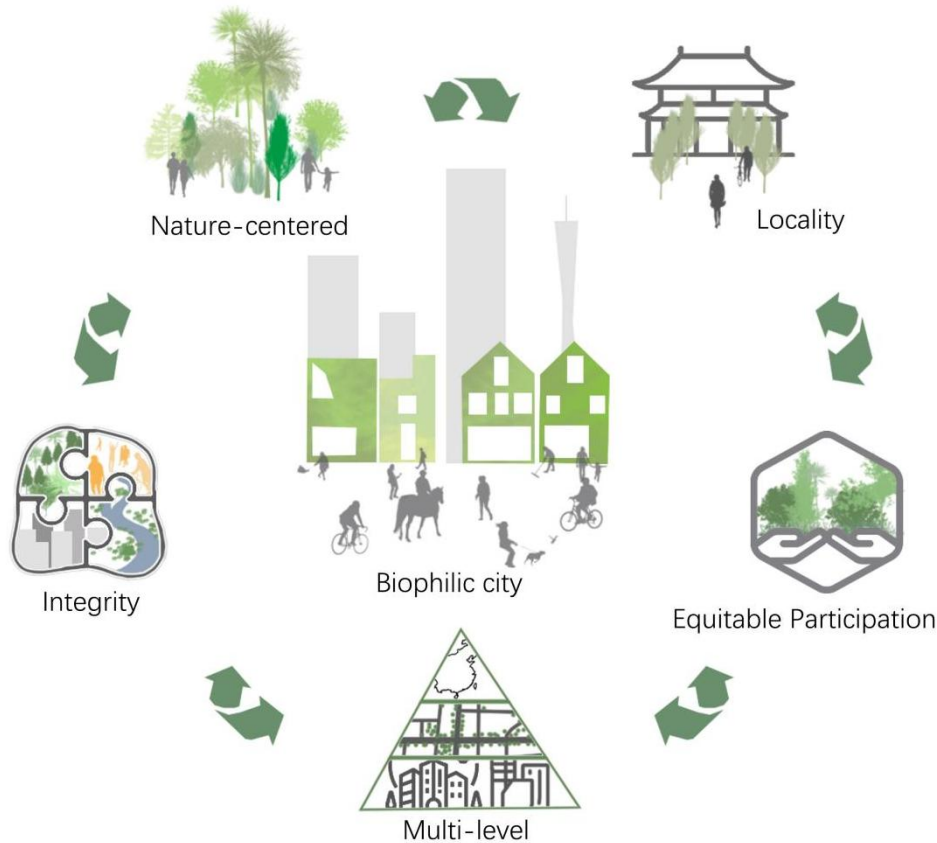


Fig 2-3 Principles of Biophilic Urban Design

Nature-centered

The experiences and research of biophilic cities have shown the immense value of placing nature at the center of urban development, not only in terms of ecology, but also in health, economy, education, and other fields. China's cities have undergone a period of rapid development, and the country is now shifting its development direction to promote high-quality development. Biophilic design provides us with the answer to how to effectively create a high-quality urban environment, which is to center urban development and transformation around nature. The former industrial city of Birmingham declared itself a green and sustainable city, strengthened the connection between health and nature, and ultimately achieved a city goal based on natural capital. To achieve these goals, the city council developed the "Green Living Spaces Plan," which included establishing a network of rivers and streams as a grid of paths and trails for citizens and restoring their natural ecosystems. This initiative provides an effective example of how biophilic design can impact urban economic growth, both directly and indirectly.

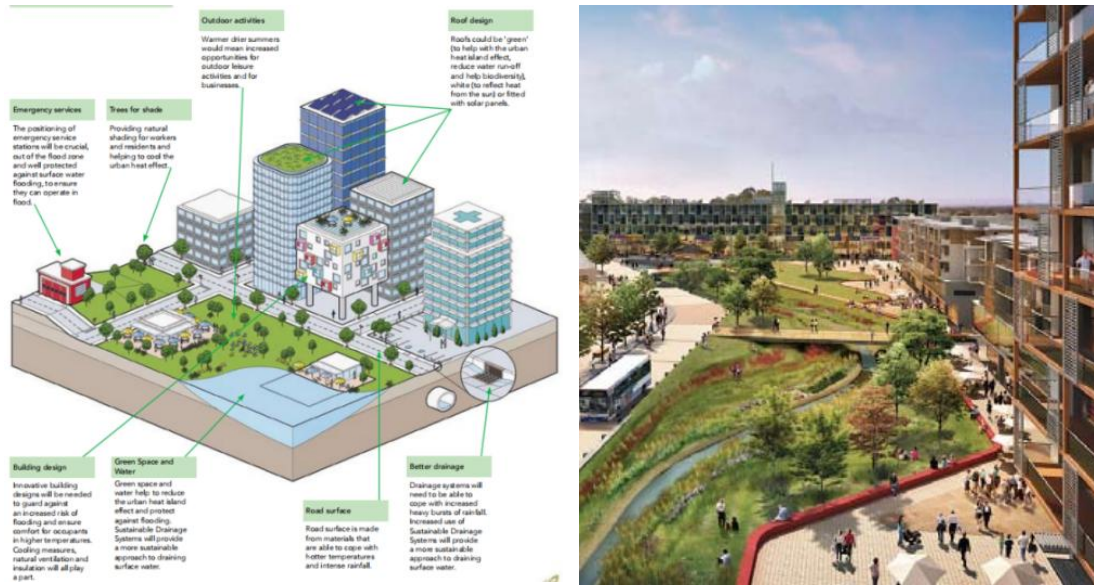


Fig 2-4 DEFRA Cityscape 2030 of BIRMINGHAM

source:Green Living Spaces Plan

Integrated view of urban nature

With the development of cities, high-density and high-intensity urban construction has led to the degradation and fragmentation of urban natural habitats, and the resilience and ecosystem services are limited by the fragmentation of natural spaces. This leads to a lack of resilience in cities, making it difficult to have the ability to respond to risks, recover, and have autonomy, so holism is the foundation for the functional expression of a biophilic city. From the perspective of urban space and ecology, the strategies that need to be considered must be included at both the large-scale design and planning strategies, as well as in smaller-scale community streets^[32]. Using a complete regional planning process that extends from the city center to various areas and clusters, improving green channels, ensuring close contact between humans and nature, and constructing a complete biophilic urban system.

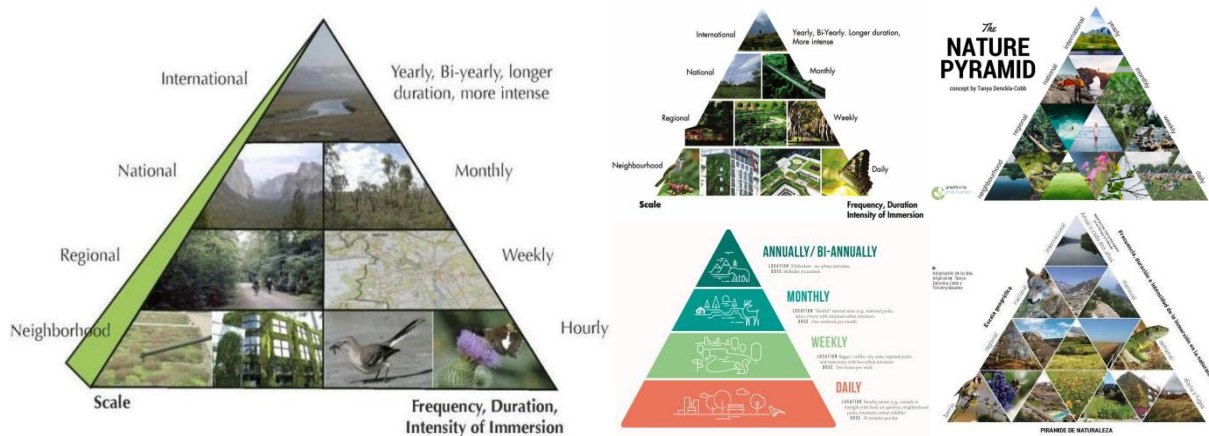
Multi-level, multi-scale design

The continuous integration of natural elements into urban society is the primary feature of a biophilic city. Therefore, constructing a biophilic city requires constantly strengthening the connection between human society and the natural system, promoting people's comprehensive thinking about the inherent value of natural systems in urban development^[33]. The natural

[32] Xue M C. Study on the Design Method of Bio Friendly City based on Green Network Analysis—Taking Changchun City as an Example[D]. Beijing: Beijing University of Civil Engineering and Architecture, 2020.

[33] Wu J. The inner logic and resilience construction of biophile city[J]. Journal of Soochow University(Philosophy & Social Science Edition), 2022, 43(05): 27-34.

scales in cities vary in size, with habitats both obscure and apparent, and the quantity of diverse, complex natural elements is astonishing. The ability of cities to support biological functions is remarkable, from macro to micro, from visual perception to auditory perception, from the whole to the individual. Therefore, only by establishing a multi-level and multi-scale system structure can the benefits of natural ecosystems be realized in the urban environment. Since 2012, Tim Beatley has developed expressions for natural recommended doses at multiple scales and continues to apply them in novel and interesting ways.



First presented in Tim Beatley (Aug, 2012)

Applied in new and interesting ways

Fig 2-5 The Nature Pyramid

Source: <https://www.biophiliccities.org/the-nature-pyramid>

Equitable and diverse public participation

The intimate relationship between people and nature needs to be built in a fair and diverse manner for a nature-friendly city. Many marginalized communities exist in cities, whether it's China's urban villages or foreign slums, which are the result of the imbalance in urban development over several decades. To become a biophilic city, it is necessary to bridge the gap of natural fairness and make all community members feel welcome in public natural spaces. In addition, creative ways are needed to attract the public and generate the desire and curiosity to interact with nature. Melbourne has made many efforts in this regard, such as coding and setting up mailboxes for 77,000 trees throughout the city, allowing the public to write letters to their favorite trees. Over 3,000 emails have been sent to these trees, many of which are from other countries^[34].

^[34] Tan M. Leaf Letters: Fan Email for Melbourne's Trees Pours in from around the World. Guardian. <http://www.theguardian.com/australia-news/2015/jul/15/leaf-letters-fan-mail-melbourne-trees-pours-in-around-the-world>, 2015, July 15

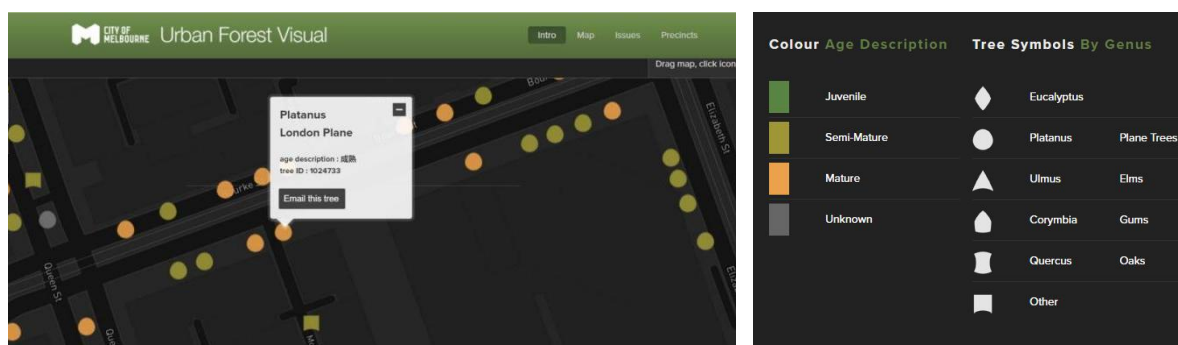


Fig 2-6 Explore Melbourne's Urban Forest
Source: <http://melbourneurbanforestvisual.com.au/>

Positive display of local distinctiveness

Urban society is essentially a humanistic, emotional, and networked society. Building a biophilic city is not simply expanding and optimizing natural space, but constructing an open, shared, and harmonious city with humanistic connotations^[33]. Humans are sensitive beings with a humanistic nature. Sensory communication is needed between people, and people have a unique emotional attachment to places. Regional biota preserved by natural laws is not only the best choice for the local environment, but also the inheritance of people's memories. Therefore, in the process of designing a biophilic city, it is necessary to fully understand the local resources of the site, and to use regional materials and local vegetation for the design. This not only extends the characteristics of the site, but also reflects an understanding and inheritance of local culture. In the latest Green Mark standard compilation, Singapore has added many biophilic indicators that fully utilize the design features of biophilia in a humid tropical climate, creating a tropical human habitat environment with regional characteristics^[35].

2.2.2.3 Differences between Biophilic Cities, Green Cities and Sustainable Cities

Biophilic City design is not a completely new concept, it overlaps with other ideas such as green design, sustainable design, and biomimicry, all of which propose design concepts and methods based on nature and aim to balance the relationship between humans and nature^[18]. However, there are differences, which are reflected in the essence, scope of exploration, and design objects.

In terms of essence, Biophilic Cities differ from green and sustainable designs in that they

^[35] Wang J, Feng D Y, Zhang Q N, Research on the Biophilic Index of Green Mark: Based on the Perspective of Climate Response. Chinese Landscape Architecture, 2022. 38(03): 84-89.

emphasize not the direct introduction and use of nature, but rather the analysis and extraction of environmental traits and patterns that are beneficial to human survival and development in the evolution process of human-nature interaction. These traits and patterns are then applied to artificial environments, with the ultimate goal of not only achieving the integration of cities and nature, but also emphasizing the positive impact of nature on humans. If green and sustainable design wanted to introduce a tree into the environment to protect it or improve air quality, then Biophilic design would not only achieve this goal, but would also maximize the creation of shelter and aesthetic experiences for humans by this tree in the environment. If the existence of the tree contradicts the human biophilic nature, such as blocking the view or adding a sense of fear, then the positive function of nature would be lost, and Biophilic Cities would not plant such a tree in order to meet green and sustainable goals.

In terms of scope of exploration, previous design concepts, such as sustainable design, have focused on the intensive and optimized use of natural material resources, while Biophilic design enables the non-material functions and benefits of nature to be explored and demonstrated. This makes the image of nature in human society more abundant and three-dimensional, and human beings need to draw spiritual nutrients from nature just as they need material resources. Imagine an apartment completely composed of solar panels, which is undoubtedly ecological and sustainable, but cannot meet the aesthetic needs of residents, and cannot awaken people's love for life. People do not want to stay in such an environment, and this model cannot be sustained.

In terms of design objects, the nature that traditional green design focuses on is limited to vegetation, water bodies, and biodiversity, while Biophilic Cities pursue multiple ways of using nature. In addition to traditional elements, these natural elements also include the stars, oceans, geology, hydrology, climate, and even moss, lichens, and soil microorganisms in the city. For example, New York City has launched park camping activities to provide families with opportunities to camp in city parks and make full use of natural resources in parks through the "Weekend Adventure Plan". In addition, Biophilic design promotes a deeper understanding of nature from surface to interior, from a single visual connection in traditional concepts to multi-sensory experiences of natural environments in Biophilic design. This means that the interaction between humans and nature is deepened and the potential of limited

resources is expanded.

Table 2-2 The difference between a biophilic city and green, sustainable cities (Source: Drawn by the author)

	Differences			Similarities
	Inner essence	Scope of the study	Design objects	
Biophilic City	Creating an environment conducive to human survival and development, with an emphasis on the positive impact of nature on the human being	Enables the non-material functions and benefits of nature to be explored and revealed, giving a fuller and more three-dimensional image of nature in human society	The pursuit of a multifaceted use of nature, also focuses on multi-sensory design, allowing nature to permeate all aspects of life	Using the power of nature to transform cities for a better future
Green City	Through low disturbance methods, the focus is on energy use efficiency, pollution reduction, biodiversity conservation, etc.	The focus is on the optimal use of natural material resources and the low impact design, with the use of narrowly defined natural elements.	Focusing on the rational use of natural resources, reducing the environmental impact of buildings, and also considering ways to improve air and water quality.	
Sustainable City	Not only should natural resources be used sparingly, but also through the coordinated development of economic and social aspects to achieve a multifaceted sustainable		The focus is on the harmonious development of the three dimensions - environmental, economic and social - and more integrated strategies are needed, such as urban planning, energy use, etc.	

Through the above comparison and analysis, it can be found that from a natural perspective, the design goals of green and sustainable cities mainly focus on low interference, that is, based on not destroying or reducing the destruction of nature, with a focus on energy efficiency, pollution reduction, biodiversity protection, and other aspects^[36]. However, biophilic design pays more attention to whether it can generate positive effects, taking urban space as a carrier but with human emotions as the main focus, seeking a harmonious coexistence between humans and nature, and producing multi-level positive effects on human physiological, psychological, and social health while restoring the natural environment, achieving a win-win situation between humans and the environment. Cities are the products of human production activities, that is, humans are the origin, so rebuilding the connection

^[36] JXie X L.Study on the Morphological Diversification Design of High-riseResidential Buildings in Cold Area from the Perspective of Pro-Nature[D].Jinan.Shandong Jianzhu University,2021.

between humans and nature is the essential measure to promote the sustainable and healthy development of cities.

2.2.3 Research on Biophilic City Design Methods

After Stephen Kellert provided a clear definition for biophilic design, he first revealed 70 characteristics that belong to six categories of biophilic architecture and created a "toolkit" that is easy to index and use. This is the precursor of biophilic design methods and the foundation of subsequent research. After years of exploration and practice, scholars have refined and reconstructed the initial 70 environmental characteristics, simplifying and clarifying the design method. Among them, there are two key node conclusions: first, in 2014, William Browning and others from the consulting company Terrapin Bright Green proposed 14 biophilic design patterns, which are a tool manual that explains the relationship between nature, humans, and architecture. These patterns are based on interdisciplinary knowledge from biology, psychology, and architecture, aimed at helping designers integrate natural elements into building and interior design, improving people's quality of life and happiness^[37].

Table 2-3 The biophilic design methods from William Browning in 2014 (Source: Compiled by the author)

Classification of design methods	Elements of design
Applying natural elements	1. Visual Connection with Nature; 2. Non-Visual Connection with Nature; 3. Non-Rhythmic Sensory Stimuli; 4. Thermal & Airflow Variability; 5. Presence of Water; 6. Dynamic & Diffuse Light; 7. Connection with Natural Systems
Simulation of natural elements	8. Biomorphic Forms & Patterns; 9. Material Connection with Nature; 10. Complexity & Order
Building the relationship	11. Prospect; 12. Refuge; 13. Mystery; 14. Risk/Peril

Then, in 2015, Stephen Kellert and Elizabeth Calabrese proposed 24 biophilic design strategies^[16], And classify them into three categories: direct experience, indirect experience, and spatial and place experience, with a greater focus on human emotions in the design, hoping that people can see and experience the main features of natural elements in urban design, not only involving buildings but also public spaces in cities.

^[37] BROWNING W, RYAN C, CLANCY J. 14 Patterns of Biophilic Design[M]. New York: Terrapin Bright Green LLC,2014.

Table 2-4 The biophilic design methods from Stephen Kellert in 2015 (Source: Compiled by the author)

Classification of design methods	Elements of design
Direct Nature Experience	1. light; 2. air; 3. water; 4. plants; 5. animals; 6. weather; 7. natural systems; 8. fire
Indirect Nature Experience	9. natural patterns; 10. natural materials; 11. natural colours; 12. simulated natural light and natural ventilation; 13. natural shapes or forms; 14. natural associations; 15. information richness; 16. the changing of time; 17. natural geometry; 18. bionics
The experience of space and place	19. foresight-refuge; 20. organised complexity; 21. integration; 22. transitional spaces; 23. mobility and wayfinding; 24. place-emotional connections

Analyzing and comparing the biophilic design patterns of Browning and Kellert can be summarized into three aspects. The first is the application of real natural elements, which mainly includes the direct use of natural elements and summarizes the urban natural elements that people can touch. The second type is the abstraction and application of natural elements, expressing ideas or emotions through abstracted natural elements. The third type is the deduction of space and place, attempting to use spatial context to shape and awaken the connection between people and nature.

In 2021, Wang and others, based on "Biophilic Cities: Integrating Nature into Urban Design and Planning" and other relevant studies, comprehensively summarized and compiled the measurement indicators for biophilic cities, including eight sub-items under 22 sub-items with rich natural experience, imitation of nature, and protection of broad nature.

Through the analysis of biophilic design methods and patterns, it can be found that biophilic design has entered the field of urban design, but the specific design elements and methods are still in the exploration stage. Based on previous research and Chinese urban issues, this study proposes a collection of design elements for biophilic city design. As shown in the fig 2-7, design elements can first be divided into two themes for biophilic design: natural and human perspectives. The natural perspective elements can be divided into three directions of infrastructure, architecture, and equity, and further subdivided into sixteen subcategories. The use of infrastructure is an important aspect on the urban scale, including the deep excavation and use of existing natural elements such as land, vegetation, and water in the city. Architecture focuses on the use of biophilic design techniques to transform or design buildings with more natural attributes. The cultivation of equity includes the use of small

doses of nature in the city, such as increasing the coverage of parks and green spaces.

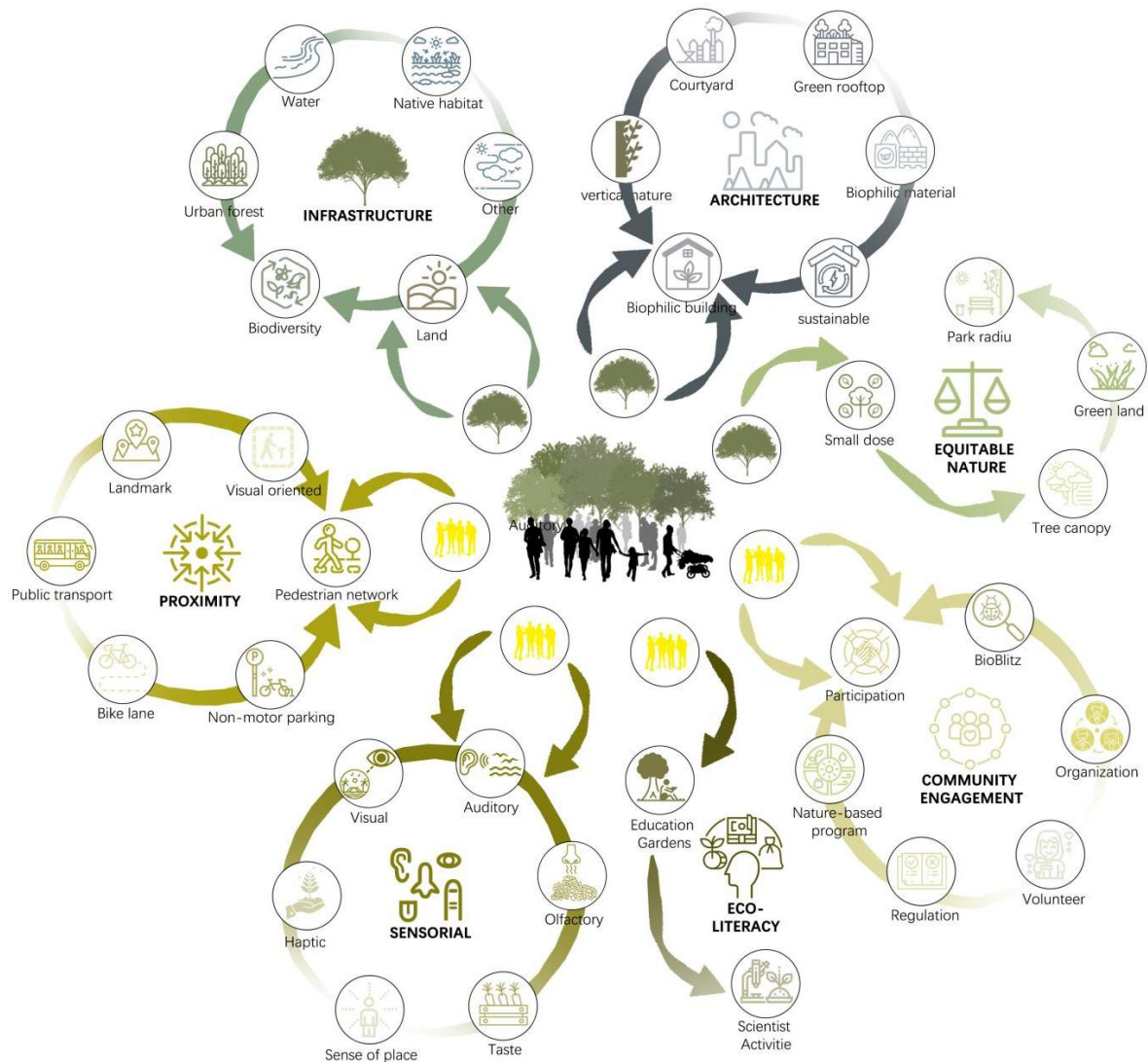


Fig 2-7 Collection of elements of biophilic urban design

The human perspective includes four aspects: perception design, proximity, cultivation of literacy, and organizational management. These are further divided into twenty sub-items. Perception design involves stimulating the five senses and creating a sense of place, evoking people's sensory experiences. Proximity is achieved through optimizing the design of various modes of transportation, expanding the service range of personal natural spaces, and benefiting more citizens. The cultivation of literacy focuses on the creation of various educational spaces, stimulating people's learning spirit towards nature. Organizational management is based on the community, enhancing the cohesion of the community through a series of organizations and activities, and achieving sustainable development. As the focus is on people, the design elements in this part are mainly concentrated at the community scale.

Table 2-5 Collection of nature elements of biophilic urban design

Category	Element	Strategy example	Scale	
Beginng in Nature	Land	Trails and greenways	Renewal of existing streets with pro-natural design for inappropriate scale, make-up landscapes and haphazardly planned streets	city-community
		natural areas protected	Establishing peri-urban or intra-urban reserves according to the concentration of species	city
		Parks	To meet people's enjoyment needs, design a varied topography with diverse plants, this highly diverse landscape also tends to create biodiversity	city-community
		Community gardens	Firstly, focus on the cultivation of native plants; secondly, respect life and plan the garden to be a suitable site for microorganisms, plants and animals to live; thirdly, eliminate pesticides.	community-neighborhood
		Vacant land	Use different types of remaining space to arrange heterogeneous landscapes and diverse natural environments; implement differentiated maintenance strategies and management measures by site type and current problems	city-community-neighborhood
		The (half) wild land in an urban area	Firstly, the site should be evaluated for biodiversity and assessed for retention value; secondly, the site should be developed with low impact to allow interaction between man and nature	city-community-neighborhood
		brownfields	Firstly, the soil should be modified according to the current conditions; secondly, biological habitat spaces should be actively created, using plant communities to provide habitats for local microorganisms and wildlife	city
	Urban forest	trees	To count and protect existing trees in the city, and to provide more activity areas in tree rich areas to enhance pro-nature interaction	city-community-neighborhood
		Street tree species diversity	Staggered distribution of street trees according to street scale and functional needs to maximise the use of street tree resources and create more interesting green street spaces	city-community
		Multilayer plant community	One is to survey the local flora; the other is to design multi-layered flora to avoid homogenous green spaces that destroy urban biomes and better meet multiple experiences	city-community-neighborhood
	Native habitat	native habitat	Survey native species and their movements to establish in situ reserves or create suitable habitats	city
		wetland	Include all wetlands within the city limits; integrate wetlands with other ecosystems; and manage different wetlands in a hierarchical manner	city-community
	Biodi- versity	Pollinator nest boxes	Consideration should be given to the provision of appropriate amounts of vegetation, water, safe access, avoidance of other insects and animals in nesting boxes and, most importantly, reduction in the use of chemicals	community-neighborhood
		Wildlife passage	Active use of space, such as rooftop curbs, to plant special plants, as well as to improve the crowded and cluttered urban built environment and create a suitable living environment.	city-community-neighborhood
		native species	Establish nature reserves, including urban parks, wildlife sanctuaries, etc. Provide better habitat and breeding conditions for native species through increased greenery, construction of landscaped lakes and wetlands, etc.	city-community-neighborhood
	Water	Stream restoration & daylighting	Restoration of the river to its natural state, restoration of riparian vegetation, increase of vegetation cover; establishment of sewage treatment systems, establishment of sewage treatment plants, rainwater collection systems,	city-community

Table 2-5 Collection of nature elements of biophilic urban design (Continue)

Category		Element	Strategy example	Scale
Beginng in Nature	Water	Diversified water allocation	Need to take full account of the natural, historical and economic character of the waterfront; increase green vegetation; increase diversity of activities and facilities; increase diversity of transport facilities	city-community-neighborhood
		Nature-based stormwater mitigation projects	Direct rainwater into collection ponds or underground cisterns through drainage outlets on surfaces such as roofs, roads and squares; use natural filtration methods such as turf, reeds, gravel etc.	city-community-neighborhood
	Other	Sky	Use the colours and shapes of the sky to increase the aesthetic and visual impact of public spaces; design public spaces suitable for use at night, such as stargazing observatories and night markets.	city
		Climate	Rain, snow and wind can all bring different experiences and activities to public spaces, and design solutions are developed accordingly to enhance the suitability and diversity of public spaces.	city-community-neighborhood
	Equit- able nature	park radius	Increasing the number and distribution of urban parks can make parks easily accessible to more people, thus enhancing the service radius of parks	community-neighborhood
		Small doses close to nature	From green infrastructure, green travel, architectural design, vertical greening and nature reserves and other aspects of comprehensive consideration.	city-community-neighborhood
		Green land rate	The e use of roof space in the community to establish green areas, such as roof gardens, roof gardens, etc.; Encourage community residents to greening, such as planting flowers and trees in homes and communities.	city-community-neighborhood
		tree canopy coverage	Planting more trees, especially large trees, can increase the canopy coverage of the site. Set reasonable green belts in the site, such as street trees, road green belts, etc., to beautify the environment and purify the air.	city-community
	Archi- ecture	green rooftops, green walls, vertical nature	Plantable: a wide range of plants such as lawns, shrubs and flowers; water harvesting greenery: a water harvesting system is set up on the roof of the building to collect rainwater and use it for plant irrigation.	neighborhood
		Bionic strategy	Structural design: bird's nest structure applied to building design; Form design: shark's texture applied to building skin design; Environmental control: building ventilation designed using the ventilation method of ants.	neighborhood
		Biophilic building material	Selection of natural materials: e.g. wood, bamboo, loess, etc.; emphasis on natural features to create a distinctive fabric; materials can be treated in a way that preserves the appearance and texture by painting, firing, etc.	neighborhood
		courtyard	Focusing on the use of natural elements, choosing suitable plants, considering topographical features, creating a comfortable resting space and appropriate lighting design to create a courtyard environment full of nature.	neighborhood

Table 2-6 Collection of Humanity elements of biophilic urban design

Category		Indicator	Strategy example	Scale
Beginning in Human	Proximity	Public transport	Improve the comfort and convenience of public transport; Increase the number, frequency and coverage of public transport lines; Policies that encourage people to use public transport could also be adopted	city-community
		Fully covered pedestrian network	Carry out comprehensive planning to determine the coverage and routing of pedestrian networks and develop sustainable solutions	city-community -neighborhood
		Accessible and dedicated bike lanes	Existing roads need to be improved and updated; New work is needed in areas lacking barrier-free and dedicated cycle lanes; Ecological isolation zones are set up between the bike lane and the road to guide bicycles and cars to drive separately while enhancing the biophilia of the route	city-community -neighborhood
		Non-motor vehicle parking facilities	Choose green Spaces, parks and other places to build non-motor vehicle parking facilities, which can be coordinated with the surrounding environment; Choose materials that can be recycled or have good durability to reduce consumption	city-community -neighborhood
		Landmarks in space	Various media means shall be used to publicize the green image and construction results of the landmark area, so as to let more people know the biophilic image of this area.	city-community
		Visual oriented information design	Design with sustainable materials; The design should pay attention to the concise information, avoid excessive text and complex graphics, to ensure that the information is easy to understand and digest, so that people can better access and understand the information; Combined with data visualization, enhance the readability and comprehensibility of information	city-community -neighborhood
	Sensorial Design	Visual scene design	The use of high and low, linear construction, perspective and other techniques to enhance the sense of space and depth of the landscape. Enhance the visual effect of the landscape by creating different layers of space, such as using vegetation or buildings of different heights to create a sense of hierarchy.	community-neighborhood
		Auditory scene design	The design of green space should take into account the surrounding natural sounds, such as birdsong, wind and running water, etc. The auditory effect of green space can be enhanced by adding water features such as fountains, fountains or streams.	community-neighborhood
		Olfactory scene design	The vegetation in the green space has different aromas, which can be enhanced by choosing fragrant plants. Some aromatherapy devices can be set up in the green space, such as aromatherapy stone or aromatherapy spray, which can make the smell of the green space more gentle and pleasant.	community-neighborhood
		Haptic scene design	Tactile elements can be added to green Spaces, such as wooden climbing facilities, artificial rocks or rope Bridges. The ground materials can be selected with comfortable texture, such as artificial lawn, wood chips, sand or stones to increase the tactile layer of green space.	community-neighborhood

Table 2-6 Collection of Humanity elements of biophilic urban design (Continue)

Category	Indicator	Strategy example	Scale
Beginning in Human	Sensorial Design	Taste scene design In green space, plants suitable for eating, such as trees, vegetables, herbs, etc., as well as plants that do not contain toxic or harmful substances, organic fertilizer should be applied and scientific management should be carried out to enhance the edible applicability of green space plants.	community-neighborhood
		Sense of place Geographical location, natural landscape, history and culture can be highlighted to enhance the Sense of place; The design and layout of the place can be used to create a specific atmosphere, such as quiet, relaxed, cheerful or vibrant.	community-neighborhood
	Communi- Engage- ment	Community BioBlitz Natural parks, forests, beaches and other sites with rich biological diversity can be selected. A lot of volunteers and experts are needed; Develop detailed activity plan and task allocation; Finally, share and display the results.	community-neighborhood
		Community participation Organize nature experience activities to let community members experience the beauty and wonder of nature; Transforming community open Spaces into green parks, gardens, farms, etc., provides places for community members to interact with nature.	community-neighborhood
		nature-based programs Urban agriculture projects within cities, such as urban farms, community gardens and urban agricultural markets on public Spaces and roofs of buildings to provide healthy food and increase urban vegetation. Create natural playgrounds and outdoor fitness facilities, such as urban parks and forest walks, to promote physical and mental health, also increase urban vegetation and wildlife habitat.	community-neighborhood
		Volunteers for nature-based activities Publicize nature-based activities through community publicity channels such as social media, community bulletin boards, community radio, etc., and recruit volunteers to participate in the activities.	community-neighborhood
		regulations that promote biophilia Understand existing regulations and policies, master relevant laws and administrative procedures, and provide reference and support for the formulation of new regulations that promote biophilia; The content of the provisions should take into full consideration the needs of natural environment protection and sustainable urban development, as well as reasonable consideration of the feasibility and effect of implementation.	community-neighborhood
		Natural organizations and clubs Establish contacts and cooperation with other relevant organizations and institutions, such as local nature reserves, zoos, museums, etc., to jointly develop activities and projects to increase the visibility and influence of nature organizations and clubs. Innovate the form and content of activities to attract more people to participate in them. Such as nature photography and wilderness expeditions.	community-neighborhood
		Biophile test project Bird observation: By setting bird feeders and water sources to attract birds to forage, bird observation activities are organized to let residents know about the species and habits of local birds and increase their knowledge and interest in nature. Ecological gardens: Establish ecological gardens within the community to plant a variety of native plants and herbs to attract butterflies, bees and other insects to collect honey and pollinate, increasing the stability and diversity of the ecosystem.	community-neighborhood

Table 2-6 Collection of Humanity elements of biophilic urban design (Continue)

Category		Indicator	Strategy example	Scale
Beginng in Human	Eco- literacy	Campus Nature Education Gardens	Add more green plants and natural elements to the campus, such as gardens, ponds, woods and meadows; Increase nature learning Spaces such as outdoor classrooms, nature walks and wildlife observation areas; Wildlife habitats and food sources, such as plant communities and bird nests, will be added to the campus to provide more vivid teaching materials for nature education.	city-community
		Community Scientist Activities	Create a communication space for the community, such as open LABS, shared working Spaces and community learning centers, to promote education, learning and communication; Attractive signs and billboards can be placed around the site to encourage the public to participate in the activities and research of community scientists, while a variety of interactive and participatory projects and activities can be set up within the site to attract more community residents to participate.	city-community

2.3 Case Studies

In 2013, the Pro-Nature Urban Network was officially established, and partner cities that joined have made significant efforts over the years to jointly plan and design cities, incorporating pro-nature as a fundamental element for citizens' health and well-being within their unique and diverse environments and cultures.

In the UK, Birmingham and Edinburgh are exploring joint investments in health and nature strategies by protecting green and blue infrastructure throughout the entire city, and have also developed the Future Parks plan, which aims to create innovative and sustainable solutions for managing and funding parks and open spaces, with a specific goal of ensuring that parks contribute to the physical and mental well-being of the public. Austin, Texas has prioritized creating a healthy city by implementing the Imagine Austin comprehensive plan, which provides spaces for easy walking, cycling, playing, and healthcare.

In Canada, Edmonton's WinterCity Strategy aims to reduce social isolation during the winter by developing projects and infrastructure that facilitate outdoor activities for residents. In Milwaukee, Wisconsin, the HOME GR/OWN program is reusing urban spaces for urban agriculture, parks, orchards, and green spaces to improve residents' quality of life and provide local healthy food. Pro-Nature Urban cities are using urban development plans to strengthen the connection between people and nature.

In China, Chengdu plans to build an ecological green belt along the inner ring expressway, which extends 500 meters on either side of the expressway. This is one of the most eye-catching ecological projects in the city and a major element of the city's planning vision. Chengdu has also invested in building a new pedestrian and bicycle network, with the ultimate goal of creating an 800km pedestrian and cycling path^[38].

This chapter analyzed typical and reference-worthy solutions from pro-nature urban development projects around the world. These cities have different economic and cultural backgrounds, but their common goal is to become richer, more vibrant, and more natural 21st-century cities through pro-nature urban development.

2.3.1 SAN FRANCISCO, CALIFORNIA

As the cultural, commercial, and financial center of Northern California, San Francisco is also surrounded by natural beauty. The city is located at the top of a peninsula, with the Pacific Ocean to the west and the San Francisco Bay to the east. Nearby parks include the Point Reyes National Seashore and the Golden Gate National Park. However, the use of the natural environment is limited in most of the city's hilly, dense, and highly urbanized communities. The city government recognizes the need to ensure that San Franciscans have more opportunities to connect with nature at the community level to ensure the health and well-being of citizens and the city's sustainable development. It has built a pioneering city of nature through programs such as the Urban Forest Plan, the Green Connections Network, the transformation of sidewalks into parks, and the Better Streets for San Francisco plan to increase opportunities for contact with nature within the city.

2.3.1.1 Citywide-Green Connections

Green Connections aims to increase access to parks, open spaces, and the waterfront by envisioning a network of "green connectors". Over the next 20 years, urban streets will be gradually upgraded to be more healthy, sustainable, and livable through pedestrian and bicycle infrastructure, sidewalk trees and other landscape beautification, stormwater management and beautification opportunities, public art, and community stewardship.

The creation of green connections is intended to improve access to parks and open spaces

^[38] Beatley T. Handbook of Biophilic City Planning & Design[M]. Island Press.2016

through a network of walking and biking routes, with the goals of promoting public health, sustainability, and livability.

San Francisco's compact, dense urban environment provides an excellent opportunity to connect people with parks, as almost all households live within a quarter to half mile range of a park, recreation facility, or open space - a 10-15 minute walk or a few minutes bike ride away. Enabling people to conveniently access parks using active modes of transportation - walking, biking, skating, rollerblading, or other sports-related activities - can maximize the public health benefits, encourage people to be more physically active, and allow them to visit more frequently.



Fig 2-8 Masterplan of Green Connections

Source: <https://sfplanning.org/project/green-connections#timeline>

The purpose of constructing these networks primarily involves three aspects:

- (1)Public Health: Increase active transportation to parks;
- (2)Sustainability: Enhance urban ecology;

(3)Livability: Support neighborhood stewardship and placemaking.

A successful green connection will encourage people to truly explore the city on these routes because they are comfortable, attractive, and safer. The routes in the network consider ideas generated through the community planning process, as well as projects related to open space and sustainability. The San Francisco government surveyed various factors to implement the network's construction: streets for walking and biking, parks and other destinations people will visit, streets best suited for integrating into the natural system and human environment, and existing and proposed projects. By combining these factors, a complete set of 25 green networks was planned.

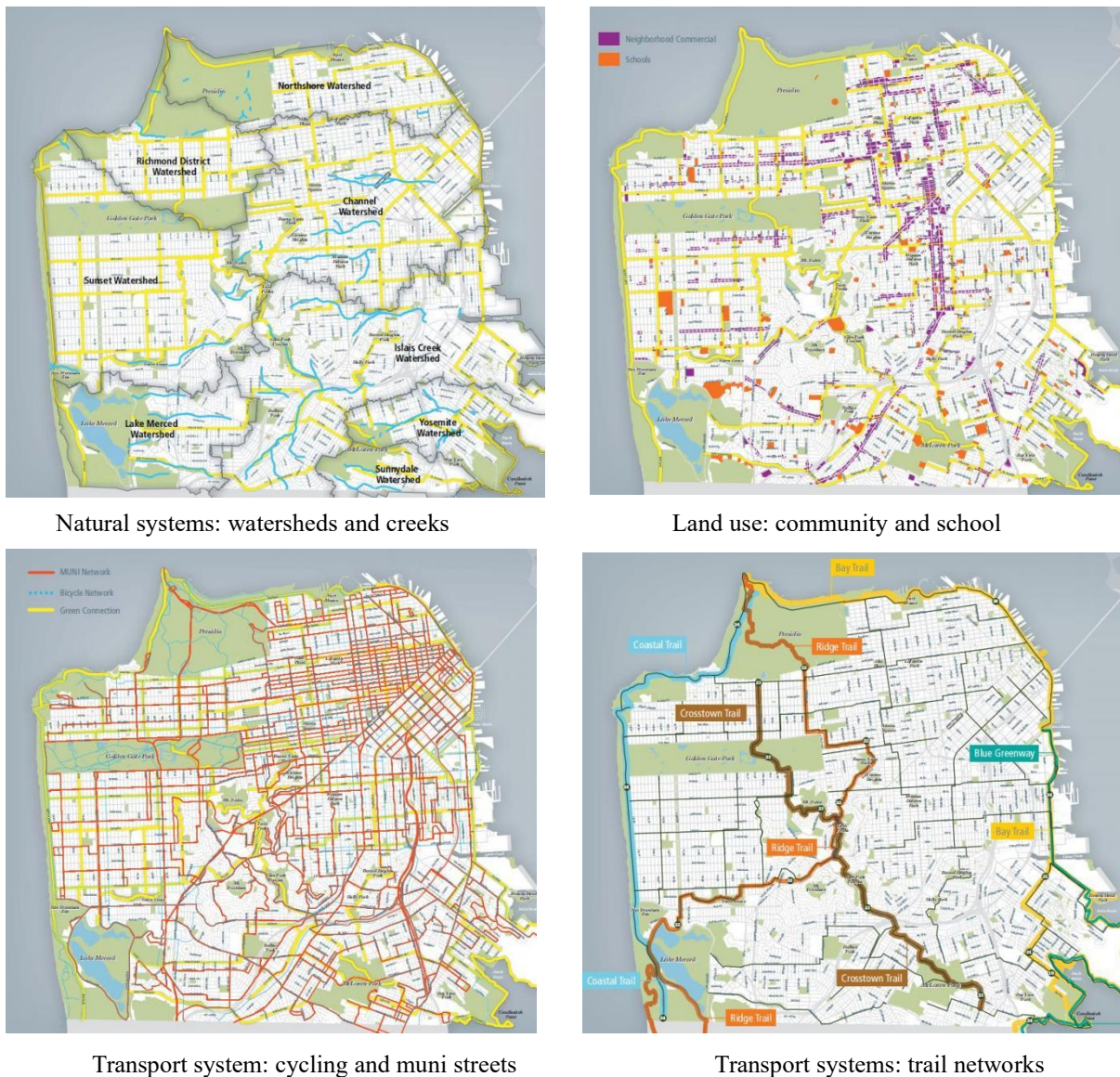


Fig 2-9 GREEN CONNECTIONS: SYNERGIES WITH CITY SYSTEMS

Source: <https://sfplanning.org/project/green-connections#timeline>

Through a series of explanations, the green connection network demonstrates how it adapts to the large urban system related to transportation, land use, and urban ecology.

2.3.1.2 Community-Better Streets

In order to create places that provide a personal and natural experience for all citizens of San Francisco, while improving the city's most basic living environment, policies have been introduced to encourage participation in the design and development of "Better Streets", also known as "Complete Streets". The Better Streets plan, introduced in December 2010, states that "the design and construction of Better Streets is aimed at balancing the needs of all users, regardless of their physical abilities or modes of transportation. Better Streets first and foremost focus on people's needs, considering pedestrians, cyclists, public transportation, street trees, stormwater management, utilities, livability, and vehicular circulation and parking." The goals of the plan include:

- (1) Re-emphasizing the public space attributes of streets;
- (2) Creating pedestrian-safe and accessible walking environments;
- (3) Tapping into the ecological potential of streets;
- (4) Encouraging sports activities and improving public health through livable streets.

The Better Streets plan has also created a set of unified standards, guidelines, and implementation strategies to guide the design, construction, and maintenance of street environments throughout the city. The aim of the plan is to balance the needs of all street users, with a particular focus on how pedestrians, as the primary users of streets, can use them as public spaces. The plan reflects an idea of the biophilic city, that is, the street environment is not just a transportation issue, it should also serve the needs of a variety of pedestrians, nature, and society.

The Better Streets project has developed design guidelines for streets, with the aim of improving San Francisco's streets, sidewalks, and streetscape elements by providing design guidance. The design guidelines include street types, streetscape elements divided by street type, sidewalk widths, sidewalk zones, streetscape layouts, etc., with the aim of connecting street space with pedestrians. Some guidelines may be required as a mandatory part, while other guidelines include suggestions and best practices for street element design for implementers to choose from.

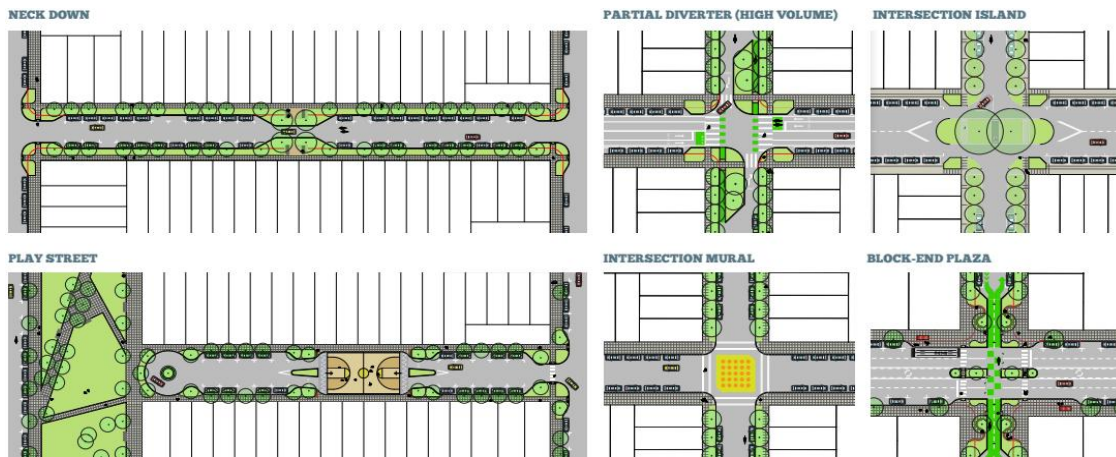


Fig 2-10 Layout of different functional street designs

Source: <https://www.sfbetterstreets.org/>

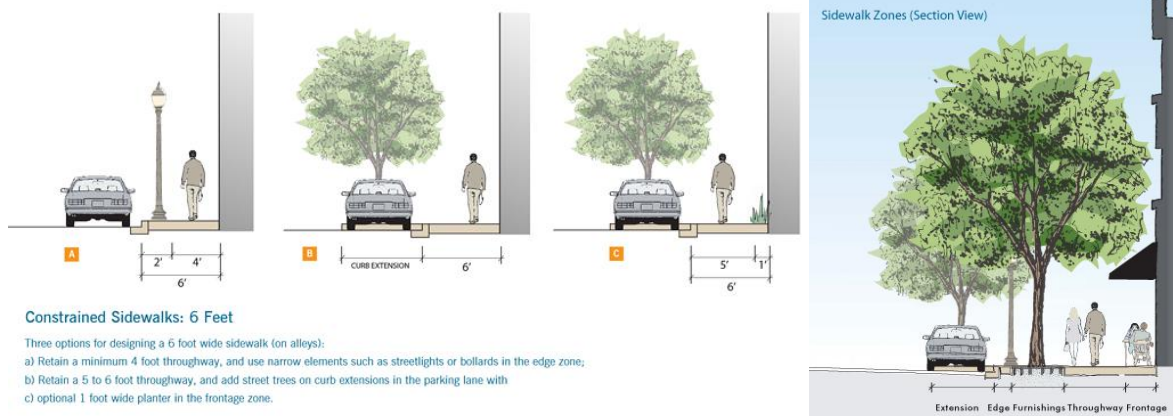


Fig 2-11 Street section guide

Source: <https://www.sfbetterstreets.org/>

2.3.1.3 Site-Miniature Parks

One important component of San Francisco's commitment to nature and innovation is the creation of small parks and green spaces in new ways, especially through the establishment of street-side gardens and the concept of mini-parks, pocket parks, and meeting spaces created by transforming two or more on-street parking spaces.

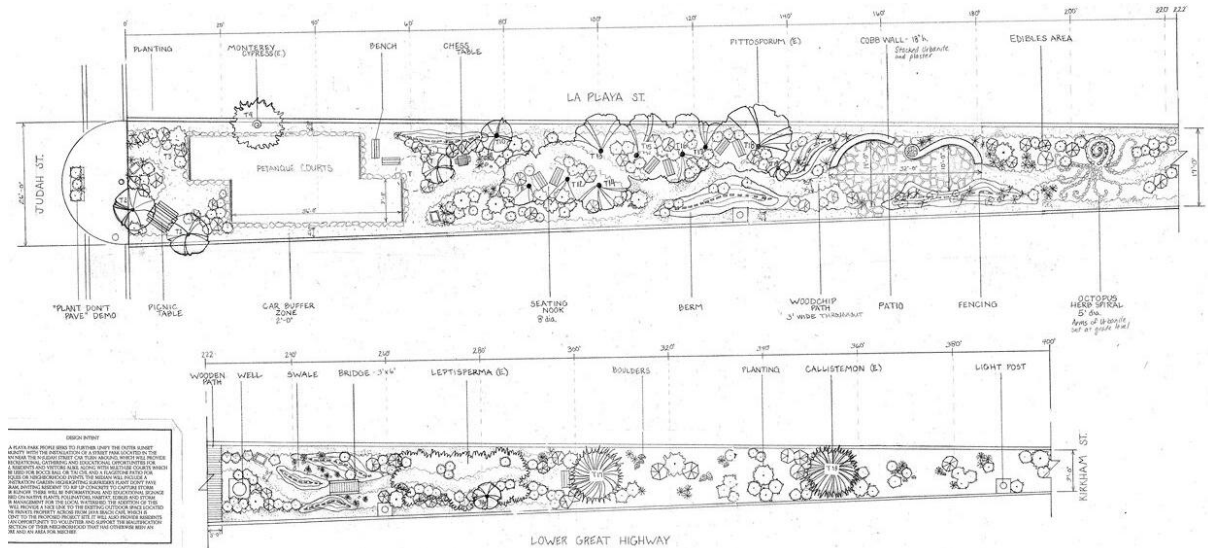


Fig 2-12 Layout of La Playa park

Source: <https://www.biophiliccities.org/street-parks>

Many of these small parks are built in underdeveloped areas of the city and blend seamlessly with the environment of the urban villages. La Playa Park, located in the Sunset District, is a typical example. La Playa Park impressively demonstrates that it is possible to build parks at a low cost in a very small and oddly-shaped urban space. The park is a long and narrow site, 168 meters in length but only 5 meters wide. This narrow strip of land, similar to a central median, has been actively transformed into a linear oasis park, partly as a refuge for native plants and partly as a space for community gatherings. The park was mainly constructed by volunteers composed of residents and sponsors, who turned the littered and neglected area into a beautiful community space.



Protecting native species



Provision of leisure space



Resident participation

Fig 2-13 Site functions

Source: <https://www.biophiliccities.org/street-parks>

2.3.2 MILWAUKEE, WISCONSIN

As an industrial city, Milwaukee has dealt with the byproducts of industrial manufacturing

and pollution, but now it is leveraging its location at the confluence of three rivers and Lake Michigan to position itself as the world's freshwater research hub. To achieve sustainable development, Milwaukee has developed a sustainability plan called ReFresh MKE, committed to prioritizing sustainable development initiatives based on people, the planet, and profits. Many non-profit organizations are also promoting green initiatives, making Milwaukee greener and bluer. Through this plan, key areas of Milwaukee, such as the inner harbor, are being revitalized based on the principles of biophilic. In addition, Milwaukee has gained considerable recognition for its innovative work in urban agriculture and community food production. However, this article believes that the most worthwhile exploration of Milwaukee is a variety of micro strategies, such as the ECO Neighborhoods Initiative, Alice's Garden, the Urban Ecology Center, the Resilience Center, and the Milwaukee Home Grown Initiative, which are natural facilities that people can easily access in their daily lives and bring Milwaukee citizens closer to nature in the city.

2.3.2.1 ECO Neighborhoods Initiative

This is a community-level biophilic construction proposal put forward by the Milwaukee government. The goal is to concentrate enough eco-friendly activities in the community to encourage neighbors to continuously practice eco-friendly behaviors and create a lasting visible impact. The most important aspect of this strategy is to emphasize public participation and the creation of public space by themselves. Therefore, the government proposed the ECO-Neighborhood Toolkit as a design guide and a catalyst for community organizers to promote collective green actions in the community. The Toolkit provides suggestions for construction in the areas of air, land, and water, and hopes that influential roles in the community can take responsibility for transforming the community.

The steps to achieve an eco-friendly community are as follows:

- (1) Form a team of at least four community members dedicated to becoming sustainable development ambassadors.
- (2) Organize participants in the community to complete three community beautification projects (including community gardens, rain gardens, tree-planting days, etc.).
- (3) Hold two information meetings and two family gatherings in the community.
- (4) Hold three sustainable development community events.

(5) Complete the requirements listed within one year.

The goal is to become a biophilic community, where people and nature can be more integrated. The city government will recognize the community as an environmental protection community, enhance the community's status in the city, and become an ideal space. The shared participation approach can promote deeper connections among neighbors and improve neighborhood relationships.



Fig 2-14 ECO-Neighborhood Toolkit

2.3.2.2 Neighborhood Green Spaces

(1) The Green Corridor

S. 6th St and its surrounding areas are a prominent transportation corridor connecting the airport and station with all other areas of the Milwaukee metro via the subway. Therefore, this highly public street would have a significant impact if it could serve as a demonstration of sustainable innovation.

This street is more like a laboratory showcasing green technologies and innovations that can improve water quality, reduce stormwater runoff, save energy, purify the air, and stimulate business and employment growth. It also aims to educate businesses and residents on best practices for green technology and encourage its application in all sectors, including public and private, commercial, industrial, and residential.

The core design elements proposed for this green corridor include a farmers' market, community gardens, solar-powered water pumps, permeable pavement, food production greenhouses, mushroom and indoor micro-vegetable production, a bioswale, worm farming, orchards, and more.

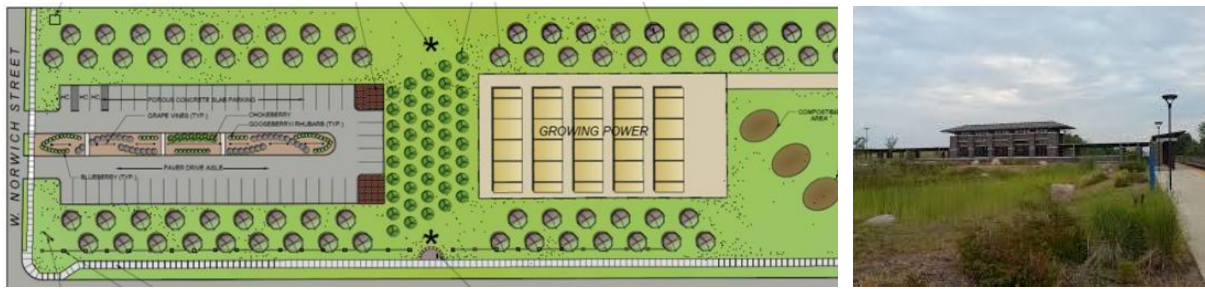


Fig 2-15 Layout of The Green Corridor

Source: <https://city.milwaukee.gov/eco/homegrownmilwaukee/Green-Corridor>

(2) PARKS & COMMUNITY GARDENS

Through collaboration with the community, ECO supports community redevelopment and improves residents' quality of life by maintaining and managing green spaces and commercial corridors. Past projects have revitalized unused land into green community spaces and assets, including pocket parks, orchards, community gardens, and urban farms with the help of community partners. ECO and its partners have developed 8 pocket parks and 14 orchards throughout the north side neighborhoods of the city through the HOME GR/OWN program. These green spaces serve as centers for community activities, access to healthy food, environmental education, and green job growth. Most of the green spaces also incorporate stormwater management features that help reduce the risk of flooding in the surrounding areas, such as rainwater harvesting, permeable paving, fruit trees, rain gardens, and native gardens. Currently, the focus is on ensuring that these locations are well-maintained and continue to serve as spaces where community care and environmental management can coexist.

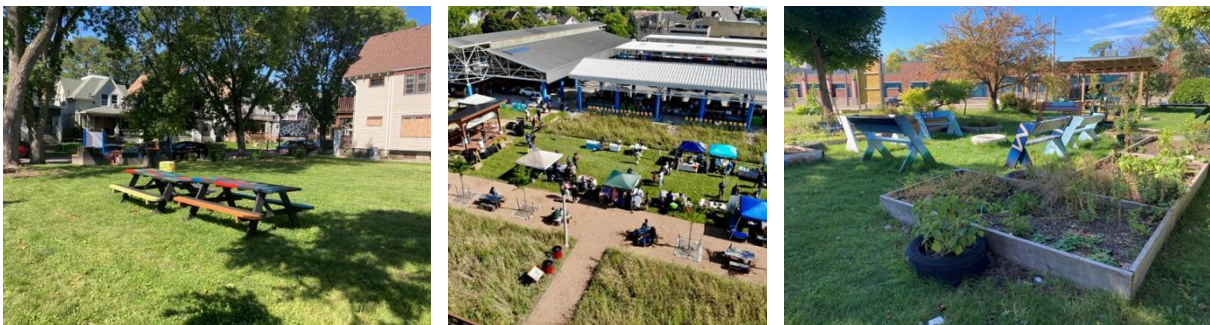


Fig 2-16 Diverse community gardens

Source: <https://city.milwaukee.gov/Neighborhood-Green-Spaces>

2.3.2.3 Outdoor Recreation Plan

This plan comes from the Milwaukee city government and aims to transform city parks through a community-based approach. The plan seeks not only to create opportunities for

children to play, but also to create spaces where neighbors can interact, exchange cultures, experience nature, and actively contribute to the community. Based on information collected from the community, the playground will have three focus areas for renovation: meeting local needs and interests by rebuilding park spaces, enhancing local gaming experiences, and increasing healthy sports activities; by involving residents in the rebuilding process, we will encourage neighborhood cooperation and promote citizen participation; by improving the appearance and functionality of park spaces, we will enhance community stability and pride.

The plan has five objectives:

- (1) Ensure that all residents of Milwaukee have access to outdoor recreational facilities.
- (2) Collaborate with the community to improve and plan local outdoor recreational spaces.
- (3) Fairly allocate resources and prioritize initiatives.
- (4) Improve the efficiency and sustainability of park rebuilding and maintenance.
- (5) Expand and diversify funding sources, including city resources and private funds.

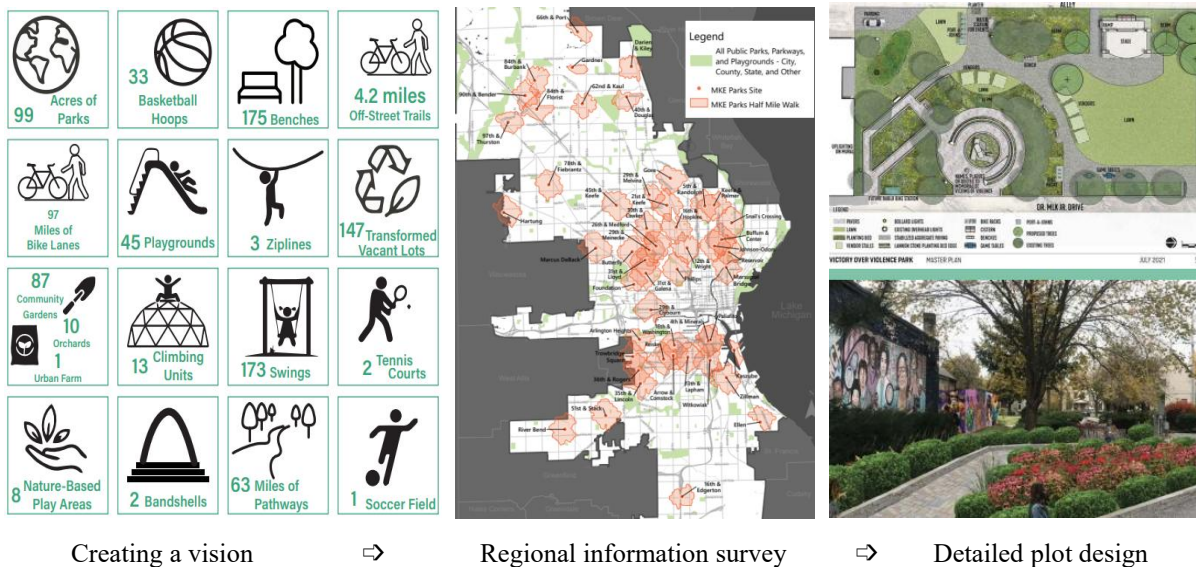


Fig 2-17 Outdoor plan design procedure

Source: ComprehensiveOutdoorRecreationPlan2022-2027-FINAL

2.3.2.4 the Urban Ecology Center

In Milwaukee, the Urban Ecology Center is another unique organization that plays a key role in restoring the Menomonee River. It is a hands-on learning center with a focus on educating about urban environment and ecology.

In fact, Milwaukee has not just one, but three Urban Ecology Centers. The third center opened

in September 2012 along the Menomonee River. The center was once a small tavern and was transformed into an office space for the ecology center by adding green elements. The center includes not only this building, but also a 9.7-hectare restored abandoned railroad yard near the Menomonee River. This site will be gradually restored and transformed into an outdoor classroom with new pedestrian and bike bridges and new community gardens.

In fact, Milwaukee is leading the country in creatively engaging children and adults in learning and practicing about nature and science. These ecology centers engage in impressive work, most of which is a place for family activities, from monitoring butterfly larvae to building bluebird houses, to adult education and interest groups such as the Urban Ecology Photography Club, urban astronomy enthusiasts, and morning bird-watching walkers. These ecology centers also host many school visit activities and are highly integrated into their neighborhoods, and have strong partnerships with nearby schools^[38].



Fig 2-18 Multiple community and educational activities

Source: <https://urbanecologycenter.org/what-we-do/what-we-do.html>

2.3.3 Summary

Through the analysis of the two cases above, it can be concluded that the most important aspect of creating a biophilic city.

San Francisco planned its biophilic network from large to small scale, including the city, community, and site dimensions. At the city level, the entire city's greenway was reorganized, with updates to poorly designed greenways and the planning of new valuable greenways. This allowed people to access nature directly from the city and connect various network centers within the city, forming the biophilic backbone of the city. At the community level, San Francisco proposed the concept of better streets and applied it to the renovation of main streets in the community, creating more biophilic public spaces and allowing people

to enjoy urban spaces and natural resources more fairly. At the site scale, San Francisco constructed a variety of community parks, renovated them according to community needs, and encouraged community residents to participate in the renovation process, enabling people to enjoy nature at their doorstep.

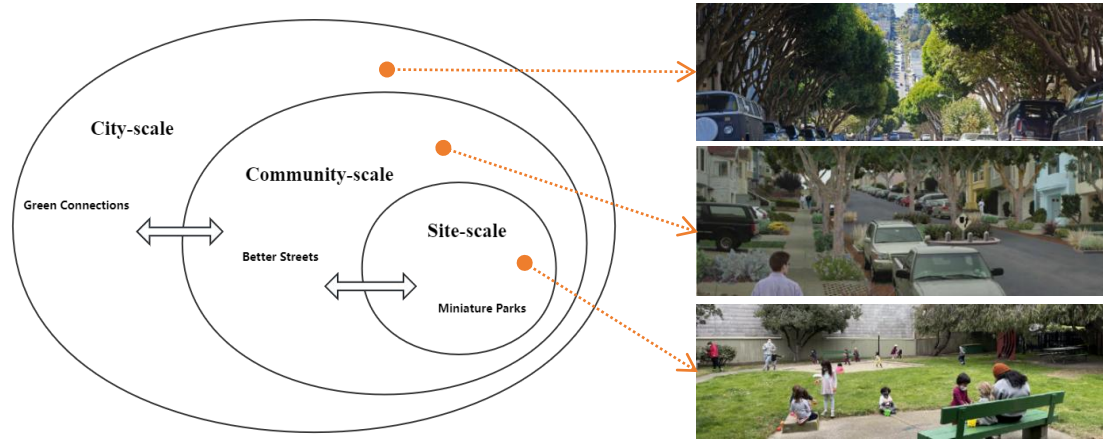


Fig 2-19 biophilic network construction structure in San Francisco

Milwaukee's focus was on the use of multiple methods to create a biophilic city beyond the level of urban planning and construction. From guidebooks to green space updates to educational activities, people can experience nature through multiple senses and perspectives, thus creating a more sustainable future for the city. It can be learned from this that more diversified designs should be done at the micro scale, rather than simply placing green spaces. It is necessary to build a biophilic environment from multiple dimensions and angles.

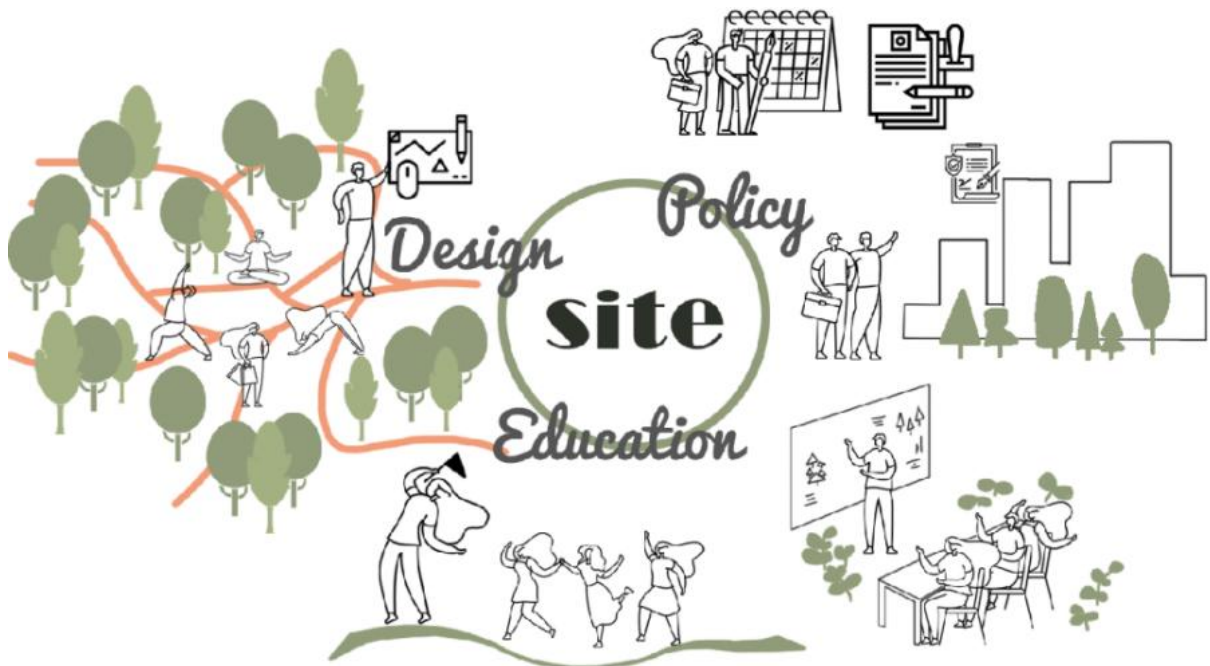


Fig 2-20 Milwaukee applied various level strategies to the site

Therefore, through the study and analysis of the two cases, it can be learned that in subsequent designs, attention should be paid to scaling, and appropriate strategies should be proposed at different scales. Only by starting from the overall to the specific can a truly biophilic community that is integrated into the city network be built. At the same time, various methods should be considered in the application of biophilic elements to enrich the forms of interaction between people and nature, and to re-establish the connection between daily life and nature, making up for the missing natural elements in the city and allowing the city to become a unified entity that is organically integrated with nature.

Chapter 3 From Biophilic Urbanism to Urban Village Renewal

This chapter, based on the in-depth study of theory, cases, and practical experience in the previous two chapters, conducts a study on the compatibility between the theory of Biophilic Urbanism and the goal of urban village renewal. By discussing the current status of urban village construction in China and exploring the solutions provided by Biophilic Urbanism to these issues, we attempt to find specific directions for the renewal of urban villages under the guidance of Biophilic Urbanism. The aim is to provide feasible strategies for the subsequent renewal and transformation of urban villages by creating a biophilic environment and providing suitable methods for the sustainable development of urban villages.

3.1 Towards more natural & livable urban village

Based on the previous discussion of urban villages and the concept of biophilic urbanism, a complementary relationship between them can be identified.

Firstly, biophilic urbanism is a concept that aims to integrate the city with nature. In order to build a complete natural network and achieve sustainability, all people in the city should be considered, regardless of their land use. In the context of China, urban villages are an unavoidable topic if we want to realize the vision of biophilic urbanism. Without updating and renovating urban villages, the goal of biophilic urbanism cannot be truly achieved, which is to provide people in the city with opportunities to interact with nature and enhance their quality of life.

Secondly, the current mainstream goal of urban village space renovation is to preserve positive factors, eliminate unreasonable factors, and gradually solve social problems through space design. The external impact of urbanization and the response of urban villages themselves will result in many contradictions, which can be alleviated through biophilic urbanism to achieve effective updates of urban villages. Therefore, the benefits of combining the two are significant and require further exploration.

3.2 Existing Issues of Urban Villages

Based on on-site investigations, the most pressing and urgent issues facing urban villages can be summarized. This article categorizes the issues into three types based on the experience from the San Francisco case.

3.2.1 Urban Level Issues

Disconnected from the urban natural environment, becoming ecological breakpoint

As urbanization continues to accelerate, people's pursuit of quality of life is also increasing. A series of naturalization construction projects have been launched in public spaces in the city, including wetlands and parks, forming the basic framework of the urban ecological network. At the same time, developers have also built many high-quality residential and commercial centers that focus on shaping a green and natural environment in the surrounding areas of urban villages. However, due to the lack of effective transformation measures and widespread social prejudices, the natural ecological environment construction within the urban villages is insufficient, and their development cannot keep up with the pace of urban naturalization. As a result, they are becoming increasingly separated from the urban environment, becoming a breakpoint in the city's ecology.

Split from the urban fabric, with uncertain development prospects

In addition to natural elements, the public spaces and road systems, which serve as the carriers for people's activities in nature, are the backbone network of the urban fabric. Currently, cities are constructing unimpeded road and public space systems to achieve better urban development. However, due to the excessive construction in urban villages, these two types of spaces are continuously compressed within the urban villages and cannot accommodate the mobility of citizens, resulting in a barrier to the flow of people between the urban village and the outside, exacerbating the division between the urban village and the city. This division phenomenon creates a sense of alienation towards urban villages and indirectly leads to increasing urban gentrification, ultimately seriously affecting the development process of the urban village. This has brought about significant negative impacts on the sustainable development of urban villages, and is one of the reasons why many urban villages have been

completely demolished.

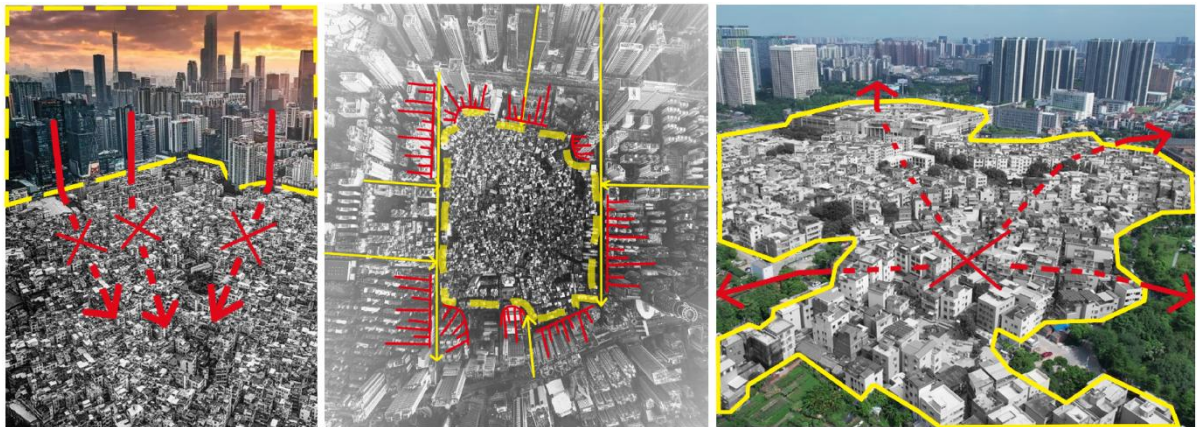


Fig 3-1 Context of the urban village

3.2.2 Community Level Issues

Lack of ecological environment, absence of public space

Although urban villages generally have good ecological genes, such as ancient trees or wells, due to poor management and underutilization, the ecological environment within the urban villages is poor. There are almost no available green spaces, and the number of urban wildlife, such as birds and squirrels, has sharply declined, resulting in a loss of biodiversity. In addition, the lack of maintenance awareness among residents and the overly homogeneous tree species, with a lack of corresponding plant groupings, result in a single form of street space that lacks ecological beauty and fails to arouse people's curiosity about the natural world, let alone their desire to protect it. At the same time, due to a historical lack of unified planning and construction and the addition and alteration of buildings by residents, there is a severe shortage of public activity spaces within urban villages. In order to obtain higher rental income, residents continue to expand and build their own homes, directly leading to the compression of public space, and a lack of functional activity facilities such as public seats, public entertainment spaces, leisure activity squares, and public restrooms in the residential areas. This makes the residents' activity space increasingly crowded.

The community management is lax, and the public participation is low

From the case of Milwaukee, it can be seen that benign community management and participation in construction are effective guarantees for the construction of eco-friendly communities. However, due to the urban-rural dual structure of the management system, there

are differences in various policies and treatments between urban and rural areas, such as household registration system, medical facilities, ecological environment, etc. Although they are under the jurisdiction of the community committees, their management power is very limited, and most of the management systems have been in a state of autonomy. Therefore, there are often management negligence and lack of organization for eco-friendly activities within the community. In addition, the low rental prices and convenient location of urban villages have attracted people from all walks of life and various social groups, resulting in a diverse population. The overly mobile population not only brings many hidden dangers, but also makes it difficult for the public to participate in construction and management. The relatively poor environment of the urban villages, whether for newcomers or local residents, only makes people feel that they can survive, but fails to stimulate their desire to participate in building a livable living environment. This has led to the stagnation of community development.



Fig 3-2 Context of the urban village

3.2.3 Neighborhood level issues

The architectural layout is chaotic and natural spaces are narrow

The urban villages are mostly old buildings from the modern era with relatively monotonous exterior and interior designs, limited functionality, and simple spatial divisions. Due to the high density of residential buildings and the lack of standardized property management, there are many problems with the use of public areas and infrastructure construction in the streets and alleys, resulting in a dirty and chaotic environment. This not only affects the physical health of community residents but also leads to the destruction of local natural resources. In

addition, the overly dense construction of buildings has also led to the serious destruction of public spaces, which could have served as breathing spaces for the urban villages' natural elements. This leaves only a narrow living environment, which not only fails to serve the ecosystem but also fails to serve human activities.

Outdated public facilities, low sense of interaction among residents

In the construction process of urban villages, there was a certain amount of public service thinking involved, so most urban villages have some public infrastructure, such as parks, cultural centers, activity centers, etc. However, due to their age, these facilities can only provide very limited services, and they often fail to provide people with a direct experience of nature. At the same time, the limited services provided by these public facilities cannot fully mobilize people's enthusiasm during activities, so they cannot stimulate people's interactive psychology. This has led to a low enthusiasm and closeness to natural elements and public spaces among people, which indirectly leads to the tolerance of behaviors that destroy natural elements and public spaces, forming a closed loop of unsustainable development. This situation must be changed in future development.

The historical foundation is weak, residents have a low sense of identity

In the process of expanding urban villages, local culture has suffered a huge impact, and many traditional cultures and local species have gradually disappeared. The main reasons for the disappearance of the urban village's history can be attributed to two main factors: residents and the community. From the perspective of individual residents, urban villages rely on superior geographical location to obtain land compensation and rental benefits in the short term, which leads to rapid growth of material wealth in the short term. However, the quality of residents has not been effectively improved, and the pursuit of benefits has made people forget the importance of inheritance. From the perspective of the community as a whole, the urban village is the product of historical evolution, and the renovation and transformation is a dynamic process. The lack of supervision has led to a lack of protection for historical elements in the entire community, education and propaganda of people's spiritual and cultural inheritance, resulting in a chaotic overall planning of the community, a weak cultural foundation, a low level of awareness of local species among residents, and obstacles to the sustainable development of the community.



Fig 3-3 Context of the urban village

3.3 User needs and the benefits of biophilic design application

There are three main groups of users in the urban villages - the elderly, young adults, and children. For the elderly, the urban village is their main living place, carrying countless histories and memories. However, the lack of a favorable spatial environment cannot meet the daily activity needs of the elderly. For young adults, the mental pressure brought by their busy work can generate negative emotions, but the dull and monotonous daily life in the urban village cannot alleviate these negative emotions. For children, natural education and play spaces are essential in their daily lives, but the public spaces in urban villages not only lack these functions but also cannot ensure basic safety. Currently, the construction of urban villages is in full swing, and user needs are putting higher demands on the updating of the urban village environment. Biophilic urbanism has a high degree of compatibility with the deep updating goal of the urban village, as it considers the physical, psychological, cognitive, and management aspects of humans and provides theoretical guidance for the excavation and application of natural elements in urban villages. According to the division of human effects, the application benefits of biophilic design can be divided into four aspects: physical, psychological, cognitive, and management.

(1) Physiological benefits: According to actual research, one of the main purposes of residents for community public spaces is to maintain physical health through exercise and other means. Although there are slight differences in the needs of public space functions among different age groups, they all show a longing for nature and expect to have more spaces that are deeply

close to nature. Children love natural things and gain happiness through activities such as climbing trees and playing in water in nature, which helps them exercise and promote growth and development. Young and middle-aged people hope to relieve the fatigue after work and study by getting close to nature, while the elderly can maintain their health by walking and relaxing in a natural environment. Contact with nature can effectively relieve fatigue and the "nature deficit disorder" that exists in modern people. Applying the concept of biophilic design to the landscape design of community parks can effectively achieve harmony between humans and nature, create a landscape environment where artificial facilities and nature are integrated, and meet the physiological health needs of users.

(2) Psychological benefits: The urbanization process has made people in cities increasingly distant from nature. The hustle and bustle of urban life can make people restless, and long-term isolation from nature can lead to sub-health problems. People are increasingly eager to enhance their health by getting in touch with nature. As the most convenient window for urban residents to contact nature, community public spaces occupy an important position in urban green public spaces. Biophilic design can effectively reduce people's tension and anxiety by increasing the frequency of contact between people and nature, and alleviate mental stress. Plenty of evidence shows that interaction with nature can effectively reduce emotional fluctuations and psychological disorders, which is why many sanatoriums are established around sites that are close to nature.

(3) Cognitive function: In addition to design, the biophilic theory also emphasizes improving users' cognitive levels through participatory experiences. In the design of spatial and place experiences in community public spaces, most lack attention to site culture and education, which makes it difficult for users to develop emotional attachment to the site and the education of local landscapes, native plants, and distinctive cultures, especially for children. Biophilic design can be tailored to the needs of different groups of people, which can satisfy their various curiosities and desires for contact with nature. This is conducive to tapping into the learning potential of all age groups and enhancing people's sense of participation in community life and their understanding of the site.

(4) Management function: The organization and management of urban villages has always been a difficult problem to solve, mainly due to low participation and low emotions among

people. The biophilic design concept creates spaces where people and nature can harmoniously coexist and organizes a variety of public participation activities. After effectively improving residents' physical and mental health, people can feel the benefits of community life, enhance their enthusiasm for participating in community management, and play an important role in achieving the development goal of "harmonious and livable" urban villages.

3.4 Principles of Biophilic Urban Village Design

This article summarized the theory of biophilic cities and proposed five principles for biophilic city design in the previous chapter. However, for the special environment of urban villages, more targeted biophilic design principles need to be proposed. This requires comprehensive consideration of user needs and the current situation of urban villages, combined with the principles of biophilic city design, in order to guide subsequent design strategies.

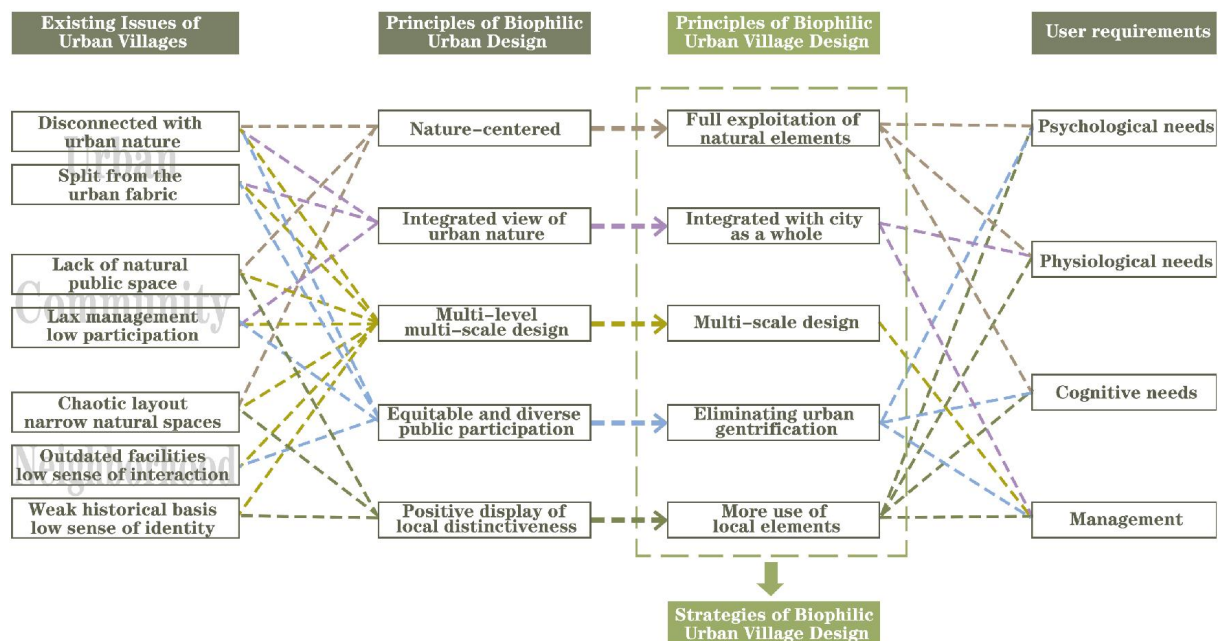


Fig 3-4 Principles of Biophilic Urban Village Design Generation Process

Full exploitation of natural elements

The principle of nature-centered construction, when viewed from the perspective of urban villages, can be refined as an in-depth exploration and utilization of both internal and external natural elements. The application of this principle can meet the physiological, psychological,

and cognitive needs of people, and provide solutions to the three-scale related issues in urban villages. Therefore, in the subsequent design strategies, the use of this principle needs to be reflected in the strategy of each scale.

Integrated with city as a whole

The principle of holistic view of nature mainly refers to the integration of urban villages with the entire city in guiding their renewal. This can meet the physiological needs of people and is conducive to the internal management of urban villages, mainly addressing the issues of the two scales of the city and the community. Therefore, when updating urban villages at the scales of the city and the community, it is necessary to pay attention to the integration with various elements of the city.

Multi-scale design

As can be seen from the graph, the multi-scale design principle can solve almost all the existing problems in urban villages from various dimensions, and is the most important one among the five principles. It plays a decisive role in guiding the design strategy to follow. Therefore, the subsequent design strategy should take the multi-scale design as the starting point to guide the design.

Eliminating urban gentrification

The fair and diverse public participation is more important in urban villages as it can resolve urban gentrification, achieve equal distribution of resources, and meet the diverse needs of people. It is also an effective way to solve problems in urban villages at different scales, such as urban division and lack of public space. Therefore, in the subsequent design strategies, the application of this principle should be considered in the design strategy of each scale.

More use of local elements

Regionality is reflected in urban villages as various forgotten local elements. Therefore, the principle that needs to be followed in urban village design is to make full use of these local elements as much as possible, and the problems to be solved mainly focus on the perspective of the community and neighborhoods. Therefore, in the subsequent strategies, this principle needs to be reasonably utilized at both the meso and micro scales.

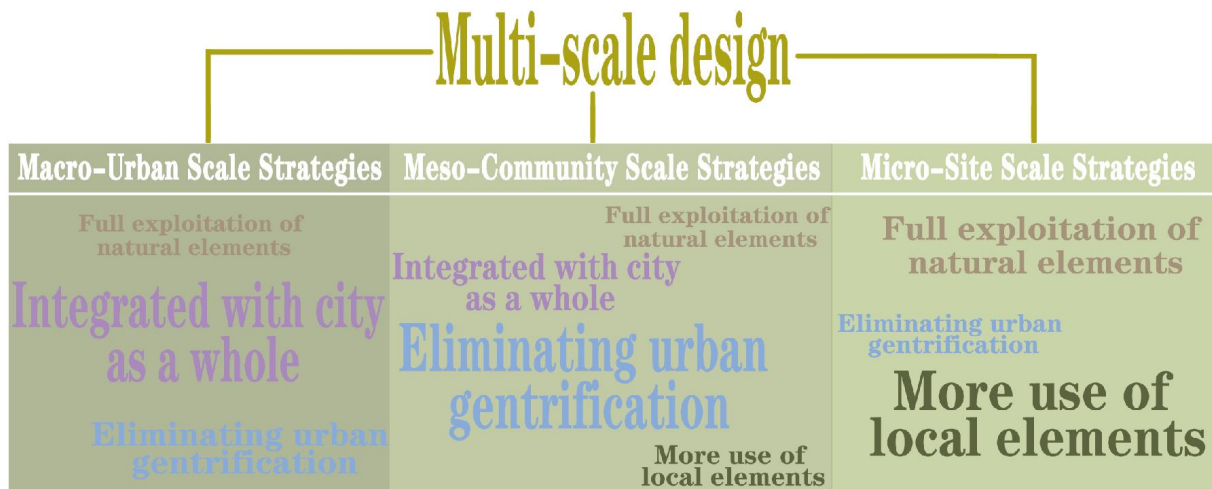


Fig 3-5 The principles of design focus at each scale

3.5 The urban village renewal system based on biophilic urbanism

Combining the above-mentioned theories of biophilic design and research on urban village renewal, it can be seen that the biophilic design approach is a comprehensive and complex system that encompasses many elements. Different types of urban village spaces have their own unique problems and user needs, so the application of biophilic design principles should focus on different aspects. Additionally, the appropriate scale for biophilic design principles in urban village renewal varies, and therefore, this study has developed a specific step-by-step approach for biophilic design in specific urban village spaces. This approach uses user needs, existing problems, and other factors as screening criteria for biophilic design principles, with natural space attributes serving as screening criteria for design element. The result is the construction of a biophilic urban village design system from the perspectives of design goals, strategies, and elements, which provides efficient and intensive strategies and methods suitable for current urban village renewal.

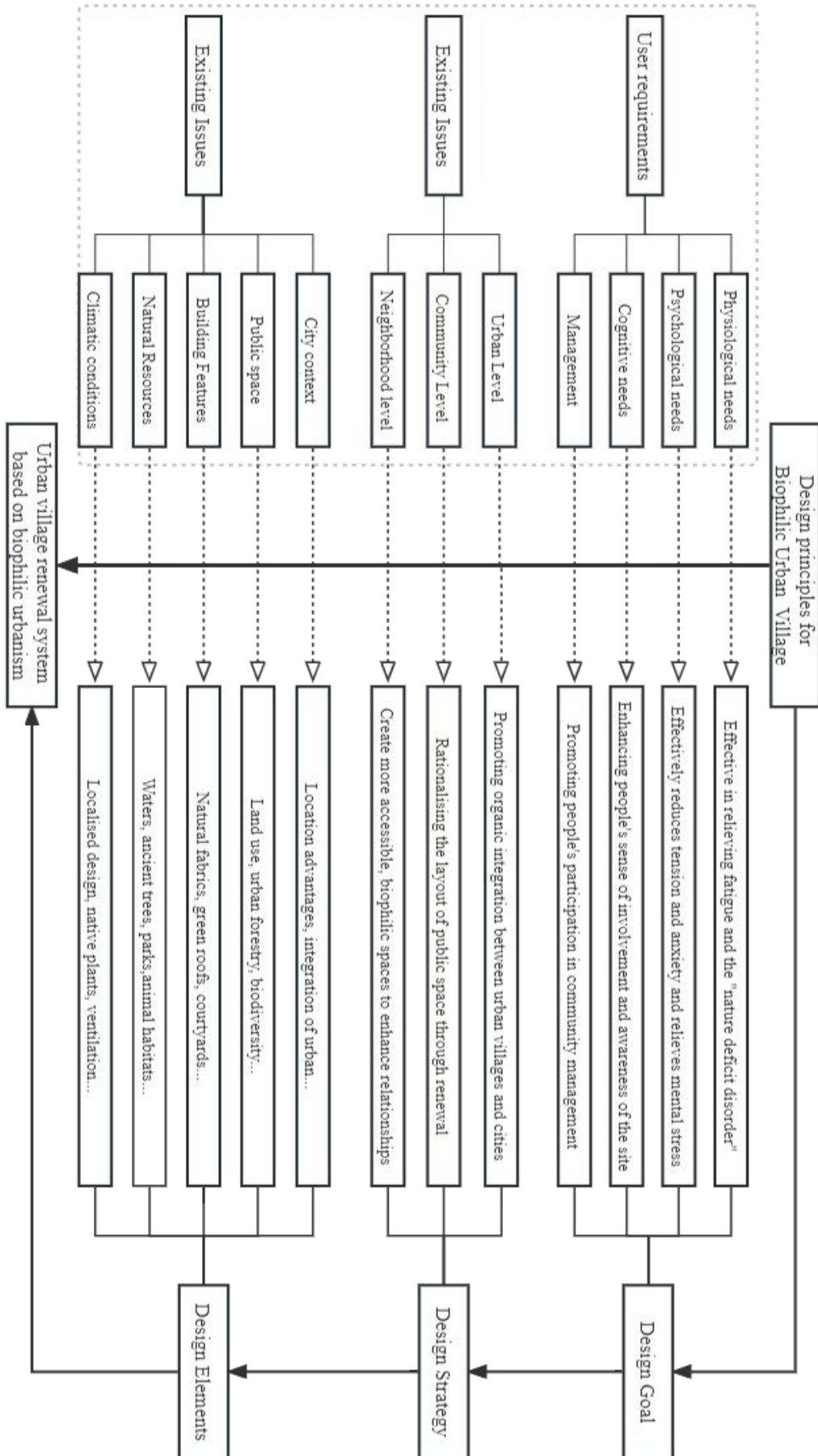


Fig 3-6 biophilic urban village design system

3.6 Summary

Through the exploration of the combination of biophilic urbanism and urban village renewal, it can be found that by localizing the design principles of biophilic urbanism, many existing problems in urban villages can be targeted and solved, and various living needs of the residents can be met, which effectively guides the renewal design of urban villages.

Applying the biophilic concept to the renewal and construction of urban villages requires target setting, strategic support, and selection of design elements. In section 2.2.3, this thesis has studied, summarized, and organized the design elements of biophilic urbanism. Next, targeted strategic research will be conducted based on the design principles of biophilic urban villages according to the design goals. Based on the research on the existing problems in urban villages, there are three major goals to be met: first, using the "biophilic" theory to connect the city and urban villages through the construction of urban natural systems, using nature as a flexible adhesive to promote organic integration between urban villages and cities; second, through renewal, the layout of public spaces in urban villages is made reasonable, the integrity of natural systems in urban villages is improved, and more suitable urban environments for living are created; finally, more accessible biophilic spaces are created to promote people's exploration of nature, enhance communication in nature, further maintain social relationships and the physical and mental health of residents in urban villages, and help with organic urban renewal.

Next, this thesis will elaborate on specific design strategies to make them more feasible and become a powerful method that can guide practical design, providing a basis for subsequent practical designs.

Chapter 4 Urban village renewal strategies guided by biophilic urbanism

In Chapter 3 of this article, the issues of urban villages and the exploration of the biophilic design system are discussed. It can be found that biophilic cities pursue rich, immersive, and multi-scaled nature, making nature easily accessible as a part of daily urban life. However, current research mostly focuses on the mesoscale content of biophilic urban nature construction, usually starting from a single intervention measure or a single location scale, and ultimately moving towards the integration and interconnection of the urban environment and surrounding areas. A comprehensive design strategy framework based on the urban scale is still lacking.

Therefore, this paper believes that for the biophilic design of urban villages, three urban spatial scales should be considered as part of the comprehensive method of biophilic planning: site, community, and city. The renewal of site scales provides opportunities for urban village residents to directly or indirectly incorporate nature into the places where they spend most of their time living and working. The community scale provides urban village residents with opportunities for more diverse interactions with nature within their daily time and space range. From a larger perspective, the design means of the city scale not only provide a broader and connected ecological experience and system for humans and non-humans in urban villages, but also serve as a medium for urban villages to integrate into the city. Therefore, for planners, only by integrating the pro-nature concept into the renewal of urban villages at different scales can there be more opportunities to achieve these benefits.

In this chapter, corresponding design strategies are proposed based on the principles mentioned earlier, and research is conducted based on multiple goals for planning purposes, steps, design points, planning vision, and life vision, to complete the biophilic urban village renewal. This is done to construct a panoramic framework for biophilic urban village community construction, shaping urban villages into livable, business-friendly, and happy urban communities where humans and nature harmoniously coexist.

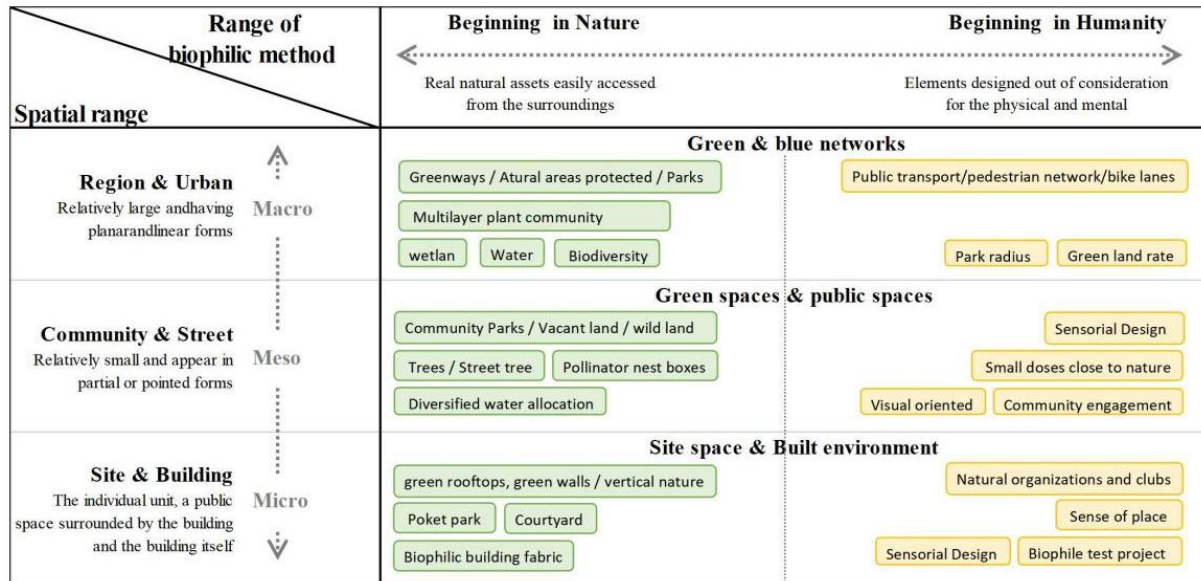


Fig 4-1 Biophilic Urban Village Design Framework

4.1 Macro-Urban Scale Strategies for Urban Village Renewal

4.1.1 Biophilic-Oriented Urban Village Planning Framework

Based on the design principles of the Biophilic Urban Village proposed in Chapter 3, this paper is guided by the theory of biophilic City and proposes a six-step planning framework for urban-scale urban villages renewal: 1- Summarize the current problems of urban villages as described in Chapter 2, and set corresponding renewal goals based on actual research findings; 2- Collect data and conduct qualitative analysis of the basic conditions of the urban village; 3- Identify and classify the elements of the urban space that meet the research scale, including the urban village and the surrounding urban environment within a radius of at least 1km, based on biophilic principles; 4-Overlay the different elements systematically, identify their characteristics, and classify them based on the relationship between human and natural activities; 5- Analyze the spatial relationships between the urban village and the surrounding environment, and select the most suitable spatial combination for connecting the urban village to the urban biophilic network; 6- Organize the design points, carry out detailed design, and propose planning visions and lifestyle aspirations.

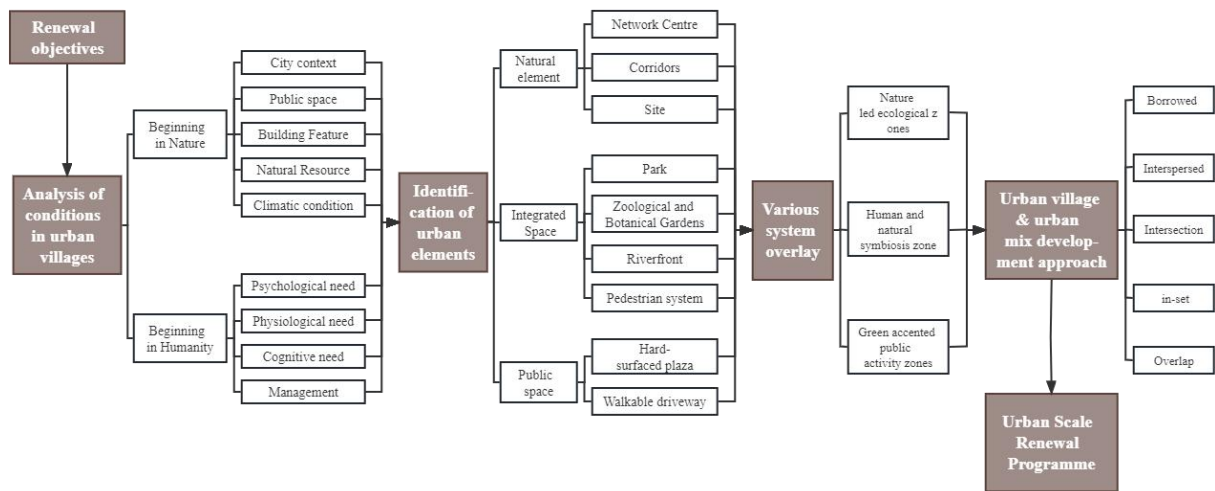


Fig 4-2 Biophilic-oriented urban village planning framework in Urban Scale

4.1.2 Renewal Objectives

The natural systems at the urban scale provide a structure and background for promoting the integration of nature into building and community design. Supporting thriving local biodiversity requires an interconnected system of core protected areas and movement corridors throughout the urban landscape^[39]. An exemplary case is the city of Singapore. After becoming known as the "Garden City," Singapore continued to expand and connect its green elements and introduced a new aspiration of a "City in Nature." A key component of Singapore's urban-scale infrastructure is the park connector network, which is a system of over 300 kilometers of paths and trails^[40]. This network provides opportunities for accessing nature at any time for major government housing projects and population centers while connecting small and large parks throughout the city.

The aim of building a biophilic urban village is to connect the urban village with the natural areas, parks, and other open spaces within the city, using nature as a flexible adhesive to stitch the barriers between the urban village and the city, promoting sustainable development of the urban village, to integrate urban villages into urban planning and surrounding environment. Based on this, building a biophilic urban village at the urban scale requires being established on the city's green network.

^[39] MAGLE S B., FIDINO M, LEHRER E W., et al. Advancing urban wildlife research through a multi-city collaboration[J]. Frontiers in ecology and the environment, 2019, 17(4): 232-239.

^[40] Hu J S, Dai F. The Model of Urban-level Greenways: The Park Connector of Singapore[C]. Proceedings of the International Urban Planning Academic Committee of China Urban Planning Society and the Editorial Board of International Urban Planning Journal 2010 Annual Conference. 2010:227-231.

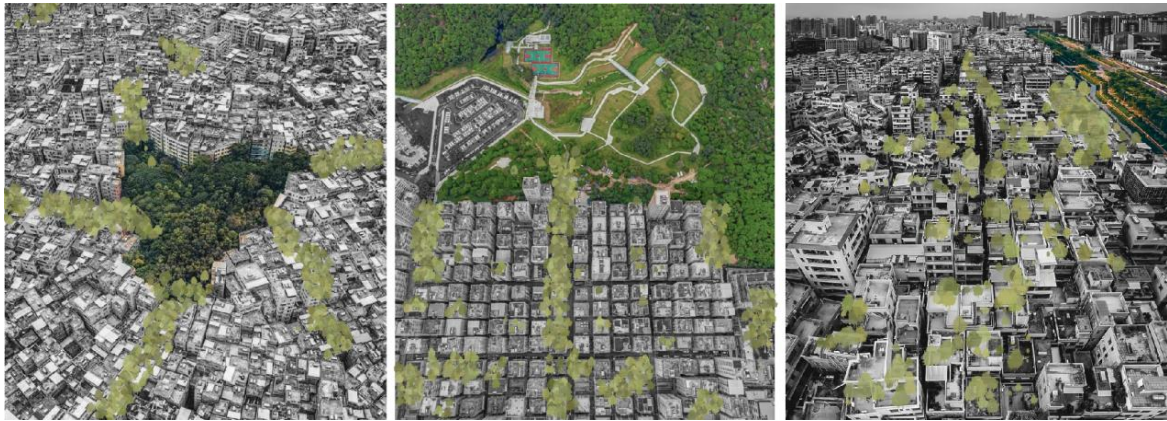


Fig 4-3 Renewed vision of objectives

4.1.3 Context analysis

Firstly, an analysis of the basic conditions related to urban villages and urban scale is conducted: the main disadvantages are: 1) fragmentation from the urban environment, leading to the formation of invisible barriers around the city; 2) disconnection from the city's public space system; 3) having certain elements of natural systems but disconnected from the city's natural network; 4) the tendency for urban construction areas to become gentrified, making it difficult for villagers to access fair urban resources; 5) poor internal accessibility, making it difficult to integrate and develop with the city; 6) detachment from urban planning and unclear management measures. As pointed out in Chapter 3, the most important design principle for the urban scale is "Integrated with the city as a whole," followed by "Eliminating urban gentrification." These principles are undoubtedly the solutions to the above-mentioned disadvantages.

Table4-1 Context analysis related to urban scale

Context		Strengths	Weaknesses
Beginning in Nature	City context	Highly connectable in the heart of the city	Split from the urban environment, with invisible barriers forming around it
	Public space	——	The disconnection between its own public space and that of the city
	Building Feature	——	——
	Natural Resource	——	Self-natural systems are disconnected from the urban natural network
	Climatic condition	Place to dissipate the urban heat island effect	——

Context		Strengths	Weaknesses
Beginning in Humanity	Psychological need	——	Urban gentrification and inequitable access to urban resources
	Physiological need	Rich system of walking networks	Poor accessibility makes it difficult to integrate urban development
	Cognitive need	——	——
	Management	——	Straying from the edge of urban planning and difficult to integrate into urban management systems

4.1.4 Element identification

Facilitating the interconnection between urban villages and the city, media plays a crucial role, and effective identification of media can establish closer connections. There are three main types of urban elements that can serve as media: natural elements, public spaces, and integrated spaces.

4.1.4.1 Identification of urban natural elements

At a macro scale, the natural elements of a city mainly refer to its green infrastructure. Li defined urban green infrastructure as a network of interconnected natural areas and open spaces within the city, which have ecological functions and value, providing natural habitats, clean water sources, migration corridors, and other natural places for both humans and wildlife^[41]. This allows us to infer the types of natural elements within a city. In order to facilitate identification and application, the natural elements at the urban scale are classified and identified according to their form, mainly categorized into three types: network centers, corridors, and sites. To identify these elements, it is necessary to include their type, location, and land-use scope.

Natural network centers refer to large, continuous areas of high ecological value within a city that are important natural areas for biota^[42]. They are generally in the form of flat areas and have the potential to connect with other network centers. Most large network centers in urban areas refer to mountain lakes, wetlands, large parks, botanical gardens, and other nature reserves. The criteria for identifying these centers include: 1) sensitive populations of plants

^[41] Li K R. Green infrastructure: Concept, Theory and practice[J]. Chinese Landscape Architecture, 2009, 25(10):88-90.

^[42] Gong C. THE STUDY OF URBAN PUBLIC OPEN SPACE SYSTEM PLANNING BASED ON THE GREEN INFRASTRUCTURE[D]. Jiangsu: Southeast University, 2018.

and animals in the area; 2) large, continuous inland forests; 3) undeveloped wetlands and rivers, including coastal wetlands and forests; 4) protected areas by public or private organizations^[43].

Corridors refer to strip-like areas that connect network centers in order to maintain the migration of animals and plants between them. Corridors are strip-shaped in plan view. Urban-scale corridors mostly refer to natural or artificial green belts, linear protective forests, waterways, linear eco-parks. The ecological benefits that corridors can produce vary depending on their width, functional type, composition, and connectivity. Urban-scale corridors need relatively independent habitat systems to meet the migration needs of small animals and birds.

Sites are the green spaces of network centers in a city and are places where animals and plants temporarily reside during migration. They are relatively small in plan view compared to network centers, and are generally divided into two types^[42]. One type has the same important ecological status and service function as network centers and corridors, providing important biological habitats and recreational places for residents. The other type, although it also provides ecological services, is separated from other natural elements of the city and has not yet entered the urban network. Examples include independent parks, wetlands, and green spaces.



Fig 4-4 Different dimensions of urban natural elements (Source:Internet)

4.1.4.2 Identification of Urban Public Space Elements

Urban public space is an important component of urban design, providing not only leisure and recreational opportunities for urban residents but also serving as an integral aspect of urban life. At the urban scale, public space typically has a service radius of 1000 meters, reachable

^[43] Maryland Department of Nature Resources, Learn Why Green Print Lands are Important [EB/OL]. <http://www.greenprint.maryland.gov/documents/VhygreenprintlandsAreImportant.pdf>.

by a 15-minute walk, and served by multiple public transportation options. Urban public space includes urban parks, plazas, public service facilities, a range of public open spaces, important historical and cultural districts, and large-scale natural resource-adjacent public space. Therefore, the identification of urban-scale public space elements is of significant importance.

Existing research indicates that urban-scale public space elements can be classified into three types: surface-shaped, consisting of large squares, parks, and groups of public spaces; line-shaped, consisting of urban trails, bike paths, and other linear public spaces; and point-shaped, which are relatively small public space clusters in comparison to surface-shaped public spaces^[42]. Surface-shaped urban public space is the primary location for urban resident activities and a crucial aspect of urban life. Point-shaped urban public space is distributed throughout the city, varying in size and form, but with limited service range. Urban line-shaped public space connects various point and surface-shaped public spaces, forming the arterial system of the city.

Therefore, urban public space identification requires two aspects: the identification of urban public space element types and the identification of urban public space locations. Identification of urban public space element types primarily relies on the spatial form, scale, and type to identify urban-scale public space's primary elements, including points, faces, and linear shapes. Identification of urban public space locations involves recognizing different types of spatial organizations and locations on a city map to provide accurate positioning and optimal planning for urban public spaces. These identification efforts provide an important foundation for scientific management and sustainable development of public spaces both inside and outside of urban villages.



Surface-shaped



Line-shaped



Point-shaped

Fig 4-5 Different dimensions of urban public space elements (Source:Internet)

4.1.4.3 Identification of Urban integrated Elements

When examining the relationship between urban natural elements and the functional elements contained within urban public spaces, it becomes apparent that some natural elements exist solely to serve ecological processes and have a significant impact on the environment. These elements are highly ecologically sensitive and include protected areas within cities. On the other hand, some urban open spaces exist solely to serve as gathering places for citizens, providing an outdoor venue for various public activities^[42]. These spaces have strong public vitality but do not contribute to ecological processes.

However, there is another category of urban elements that belongs to both natural and functional categories. These spaces have the ability to produce both ecological and social benefits and are of moderate ecological sensitivity and public vitality. These spaces are considered the most important component of the urban natural network, such as artificial parks, natural amusement parks, and open gardens. Such spaces are known as the "integrated area" of natural and public elements. These integrated areas typically refer to various functional parks, gardens, zoos, green bicycle lanes, green pedestrian walkways, riverfront and mountain-side walkways, and bicycle lanes. They can take on the form of network centers, sites, corridors, or even point-to-face linear public spaces. For instance, in some large parks, important urban public spaces can be found internally.

Overall, these integrated areas provide essential public spaces for citizens to enjoy and interact with nature. They also help to promote the health and well-being of both the environment and the community. This type of space is the most suitable urban place with a biophilic urban space attribute, and should be the focus of subsequent design. More attention should be paid to this type of public space both inside and outside urban villages



Natural network












Corridor



Site

Fig 4-6 Different dimensions of urban integrated elements (Source:Internet)

Table 4-2 Various types of elements in urban villages

	Natural element		Integrated Space		Public space	
Network centre /surface	Natural mountains, ecological wetlands, large natural bodies of water, forests		Urban activity parks, zoological and botanical gardens, green city squares		Urban squares with low greenery	
Site/ Point	Urban ecological parks, vacant land, land in a wild state in the city		Community gardens, open gardens, urban farmland		Non-car parking areas, hardened undeveloped plots	
Corridor/ Line	Linear ecological parks, green belts greenways, rivers, protected forests		Bicycle-only streets, riverfront parks, urban trails		Non-motorised lanes, large motorised lanes	

4.1.5 Systematic overlay

The key to the macro-level planning and research of the urban village renewal with a biophilic approach lies in how to integrate and utilize the resources of the urban village and the city to establish a city network pattern based on the biophilic concept.

To achieve this goal, it is necessary to integrate and classify the various elements that have been identified, plan for their reasonable locations, and superimpose and transform their functions to create a smooth system with the surrounding spaces, connecting breakpoints and facilitating the formation of a biophilic city network. Spatial properties of the spatial function overlay can be divided into three types based on the results of element identification and the requirements of biophilic urban space: Nature-led ecological zones, Human and natural symbiosis zones, Green accented public activity zones. Based on the spatial distribution of the surrounding areat, the overlay methods for these three types of spaces are mainly as follows:

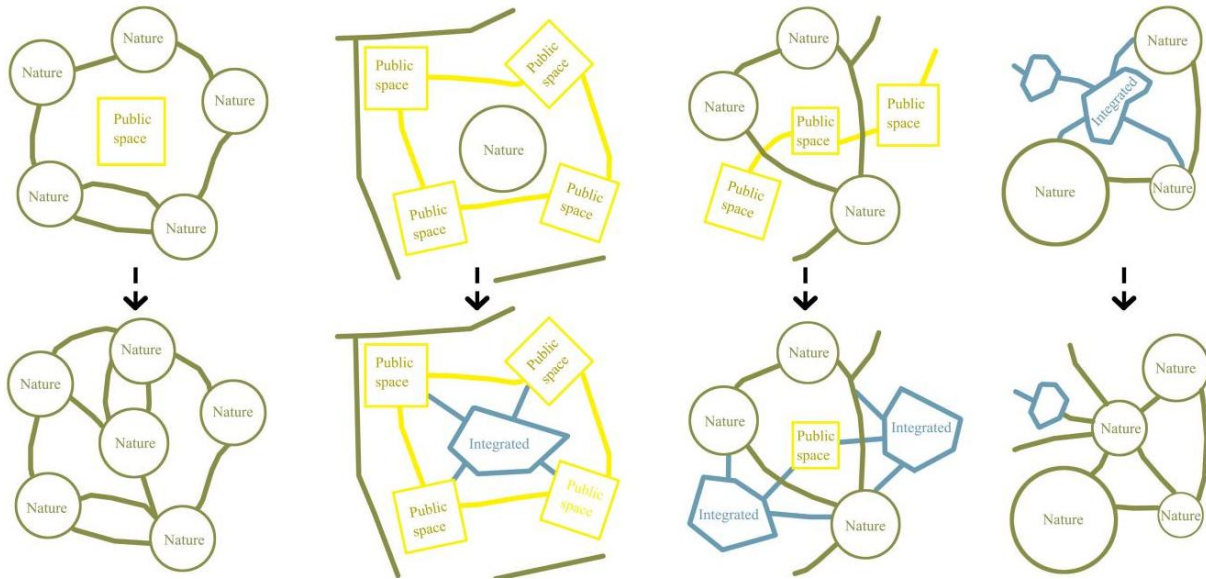


Fig 4-7 Diagram of overlapping transformation of various elements

4.1.5.1 Transformation into Nature-led ecological zones

Protecting the original ecological areas and transforming potential public spaces into natural areas

The key to constructing a biophilic network in the city is to identify and connect existing or potential natural elements and structures. The higher the connectivity of the biophilic network, the stronger the overall integrity and resilience. Protecting the original ecological areas is mainly a large-scale urban task. For urban villages, it is more important to excavate and design public spaces with potential to be transformed into natural ecological areas. Such public spaces are generally located in areas with poor geographical location, incomplete facilities, low demand for outdoor public activities, or surplus public spaces, and are located near nodes with high connectivity in the biophilic urban network. First, after identifying the public spaces in urban villages in the previous step, analyze their vitality, utilization, and the surrounding biophilic network to find public space areas with potential for transformation. Then, based on research, ecological transformation is carried out to transform them into natural ecological areas.

4.1.5.2 Transformation into Human and natural symbiosis zones

Potential public spaces and natural elements with high human activity are transformed into symbiosis zones

The most important aspect of a biophilic city is to promote the harmonious symbiosis between

humans and nature. Therefore, the symbiosis zone should be the most important and numerous area in urban planning. These spaces can provide people with places to get closer to nature while also better serving other species in the city, having both ecological and social significance. Potential public spaces refer to public spaces that lack natural elements despite being in the center of the ecological network. They need to be transformed into biophilic spaces to respond to the surrounding natural elements and connect to the urban network. Natural elements with high human activity refer to natural areas surrounded by public spaces. Although they have certain ecological functions, their connection to the urban biophilic network is weak. They can be transformed to allow human activities while preserving the overall ecological integrity. Both types of urban spaces have the potential and necessity to be transformed into symbiotic zones. Additionally, because public spaces in urban villages are small and densely populated, it is difficult to create complete ecological areas. Therefore, the symbiosis zone is the best way to turn urban villages into biophilic communities. After identifying the symbiotic zones, the combination areas that need to be transformed, potential public spaces, and natural elements with high human activity are selected. Finally, according to the biophilic network connectivity principles, the selected spaces are functionally overlaid.

4.1.5.3 Transformation into Green accented public activity zones

Transforming public spaces by incorporating natural elements

People's connection with nature is beneficial to their physical and mental health, which is why one strategy for creating a nature-friendly city is to integrate nature into people's daily lives. However, cities also require enough open space for special functions such as gatherings and shelter. Therefore, a certain amount of public space is necessary, but existing public spaces are often paved with hard surfaces, resulting in a lack of ecological performance. Moreover, many public spaces in urban villages have weak ecological functions and are not located in key positions in the urban nature network. Many of these public spaces are also incomplete in function and inadequate in size and quantity, failing to meet people's daily needs. Such public spaces are mostly parking lots, motorways, idle land, and large hard squares. To transform these spaces, some micro-scale nature-friendly design approaches need to be adopted to make them as symbiotic as possible. Therefore, after identifying the elements and analyzing the degree of utilization and the surrounding urban nature network, integrating the distribution of

such cities and listing them as areas to be transformed can improve the urban nature network in the future.

4.1.6 Urban village and urban mix development approach

After the transformation of three types of space overlay functions, the public spaces inside and outside the urban villages have basically formed a basic network. Next, in order to establish a closer connection between the internal elements of the urban villages and the urban elements, it is necessary to explore the relationship between the combination development patterns of these elements. Through the study of the relative position, scale, and mutual influence of various urban villages and the surrounding urban environment, it can be summarized that there are five main combination development patterns between the internal space of urban villages and urban space, including Borrowed, Interspersed, Intersection, Contain, and Overlap.

4.1.6.1 Borrowed

In cities with extensive natural environmental factors such as mountains and large wetlands, the ecological environment exhibits a high degree of sensitivity and therefore requires protection and restoration. In this case, the construction of urban villages should not overlap excessively with the natural environment, and efforts should be made to actively avoid such situations. Specifically, the central axis of public spaces in urban villages can either run parallel with natural structures or branch out along their periphery, using borrowed scenery to create a public space that conveys a sense of nature even from a distance. This approach not only maximizes the use of natural resources in cities but also breaks down distance barriers, providing urban villages with more opportunities to experience ecological culture. Additionally, scenic corridors can be established in remote areas, providing urban village residents with greater convenience and visual enjoyment. These scenic corridors can run along natural landscapes such as mountains, rivers, or forests, integrating the city and natural environment organically to create a unique ecological and cultural experience.

4.1.6.2 Interspersed

Based on investigations and studies, it has been observed that in some urban areas, there are urban villages situated within large scenic spots and parks. These urban villages are inherently

located in high sensitivity network centers, but some of them are situated outside of these centers, forming an "interspersed" relationship with them. For these types of urban villages, the pre-existing spatial configuration already possesses a strong affinity with nature. Therefore, in future update and renovation processes, it is crucial to leverage this advantage to reinforce the connection between internal spaces and the urban natural network center, creating a public space that coexists harmoniously with nature. However, when utilizing this development approach, it is imperative to avoid disrupting the habitats of wildlife within the scenic areas and minimize intersections with rigid biological corridors when borrowing from natural landscapes. The key is to combine with the unique landscape features of the network center, creating a spatially connected axis that enhances the internal accessibility of the urban village.

4.1.2.3 Intersection

In the design of connectivity between urban and urban village, one of the most effective and commonly used strategies is to integrate them by intersecting new public space axes with the natural urban network structure. However, this integration method may also bring some problems, one of which is the mutual interference of the intersection points. From the perspective of urban network connectivity and naturalness, if the integration-type axis intersects with the natural network, the planning of public space should try to avoid hard collisions and intersections between the two structures as much as possible. At the same time, the intersection point should not be designed too harmoniously, otherwise it will cause too much interference to natural factors. At the boundary, some isolation measures should be considered to maintain the relationship between the two structures, or the boundary site can be set as a public space with more natural elements, such as parks and gardens with higher green coverage. Such practices can not only alleviate the interference of intersection points but also improve the overall quality and sustainability of connectivity between urban and urban village. Therefore, in the design of connectivity between urban and rural areas, it is necessary to consider the urban network and natural factors comprehensively and adopt appropriate strategies to achieve good integration.

4.1.2.4 Contain

Due to the unique historical and geographical location, urban villages are located inside some

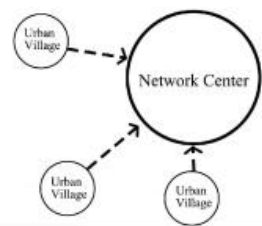

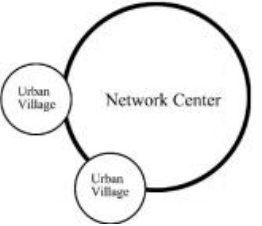

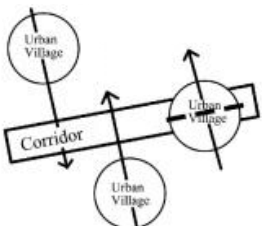

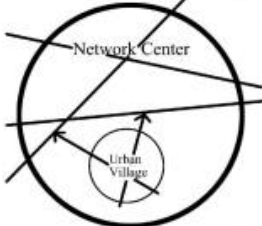

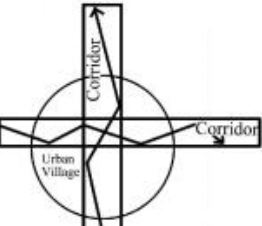

ecological network centers, and their public spaces contain abundant natural elements. Therefore, the combination of these two aspects is naturally high. In the process of renovating urban villages, it is necessary to fully utilize their green spaces and convert them into small corridors or connect them with surrounding large network centers to prevent them from becoming heterogeneous patches in natural spaces. Furthermore, in order to improve the utilization of natural landscapes and enhance the accessibility within urban villages, one or more roads, such as pedestrian and bicycle paths, should be established to connect urban villages with the ecological network center and create an ecological and humanistic corridor. However, in the construction process of urban village renovation, it is important to avoid damaging the migration corridors and habitats of wild small animals, to ensure that the ecological system in the urban network has sufficient anti-interference and ecological restoration capabilities.

4.1.2.5 Overlap

In some cities, natural elements not only provide ecological benefits but also serve as a major component of public spaces that fulfill the outdoor public needs of citizens and possess strong public vitality. In order to turn nature into a suitable factor for urban residents' life, it is necessary to create these fusion spaces. The construction of these spaces covers every corner of the city, including the spaces within urban villages. Therefore, in the process of urban village renewal, these spaces can be included in the scope of renovation and transformation, creating similar fusion areas that overlap and develop together with the natural spaces in the city, achieving integration. However, this usually requires that the public spaces within the urban village have a good ecological gene in order to better form overlapping relationships.

The structural relationships between most urban villages and surrounding cities are often complex, and there are multiple methods that can be used. To transform them, it is necessary to conduct a detailed analysis from the previous steps for different urban villages, and then determine feasible development strategies that can be implemented.

Table 4-3 Development approaches and diagrams of urban villages combined with urban elements

Approach	Diagram	Characteristic	Example
Borrowed		In cities with a large range of natural elements, whose ecological environment is highly sensitive, the construction of urban villages should not intersect too much with them, but should visually feel the scent of nature.	Chisha village 
Interspersed		These urban villages are already inside the network center, but another part is outside the network center. Therefore, this advantage can be used to create a public space that coexists in harmony with nature by combining it with the characteristic landscape points in the network center.	Shangjiao village 
Intersection		This is the most effective and common way to integrate into the urban network through intersections with the biophilic urban network structure, where plots are set up as integrated spaces with more natural elements, such as parks and gardens with high green areas.	Bujiao village 
Contain		Urban villages are located within the center of ecological networks, and their own public spaces contain many natural elements, with a high degree of integration between the two. The transformation should strengthen connectivity, improve the use of nature and enhance human affinity.	Xiaozhou village 
Overlap		The natural elements in the city not only have certain ecological benefits but also serve as the main public space structure of the city to meet the outdoor public needs of citizens, and these spaces are created to turn nature into a pleasant urban factor.	Zhejitang village 

4.1.7 Urban scale renewal elements and achievements

4.1.7.1 Urban scale renewal elements

The application of biophilic design elements is not the focus at the urban scale, as the design at this scale mainly focuses on the planning layout of large spaces. However, there are still some elements that can play a role in promoting the formation of urban biophilic networks, mainly through the application of infrastructure, proximity, and management aspects. Infrastructure can be improved by increasing the coverage of water bodies, greenways, and parks to facilitate the smooth flow of urban nature-friendly networks. Proximity can be improved by effectively planning roads, public transportation, and enhancing the connection between urban villages and surrounding cities. In terms of management, multi-dimensional support for nature-friendly cities can be achieved through the improvement of regulations and the organization of experimental projects.

4.1.7.2 Urban scale renewal achievements

After sorting out and renewing the internal and external spaces of urban villages at the urban scale, the desired vision mainly includes the following points:

(1) Becoming part of the urban-scale biophilic network system after the renewal

The most important step in implementing the concept of nature in the city scale is to create a biophilic network, to connect the urban villages with different natural elements of different scales within the city, forming a multi-type, multi-scale, and multi-functional urban natural network.

(2) Integration of urban villages into the overall control plan of the city after the update

Due to their underdevelopment and unfair allocation of resources, urban villages are difficult to be included in the control plan. After updating, the overall environment of urban villages should be greatly improved, and both public space resources and natural ecological resources should reach the average level of the city.

(3) Integration of the land use system after the update with the surrounding urban environment

In addition to connecting with the natural elements of public space in the city, the planned urban villages should also consider the integration with the surrounding city's transportation

system, urban landscape system, building and spatial system, and urban facility system.

Table 4-4 Macro-scale design elements and vision

Indicator		Planning Vision
Beginning in Nature	Greenways	1- On the premise of meeting the per capita public space area index, allocating the quantity and area of public space according to the population density and demand, and forming the primary and secondary spatial sequences and axial structures, and improving the planning of public space elements and structures.
	Natural areas protected	
	Parks	
	Vacant land	
	The (half) wild land	
	Infrastructure Native habitat	2-To achieve a balanced distribution of natural space and public space within the minimum walkable range, such as a 15-minute walkable living circle, and to develop a more targeted control plan for urban villages.
	Wetland	
	Wildlife passage	
	Stream restoration	3-Improve integration with the urban transportation system, focusing on the formation of a smooth public transportation network, as well as the integration of internal motor vehicle issues.
	Stream daylighting	
	Shoreline restoration	
Beginning in Humanity	Public transport	4 - Creation of a rich natural recreation landscape pattern and recreation routes that encompass the urban village area to increase the accessibility of natural heritage and create new ecological and cultural landscapes to realize the social and economic value of the urban village.
	Fully covered pedestrian network	
	Proximity Accessible and dedicated bike lanes	
	Non-motor vehicle parking facilities	
	Nature-based programs	5 - To provide unified planning guidance for the architecture to form a pro-nature architecture plan with urban regional characteristics and more natural interaction with people.
	management Regulations that promote biophilia	

4.2 Meso-Community Scale Strategies for Urban Village Renewal

4.2.1 Biophilic-Oriented Urban Village Planning Framework

After the macro-scale renewal are completed, the urban-scale biophilic network has been formed. The next step is to shape the biophilic network within the meso-scale. The main approach at the meso-scale is to study the service scope of public resources, and to achieve a layout that is more conducive to network formation through small-scale demolitions and new constructions. Therefore, the biophilic-oriented community-scale urban village renewal planning framework consists of six specific steps: 1- Summarize the current problems of urban villages as described in Chapter 2, and set corresponding renewal goals based on actual

research findings; 2- Collect data and conduct qualitative analysis of the basic conditions of the urban village; 3- Identify all types of public spaces in the community, draw a map of public spaces, and classify the types of community public spaces based on their biophilic functions; 4- Study the distribution characteristics of public spaces with different social functions on the map, mainly the accessibility, biophilic nature, and degree of spatial function integration within a range of 400 meters and 200 meters; 5- After block analysis, obtain the optimized planning map for the entire community, re-plan the block properties, and select the blocks to be optimized; 6- Optimize the design for the blocks, organize the design elements, and combine with the macro renewal strategy to obtain the updated master plan.

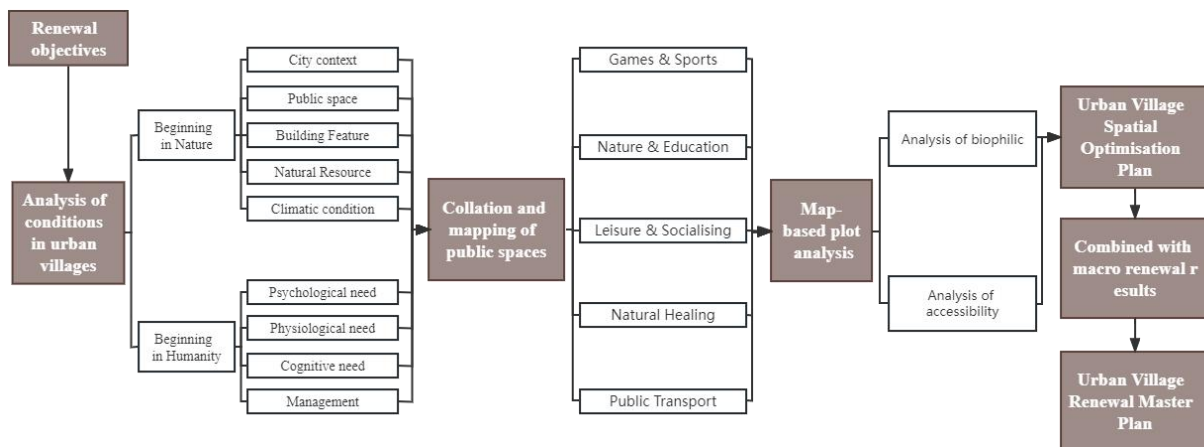


Fig 4-8 Biophilic-oriented urban village planning framework in community Scale

4.2.2 Renewal Objectives

Community is the basic unit of a city and the fundamental carrier of natural construction in a biophilic city. In terms of the nature of the relationship between community and people, a community is a human settlement area formed by residents living in the same region. It is a distinct living and cultural circle, as well as a habitat for human group living and a place of emotional belonging. The community is not only a place where urban residents directly experience life after work, but also the best place for people to establish identification and connection with nature, and to form emotional memories and attachments. Therefore, building biophilic communities in cities can provide residents with more opportunities to connect with natural elements, not only to heal, purify and sublimate their minds, but also to cultivate a more thorough understanding of nature, a deeper love for nature and a more conscious protection of nature. Over the years, Milwaukee's Environmental Collaboration Office has

implemented the HOME GR/OWN project, which repurposes vacant lots into pocket parks, community gardens, and orchards. One of the latest achievements of this project is Fondy Park, which is a vacant lot adjacent to a historic farmers' market that has been repurposed as a green community gathering space, including a wildflower meadow. The park also serves as a rainwater infrastructure, capable of collecting and retaining over 83,000 gallons of rainwater^[44].

Therefore, The aim of building a biophilic urban village at the community scale is to require strengthening the coexistence of people and nature, updating and transforming the natural elements and public spaces in the urban villages to make them more biophilic, achieving a balanced layout of resources within the community, constructing an internal biophilic network, and enhancing the resilience and sustainability of community development. This will allow urban village residents to experience a sense of closeness and return to nature in their daily lives, despite the high-density concrete jungle they live in.

4.2.3 Context analysis

According to the framework proposed in section 2.4.2 for analyzing the basic conditions related to urban villages and urban scales, the advantages and disadvantages of urban village development are obtained. Based on the natural conditions, such as public space, building attributes, natural resources, and climate conditions of the site, the advantages are: 1. the public space has a certain historical element and is highly utilized regardless of size; 2. the building layout has a strong texture and diverse forms; 3. it has a certain historical and natural element, such as rivers and ancient trees; 4. the microclimate within the community is pleasant. The disadvantages are mainly: 1. the public space has a single form, fewer in quantity, and is often occupied; 2. the building density is high and it is difficult to meet the daily outdoor activity needs of people; 3. natural elements often yield to urban development and are not used properly; 4. extreme weather such as heavy rain can easily cause waterlogging.

Based on the analysis of human needs, it is necessary to analyze the three main types of users in the site, namely the elderly, families with children, and young people. The advantages

^[44] Erik S, McCollow T. Milwaukee's Vacant Lot Strategy: Creating Biophilic Green Spaces in Underserved Neighborhoods[J]. *Biophilic Cities Journal*, 2019, 2(2): 30-31.

are:1.for the elderly: a strong sense of belonging;a developed walking network that meets the need for strolling;a historical background that gives a sense of belonging;2.for families: urban villages are places with a historical background;3.for young people: urban villages are affordable for living.The disadvantages are:1.for the elderly: too few social activity places, difficult to meet the need for making friends;lack of daily exercise venues, inadequate completeness of walking space;lack of education facilities specifically for the elderly, etc.; 2.for families: children have limited exposure to nature and social places, low security;few places for children's entertainment, nowhere to expend energy;lack of education activities and facilities makes it difficult for children to understand nature;3.for young people: lack of leisure and social places, insufficient psychological healing places;fewer places for daily activities, less space for exercise and rest;lack of understanding of the history of the urban village makes it difficult to have a sense of belonging.In addition, there are also problems with the complex internal management organization of urban villages, and the large workload of community organization that makes it difficult to play a role.

Table 4-5 Context analysis related to community scale

Context		Strengths	Weaknesses
City context		——	——
Beginning in Nature	Public space	Public spaces have certain historical elements and are highly utilized regardless of size	Public space is single in form, less in number and more seriously occupied
	Building	The building layout has a strong sense of	High building density makes it difficult to meet people's
	Feature	texture and various forms	daily outdoor activity needs
	Natural	Certain historical and natural elements, such	Natural elements often succumb to urban development
	Resource	as rivers, old trees, etc.	and are not reasonably utilized
	Climatic	The microclimate inside the community is	Heavy rainfall extremes cause flooding
	condition	more pleasant	
Beginning in Humanity	Psychological need	Elderly: Strong sense of belonging; Family: --; Youth: Affordable, suitable for living	Elderly: too few places for social activities to meet the needs of friends; Families: few places for children to meet nature and socialize, low security; Youth: not enough places for leisure and socialization
	Physiological need	Elderly: walking network is well developed to meet the demand for walking; Families: ---; Youth: ---	Elderly: lack of daily exercise sites, insufficient walking space integrity; Families: few places for children's entertainment, no place for energy consumption; Youth: few places for daily activities, little space for exercise

Cognitive need	Elderly: historical heritage;	Elderly: lack of educational places specifically for the elderly;
	Families: historical heritage;	Families: few educational activities and places, difficulties in cognition of nature;
	Youth: --	Youth: lack of understanding of the history of the urban village, and difficulties in developing a sense of belonging
Management	——	Complicated internal management organization, community organization workload, difficult to play a role

4.2.4 Collation and mapping of public spaces

The creation of natural spaces at the community scale differs from other methods of protecting land and natural resources. At this scale, the creation of natural spaces must take into account the need for places to live, work, shop, and enjoy nature, while balancing the needs of humans and the environment^[45]. Therefore, in addition to protecting biodiversity to some extent, avoiding habitat fragmentation, and maintaining and restoring ecological functions within the community, these natural spaces must also serve a variety of functions such as entertainment, sports, sightseeing, leisure, aesthetics, meditation, education, production, and social communication to serve the community. Such multifunctional natural spaces that can efficiently, fairly, and stably serve a variety of roles are the most numerous and diverse spaces in cities^[46]. Therefore, the main focus of planning such community natural spaces with multiple social service functions is on the transformation of public spaces with ecological and social functions, the layout and optimization of accessibility in areas where humans and nature coexist. After analyzing the demand for natural spaces among urban villagers and the functionality of public spaces, valuable public spaces were classified into five categories: Gaming and sports, Natural education, Leisure and Socialising, Natural healing, and Public transportation. Based on this classification, a map of public spaces was created.

Gaming and Sports: Public spaces in this category provide a variety of natural activities for people of different ages, primarily for children's games and adult exercise. These spaces

^[45] Zhang X O, Li Z H, Xiong H P. The near-nature design of community linear space based on green infrastructure construction[C]. 2013 Proceedings of China Urban Planning Annual Conference. 2013:1-13.

^[46] Gong C, Hu C J. Community public space planning based on multiple social functions of green infrastructure[J]. Chinese urban forestry, 2021, 19(1):12-18.

provide a place for people to exercise in natural surroundings, which is beneficial for physical health. These public spaces generally include playgrounds, slow walkways, bicycle lanes, walking parks, and fitness parks.



Fig 4-9 Gaming and Sports of biophilic city

Source: Internet

Natural Education: There are few public spaces for daily natural education in urban areas. The universal sharing mechanism of natural education resources meets people's spiritual and cultural needs for experiencing, perceiving, and learning about nature, improves citizens' quality of life, guides the masses to participate in nature conservation, enhances their understanding of the landscape environment, arouses awareness of respecting and loving nature, and establishes the concept of harmonious coexistence between humans and nature. Therefore, natural education spaces should also be evenly distributed within the community rather than being centered around minors. These public spaces include ecological centers, urban farms, educational centers, outdoor natural classrooms, and scenic gardens.



Fig 4-10 Natural Education spaces of biophilic city

Source: Internet

Leisure and Socialising: Leisure and communication spaces are the most common type of public space in urban areas, providing places for people to socialize and entertain. These public spaces in urban villages mainly include various community parks, riverside waterscapes, community centers, and slow streets.



Fig 4-11 Leisure and Socialising spaces of biophilic city

Source: Internet

Natural Healing: Nature has a multifaceted impact on people, and healing is one of them. It can provide physical and psychological comfort to people. These spaces are more for people who prefer quiet and provide a place for meditation or communication. By perceiving nature through sensory stimuli such as sight, touch, smell, and hearing, and being surrounded by natural elements, people can experience the healing effects of nature. These public spaces include green corridors, wetland parks, botanical gardens, and birdwatching parks.



Fig 4-12 Natural Healing spaces of biophilic city

Source: Internet

Public transportation: Public transportation and its affiliated public spaces are the main places for urban residents to interact, live and work. The development of slow transportation systems will inevitably affect the balance and accessibility of community's main natural space resources. In addition, the planning of slow transportation system emphasizes the appropriateness of road network scale, the diversion of slow transportation modes, the association with public facilities, and the humanization of landscape^[47]. Therefore, selecting public transportation spaces is conducive to studying the completeness of various types of transportation. These spaces include bus stops, subway stations, port terminals, and so on.

^[47] Qing Q, Yaun Z Z, Tian Y F. Research on planning method of slow traffic system under green traffic concept[J]. Planner, 2012, 28(S2): 5-10.



Fig 4-13 Public transportation spaces of biophilic city

Source: Internet

4.2.5 Map-based plot analysis

After organizing, drawing and classifying the public spaces in the urban villages, it is necessary to analyze each type of land parcel. Based on the principles of biophilic urban design and the spatial needs of urban village residents, in order to achieve the integrity of the biophilic network within the community, the main elements that need to be analyzed are: biophilic affinity and accessibility.

4.2.5.1 Biophilic affinity

Effective planning at multiple urban scales requires an understanding of the abundance and spatial distribution of nature within the city^[48]. After categorizing the public spaces, natural affinity evaluation indicators can be used to help assess the biological characteristics of the area. Common natural affinity city indicators include measures of species biodiversity, water quality of rivers and streams, the prevalence of artificially designed natural environments, proximity and accessibility to public pathways and open spaces, and opportunities for residents to participate in nature-based community activities. However, for the urban village environment, specific analysis is needed to select indicators that can be used to assess the natural affinity of each site.

^[48] Darren G, Corstanje R, Harris J. Linking Ecosystem Services, Urban Form and Greenspace Configuration Using Multivariate Landscape Metric Analysis[J]. *Landscape Ecology*, 2018, 33(5): 57-73.

Table 4-6 Biophilicity assessment index table

Category	Indicator	Measures
Beginning in Nature	Trails and greenways	Length and area per capita (1.6 km of trails per 1,000 people in Anchorage, Alaska)
	Parks, Community gardens, Vacant land incorporating green infrastructure practices, The (half) wild land in an urban area	Community parks per capita ownership of community parks or green spaces (Seattle's pro-biotic city goal: at least one community garden for every 2,500 residents) Number of people within 100m of a park or green space (New York's Pro-Bio City Plan: all city residents able to walk to a park or green space in 10min)
	trees	Total area, per capita (Japanese scholars suggest that 10% of land in cities should be nature reserves) Percent canopy coverage (American Forests Association recommends 40% urban forest canopy coverage, with higher levels in outer areas and lower levels in urban centers) Total number of trees
	Street tree species diversity, Multilayer plant community	Size class distribution Number of classes
	native species	Number
	Wildlife passage	Number and acres of restored connectivity
	Stream restoration, Stream daylighting	Number, distance, overall area
	Nature-based stormwater mitigation projects	Number, area
	Diversified water allocation	Number of types, total number
		Proportion of the population involved in nature activities (at least 1/4 of the population is an active participant in such activities)
	Physiological, psychological needs	Area of places where you can participate in activities Population engaged in nature restoration and conservation work or volunteering (at least 1.5% of city residents engaged in such activities)
		Proportion of city residents who engage in planting activities (44% of Vancouver residents engage in planting activities for their own consumption)
	Beginning in Humanity	
	Sensorial Design	Visual scene design, Auditory scene design, Olfactory scene design, Haptic scene design, Taste scene design Yes or No Whether the purpose was met
	Cognitive needs	To be able to see common native plant and animal species To provide a place to observe, explore, or learn about the nature around them Function as a pro-nature education class in the space around the school

4.2.5.2 Accessibility

Accessibility refers to the ease with which people can reach an area by choosing a route, and is determined by the spatial distribution of potential destinations, the ease of access to each destination, and the size, quality and characteristics of activities at the destination. The study of accessibility is essential for the efficient and equitable performance of the dual social service function of biophilic spaces. The accessibility of public spaces in biophilic cities depends on the distribution pattern of biophilic spaces in different street networks and the time taken to reach them. There have been studies on the accessibility evaluation of public services in ecological communities, and there are five basic methods of analysis: buffer analysis, proximity distance, gravitational modeling, cost-of-engagement and network analysis^[49]. As the architectural layout of urban villages is more obviously gridded with a strong sense of fabric, this section adopts the pictorial network analysis method, disregarding for the time being the purpose of travel, cost costs, land nature and population distribution, to analyse the accessibility of the public spaces in urban villages mapped out in the previous subsection. The first step is to quantify the service radius, and the data indicators in this section mainly refer to the service radius of various urban green infrastructures proposed in Jia's "Research on Green Infrastructure Planning under New Urbanisation", using the whole urban village as a scope for research^[50]. Due to the narrow space of urban villages, the internal public space area is basically below 1.2ha, so 400M and 200M can be used as the standard values for the service range of facilities, and their accessibility can be studied according to the community street texture and spatial plan shape.

Table 4-7 Service radius of various types of nature infrastructure

Community Level Public Space Rating	Surface area	Service Users	Service Radius	Service Area	1KM ×1KM range ideal quantity
Small public spaces such as street corner green spaces	<0.2ha	Neighborhood	200m	8ha	13~15
Small multifunctional public spaces	≥0.2ha	Community	400m	32ha	3~5
Community-level public spaces such as city parks	≥0.5ha	Community and City	600m	72ha	1~2

^[49] Liu C Y,Zhao Z X,Yan X Q.Analysis of the Differences in the Exploration of Community Park Users[J]. Architecture and culture, 2021(10): 48-50.

^[50] Jia K Z. Study on Green Infrastructure Planning under New-type Urbanization[D].Tianjin: Tianjin University,2014

The graphical study shows that increasing the density of facilities can improve the equity of accessibility, and that the indirect arrangement of infrastructure of different sizes can achieve an ideal layout of the site with an intensive use of resources.

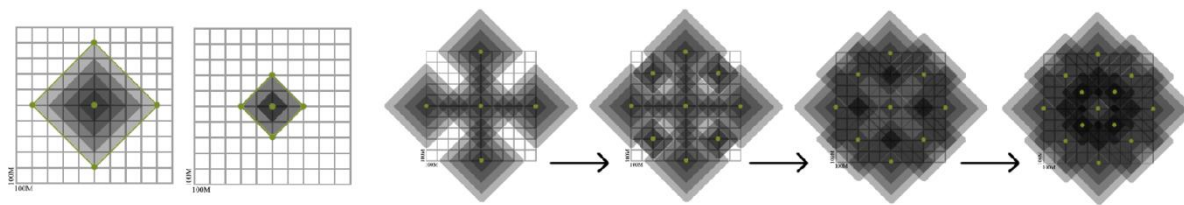


Fig 4-14 Scope of public space services and ideal layout⁴²

Thus, the specific study of the urban village should be based on these two properties, a detailed study of the site, a map of each type of public space, a study of the parcels that need to increase their biophilic and accessibility, and an optimised plan of the entire urban village.

4.2.6 Urban Village Space Optimization Planning

Through the analysis of land plots, the distribution and service of each type of land plot in urban villages can be discovered, as well as identifying areas where the land use is inadequate. In Chapter 3 of this thesis, the design principle of "Eliminating urban gentrification" is proposed for the meso-scale of biophilic urban villages. Therefore, by using the analysis above, combined with macro planning, an overall plan guiding space optimization can be deduced, and a general plan for urban village renovation can be obtained, with the following specific steps:

First, system integration. In conjunction with macro and mid-range planning, it is necessary to further integrate road networks, natural networks, and public spaces to form a smooth biophilic network pattern within the urban village.

Secondly, determine the direction of renovation. After the backbone network is formed, based on the distribution of various public spaces and the need to fill, it is necessary to demolish buildings in small areas, integrate the surrounding public spaces, and focus on updating the necessary functions, and carry out more detailed design for each point-like land plot.

Finally, utilization of elements. After determining the direction of renovation, it is necessary to integrate and utilize the existing natural elements of the land plots and add more natural elements to create an environment for more interaction between people and nature. This scale

can utilize more biophilic elements than the macro scale, and detailed information can be found in the appropriate community scale biophilic elements proposed in section 2.2.3.

Through the above steps, a complete overall plan for biophilic urban villages can be obtained. After that, detailed designs need to be carried out for important land plot nodes. The selection of key land plots is mainly based on two aspects: the current distribution of people flow and the benefits that can be obtained after subsequent updates and renovations.

4.3 Micro-Site Scale Strategies for Urban Village Renewal

4.3.1 Biophilic-Oriented Urban Village Planning Framework

The design at the micro scale is the most important part among the three scales of updates, because the updates in this part are closely related to people's lives and it is the design stage where various biophilic elements can have the greatest impact on shaping the space.

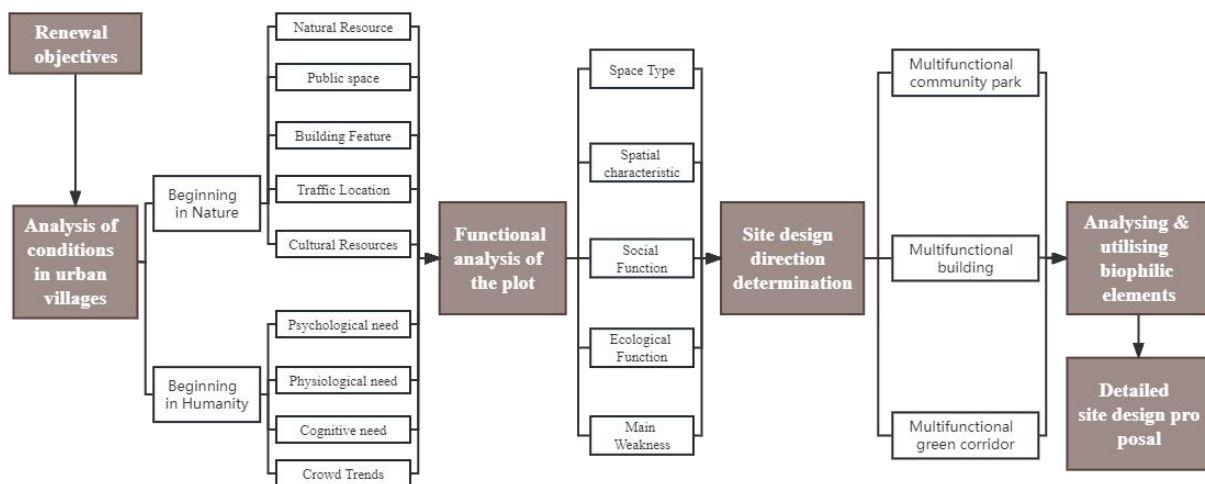


Fig 4-15 Biophilic-oriented urban village planning framework in site and architectural

The biophilic-oriented urban village renewal planning framework at the site scale consists of six specific steps: 1 - Analyze heat maps and update benefits to select the primary sites for renewal and design; 2 - Investigate the existing problems of the selected sites and set corresponding renewal objectives; 3 - Conduct a functional analysis of the sites to identify design deficiencies as the basis for subsequent improvements; 4 - Based on the previous analysis, subdivide the design direction for each site, including three design directions; 5 - Analyze the existing biophilic elements of the sites to identify resources that can be utilized and needs to be supplemented; 6 - With an emphasis on enhancing biophilia, use biophilic

elements to carry out detailed design for the sites that require priority renewal.

4.3.2 Renewal Objectives

In biophilic cities, citizens do not have to travel long distances to explore nature, as it is an integral part of their daily lives and easily accessible. Therefore, biophilic urban design aims to guide citizens towards outdoor activities and create opportunities for interactions with nature. Biophilic public spaces, streets, and buildings not only integrate natural elements into their design, but also serve as gateways for the public to connect with nature on a regular basis. Thus, moderate biophilic interventions at the building and site scale can have a significant impact on both wildlife and human inhabitants, especially in ecologically barren areas like urban villages. In St. Louis, Missouri, more than 400 monarch butterfly gardens have been created outside homes, schools, churches, and other urban buildings. These small personal gardens provide important habitats for migrating monarch butterflies and many other pollinators, contributing to improving the ecological literacy of city residents^[51].

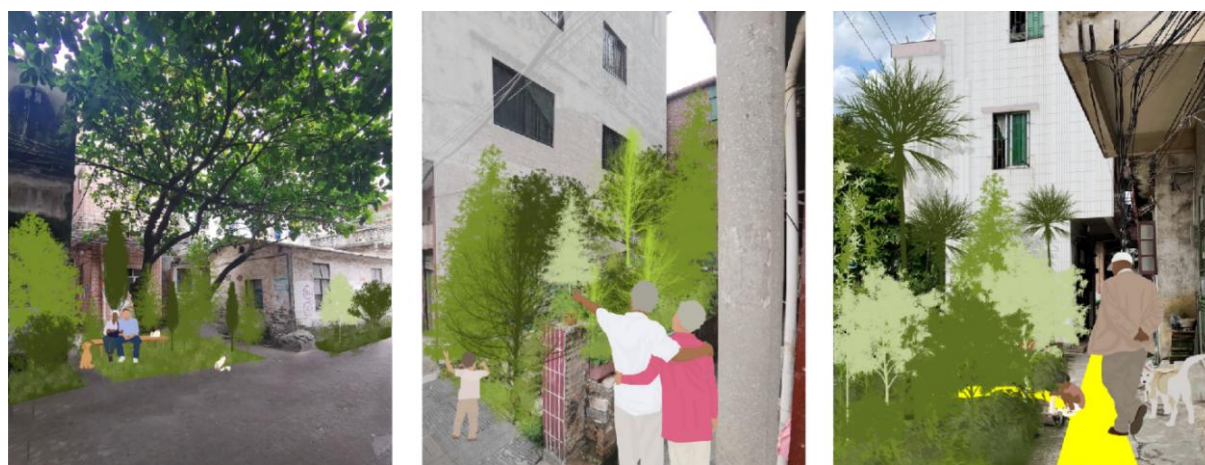


Fig 4-16 Site Scale Renewal Vision

Based on this, the main task of micro-level urban village renewal design is to further handle the human scale on the basis of macro qualitative and mid-quantitative analysis, to maximize the various functions and benefits of natural elements at this scale, while ensuring the public nature of public spaces and the sense of place. The aim is to make urban villages a place that integrates natural processes and human influences, providing citizens with long-term biophilic experiences and promoting effective public ecological awareness, thereby promoting

^[51] Cutting B T, Tallamy D W. An Evaluation of Butterfly Gardens for Restoring Habitat for the Monarch Butterfly (Lepidoptera: Danaidae)[J]. Environ Entomol. 2015 Oct;44(5):1328-35.

sustainable development of urban villages.

4.3.3 Context analysis

The specific design for a site requires the collection of a series of basic information about the site. The required information mainly includes two categories: those related to nature and those related to people. The information related to nature includes categories such as natural resources, public space, transportation location, architectural properties, and human resources. The information related to people includes psychological needs, physiological needs, cognitive needs, and crowd dynamics. This information needs to be collected through research with a set of questions, analyzing the current state and historical environment of site.

Table 4-8 Information table of the analysis of the basic conditions of the site

Basic conditions		Issues that need attention
Beginning in Nature	Natural Resources	Are there natural elements? What are the types of natural elements? How many natural elements are there? Is it worth developing and preserving?...
	Public Space	What is the usage rate of public space? What kind of public space design is there? What activities can be accommodated? How is the interconnectedness of the spaces?...
	Transportation Location	What is the distribution of public transportation stations? How is the pedestrian traffic around the site? How and when do peoples get to the transportation stations?...
	Architectural Properties	What are the types of buildings on the site? What is the degree of openness? Are there biophilic architectural elements? What is the use of the building space?...
	Human Resources	Does the site have a culture foundation? Are the buildings historic? What are the historical elements?...
Beginning in Humanity	Psychological Needs	Survey people's psychological demand for biophilic public space, categorized as elderly, children and youth; how much do they like nature? How much do you feel the healing of nature? What is the demand for nature?...
	Physiological Needs	Survey people's psychological demands for biophilic public spaces, categorized as elderly, children, and youth; what types of physical activities do they want to do? Do they want to exercise in a nature-friendly space?...
	Cognitive Needs	Survey people's perceived needs for biophilic public spaces, categorized as elderly, children, youth, understanding of nature education? Have they experienced nature education spaces? What nature knowledge do you hope to learn? ...
	Crowd dynamics	Study the activity trajectory and preference of different groups of people in the site by time, categorized as elderly, children, youth, what is the distribution of people in the morning, midday and evening? What is the heat map of the venue? ...

4.3.4 Functional analysis

The functional analysis of the plot is the process of integrating the collected site information. Based on the characteristics and elements of public space, there are two types of functional categories for public space in the city: social functions and ecological functions.

Social functions include: 1. Dynamic functions such as entertainment, sports, gatherings,

fitness, and transportation;2.Static functions such as recreation, leisure, sightseeing, and socializing;3.Educational functions such as outdoor education and biological research.

Ecological functions include:1.Beautification of the environment, improving air quality, and creating a beautiful environment;2.Providing natural interaction, healing, relaxation, and other services that are beneficial to human physical and mental health;3.Large-scale greening and water maintenance to balance local and even urban ecological systems, playing a role in ecological protection.

The goal of biophilic city is to integrate these two types of functions into one site, which is also a space that is urgently needed in high-density areas with tight land use, such as urban villages. Therefore, after analyzing the basic conditions of each site, a functional table can be obtained for each site, based on which the design direction of the site and the key parts that need to be supplemented can be determined, thus guiding the subsequent design.

Table 4-9 Site functionality analysis evaluation

Type	Analysis point	Site
Space Type	Degree of openness	private / semi-enclosed / semi-open / open
	Space shape	point / line / surface
	Terrain	undulating/flat
Spatial characteristic	Interface	complete/no boundary
	Accessibility	strong/normal/weak
	Pavement design	Yes/No
Social Function	Dynamic function	entertainment/sports/gathering, etc
	Static function	recreation/leisure/viewing, etc.
	Educational function	outdoor education / biological research
Ecological Function	Beautification function	beautify the environment / optimize the air, etc.
	Service function	Nature interaction/healing/relaxation
	Ecological protection	species diversity/rainwater treatment, etc.
Main Weakness	Lack of natural elements / ecological design / lack of public space planning / scattered humanistic elements, etc.	

4.3.5 Site design direction

After analyzing the basic conditions and functionality of the site, the design direction of the site needs to be determined. Due to the shortage of available land in urban villages, biophilic spaces at the micro level should have multiple social functions and be combined with public spaces in order to maximize the benefits of renewal. In the design process, the principles of

complementarity, compatibility, efficiency, functional flexibility, and adaptability should be fully utilized to create biophilic public spaces with multiple functions, including recreational, cultural and entertainment, educational, social, and ecological functions. Therefore, the main direction of updating public spaces in urban villages should be the construction of multifunctional biophilic spaces.

Multifunctional biophilic spaces have different design directions based on the characteristics of the site. In response to the main spatial requirements of urban villages, this design direction can be divided into three categories: Multifunctional community park, Multifunctional building and Multifunctional green corridor. The following sections provide design highlights and detailed analysis for each type of space.

4.3.5.1 Multifunctional community park

A multifunctional community park refers to a community-owned natural space that caters to various forms and serves different populations, addressing multiple public needs. Compared to regular community parks, it possesses a more diverse range of functions and elasticity and offers more opportunities for natural interaction. While meeting functional requirements is crucial in designing any community park, these spaces need to interact with nature and interweave with it to enhance their biophilic properties. Motion-oriented parks is a community green space that serves multiple sports and activities on the same site. The proportion of paths and open spaces in the park should be around 20%-30%^[52] to create a certain scale of activity space. The primary social functions of the park's green space are sound insulation, noise reduction, dust prevention, the division of activity spaces, and providing shaded resting areas. Tranquility-oriented park is a community green space that serves various leisure and recreational activities on the site, with the proportion of paths and nodes around 10%-20%^[52] to ensure a peaceful environment. Natural elements within the park need to limit space and regulate environmental comfort to achieve its main functions. Balanced park integrates both types of functions on the same site. In addition to requiring a larger area, this type of park design needs to pay attention to the zoning of activities and create spaces with different degrees of openness according to their activity requirements.

^[52] GB 51192-2016, Design Code for Parks[S].Beijin: china building industry press,2017.



Fig 4-17 Park intention diagram (Source:Internet)

4.3.5.2 Multifunctional building

Originally located in villages, the buildings in urban villages had their own courtyards and a strong biophilic element. However, as the area developed, the courtyards were abandoned and the buildings lacked responsiveness to natural elements, resulting in a lack of biophilic design in urban village architecture. Therefore, the use of biophilic elements is the first key point in architectural design. As discussed in Chapter 2's biophilic design patterns, to achieve biophilic design in buildings, it is mainly through creating direct natural experiences, indirect natural experiences, and creating a sense of place.

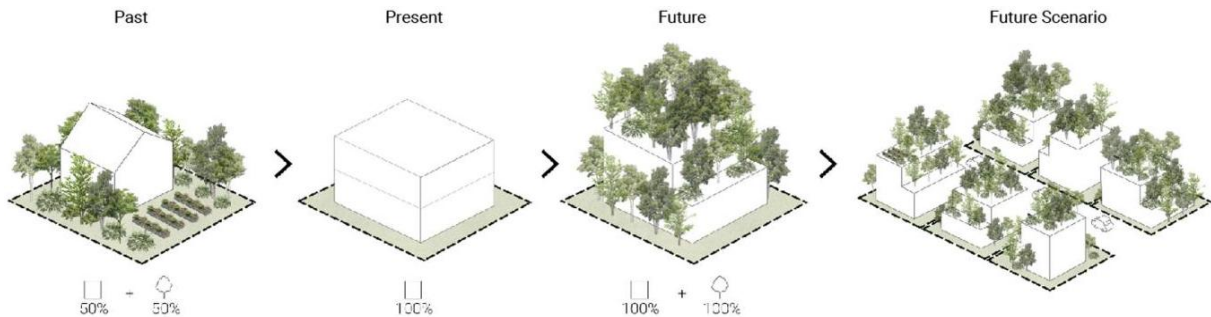


Fig 4-18 The transformation of the biophilic building

(1) Public Buildings

Currently, public service buildings required in urban villages mainly include community centers, senior schools, youth centers, activity centers, exhibition and convention centers, etc. If multifunctional integration can be achieved in each public service building, the service range can be maximized. In addition, an important aspect of building biophilic cities is to establish public buildings that can provide various biophilic services for residents, such as nature centers, ecological centers, and gathering halls, etc., providing educational services, organizing activities, and maintaining the environment for the entire community. Therefore,

the above functions should be combined to build public service buildings with biophilic features, as an activation point for public events..

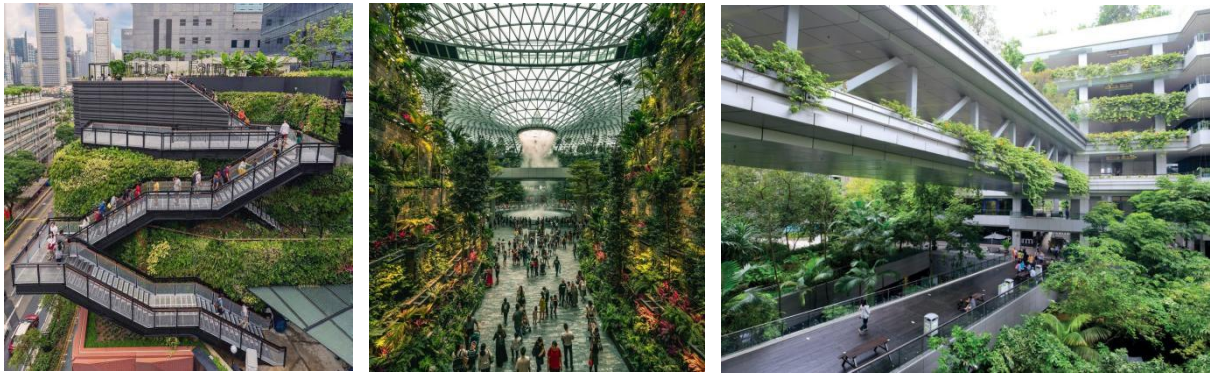


Fig 4-19 Biophilic public building design (Source:Internet)

(2) Residential Buildings

The single function of urban village residential buildings is mainly to meet the housing needs of humans, without satisfying more biophilic activities. Therefore, when renovating residential buildings, attention should be paid to creating more biophilic spaces. Firstly, biophilic-friendly facilities can be established, such as facilities that provide resting services for different types of animals, which not only meet the comfort requirements of animals, but also pursue ecological, comfortable and aesthetic goals. Secondly, agricultural plots can be set up to allow people to experience a true rural lifestyle in the urban village and fully interact with nature during the planting process. Finally, additional facilities of energy-saving green buildings can be built, such as green roofs, solar equipment, etc., to achieve sustainable development of residential buildings.



Bio-friendly facilities

Urban Agriculture

Green Buildings

Fig 4-20 Three forms of residential building renewal (Source:Internet)

4.3.5.3 Multifunctional green corridor

The design emphasis of a multi-functional corridor is to combine different forms and functions of biophilic elements such as streets or rivers, forming a biophilic linear public space with multiple social service functions. This type of multi-functional corridor within the community does not have significant ecological benefits. Its main function is to serve as the backbone of the network, connecting the multifunctional park and the multifunctional building after the completion of the first two categories of spaces, providing a shortcut for the community and surrounding residents to access biophilic activity spaces, and promoting an internal biophilic network^[53].

(1) The composite biophilic street

The mixed transportation in urban villages is a historical problem, with streets mostly accommodating multiple modes of transportation. When renovating such places, Firstly, it is important to perfect the street layout through biophilic elements, allowing various modes of public and non-motorized transportation to coexist and forming a composite biophilic street. This can alleviate traffic congestion problems in urban villages, with public transit lanes, car lanes, dedicated bike lanes, and pedestrian paths separated by tree-lined green belts. Trials have highlighted the benefits of integrating biophilic design and sustainable transit to lessen the environmental impact of climate change^[54]. Secondly, it is important to set up bike parking facilities, bus stops, street squares, street parking, food and leisure spaces, and tree-lined facilities around the street, which can form a complete composite biophilic street through dispersed combination of these elements. Lastly, it is necessary to strengthen the connection between the slow traffic system and roads within the urban village, creating more shortcuts to ultimately weave the non-motorized transportation network and composite transportation network together^[42].

^[53] Su T X, Study of the construction of urban and rural green space ecological network -- taking Yangzhou City as an example[M]. Beijing: China building industry press, 2018.05

^[54] Cabanek A, Zingoni d B M E, Newman P. Biophilic streets: a design framework for creating multiple urban benefits[J]. Sustain Earth 3, 2020, 7

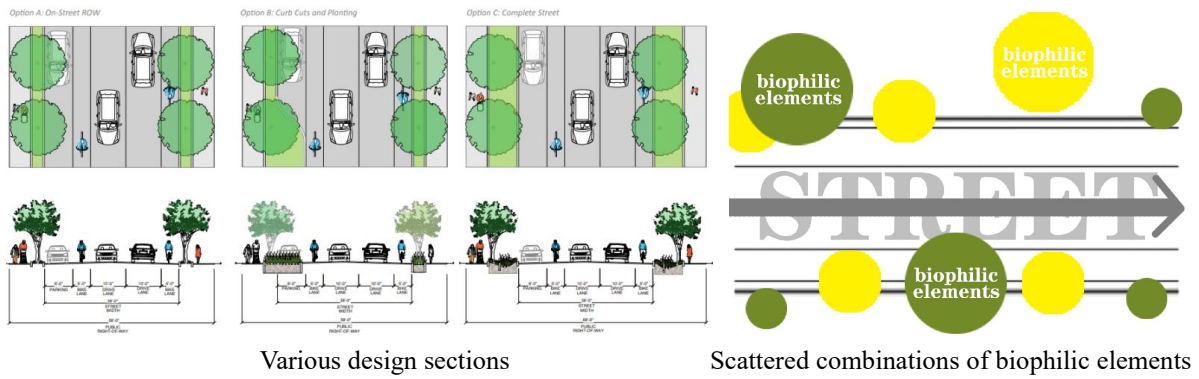


Fig 4-21 The composite biophilic street design

(2) Biophilic Slow System

The internal slow traffic network in the urban villages is well developed, and the vehicle traffic rate of buildings is generally low. However, these slow traffic spaces are often unfriendly to experience. Therefore, the goal of design in this area is to create high-quality slow traffic spaces through biophilic elements. The main focus of pedestrian space design is to utilize natural functions while not interfering with traffic, considering the use of terrain, water bodies, vegetation, and other elements, and integrating multiple public activities and functions with street-side buildings to create a complete facade for the streets. For non-motorized vehicles, connectivity with large biophilic elements in the surrounding area needs to be considered to improve the biophilic experience. For example, when non-motorized roads are disconnected from parks and greenways, ecological paths can be used to connect roads and public spaces to achieve accessibility and completeness.

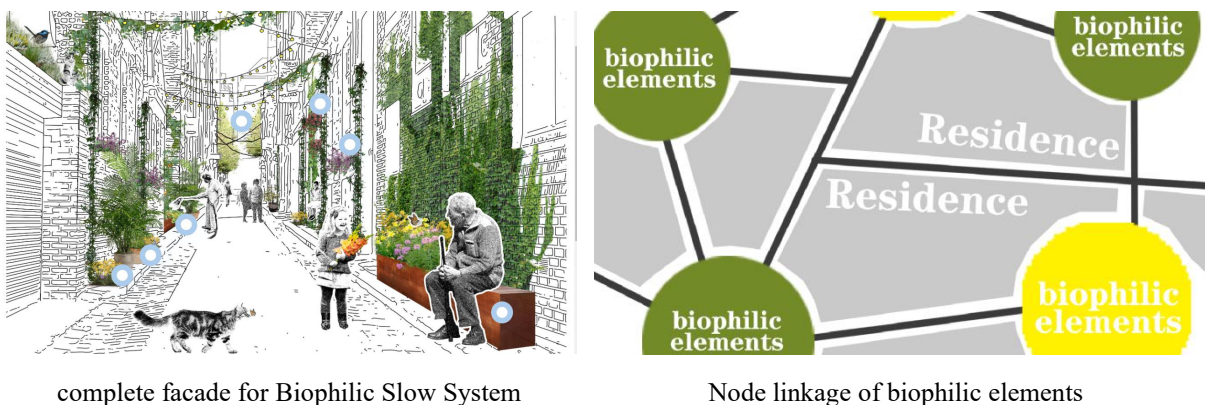


Fig 4-22 Biophilic Slow System design

(3) Biophilic Riverfront Space

Riverfront areas in urban villages generally have a strong biophilic character. With the

increasing awareness of villagers' protection, there are many biophilic elements in the rivers of urban villages that are worth exploring and utilizing. Therefore, in this type of site design, it is necessary to first use the riverfront space as the base and excavate and utilize the natural elements along the line to design a series of biophilic point spaces according to the previously mentioned design categories. Then, through the creation of riverfront trails, as a backbone to connect various spaces, enhance the accessibility and utilization of the space, and bring people closer to nature. Finally, using this as an activation point, the biophilic network is radiated to the surrounding areas, combined with other multifunctional greenways, connected to more biophilic elements, and formed into a complete biophilic network.

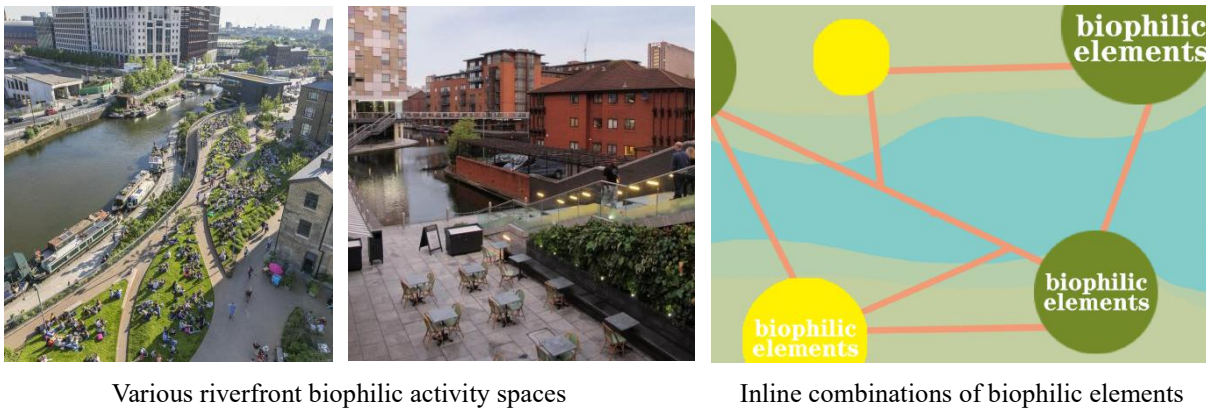


Fig 4-23 Biophilic Riverfront Space design

4.3.6 Analysing & utilising biophilic elements

Compared to macro and meso scales, the site scale is the most intuitive part of architectural design because it requires analysis and utilization of biophilic elements firsthand in order to fully embody their role in the design, thus creating spaces that truly meet people's needs for nature. Among the biophilic elements proposed in section 2.2.3, after scale filtering, the design elements that require particular attention at the micro scale can be identified. These mainly include various infrastructures, accessibility design, sensory activation design, and organizational management design, which almost cover all design elements. Therefore, at the site scale, designers have a high degree of freedom to design based on the needs of the site population and the existing biophilic elements. The purpose of this is to ensure that the renewal of these public spaces is not just a homogeneous space that accommodates people, but also a unique, sensory-stimulating, natural, and more comfortable space.

After analyzing the biophilic elements and combining them with appropriate design directions, the next step is to proceed with the detailed design of the site, which includes specific utilization of the elements and shaping of the site.

Table 4-10 Biophilic elements available at the micro-scale

Category		Element
Beginning in Nature	Infrastructure	Greenways; Community gardens; Parks; Vacant land; The (half) wild land; trees ; Pollinator nest boxes; Wildlife passage; Stream restoration; Stream daylighting; shoreline restoration
	Proximity	Public transport; Fully covered pedestrian network; Accessible and dedicated bike lanes; Non-motor vehicle parking facilities; Landmarks in space; Visual oriented information design
	Sensorial Design	Visual scene design; Auditory scene design; Olfactory scene design; Haptic scene design; Taste scene design; Sense of place
Beginning in Humanity	management	Small doses close to nature; Green land rate; tree canopy coverage; Community BioBlitz; Community participation; Natural organizations and clubs; Campus Nature Education Gardens; Community Scientist Activities

4.3.7 Site scale renewal achievements

After the specific renewal and design at the site scales, the main objectives to be achieved are:

(1) To provide a natural and comfortable daily life for people after the updates.

The purpose of urban village updates at the community level is to incorporate natural elements into people's daily lives, enhance the connection between people and nature, and allow every urban village resident to feel and experience nature as much as possible in a harmonious coexistence between humans and nature, thereby improving the living environment of the urban village. In addition, the use of nature-friendly design can also meet the sensory, behavioral, and spiritual experience needs of residents, allowing people to enjoy pleasure and health in their daily lives, increasing the frequency of harmonious interactions with nature, and satisfying their physiological and psychological needs to be close to nature^[55].

(2) The overall planning of the updated urban village is more reasonable and sustainable.

The current community environment and planning of the urban village are chaotic. Detailed

^[55] Ma Y Q. STUDY ON LANDSCAPE DESIGN OF EXPERIENTIAL COMMUNITY PARK BASED ON PRO NATURE DESIGN——TAKE YANCHUN PARK IN YANGPU DISTRICT OF SHANGHAI AS AN EXAMPLE [D]. SHANGHAI, Donghua University, 2021.

sorting of public spaces at the community level and organic updates and demolitions, as well as repositioning and rational planning of land use, can make the spatial structure of the urban village more reasonable and in line with the development vision of modern cities, no longer being a victim of urban gentrification.

(3) Integration of public spaces with other elements after the update.

To achieve a true overall update of the urban village after the public spaces have been re-planned, further integration is required, including repairing the texture, improving the road system, and connecting the public spaces. In addition, it is necessary to connect and extend the nature-friendly public spaces of the urban village to the surrounding areas, especially linear spaces, to form a more unobstructed biophilic urban network.

4.4 Summary

From the perspective of creating a biophilic urban environment, this chapter establishes a macro-meso-micro level urban village renewal design method. The purpose is to update the existing urban village spaces from top to bottom, and from outside to inside, in order to achieve the application and reflection of biophilic theory in specific urban issues. From a city perspective, the biophilic urban theory can break the barrier between urban villages and cities, and integrate the development of urban villages and cities by integrating into the biophilic network of the city. From a community perspective, biophilic-oriented renewal planning is the answer to how to create a human living environment, solve resource fairness and other issues in urban villages, and create a more optimized and livable urban planning design for urban villages. From the perspective of site, biophilic design can make the site and building more multifunctional, better meet the physical and mental health needs of residents, and enable more effective interaction between people and nature. Through the design of the three levels, the ultimate goal of this design research is to shape the urban village into a harmonious and symbiotic community where people and nature can coexist, and where it is livable, business-friendly, and enjoyable.

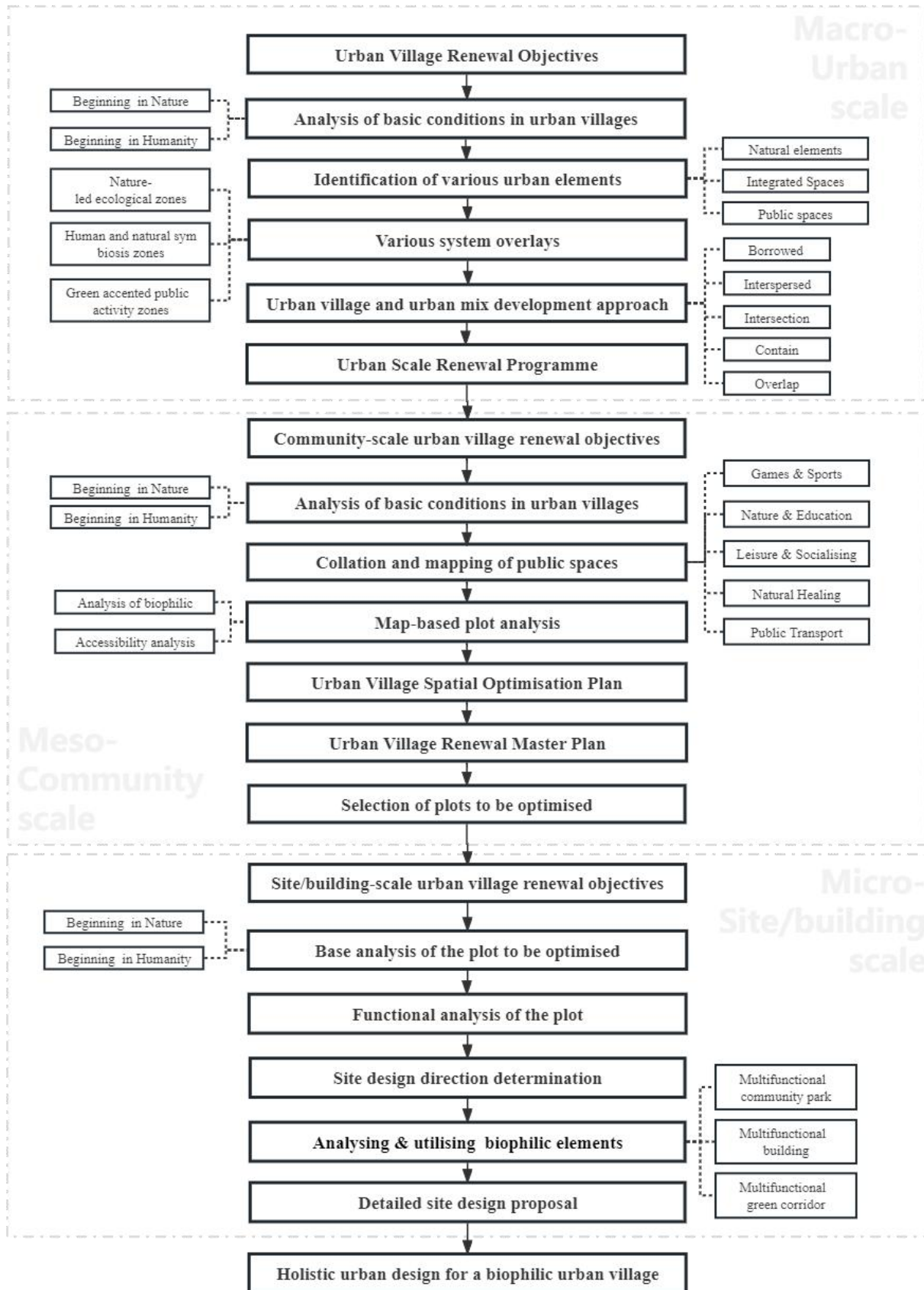


Fig 4-24 Flowchart of the master renewal strategy of the biophilic urban village

Chapter 5 Analysis of the Lijiao area

5.1 Introduction to Lijiao

As one of the earliest cities in China to open up to the outside world, Guangzhou took a lead in the modern urbanization development of China. The urban villages in Guangzhou are a microcosm of the urbanization process in China. The changes and development of these villages have significant representative significance. According to official data from Guangzhou in 2014^[56], there are a total of 304 urban villages in the 11 districts of Guangzhou, covering an area of 716 km², with approximately 348,900 households and a total population of 982,500 villagers. In addition, there are about 5 million migrants, the overall population much larger than that of the villagers. The social relations and environment within these urban villages are extremely complex, with many social conflicts and disputes, which have become a bottleneck problem in the development of urbanization in Guangzhou. The renovation and transformation of these urban villages have become an important part of Guangzhou's urbanization construction in recent years^[57].

Li Jiao Village is located in the southeast of Haizhu District, Guangzhou, facing Panyu District across the river. It covers a total area of 4.96 square kilometers, with a permanent population of 10,370 and a floating population of about 50,000^[58]. As a typical southern water town, Li Jiao Village has a dense network of rivers and streams, surrounded by water on all sides. According to records, there was a "Fengtian Chengyun" archway built in the village, which was praised by the emperor, and the folk saying "Nine Dragons go to the sea, Six Cranes return home" has been passed down to this day^[59]. According to the "History of Li Jiao Village" (2008), as early as the period of the Republic of China, Li Jiao Village presented a clustered and vertically arranged village pattern. Villagers lived together in groups, and as the population increased, houses expanded outward and were built on both sides of the rivers

^[56] Guangzhou Municipal People's Government. Three-year Action Plan for the Rectification of Safety Hazards in Urban Villages of Guangzhou (2014-2016)[Z]. 2014.

^[57] Li X M. A Comparative Study on the Linguistic landscape of Urban Village in the Process of New-type Urbanization——Taking Liede Village, Huadi Village and Lijiao Village in Guangzhou as an Example[D]. Guangzhou, Ji'nan University, 2020.

^[58] Zhang X M, Zeng W K, Yao W Z. Li Jiao in 900 years: The ancestral hall is the soul of the village[N]. Guangzhou Daily, 2009-09-30(D6).

^[59] Li C H. Where to transform the ancestral hall of Ming and Qing Dynasties in Lijiao Village[N]. Nanfang Metropolis Daily, 2012-02-03.

and streams, highlighting the characteristics of a water town. Li Jiao's unique and strong affinity with nature is nurtured by its dependence on water.

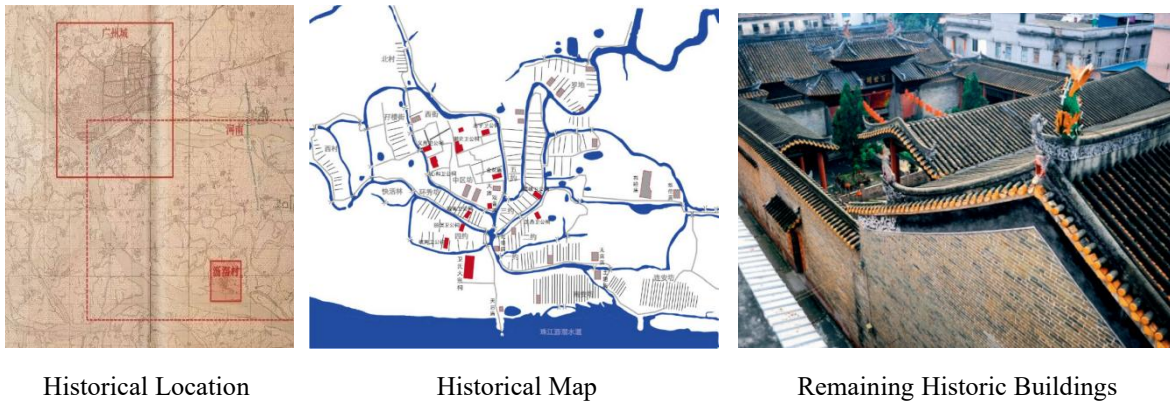


Fig 5-1 History of Lijiao

Source:Internet

Unlike the typical dense urban village landscape, Li Jiao Village has a rich and concentrated historical landscape, still retaining the form of a traditional ancient village. In the past, the village had one of the most complete ancestral hall clusters in the Guangfu region, with 30 ancestral hall buildings distributed along the river. Although only 13 ancestral halls remain, the larger Beidi Temple is one of the many folk temples that still exist in the village, which testifies to the historical development of Guangzhou's culture and commerce during the late Qing Dynasty and Republican era^[60]. Although some of the buildings themselves are not particularly valuable, their decorative craftsmanship, such as the mountain flower wall, Shiwan pottery roof, oyster shell wall, and delicate wooden lattice windows, are exquisitely crafted and have considerable research and appreciation value.

After the reform and opening up, Lijiao Village transformed from a traditional ancient village to one of the largest urban villages in the center of Guangzhou. Its economic development model changed from the traditional "agricultural" type to an "industrial" type production. The river was filled and turned into rented houses, and the scenery of the water town was no longer visible. After the 1990s, relying on the transportation conditions in the area north of Luoxi Bridge, Lijiao Village actively developed commerce and service industries and built a professional wholesale market.

^[60] Chen J H. Guangzhou cultural relics survey compilation: Haizhu District[M].Guangzhou: Guangzhou Press,2008.



Fig 5-2 History of Lijiao
Source: Internet and Self-photographed

In addition to natural landscapes being buried, public buildings with important values have also been used for other purposes. There have been partially destructive additions and renovations, lack of maintenance, and are used for economic and social offices, workshops, rental housing, idle, etc. They have completely lost their original functions, let alone the inheritance of historical culture. 30 ancestral halls were demolished, leaving only 13, most of which cannot be effectively protected. A large number of traditional houses were demolished or rebuilt, and old houses with historical value were also demolished. Originally, there were hundreds of Ming and Qing dynasty houses, but now less than 30 have been preserved. The slightly larger folk worship temples have been demolished, and only the larger Beidi Temple still has villagers worshipping, as well as some roadside small land temples.

However, the overall landscape of Lijiao Village still presents the overview of the traditional Lingnan urban village. Lijiao Village still retains the spatial structure of traditional villages, with a mixed functional zoning of residential areas, commercial areas, and industrial areas. The language landscape of the garment manufacturing industry has obvious clustering characteristics. With the development of collective industries in Lijiao Village, the construction of urban municipal infrastructure, and the development of commercial housing, most of the surrounding land in Lijiao Village has been occupied or requisitioned, becoming a typical urban village in Guangzhou.

5.2 Basic context about Lijiao

5.2.1 Location

LiJiao is located in the south of Guangzhou city, on the north bank of the LiJiao waterway of the Pearl River. It is a clan village dominated by the Wei and Luo surnames. The village's name accurately describes its topography, with "Li" referring to the narrow streams and "Jiao" referring to the branching river channels. The village's unique feature is its branch-like water system formed by more than ten small streams, which sets it apart from other water villages along the Pearl River.

The current LiJiao area covers an area of 4.7 million square meters, which is two-thirds the size of the Pearl River New Town. It is located at the green growth pole of the second meeting point between Guangzhou's central axis and the Pearl River. It has been included in Guangzhou's urban planning as the "last kilometer" of the southern end of the new urban central axis. The surrounding ecological resources are rich, including the Haizhu Lake Park, Haizhu Wetland Park, and the project stretches along the riverside for 7.1 kilometers. Therefore, it bears the mission of continuing and deepening the new urban central axis and helping Guangzhou achieve its grand vision of a 12-kilometer urban central axis. In addition, LiJiao is also located in the middle section of Haizhu Innovation Bay, which is the intersection of Guangzhou's new central axis and the Pearl River's waterfront innovation industrial belt. It is not far from various facilities within the city and is the central area for the future development of the city.

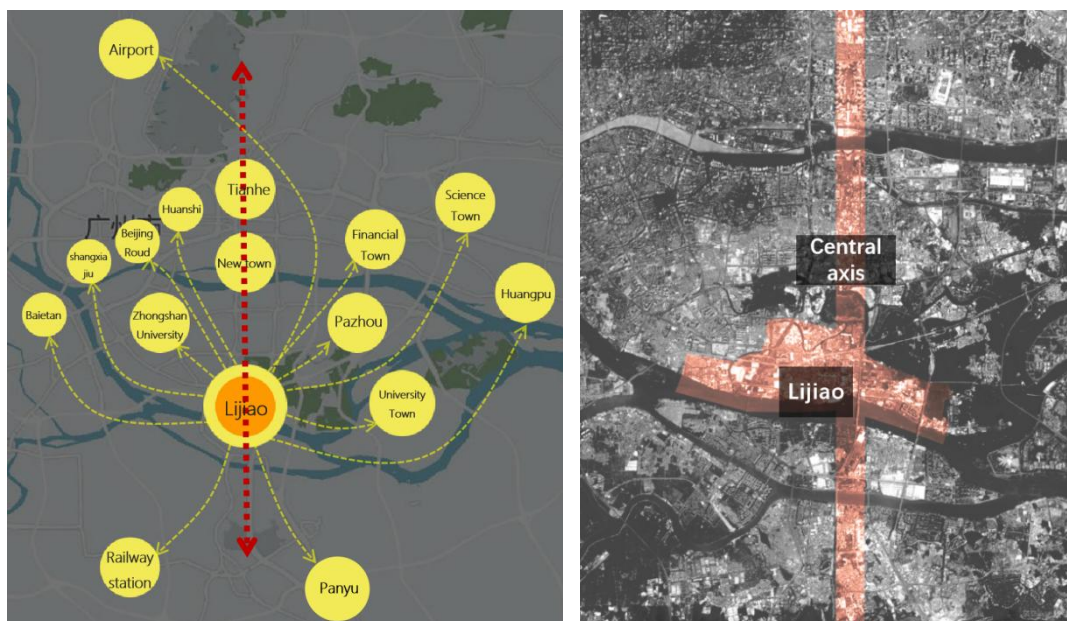


Fig 5-3 Location Map of Lijiao

5.2.2 Population composition

Li Jiao is located in the southern part of Haizhu District and includes 11 communities, namely Hou Jiao, Chi Jiao, Yong Ji, Xi Jiao, Dong Huan Bei, Xi Cun, Xin Nan, Da Sha, Jin Bi Nan, Fu Quan, and Tu Hua, covering three streets of Nanzhou, Huazhou, and Ruibao, as well as four urban villages of San Jiao Village, Li Jiao Village, Shi Xi Village, and Xiao Zhou Village. By analyzing the population data of the three streets, we can obtain the basic population data of the area. In terms of population types, due to the rapid development of the city in the past decade, Li Jiao has witnessed considerable population growth, mainly driven by migrant workers, accounting for nearly 50% of the total population. In addition to the floating population that arrived in Li Jiao a decade ago, the current total population of Li Jiao is 183,000, including 52,000 permanent residents and 131,000 floating population. Therefore, the main population type in Li Jiao is migrant population, and the proportion of local population is relatively small.

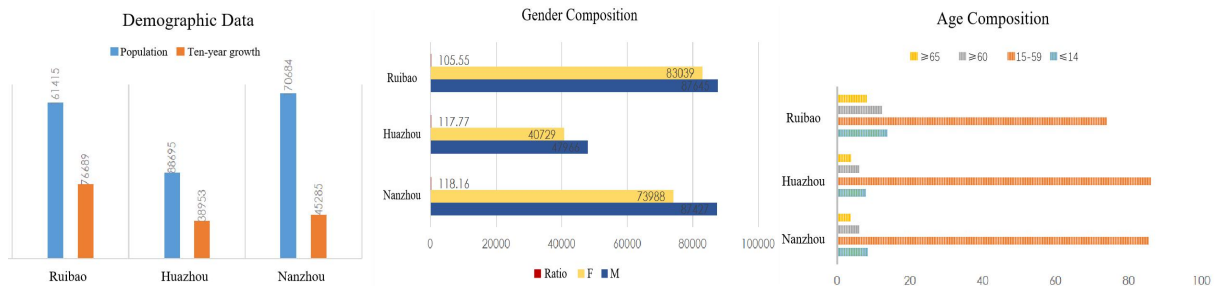


Fig 5-4 Population Composition of Lijiao Area

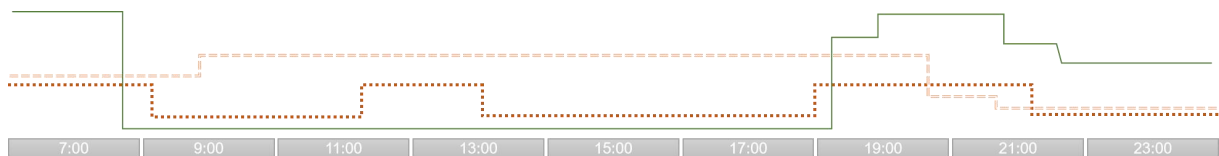


Fig 5-5 Activity time for different groups of people

In terms of gender, the proportion of males is also relatively high in Li Jiao, mainly due to the disorderly order and lack of management in urban villages, which makes females less likely to choose to rent here. In terms of age composition, the proportion of people aged 60 and above and children in Li Jiao reaches 20%, so this group of people must be considered in the design. Through on-site research on activities for the elderly, children, and youth, a rough activity schedule can be obtained, which shows that the activity room for the elderly is available all day, children's activities are concentrated in the morning and afternoon, while young people

are mostly active in the afternoon.

5.2.3 Transportation

The Li Jiao area is surrounded by six urban roads in a three-by-three grid pattern, with the Guangzhou Ring Expressway having an entrance/exit near the area for quick access by city vehicles. However, there are few urban roads that lead directly into the area. The ground traffic conditions are poor, with few surrounding roads mostly consisting of internal roads within villages or residential areas, making it difficult for vehicles to pass through.

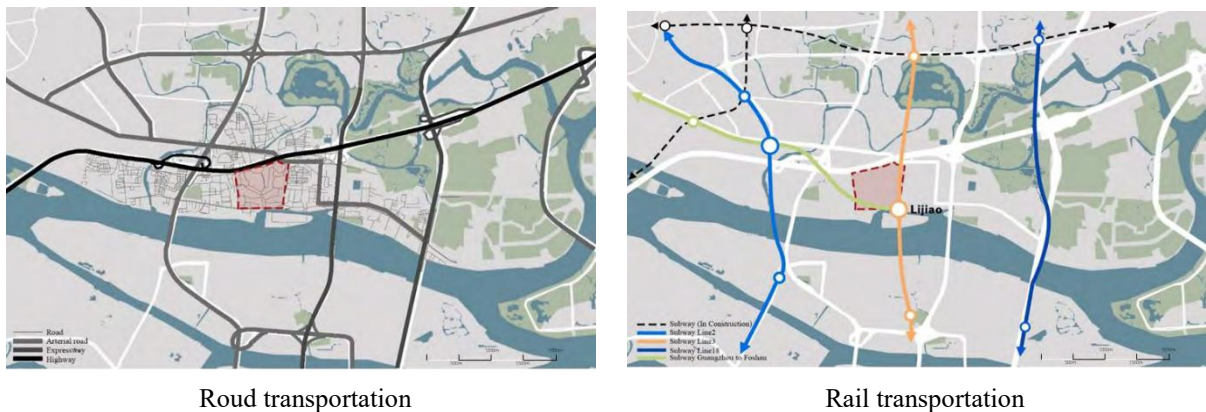


Fig 5-6 Transportation conditions of Lijiao

Four existing subway lines run through the area, but only one subway station is located within the area. The "transfer hub" station is heavily relied on by residents within the area for transportation. Currently, the Li Jiao station has four entrance/exit points, with the north side leading to the Li Jiao village and the south side being a wall with several factory buildings according to satellite imagery. The area around the entrance/exit points is relatively spacious, with ample parking for non-motorized vehicles. However, there are not many non-motorized vehicles parked at the station during working hours, with more parked at the entrance of the Guangzhou Window Business Port.

5.2.4 Public space

Li Jiao Village belongs to a network-type water town settlement. Most of the network-type water town settlements are connected to the Pearl River, with water as the core, and the main street of the settlement runs parallel to the water and expands on both sides.

In the early development of Li Jiao Village, water was the most important part that controlled

the entire village pattern. The division of the district, the orientation of the ancestral temple, and the distribution of houses were all related to the river. The construction of the ancestral temple and the front square is usually located in the core position of the front end of the residential cluster, facing the main traffic artery of the settlement, with a Fengshui pond in the front and a Fengshui forest in the back, in order to seek the blessings of the ancestors.

Banyan trees and rivers are the most typical natural environment features of the Lingnan water town. "Asking the Moon under the Banyan Tree," one of the ancient Eight Scenic Spots of Li Jiao, depicts the combined landscape effects of elements such as the river, water, clouds, banyan trees, and the moon. Residents often rest and enjoy the cool breeze under the banyan trees.

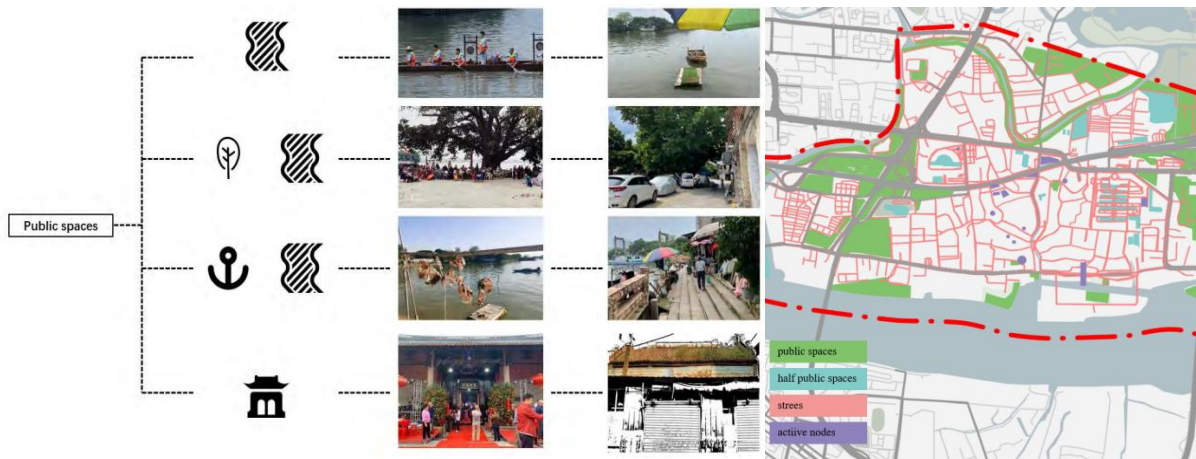


Fig 5-7 Main public spaces

5.3 Criticism and orientation

5.3.1 Upper plan

In 2016, the Eighth Plenary Session of the Tenth Guangzhou Municipal Committee proposed "focusing on optimizing and improving the economic, innovation, and ecological landscape belts on both sides of the Pearl River, and building a high-quality Pearl River." In accordance with the overall plan of Guangzhou for developing and constructing the Pearl River landscape belt, Haizhu District proposed to enhance the quality of the three belts on both sides of the river, and to form the development concept of the Pearl River front and rear navigable economic, innovation, and landscape belts that are integrated with the development of the Guangdong-Hong Kong-Macau Greater Bay Area. The overall development plan for the

Haizhu Innovation Bay Area was also launched.

Located in the middle of the Pearl River with the three belts on both sides, Li Jiao is an important part of the Pearl River economic, innovation, and landscape belts. In the future planning, Li Jiao will focus on residential and commercial land, and will become a new landmark for the waterfront of the Guangdong-Hong Kong-Macau Greater Bay Area, integrating technology innovation, high-end business, cultural exhibitions, sightseeing tourism, and high-quality living.

Therefore, the planning for the Li Jiao area involves overall demolition and reconstruction, with the main plots being mixed-use commercial and residential land. The road layout will be improved by increasing the urban roads and implementing a grid layout to enhance accessibility and order. In addition, there will be an increase in green parks and water systems, improving the connectivity of the city's ecosystem.



Fig 5-8 Land Use Planning in Lijiao Area

Source: Haizhu Bay Lijiao Area Regulatory plan

5.3.2 Criticism of the existing planning

The current plan aims to introduce the most efficient grid layout into the site from the perspective of urban modernization, and to achieve the reconstruction of the site through a large number of demolitions. However, this will bring many problems. In terms of economic development, the large-scale demolition and construction will bring economic pressure, and communication with villagers will be time-consuming and laborious. Since the initiation of the demolition and construction work in 2007, when Lijiao Village Credit Cooperative signed the "Cooperation Intention Letter for Reconstruction" with Zhuguang Group, sixteen years have passed, and Lijiao has not yet started the demolition. In addition, as the current urban

construction tends to be saturated, Lijiao's desire to build a modern high-rise building complex may not necessarily achieve significant returns compared to the investment. In terms of cultural development, although the plan has preserved the design of the Wei's Ancestral Hall, the grid layout of the road network and the construction of high-rise buildings, along with the relocation of the original residents, will destroy the texture of the Lingnan water village, and the absence of a sense of place and regional identity may cause Lijiao to disappear in the future urban development. In terms of social development, the pattern of the superior plan is prone to over-realization of real estate, high house prices, and a layout of over-suppressed high-rise buildings, which will continuously compress the urban space and thus unable to be organically integrated with the high-quality development goals of the city. Therefore, the large-scale demolition and construction will inevitably encounter many difficulties in Lijiao, and the results obtained may not be satisfactory. It is necessary to adopt other more organic forms of urban village renewal and promote overall improvement through partial renewal in Lijiao's transformation to maximize the benefits of urban renewal.



Fig 4-9 Criticism of the Lijiao Upper Plan

5.4 Biophilic in Lijiao

Lijiao, with a 900-year history, has evolved from a Lingnan water village into an urban village, with countless natural and historical elements, forming the basis for it to become a biophilic community. The overall environment of Lijiao can be classified according to the design elements of a biophilic city, studying its current status and whether it has the inherent foundation of biophilic design.

Chapter 5 Analysis of the Lijiao area

Table 5-1 Collection of biophilic design elements of Lijiao

Category	Indicator	Site Status		Situation
Land	Greenway			The greenway is composed of street trees and the living environment is compacted by the lane.
	Parks			The park has plants but few and monotonous spaces for activities, lacking interaction with nature.
	Vacant land			Many small open spaces have been planted with vegetation, reflecting the residents' desire to be biophilic.
	trees			The vegetation is rich and widely distributed, but the living space has been severely compressed and the ecological benefits are low.
	Urban forest			Some streets have street trees, but the species is homogeneous, and the living space is occupied by parking
	Street tree			Some streets have street trees, but the species is homogeneous, and the living space is occupied by parking
Water	Stream restoration			The water quality of the river has been improved and is regularly cleaned, but it lacks the mobility of a natural system.
	Water allocation			The river barges are hard barges, which are not conducive to natural ecological development and create a gap between human and water.

Table 5-1 Collection of biophilic design elements of Lijiao (Continue)

Category	Indicator	Site Status	Situation
Architecture	Biophilic buildings		Many of the buildings are of more naturalistic building materials such as brick and stone, and are accompanied by a richly vegetated courtyard.
	Historic buildings		Historic buildings are scattered throughout the village but are not really used, making it difficult to highlight the culture.

After classifying the natural elements of Li Jiao, it can be seen that, compared to general urban villages, Li Jiao has very rich natural resources, including water, vegetation, parks, and so on. However, according to the current survey, most of these elements are well-maintained but have not been utilized properly and have become urban landscapes that can only be admired from a distance. If these natural elements can be reasonably utilized, a better living environment can be created within Li Jiao with relatively little effort. This is the more organic updating mode that Li Jiao currently needs, and the concept of a biophilic city design can achieve this goal. Through biophilic design, small-scale demolition and construction can be used to fully utilize the natural elements within Li Jiao and bring more benefits, thereby improving the overall living environment of Li Jiao.

5.5 Summary

In summary, Li Jiao is a hundred-year-old ancient village rich in natural and cultural atmosphere. It not only has a long history and cultural heritage, but also has high humanistic value. If it can be reasonably developed and utilized, it can not only make up for the deficiencies in the process of urban development, but also enhance the attractiveness of the city to its residents. As a special type of urban village, Li Jiao has a high appeal to city residents, and therefore plays a significant role in injecting new vitality and vitality into the city. However, in the process of urban development, it has lost its direction and fallen into a

dead end of maximizing profits, resulting in development obstacles and being restricted and influenced by various factors, which has led to many problems in the village, such as chaotic building layout, narrow and crowded spaces, serious illegal construction, dirty and disorderly environment, lack of systematic planning, and outdated public facilities. For Li Jiao, its natural elements are precisely its advantages. Activating and utilizing these natural elements, and giving them new life, will make Li Jiao shine again.

Therefore, Li Jiao should use "biophilic" means to strengthen the connection between people and nature to carry out transformation. By using neglected elements such as trees, rivers, and climate in the village in a reasonable manner, it can not only improve the living environment but also enhance Li Jiao's unique ecological construction. Li Jiao can become an ecological village, which will bring more benefits not only to natural ecology but also to long-term economic and social benefits. By bringing people closer to nature, urban managers can also promote the development and updating of urban villages and industries through the construction of greenways.

Chapter 6 Strategic use of biophilic urban design

--the case of Lijiao

6.1 Macro-Urban Scale Renewal for Lijiao

6.1.1 Renewal Objectives

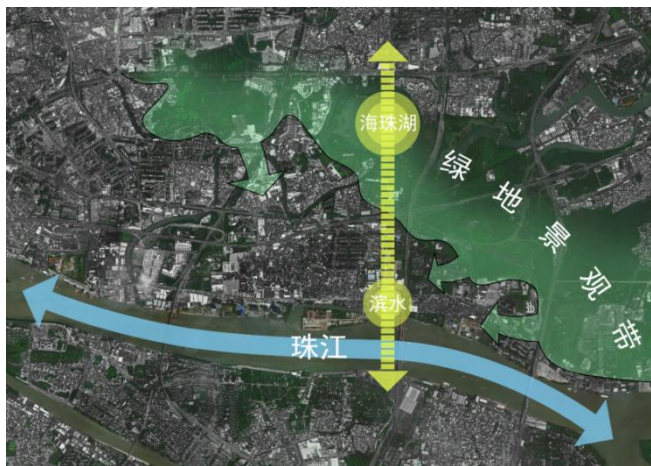
To create a biophilic urban village at a macro scale, it is necessary to establish a green network in the city. The purpose of the network is to connect Lijiao with natural areas, parks, and other open spaces in the city, using natural areas as a flexible adhesive to bridge the gap between Lijiao and the city, and integrate their development. Therefore, in the planning process, it is necessary to fully develop and utilize linear natural elements such as urban recreation greenways, linear park green spaces, and riverfront green belts to connect Lijiao with different scale natural elements in the city, forming a multi-type, multi-scale, and multi-functional urban nature-friendly network. At the same time, integration with the surrounding city's transportation system, urban landscape system, building and space system, and urban facility system should be considered to truly bring Lijiao back to the embrace of the city.

6.1.2 Context analysis

The analysis of basic conditions mainly starts from two aspects: natural conditions and human conditions. Through comprehensive analysis, the advantages of Lijiao are its abundant natural resources and urban location, which give it the potential to develop into an important node in the biophilic network. The existing problems of Lijiao are also common in many urban villages in Guangzhou, such as the disconnection between public space and the city, disconnection from natural resources, negative impacts of urban gentrification, and low accessibility to transportation. These issues hinder the future development of Lijiao and lead to the prospect of complete demolition and reconstruction.

Table 6-1 Lijiao Urban Scale Base Conditions Analysis

Context		Strengths	Weaknesses
Beginning in Nature	City context	North of Haizhu Lake, south of the Pearl River back channel, east of South China Expressway, located in the southern end of the central axis of Guangzhou	There are more urban villages in the surrounding area, and the park to the north causes a certain development blockage
	Public space	—	Little public space of its own and disconnected from urban public space
	Building Feature	—	—
	Natural Resource	To the north and east are adjacent to the Haizhu Wetland Park, to the south is the Pearl River, and to the west is the Haizhu Children's Park and a large urban green space, located in the embrace of natural resources	Lijiao's internal space and natural resources are not connected to the surrounding natural resources and cannot form a complete pro-nature network
	Climatic condition	A place to dissipate the urban heat island effect	Extremes of rainfall can easily cause flooding
Beginning in Humanity	Psychological need	—	Urbanization and gentrification of the surrounding area, which prevents equitable access to urban resources
	Physiological need	Rich pedestrian network system with high safety of internal traffic	Poor internal accessibility, all transportation systems are difficult to integrate with the city
	Cognitive need	—	Villagers have difficulty interacting with the city, resulting in a lower urban status
	Management	—	Although included in the plan, they are still on the edge of the city, difficult to integrate into the city management system, and face the risk of total demolition



Located in the embrace of natural resources



Poor internal accessibility

Fig 6-1 Conditions Analysis of Lijiao

6.1.3 Element identification

Conduct research on Lijiao and its surrounding areas, and analyze and organize the natural elements, public spaces, and integrated elements according to the three categories proposed in the design strategy in Chapter 4, extracting available elements and drawing identification maps for each type of element.

6.1.3.1 Identification of urban natural elements

Firstly, identify and analyze the natural elements around Lijiao, which are mainly green infrastructure such as wetland parks, rivers, and abandoned green spaces.

Lijiao has very favorable natural location conditions, with two natural network centers in its surroundings, namely Haizhu Wetland Park and the back channel of the Zhujiang River. Haizhu Wetland Park is a large, continuous, ecologically valuable wetland protected area and is a very important natural conservation area in Guangzhou. Although the back channel of the Zhujiang River has less ecological value for sightseeing and entertainment compared to Haizhu Wetland, it is indeed the source of life in Guangzhou and has very high biological sensitivity.

There are fewer green corridors around Lijiao, with a single type of various rivers and surrounding ecological areas, but these rivers connect the two network centers of the Zhujiang River and Haizhu Lake, forming the backbone of a natural network.

There are many patchy sites in this area, which are basically abandoned urban land, mostly semi-wild environments, as well as some ecological experimental areas and parks, scattered mainly in the surrounding plots of Lijiao, with the possibility of being connected.

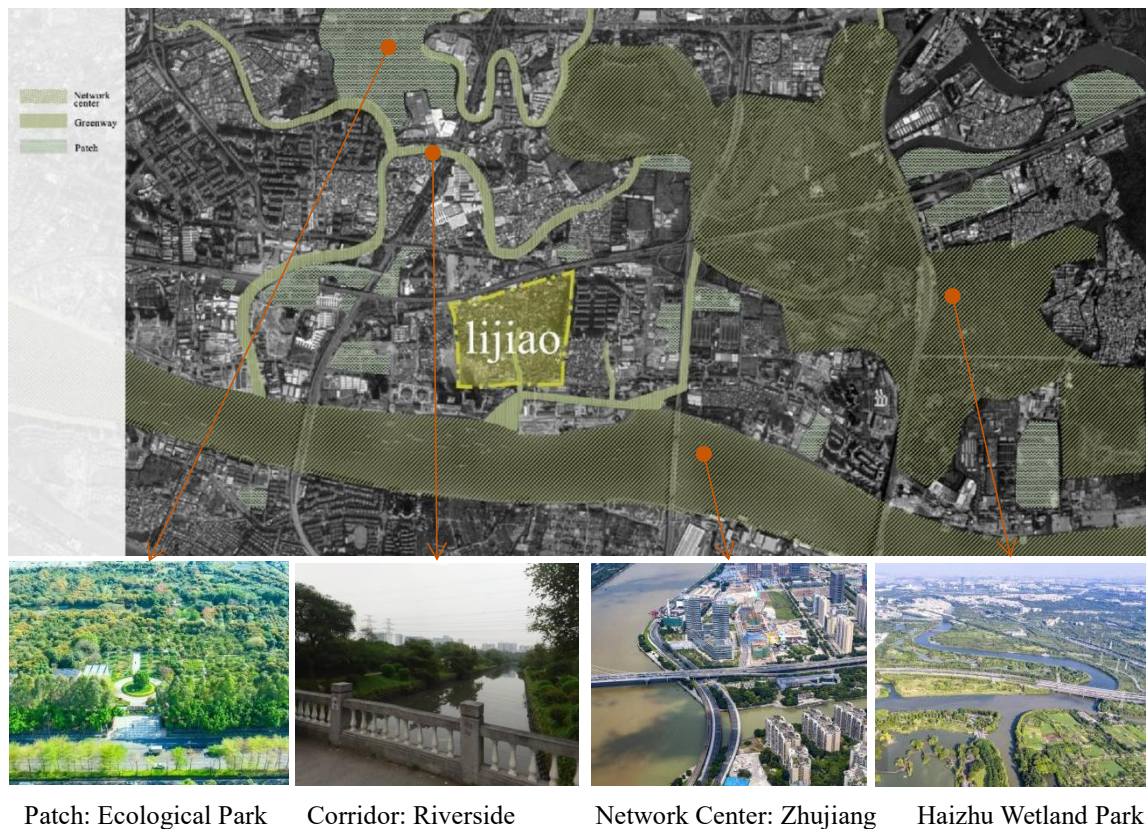


Fig 6-2 Lijiao nature Elements Identification Diagram

6.1.3.2 Identification of Urban Public Space Elements

Identify and analyze the urban public spaces around Lijiao, which mainly refer to public spaces that can meet the needs of public activities but do not provide natural environmental elements, such as walkable motor vehicle lanes and urban undeveloped land.

The Lijiao area is already urbanized, but due to its good ecological environment, there are not large areas of purely public spaces. Instead, there are mostly patchy public spaces, which are usually urban land that has been hardened but not yet developed for use. Some of these lands exist within the Lijiao area, mainly due to the demolition of some village houses, but no continuous construction has taken place.

The linear spaces around Lijiao are mainly composed of streets designed to reserve space for pedestrians. Lijiao forms a north-south layout and an east-west transverse trend, but there is no space within Lijiao that can link the two, resulting in poor connectivity between the two streets and not conducive to the continuity of slow traffic.

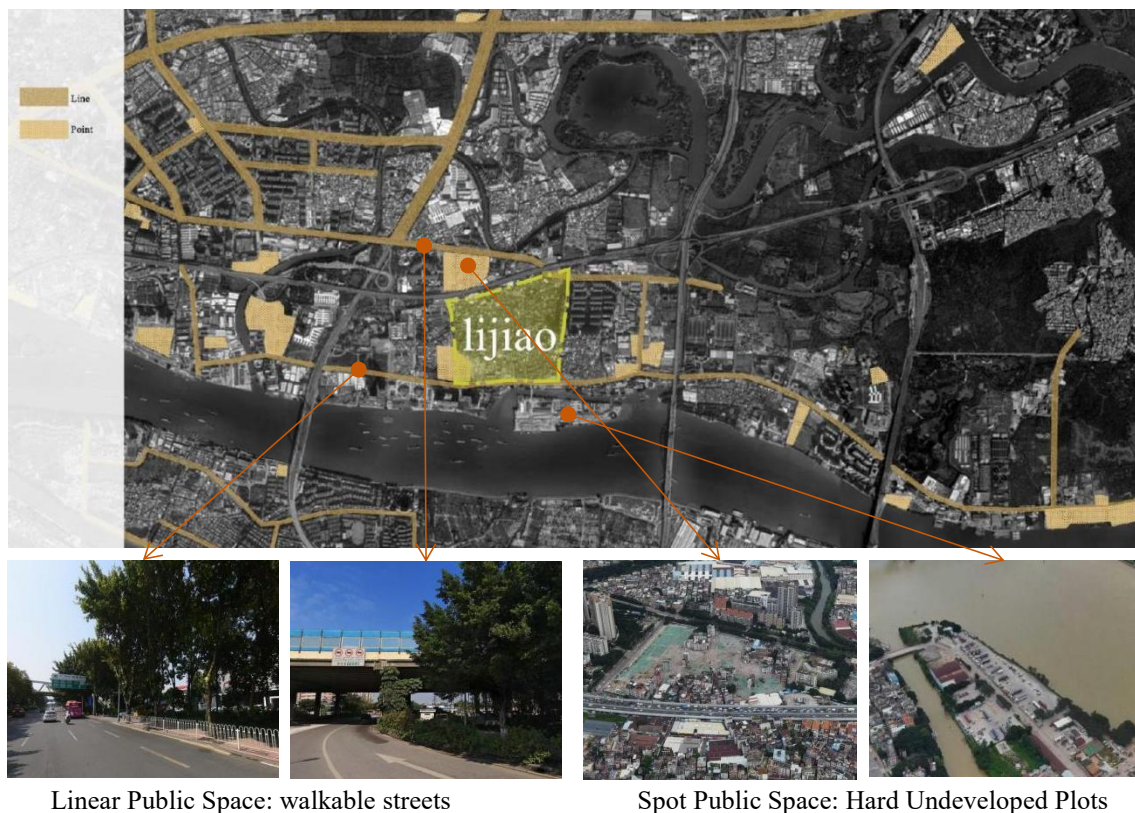


Fig 6-3 Lijiao public spaces Identification Diagram

6.1.3.3 Identification of Urban integrated Elements

Due to the rich ecological resources in and around Lijiao, there is a wide distribution of

integrated public spaces in the surrounding areas. However, within Lijiao itself, there is limited urban space, resulting in fewer integrated spaces.

The area's most significant proportion of integrated spaces is in the form of flat-shaped spaces, particularly those near the network center Haizhu Wetland Park. These spaces consist mainly of urban farmland and activity parks, maintaining the farming habits of the village.

Linear-shaped integrated spaces mainly include riverside walkways on both sides of the river channel. The river channel on the northwest side of the site has good greenery and walking conditions. However, for the space along the Zhujiang River, the connectivity of the walkway is low, and there are many breakpoints that need to be strengthened.

Point-shaped integrated spaces are relatively scarce around Lijiao, with most of them being residential areas with attached greenery or parks. They have low openness and generally serve a small area.



Fig 6-4 Lijiao Integrated spaces spaces Identification Diagram

After drawing each type of public space, a detailed element type map was summarized. By identifying the map, it can be seen that although various types of surrounding space resources

are abundant, they are complex in type and lack vitality, resulting in many pure public spaces that cannot form a network pattern. Secondly, there is a lack of living space for various types of elements within Lijiao, which leads to a lack of functional connection with surrounding blocks, resulting in a discontinuity of human and biological activities. Therefore, it is necessary to systematically overlay the functions of surrounding blocks to achieve a smooth surrounding network, then develop public spaces within Lijiao to connect to the urban network, forming a connected pattern.



Fig 6-5 Lijiao Element Identification Diagram

6.1.4 Systematic overlay

The key to planning and researching the renewal of urban villages with a pro-nature city orientation at the macro level lies in how to integrate and utilize the resources of urban villages and cities to establish a city network pattern based on the biophilic concept. After identifying various elements in Lijiao and its surrounding areas, it is necessary to optimize and transform various spaces to form a more connected network pattern at the macro level under the biophilic city orientation by integrating and utilizing the resources of urban villages and cities. In various spaces surrounding Lijiao, public spaces are mostly undeveloped land and hard-surfaced spaces that should not be used for parking. Therefore, such spaces can serve as the main body of transformation and be transformed into nature-led ecological zones

and human and natural symbiosis zones based on the surrounding environment and usage to promote the formation of a biophilic network.

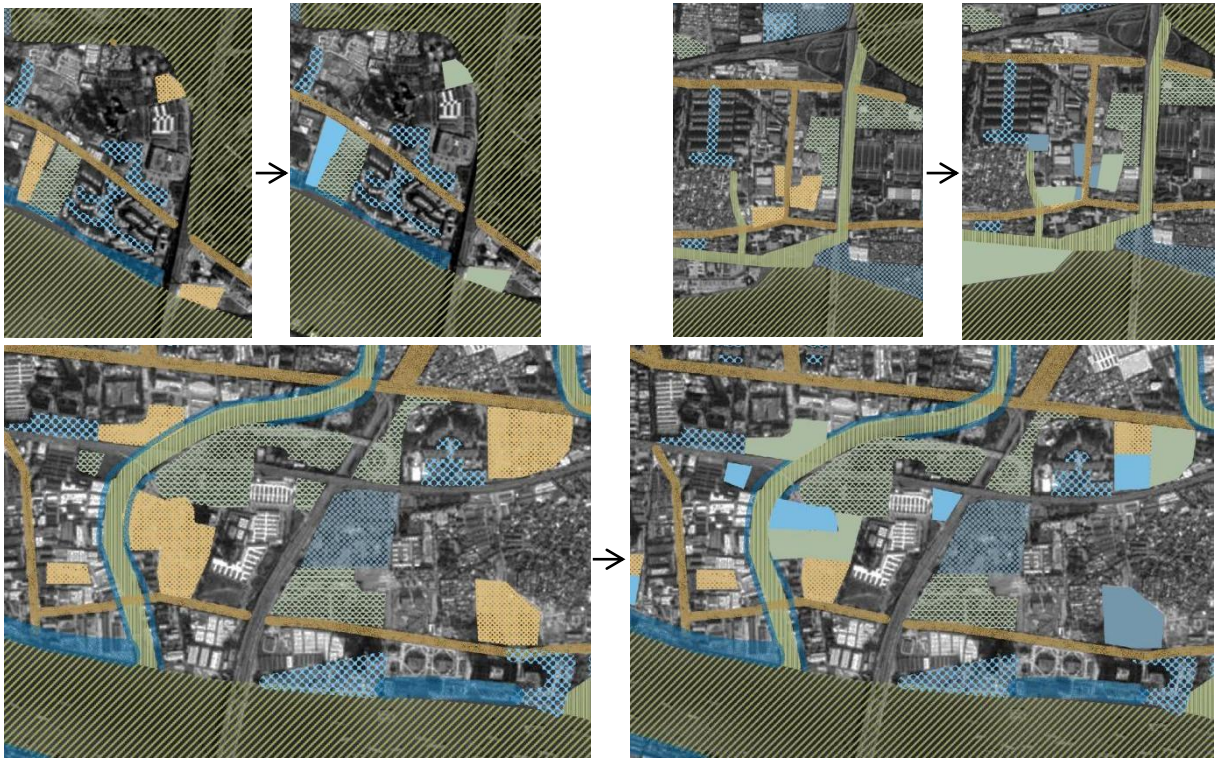


Fig 6-6 Functional overlap of various types of plots

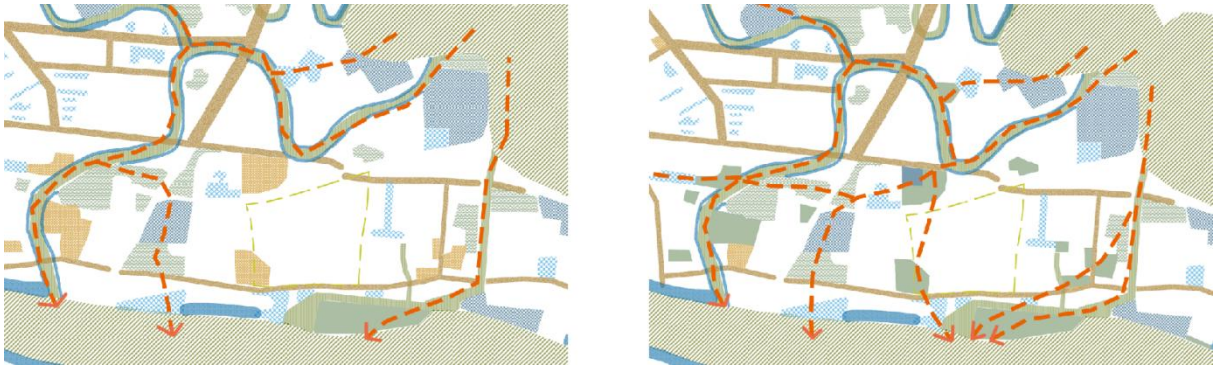


Fig 6-7 Biophilic network integrity creation

6.1.5 Lijiao and urban mix development approach

After shaping the network around the urban village, the next step is to ensure the smooth connection between the internal spaces of the village and the surrounding network. There is a river in the Lijiao area, which provides a clear spatial axis, but this axis is broken within the village and cannot connect to the urban network. Additionally, it lacks ecological value and does not meet the conditions for high-quality public space. Therefore, the site needs to be updated and planned to facilitate network connectivity.

Specifically, it is necessary to ensure the smooth connection of the natural network and public space network of Lijiao and study their combined development with other urban area. In terms of the ecological network, Lijiao is located in the periphery of the network center and corridor, and the available combined development methods are mainly borrowing scenery and intersection. To create a line of sight through the network center, borrowing scenery can be employed, and for the corridor, network shaping needs to be carried out internally, extending the network outwards to intersect with the urban corridor for mutual development. As for the public space, Lijiao needs to rely on the construction of linear public space to connect the internal and surrounding public spaces, forming a combination of intersect and overlap to enhance integration and allow the surrounding population to flow into Lijiao.

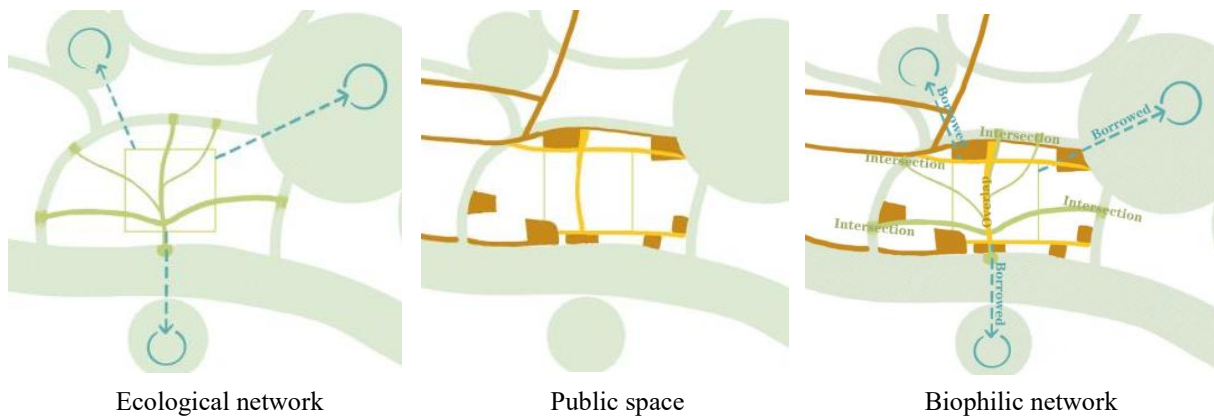


Fig 6-8 Internal diagram of different network connections

After shaping the network, it is discovered that the central axis of Lijiao is not only the network range of public space, but also the network range of ecological space. Therefore, it is necessary to develop a fusion zone that overlaps both, and create a series of fusion zones under the elevated highway on the north side to blur the boundaries of urban villages. The east-west axis is mainly the range of ecological space, so it needs to be optimized and designed to achieve a vision of a biophilic street and maximize ecological value.

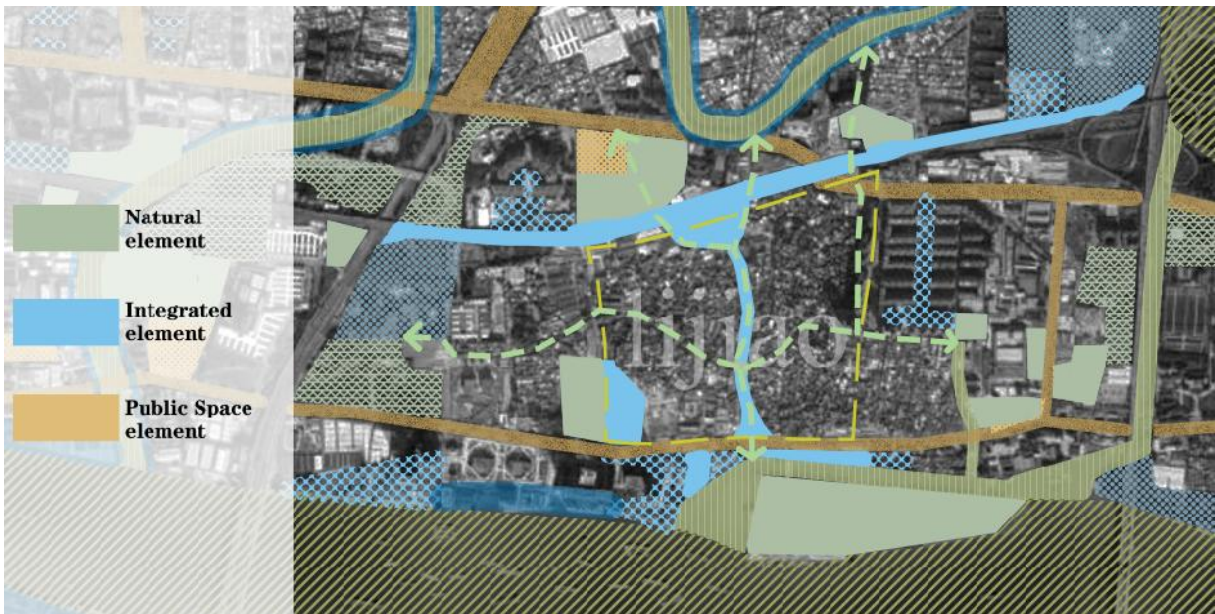


Fig 6-9 Functional space classification and optimal layout

6.1.6 Urban scale renewal achievements

The key focus of the design is to conduct a comprehensive analysis and construct a holistic network system by sorting out the resources around the urban village. By sorting out the existing natural elements, more green spaces that can be reasonably built can be provided for the site, enhancing its connection with the surrounding environment and improving the environmental quality and landscape effect of the urban village. Through sorting out and planning the integration elements, people can get closer to nature, have more places and opportunities to interact with nature, and attract more citizens to participate in activities in addition to the villagers. Recognizing and constructing public spaces can create multiple urban open spaces, increase space for citizen activities, strengthen the connection and interaction between the urban village and the surrounding areas.

The most important aspect of the design at this scale is how to connect the natural elements inside the Lijiao district with those of the city through the application of biophilic elements. First, regarding the use of water systems, there is an abundant water system in the Haizhu Wetland located in the north of the site. Therefore, connecting the Lijiao River in the south of the site with the river in the north and integrating it into the surrounding water system network of the Haizhu Lake can create a north-south flowing river and enhance the ecological nature of the river. Then, excavating the park green space and other block facilities, the north

of the site is the Haizhu Wetland Park, which is the center of a large natural network. However, there are no block green spaces within the site and its surroundings, so some green spaces are added around the site to supplement the green rate. Next, the greenway serves as the backbone connecting the network, and the existing network mainly concentrates in the north of the site, so it is necessary to increase the setting of greenways inside the site and along the riverbank. The final step is to sort out the road system, increase the accessibility of the site, and integrate the urban village into the natural network.

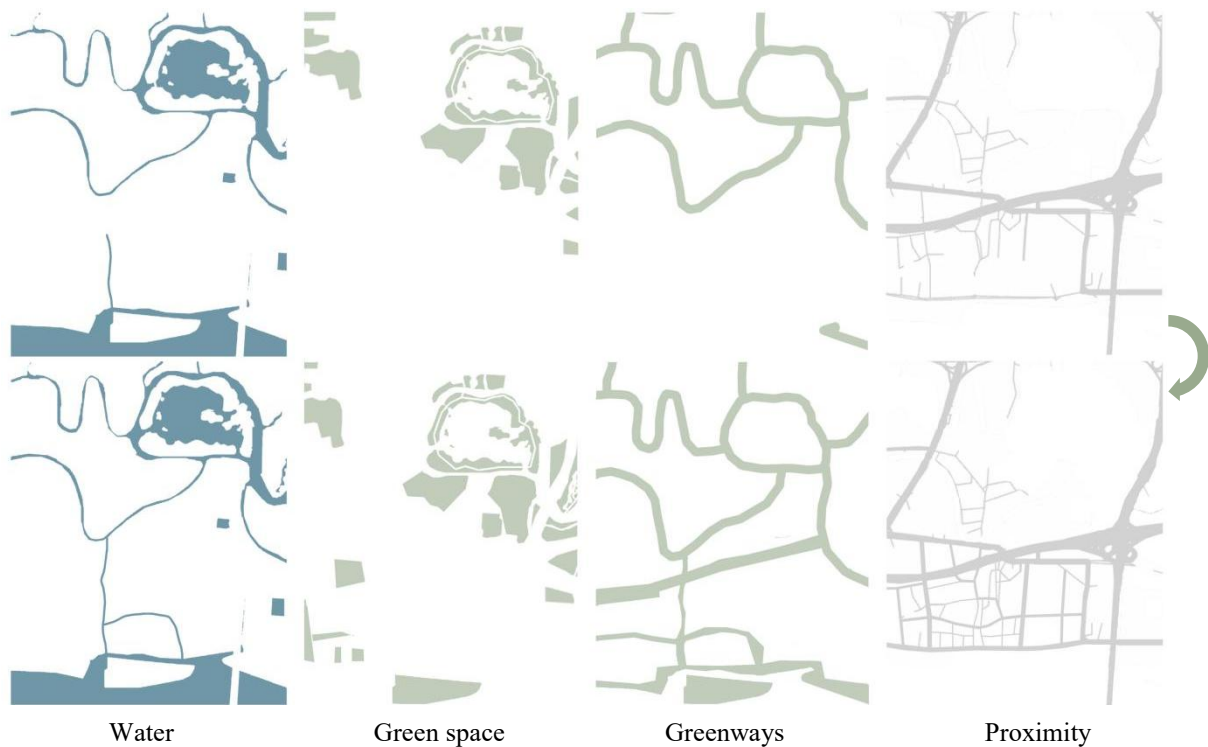


Fig 6-10 macro-scale renewal of integrated biophilic elements

In summary, through sorting out various elements in the surrounding area of Lijiao, establishing an internal and external network pattern of proximity to nature, strengthening the connection between the site and the surrounding natural elements, breaking the boundaries of the site, allowing Lijiao to become a site that is accessible from north to south and from east to west, and integrating with the surrounding cities for development rather than being an isolated island of urban development.

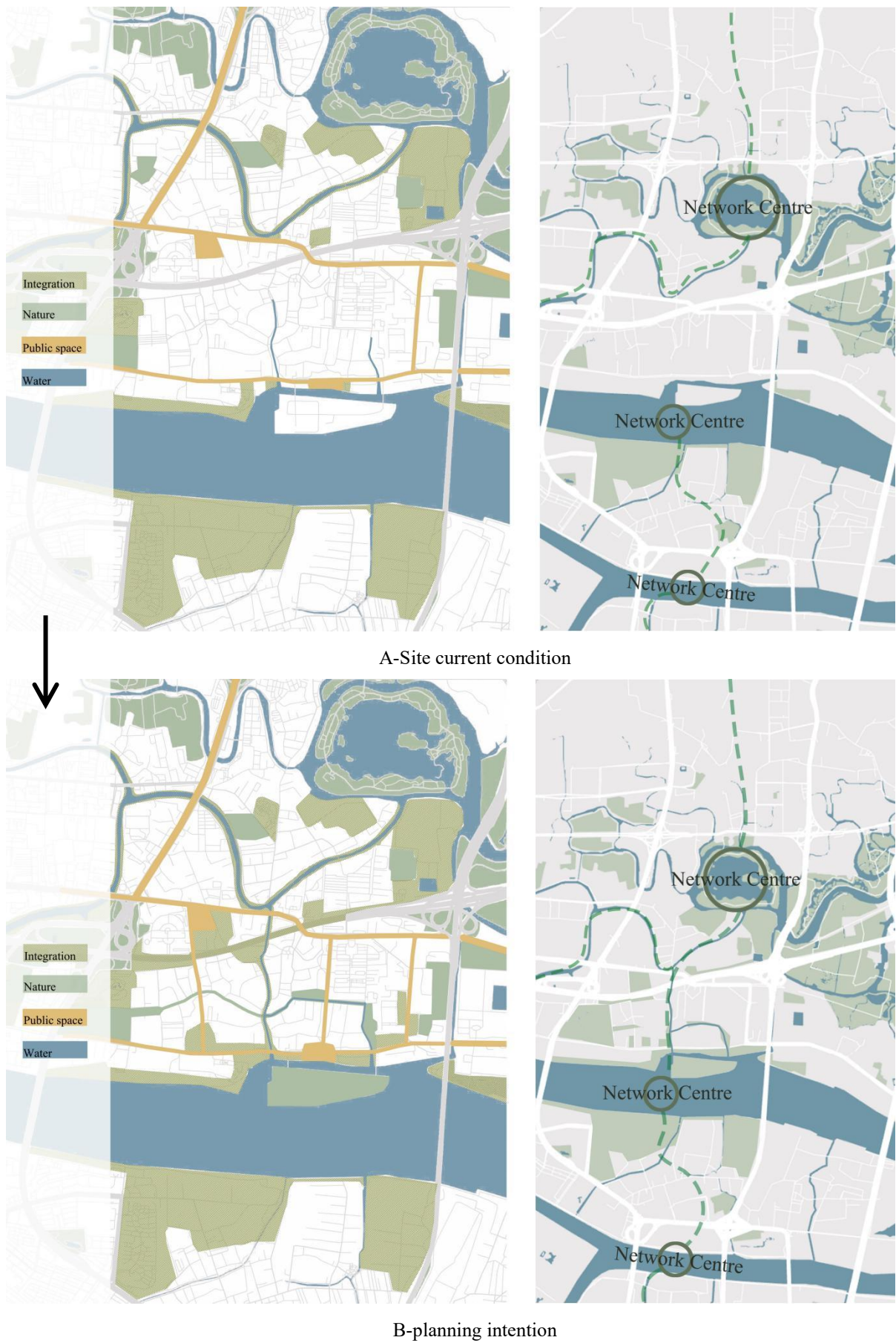


Fig 6-11 Comparison of site current condition and planning intention

6.2 Meso-community Scale Renewal for Lijiao

6.2.1 Renewal Objectives

Urban villages are special human settlements within the city with distinct cultural circles of life, serving as a habitat for various urban populations who spend a lot of time living here. However, environments like Lijiao, a typical urban village, are not suitable for human habitation due to the lack of urban environment, public facilities, and public spaces. An ideal community is not only a place where urban residents can directly experience life after work, but also a place where people can identify and connect with nature, and form emotional memories and attachments. By building a city's biophilic community, residents of Lijiao can have more opportunities to enjoy urban public spaces, awaken their innate love of nature, and become more conscious of protecting the natural environment of Lijiao, achieving sustainable development.

Therefore, the main design objective of meso-level design is to integrate public spaces and natural elements at the community level, deconstruct, repair, and organically update the overall functions, optimize the allocation of public resources in the entire community, form an internal biophilic network, and enable each villager to enjoy urban resources more fairly, creating a biophilic and livable community.

6.2.2 Context analysis

Table 6-2 Lijiao Community Scale Base Conditions Analysis Table

Context	Strengths	Weaknesses
Context	——	——
Public space	Most of the public spaces have historical elements and are highly utilized regardless of size	Single form of public space, mostly hardened ground and roadside open space; fewer in number, and more seriously occupied by parking
Beginning in Nature	Most of the plots have a strong sense of architectural layout and were built over a wide range of eras, resulting in a variety of forms and many historic buildings	High building density, public space is seriously squeezed, and it is difficult to meet people's daily needs for outdoor activities (mainly the elderly)
Natural Resource	Lijiao has many historical and natural elements, including Lijiao Chung and ancient trees along the axis, and many ancient trees and small gardens within the village	Natural elements have succumbed to the development of Lijiao; the perimeter of the river is occupied by parking space, and ancient trees are surrounded by hardened ground and buildings, making interaction impossible
Climatic condition	Lijiao has a pleasant microclimate due to its tight texture and low sunlight hours	Heavy rainfall extremes tend to cause flooding

Context	Strengths	Weaknesses
Beginning in Humanity	Older people: The streets and alleys are full of history and give people a strong sense of belonging	Seniors: too few places to socialize, the only places to gather are the marina and Lijiao Park, which are overcrowded, and the rest of the time they can only socialize in street side seats
	Psychological need: Families: close network of urban village life, easy to meet children's social needs	Families: children are able to contact nature in their lives, few social places, basically only park places; streets are cluttered with little safety
	Youth: Affordable rents, good for living	Youth: Insufficient places for leisure and social interaction and psychological healing; the park is occupied by the elderly and children in the north, and there is basically no public space for youth
	Physiological need: Seniors: fewer cars inside Lijiao, small-scale streets, good for walking	Seniors: There is no daily exercise function inside the park and other places, and the integrity of the walking space is not enough
	Families: Sufficient facilities such as school kindergartens, education issues can be avoided, traffic is difficult to reach the interior, safer environment for walking to school	Families: There are few places for children to play, and even around schools there are no recreational places designed for children, so there is no place to spend energy.
	Youth: -	Youth: poor subway commute, few places for daily leisure and exercise
Management	Elderly: historical heritage, able to perceive memory and history through buildings (such as ancestral halls)	Seniors: Lack of educational venues specifically for seniors, such as senior centers or senior universities
	Cognitive need: Families: with historical heritage, you can educate your children about history	Families: Apart from schools, educational activities and places that children can participate in are missing, thus making it difficult for them to know about nature
	Youth: -	Youth: lack of understanding of the history of Lijiao, little interaction with the ancient woods of Hechong, and difficulty in creating a sense of belonging
	The community management unit will do some environmental protection work, such as cleaning up the river and building trees, etc.	Internal management organization is complicated, community organizations have a large workload and can only maintain, making it difficult to play an active role



Rich in natural and historical elements



Natural elements are ignored

Fig 6-12 Lijiao Base Conditions of nature resources

From the perspective of human habitation, the advantages of Lijiao are the strong living

atmosphere, rich historical sense, and low cost of living convenience, which have led many young migrant workers to choose to temporarily reside here. However, there are also many shortcomings in the living environment of the urban village, such as a lack of public space, compressed social environment, serious overlap of space usage among different groups leading to conflicts, and a lack of public facilities that make it difficult for residents to obtain physical and psychological comfort. The purpose of updating design on a medium scale in Lijiao is to change this situation and make urban facilities better accessible to all groups.



Strong living atmosphere, high usage of public space



Less and compressed public space

Fig 6-13 Lijiao Base Conditions of Human Habitat

6.2.3 Public Space Map of Lijiao

Section 4.3.4 of this thesis proposes that the valuable public spaces for urban village populations are mainly categorized into five types: sports and games, nature education, leisure and socializing, nature therapy, and public transportation. Based on this, research was conducted on the public spaces within the Lijiao area and a map of public spaces was drawn. From the map, it can be seen that the current public spaces in Lijiao are mainly concentrated along the central north-south axis and the surrounding areas, with smaller and scattered areas. There are more open spaces outside, with some large activity areas. In terms of function, the internal public spaces in Lijiao are relatively single in function and cannot meet the diverse daily needs of people. Some peripheral plots have the characteristics of integrating multiple

functions, but they are relatively private and cannot provide too much activity space for Lijiao.

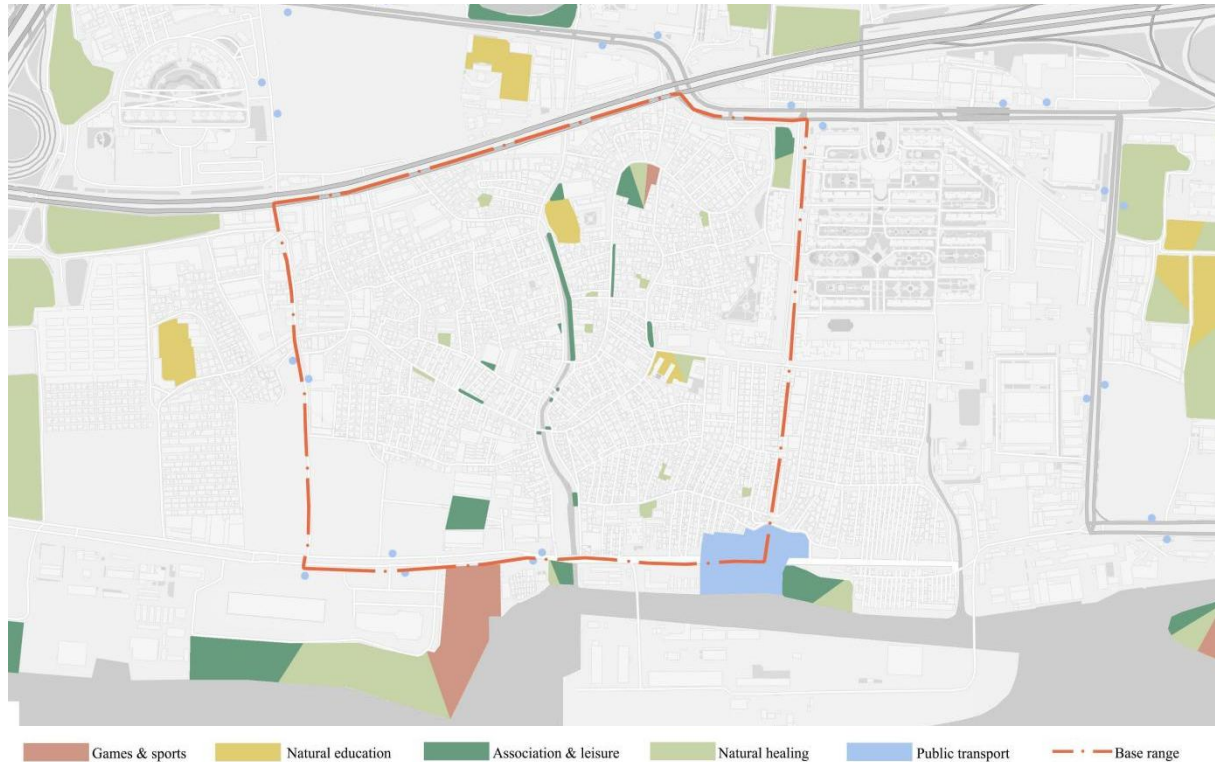


Fig 6-14 Public Space Map

Based on the above map, each plot will be analyzed for its naturalness and accessibility to determine where to add what type of functional plots and where to fill in natural elements to establish a more equitable and accessible internal network of biophilic.

6.2.4 Map-based plot analysis

6.2.4.1 Biophilic affinity

A list and analysis of the internal and surrounding land plots within the service radius are numbered. Through a brief evaluation of a series of indicators, the degree of proximity to nature of each site can be determined, and a map indicating the strength of the natural affinity of the entire site can be generated based on the service range and location of the land plots.

Table 6-3 Biophilic affinity analysis




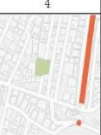














Number			1	2	3	4	5	6	7	8	9
Site											
Infra-structure	greenways	area	—	•	—	—	—	•	•••	—	•••
	Parks	The number of people living within 100m	•••	•••••	••••••	••••••	••••••	••••••	••••••	•••••	••••••
		area	•••••	•	••	••	••	••	••	•	••
	trees	Percent canopy coverage	•	•••••	•••••	•••••	•••••	•••••	•••••	•••	••••
		Total number of trees	•	•	••••	••	•••	••	••••	••••	•••
	Street tree	size class distribution	—	••••	—	—	—	•••	••••	—	••
	Pollinator nest boxes	quantity	—	—	—	—	—	—	—	—	—
	Wildlife passage	number	○	○	○	○	○	•	•	○	•
	Stream restoration	distance	—	••••	—	—	—	•••	•••	—	—
		area	—	••••	—	—	—	•••	•••	—	—
	stormwater mitigation projects	quantity	○	○	•	•	○	○	○	○	○
		area	○	○	•	••	○	○	•	○	○
	Diversified water	Type quantity	—	•	—	—	—	•	•	—	—
Physical and psychological needs	Space available for activities	••••	••	••	•	•••	••	•••	•••••	••	
	Sensorial Design	••	•	○	○	•	•	○	••••	○	
cognitive needs	Common native plant and animal species	•••	•••	•••	••	••	•	•••	•••	••	
	Observe and explore nature	○	○	••	••	••	○	•••	••••	•••	
Overall evaluation			•	•••	••	••	•	•••	••••	•••	••
Number			10	11	12	13	14	15	16	17	18
Site											
Infra-structure	greenways	area	—	•••	—	—	—	—	—	—	—
	Parks	The number of people living within 100m	••••••	••••••	••••••	•••••	•••	••••	••••	•••••	••••
		area	••	••	•••••	•••••	••••••	•••	•••••	••••	••••••
	trees	Percent canopy coverage	•••••	•••	•••	••••	••••	••••	••••	•••••	•••
		Total number of trees	••	••••	••••	••••	••••••	•••	••••	••••••	•••••
	Street tree	size class distribution	—	•••	—	—	—	—	—	—	—
	Pollinator nest boxes	quantity	—	—	—	—	—	—	—	—	—
	Wildlife passage	number	○	—	○	○	••	○	○	•••	•••
	Stream restoration	distance	—	•••	—	—	•••••	•••••	•••••	—	—
		area	—	•••	—	—	•••••	•••••	•••••	—	—
	stormwater mitigation projects	quantity	•	○	○	○	•••	○	○	••	••
		area	•	○	•	○	•••	○	○	••	••
	Diversified water	Type quantity	—	•	—	—	••••	••	••	—	—
Physical and psychological needs	Space available for activities	•	••	•••••	•	•••••	•••	•••	••	•	
	Sensorial Design	○	•••	••	○	••••	•	••	•••	•••	
cognitive needs	Common native plant and animal species	••	•••	•••	••	•••••	••	•••	•••••	•••••	
	Observe and explore nature	••	••••	•••	••	••••	••	••	••••	••••	
Overall evaluation				••••	••••		••••••	•••••	•••••	••••	••••



Fig 6-15 Site biophilic affinity map

According to the results, the northeast and southwest of the site have a strong natural affinity due to their proximity to two urban green spaces outside the site, and the presence of rivers and trees on both sides of the central axis of the site also contributes to a strong natural affinity. However, the northwest and east sides of the site are relatively lacking in natural affinity and need to be optimized and planned in these two areas.

6.2.4.2 Accessibility

The study of accessibility requires analyzing five functions: Game & Sports, Natural Education, Leisure & Socialising, Natural Healing, and Public Transportation. Depending on the size of the area, a service radius of 400 meters and 200 meters is used to observe the accessibility of the site.

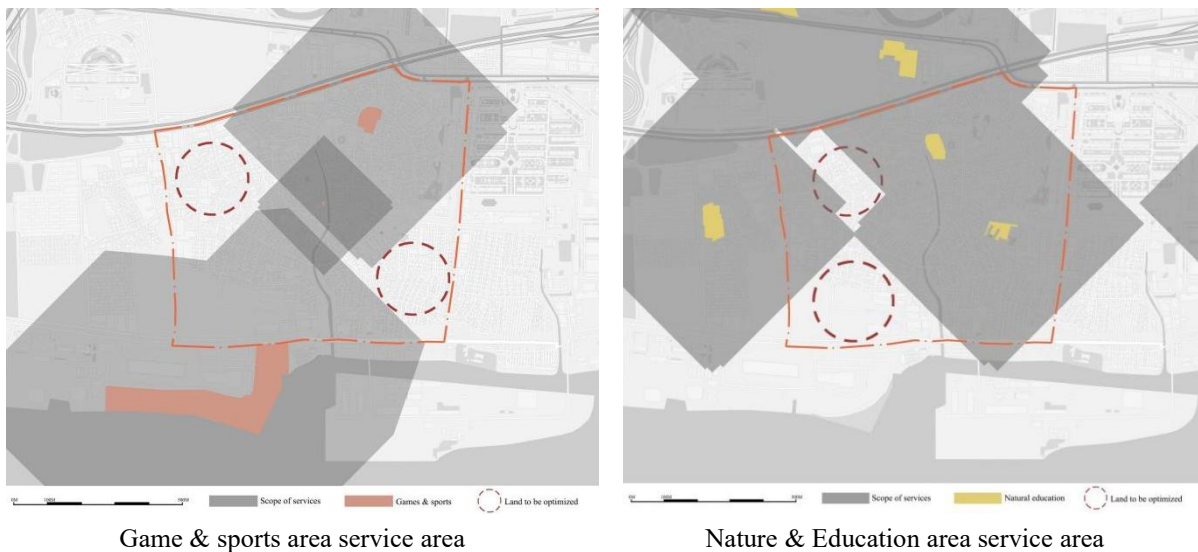


Fig 6-16 Accessibility map I

The Game & Sports area is relatively scarce both inside and outside the site, with most of the surrounding public spaces not providing relevant fitness or sports facilities. Within the site, the northwest and southeast are the gaps in the service range. In the plan, certain functional supplements should be added to these two areas, such as building sports parks within or outside the site to meet daily fitness and sports needs.

The main places for natural education are schools and kindergartens, with a single form and low degree of openness to the public. If we don't consider the closed nature of the institutions, in terms of the accessibility of the service scope, this type of place is mainly concentrated in the north of the site and is scattered. From the map analysis, it can be seen that the south and west of the site are relatively lacking in this type of place, and functional filling should be carried out in these two areas.



Fig 6-17 Accessibility map II

Compared to the first two functionally strong places, there are more places that provide Leisure & Socialising spaces, with a wider service range and stronger accessibility, but there are still some gaps within the site, especially in the northwest area where there is a lack of such places both inside and outside the site. Therefore, optimization planning is needed for the northwest area of the site to serve both the internal and external populations of the urban village.

Due to the rich natural resources, there are many natural healing spaces within and around the site, which can cover a wide range. Only the western part of the site needs some planning

supplements. However, although there are many healing spaces, most of them have not been used rationally and are in a state of disuse. Perhaps, future designs could enhance their utilization.

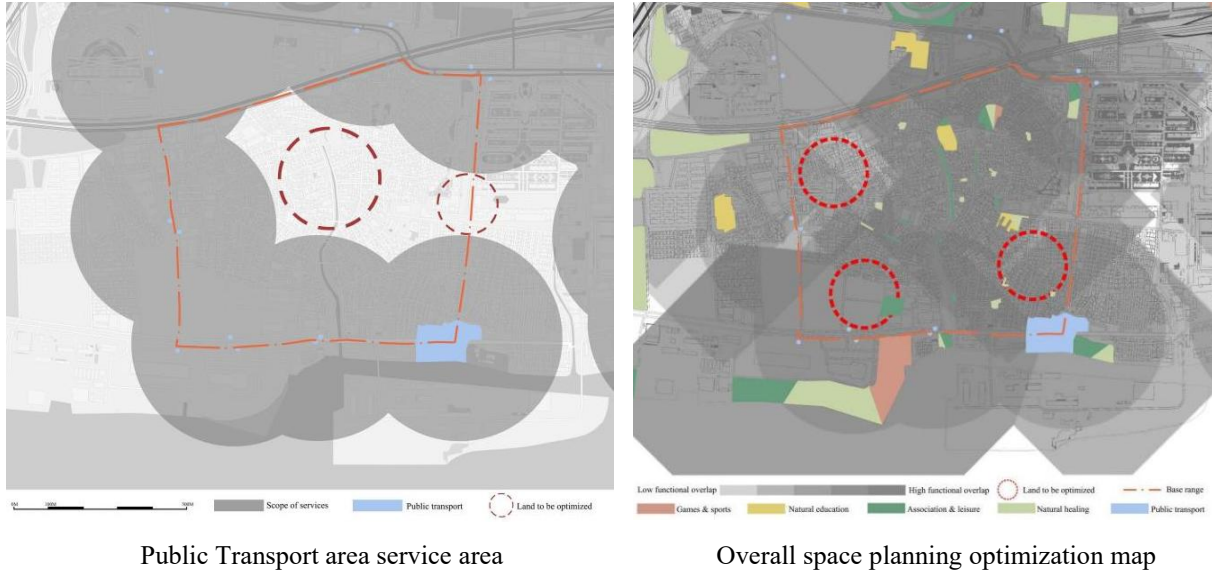


Fig 6-18 Accessibility map III

For public transportation spaces, these are important places that increase wide-ranging accessibility. However, for Lijiao, the central and eastern areas of the site are densely populated with urban village buildings, thus lacking reasonable planning for urban transportation. It is necessary to clarify the road network planning, unblock urban roads, and improve long-distance accessibility in subsequent designs.

Through the analysis of the five types of public spaces, it can be found that the site lacks plots for each type of function, so overall functional adjustment planning can be made. The northwest, south, and east of the site are the areas with the most missing functions, and more adjustments need to be made to the plots in these three places, such as demolishing some buildings and creating multi-functional biophilic community, so that people can step out of their homes to experience urban nature. For other plots, the main work is to integrate and utilize existing resources, optimize the existing spaces, and meet people's more diverse life needs.

6.2.5 Lijiao Space Optimization Planning

By constructing and connecting a biophilic network within and around Lijiao, and updating

the functionality of public space sites, we can obtain a comprehensive development plan for the future of Lijiao guided by the biophilic urbanism.



Fig 6-19 Overlapping results of two scales

The first step in biophilic design is to integrate the results of the meso-scale, which includes various types of spaces and specific locations that need to be supplemented, into the internal layout based on the macro-scale renovation.

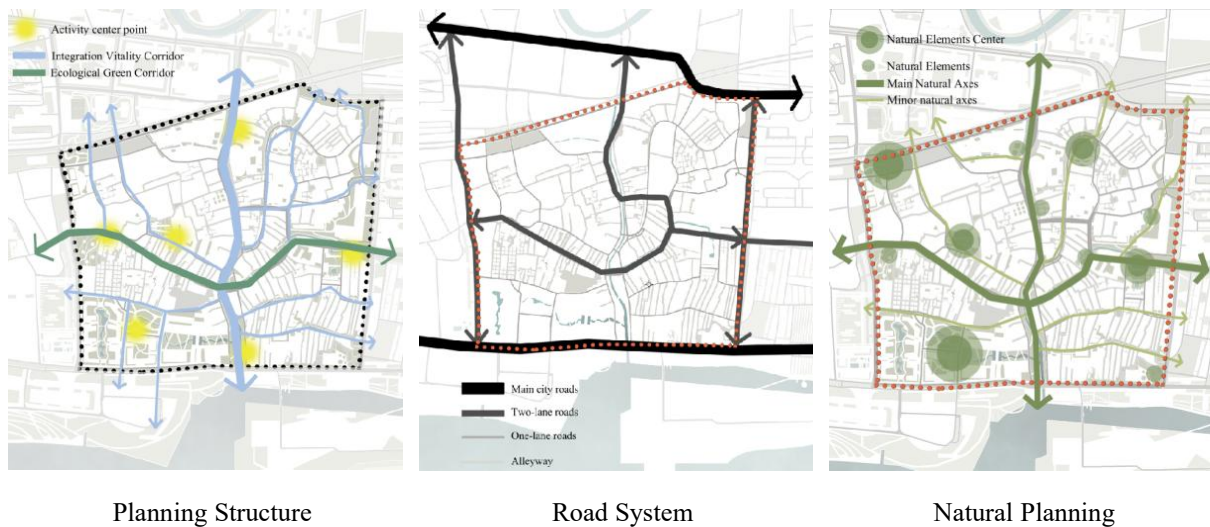


Fig 6-20 Master plan analysis I

Next is to determine the design direction of each plot, which has been basically determined through previous research, but still needs to be analyzed through various systems. Firstly, the overall Planning Structure, including the location of the two axes and the location of the main public activity points around them, is analyzed. Then the main roads are sorted out, including the internal three-way road network and the north-south roads on both sides of the site.



Fig 6-21 Master plan analysis II

Then the natural system and public spaces are analyzed to determine the specific attributes of the two axes, including the north-south fusion axis and the north-south natural corridor. Finally, based on the system analysis, the design theme of each major plot is determined, and the Land Use Planning of the site is based on this.

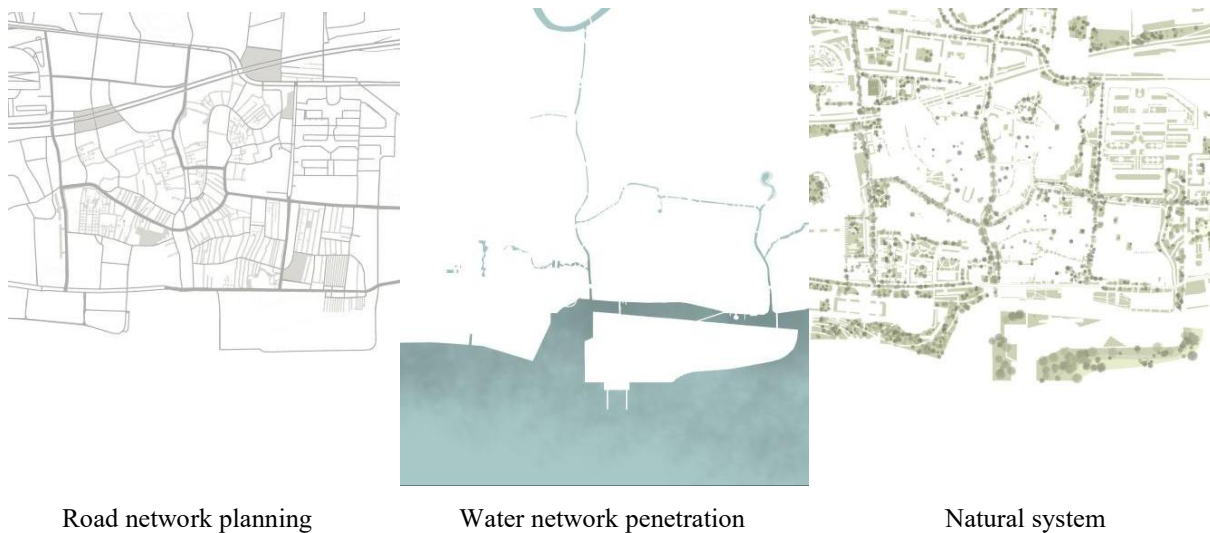


Fig 6-22 Integration of various systems

Lastly, integration and improvement of various biophilic elements, especially the network skeleton system, are carried out to refine the design based on the macro-planning. This includes unobstructed Road network planning, Water network penetration, and Natural system design.



Fig 6-23 Master plan of New Lijiao

In summary, the overall plan of the renovated Lijiao community can be obtained, which retains the ancient texture of Lijiao and maximizes the creation of a community with a natural atmosphere.

6.3 Micro-Site Scale Renewal for Lijiao

6.3.1 Site Selection of Micro-design

Micro-scale updates first require selecting high-frequency and high-benefit public spaces for renovation based on research and usage, in order to drive the positive development of the living environment for the entire area. According to the population heat map, it can be seen that the existing high-vitality public spaces are concentrated on the riverbank along the central axis and Lijiao Park near the north of the site, which are the preferred choices for crowd activities. Additionally, based on the previously mentioned accessibility analysis of public spaces, if the central public space where Lijiao Creek is located is updated and renovated, the service area can cover the entire site, and the biophilic network can also cover most of the streets in the site, which is very conducive to overall biophilicity and improved accessibility. Therefore, the selection of micro-scale blocks in the following steps should focus on these two areas, as shown in the figure.

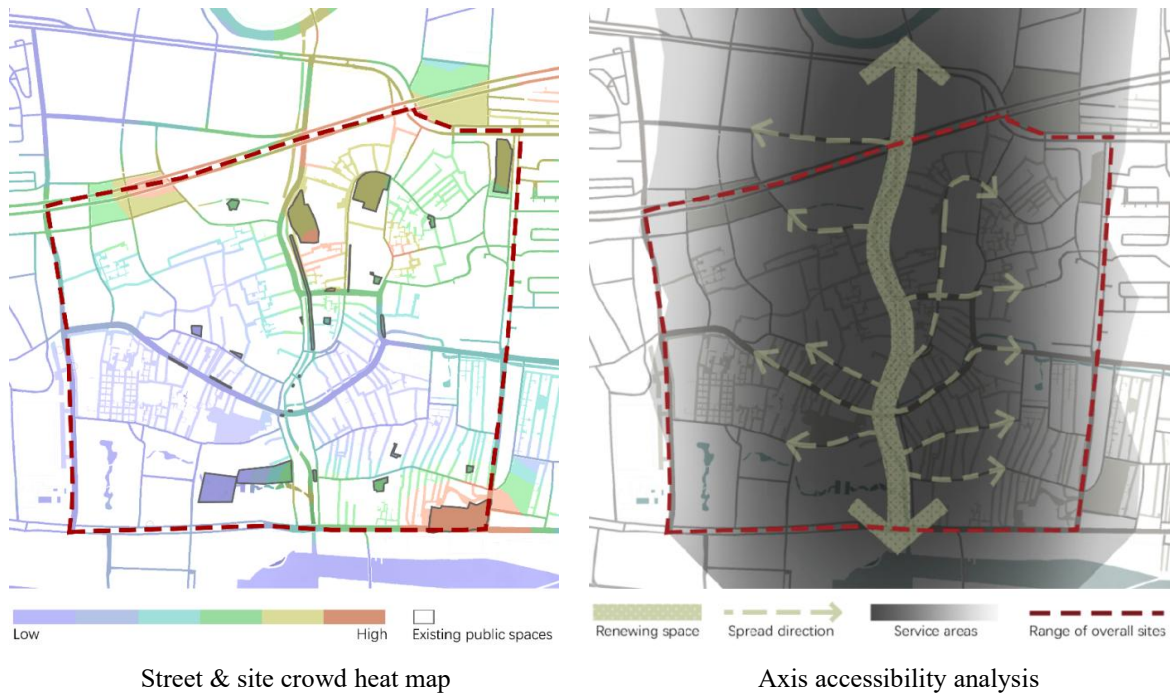


Fig 6-24 Site Selection analysis



Fig 6-25 Micro-design site areas

6.3.2 Renewal Objectives

The purpose of the urban village renewal at the micro-scale is to carry out micro-scale design in the Lijiao area of the urban village, with the aim of utilizing the small doses of natural elements that exist in Lijiao, and using the natural environment to re-use the originally inactive spaces. This includes creating biophilic public spaces, streets, and buildings in every active location, providing the public with access and pathways to nature in their daily lives, promoting daily leisure and contact between villagers and nature, and creating a more livable and healthy new life in Lijiao. Based on the original function of the site and the updates of the macro and meso scales, combined with the design directions proposed in section 4.4.5, the site will be updated and designed.

6.3.3 Multifunctional community park

6.3.3.1 Lijiao Park

(1) Context analysis

Lijiao Park is located in the northern part of the site and is the main public space where village residents can engage in leisure activities. However, due to its old construction age and the squeeze of urban village development, the park facilities are outdated and cannot meet the daily needs of residents, let alone their demands for proximity to nature. According to the research and analysis of the site, the main problems are shown in the table.

Table 6-4 Analysis of the base conditions of Lijiao Park

Basic conditions		Issues that need attention
Beginning in Nature	Natural Resources	Adequate vegetation, but the layout is limited, with a lot of vacant land, weak interaction between people and nature
	Public Space	weak overall functionality of the site, only social space and some sports facilitiesThe overall functionality of the site is weak, with only social space and some sports facilities, and not enough openness to residents, surrounded by a barrier net
	Transportation Location	Surrounded by roads, good accessibility for vehicles, but the surrounding roads are basically occupied by a lot of space for parking
	Architectural Properties	The interior building form is aging, aesthetics and functionality are lacking, and the surrounding buildings are built in a private manner, seriously compressing the natural space.
	Human Resources	Dense crowds, mainly middle-aged and elderly people and children, basically engaged in social behavior

Table 6-4 Analysis of the base conditions of Lijiao Park (Continue)

Basic conditions		Issues that need attention
Beginning in Humanity	Psychological Needs	The park doesn't have seating and other stopover facilities, so people can only socialize inside the building, and the site is too limited to interact with nature in a positive way.
	Physiological Needs	The venue has only basic sports facilities, barely able to meet the needs of adults, for another major user group of children without adaptive design
	Cognitive Needs	People cannot interact with natural elements such as plants, and the site does not provide relevant functions to achieve the nature education function
	Crowd dynamics	The venue has a high flow of people, all-weather crowd use, the use of the crowd is mainly the elderly and children, the evening is the peak period



Fig 6-26 Analysis of the base conditions of Lijiao Park

First of all, in terms of natural elements, Lijiao has a lot of vegetation, with a high vegetation coverage rate. Generally speaking, natural elements are not lacking, but the interaction with people is not close enough, and it is difficult for people to experience the benefits of the natural environment. Secondly, the lack of infrastructure is also a problem in Lijiao Park, with aging buildings, outdated fitness facilities, and garbage cans placed randomly, which diminishes the joy of activities within the park. Finally, various obstacles also hinder the vitality of Lijiao Park, including surrounding railings, houses that block the growth of trees, and a series of other problems that urgently need to be changed in Lijiao Park.

(2) Functional analysis

Through functional analysis of Lijiao Park, more problems in the current design of parks can be discovered. These include poor ecological quality, insufficient use of natural elements, weak accessibility, insufficient design of public spaces, and insufficient functional complexity, all of which need to be addressed in updated designs. For natural ecological issues, more species should be introduced to create a richer natural environment, while fully preserving and utilizing existing natural resources, and promoting positive interaction between people

and nature. For public space issues, the openness of the space should be improved, and the accessibility of pedestrian traffic and sightlines should be increased. At the same time, multi-level experiential spaces should be created to allow people to enjoy the natural environment of the park with multiple senses. For functional issues, the functional requirements of the site should be clarified, and reasonable spatial divisions should be made for the main user groups, such as children and the elderly, to make the park's functions more orderly and better able to meet the diverse needs of various groups.

Table 6-5 Functional Analysis Table for Lijiao Park

Type	Analysis point	Lijiao Park
Space Type	Degree of openness	semi-enclosed
	Space shape	point
Spatial characteristic	Terrain	undulating
	Interface	complete
	Accessibility	weak
	Pavement design	Yes
Social Function	Dynamic function	sports/gathering
	Static function	leisure
	Educational function	No
Ecological Function	Beautification function	normal
	Service function	normal
	Ecological protection	weak
Main Weakness	Lack of ecological design / public space planning /humanistic elements/Facilities/Multi-function...	

(3) Analysing & utilising biophilic elements

Lijiao Park covers an area of about 3,700 square meters and is the only centralized public open space in the surrounding area. The park is not only surrounded by old residential buildings in urban villages, but is also adjacent to public buildings such as Weiguoyao Memorial Primary School, a community cultural center, and Lijiao's commercial street, making it a necessary venue for daily activities for the people of Lijiao.

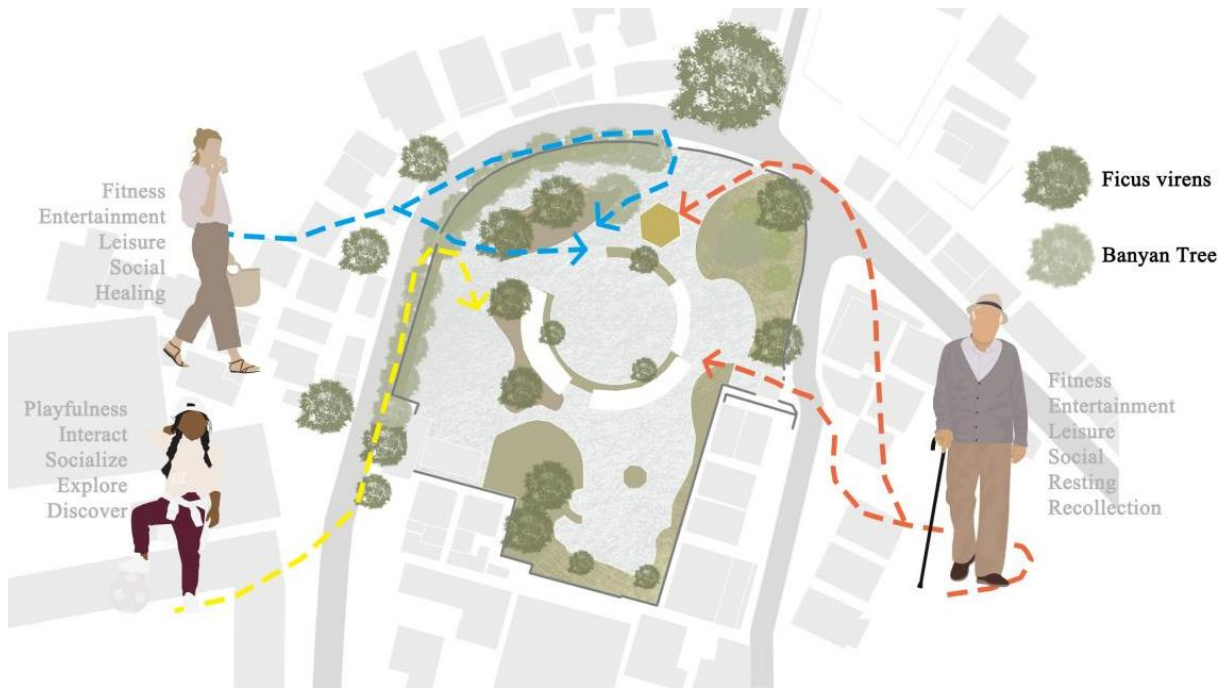


Fig 6-27 Current plan of Lijiao Park

The main elements of biophilic features within the site can be divided into three categories: trees, buildings, and open spaces.

Regarding trees, there are many ancient trees on the site, including banyan and kapok trees. The design approach for trees is to use reserved and transplantation methods to minimize damage to the plant's growth environment. In subsequent designs, forming walkways allow residents to walk through the woods, forming shade to provide gathering places under trees, and forming facilities for climbing and playing on trees.

Regarding buildings, although the current buildings are well-integrated with natural elements, their forms are outdated and the area is too small. Therefore, the approach for buildings is dismantling and new construction, retaining their function for casual gathering, retaining their form with openings on all sides, and finally changing their form to be cleaner and simpler.

Regarding open spaces, the approach is to embed natural elements and then pave the site. Retaining its function for casual gathering, changing its form to be meandering and interesting, and adding new functions to create an interest-oriented area.

Based on the above analysis, the site will undergo detailed design.



Fig 6-28 Existing biophilic elements of the site and utilization

(4) Site detailed design

The updated design of Lijiao Park takes "vitality" as its starting point, and organizes a multi-functional community park that is natural vibrant, lively, age-friendly and child-friendly, leisurely and playful and attractive to visit and enjoy.

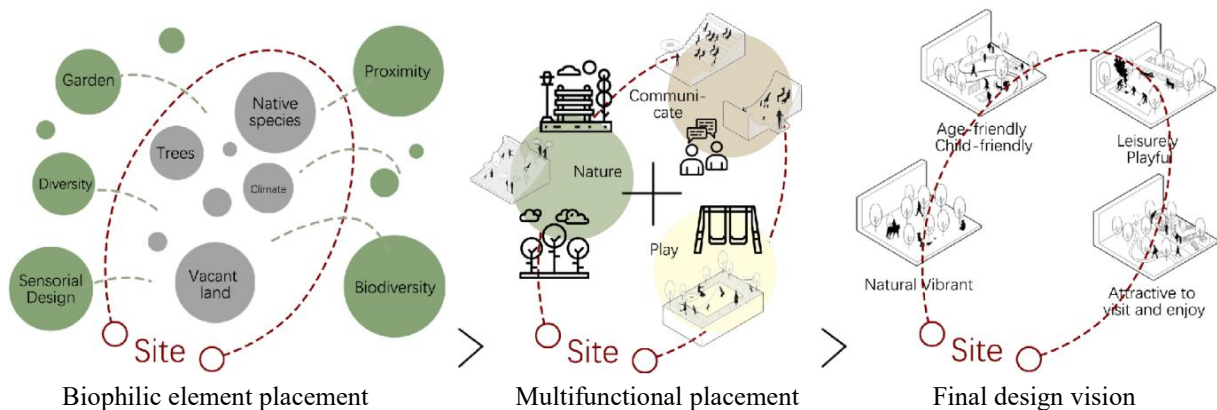


Fig 6-29 Design concept analysis diagram

The design of Lijiao Park is primarily based on preserving the original circular space in road organization. This circular space reflects the landscape characteristics of the spiral pool in front of Rongen Temple, which is a manifestation of Lijiao's historical heritage. A circular slow path is set around this circular space to better organize crowds in various directions, providing the park with maximum accessibility, enriching the experience level, presenting publicness integrated with nature, and shaping the spirit of the place.

The updated design of Lijiao Park's overall spatial structure and functionality, treating natural space as a carrier to inspire positive citizen activities and promote public life. Through green landscapes and spatial creation, the built environment becomes an interactive object. By

considering the flow of people and their interests, the activity space for the elderly and children is reasonably partitioned, satisfying the needs of the elderly and providing a natural corridor for villagers with social needs. The space under the corridor, combined with landscape architecture, provides citizens with shade and shelter from rain, creating an interesting and relaxing place to be in the natural space.

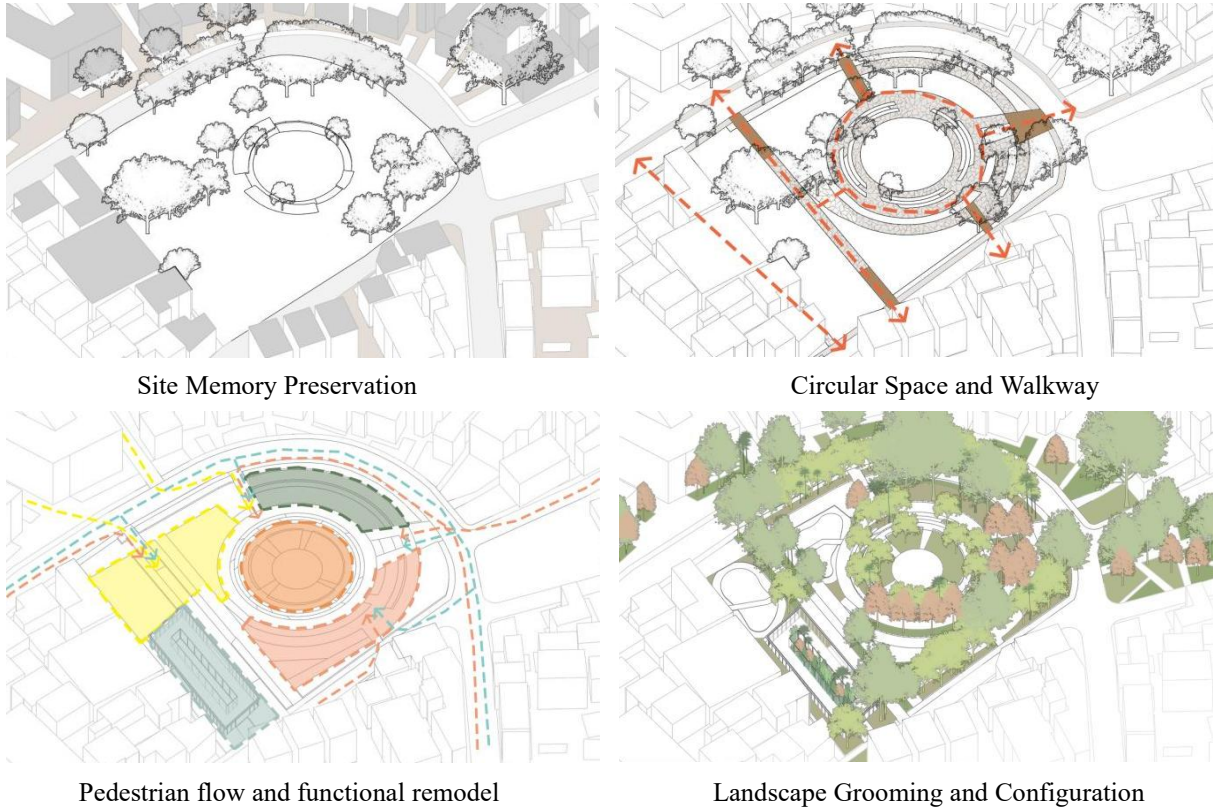


Fig 6-30 Design concept generation II



Fig 6-31 Overall Park Renewal Design

The updated design of Lijiao Park follows the principle of regionalism in its natural elements. People generally have a stronger desire to interact with familiar things, so the first step is to preserve the existing plants on site in order to create a public space that can evoke people's natural memories. The second step is to incorporate a variety of multi-sensory plants, such as red flower water chestnut and fragrant plants for olfactory experience, fruit trees for taste, and more accessible shrubs for tactile experience. Through the multi-level and multi-experience plant configuration, a diverse range of experiences can be achieved. The third step is to use functionality to interact with nature, such as designing a 100mm recessed sand area around the children's playground. Children can use this "natural toy" while sitting on white artistic concrete benches that blend in with the green landscape, promoting unrestricted recreational activities.

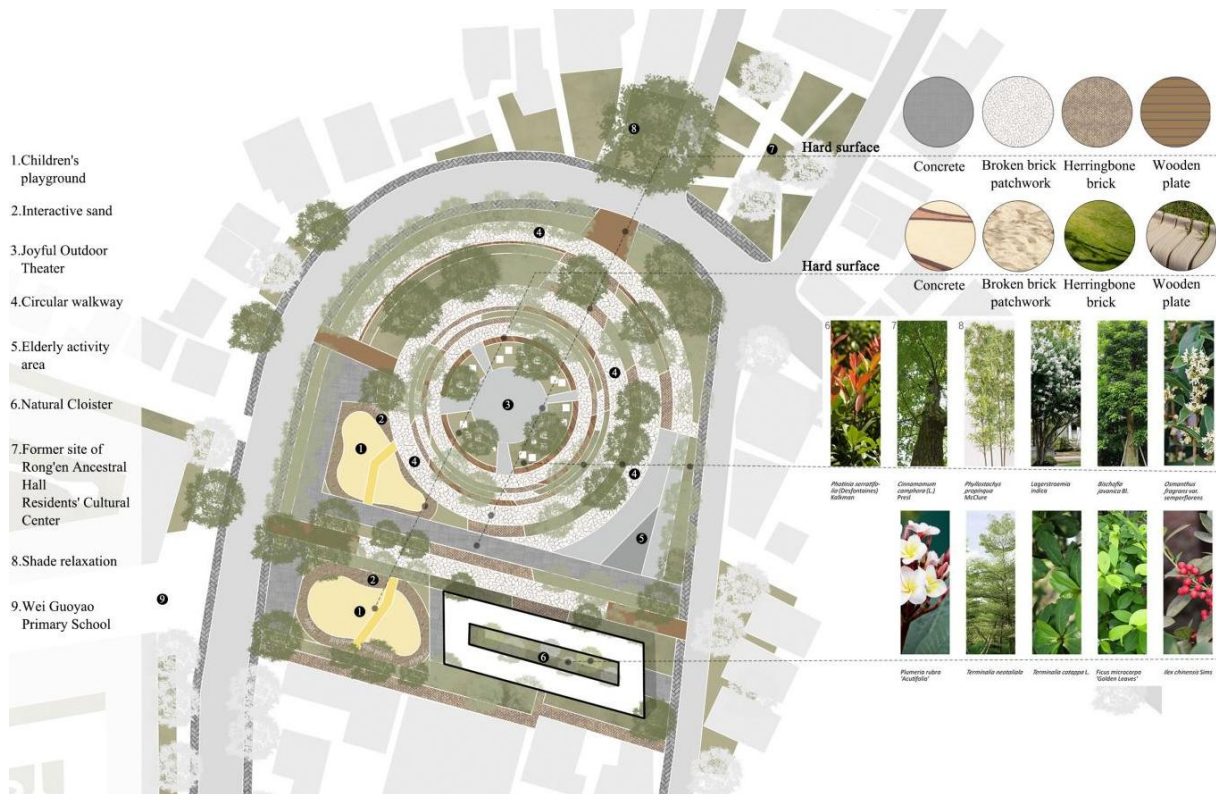


Fig 6-32 Master plan of Biophilic Lijiao Park

Through these various aspects of shaping, Lijiao Park is updated and transformed into a community space that is embedded in people's daily lives, providing more opportunities for people to connect with nature.



Fig 6-33 Perspective image of biophilic Lijiao Park II

6.3.3.2 Wetland Ecological park

(1) Context analysis

The site has many natural elements, including ancient trees and riverfront green space, but at the same time, there is also a large amount of hard-surface waterfront space and unused dilapidated houses, which severely damages the ecological nature of the site and is inconsistent with the nature of the overall planning block. Therefore, it is necessary to demolish a considerable amount of surrounding buildings and create more space to provide more habitats for nature.



Fig 6-34 Current site status

(2) Functional analysis

Through a functional analysis of this site, it can be found that there are existing design problems, including poor biophilic qualities, insufficient use of natural elements, weak accessibility, inadequate public space design, and insufficient functional complexity. These issues need to be addressed in the updated design. For natural ecological problems, more plant species should be introduced to create a rich natural ambiance, fully protect and utilize the river water, and promote positive interactions between humans and nature. For public space issues, a multi-level experiential space should be created to allow people to enjoy the park's natural environment through multiple senses and modes. For functional issues, the site's functional needs should be clarified, and reasonable spatial divisions should be made for the main user groups, such as children and the elderly, to make the park's functions more orderly and better meet the diverse needs of various groups.

Table 6-6 Functional Analysis Table for Wetland Ecological park

Type	Analysis point	Wetland Ecological park
Space Type	Degree of openness	semi-open
	Space shape	point
Spatial characteristic	Terrain	undulating
	Interface	no boundary
	Accessibility	weak
	Pavement design	No
	Dynamic function	gathering
Social Function	Static function	No
	Educational function	No
	Beautification function	normal
Ecological Function	Service function	normal
	Ecological protection	weak
Main Weakness	Lack of ecological design / public space planning /humanistic elements/Facilities/Multi-function...	

(3) Analysing & utilising biophilic elements

According to the overall plan, this node is located at the intersection of two axes, namely the north-south integration-type public axis and the east-west ecological corridor. According to the integrated development mode mentioned earlier, when two types of public spaces intersect, it is necessary to increase the ecological nature of the node to ensure the continuity of the natural space. Therefore, after shaping the terrain, the river water is introduced into the site to form multiple wetland patches and enhance the ecological nature of the site. The functional layout is based on the location of the patches, allowing people's activities to interact with natural habitats. Finally, a pathway is used as the main network to connect the patches and weave the entire site together.

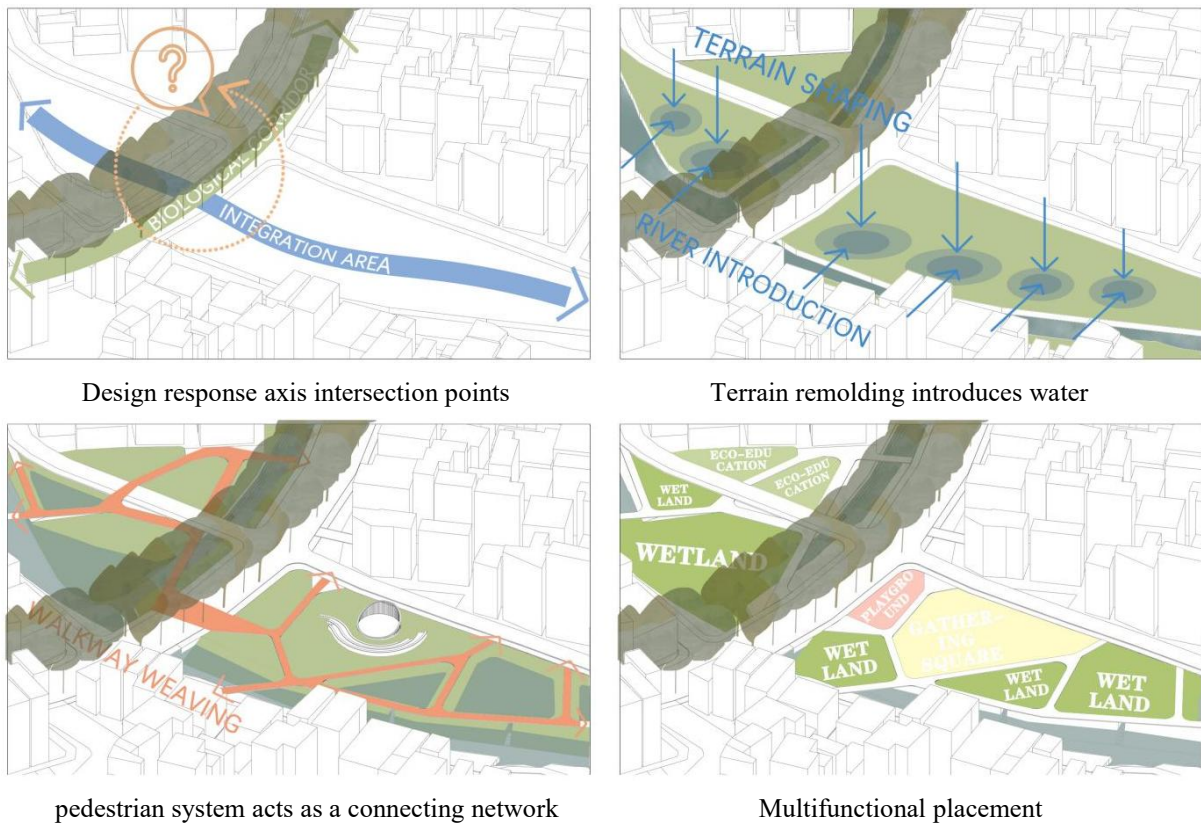


Fig 6-35 Design concept generation analysis

(4) Site detailed design

Based on the above concept, the direction of detailed site design can be obtained. The main purpose of the wetland park is to incorporate a series of public activities such as gathering squares, fitness sports, natural education, and exploration and play, while maximizing ecological value, allowing people to experience a variety of activities in a natural environment

to achieve the goal of multifunctional biophilic interaction.

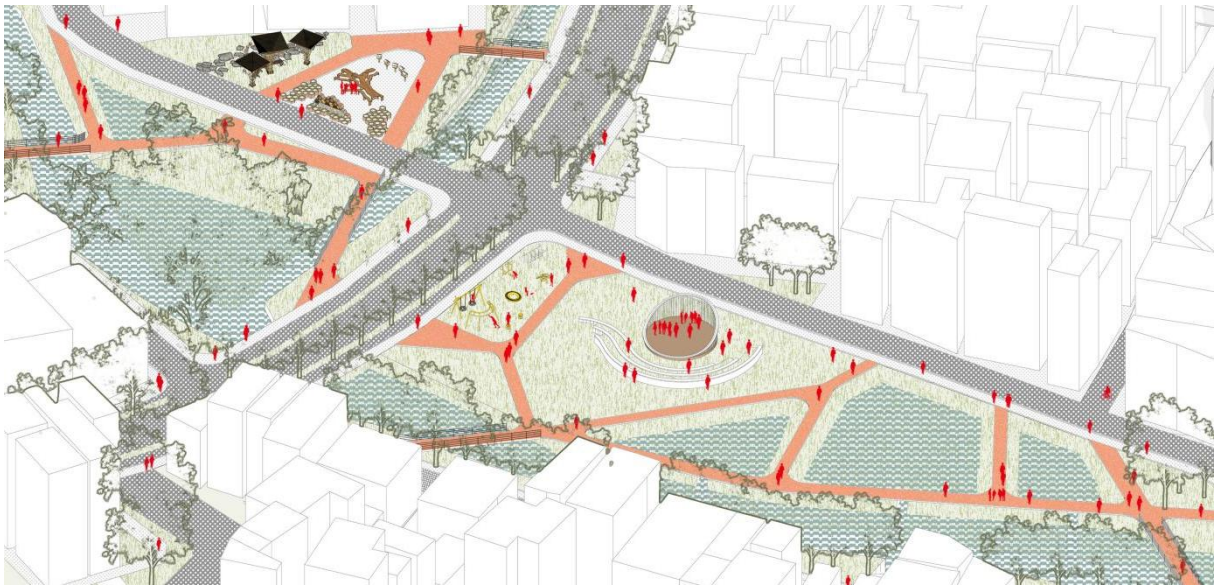


Fig 6-36 Axonometric view



Fig 6-37 Wetland Ecological Area Master Plan

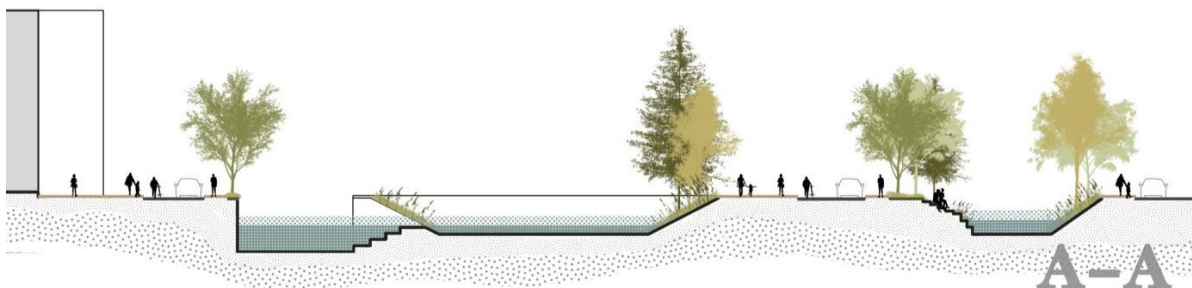


Fig 6-38 Section A-A of Wetland Ecological Area

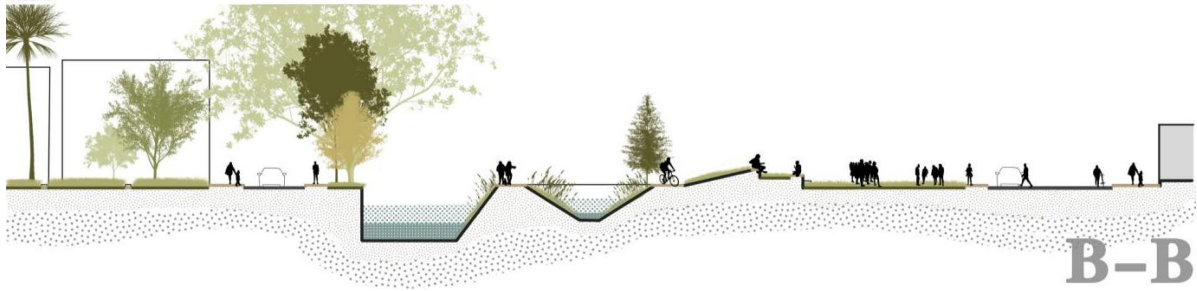


Fig 6-39 Section B-B of Wetland Ecological Area

The design of this section of the river retains the ancient stone embankment on the west bank, while mainly focusing on the ecological wetland design on the east bank. Five ponds connected to the Lijiao River were designed, which rely on the exchange of river water and the restorative function of plants to perform natural water filtration processes, while also providing a place of relief for rain and flood disasters.



Fig 6-40 Perspective view of Wetland Ecological Area

6.3.4 Multifunctional community building

6.3.4.1 Ecological Centre

(1) Context analysis

The site of this node is one of the main entrances to the south of Lijiao, and is an important node connecting Lijiao and the city. However, the main buildings inside the site are abandoned factories and residences that have not been demolished or transformed for reuse in a timely manner, resulting in wasted land resources and a broken urban interface of Lijiao, which affects people's overall impression of Lijiao. At the same time, the lanes around the site have greatly compressed the living space of the natural environment, making it difficult for Lijiao's good ecological environment to be displayed to the city. Therefore, in order to establish more benign interactive connections between Lijiao and the city, it is necessary to activate this site.

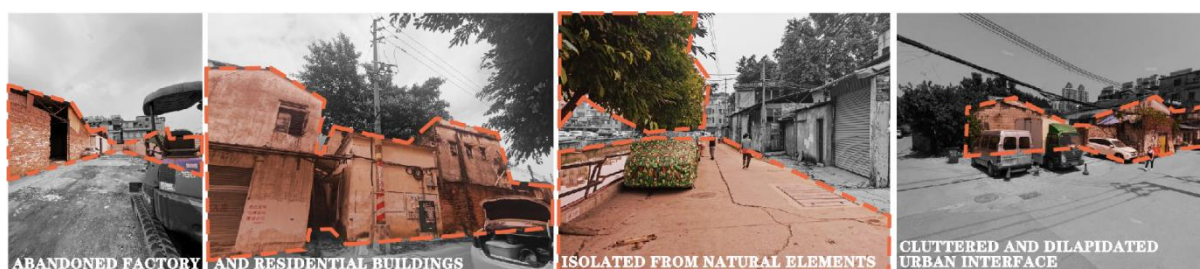


Fig 6-41 Current site status

(2) Functional analysis

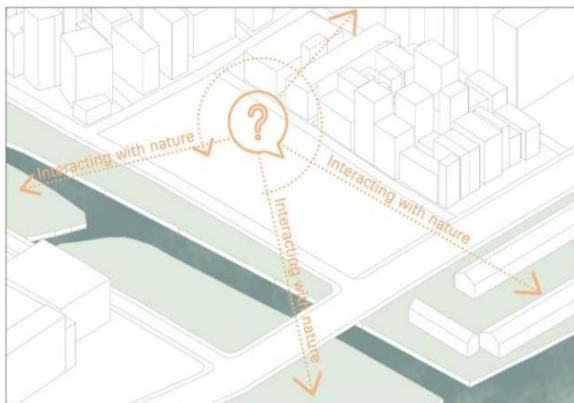
Table 6-7 Functional Analysis Table for Ecological Centre

Type	Analysis point	Ecological Centre
Space Type	Degree of openness	semi-open
	Space shape	point
Spatial character-istic	Terrain	undulating
	Interface	no boundary
	Accessibility	strong
	Pavement design	No
Social Function	Dynamic function	commuting
	Static function	No
	Educational function	No
Ecological Function	Beautification function	No
	Service function	No
	Ecological protection	weak
Main Weakness	Lack of ecological design / public space planning /humanistic elements/Facilities/Multi-function...	

Through functional analysis of the site, it is found that this area is biophilically poor, with insufficient use of natural elements and weak accessibility, as well as inadequate design of public spaces, making it unable to meet people's activity needs. However, this area is located near a major urban artery with strong accessibility, making it suitable as a larger gathering place, thus requiring a public building to be placed here.

(3) Analysing & utilising biophilic elements

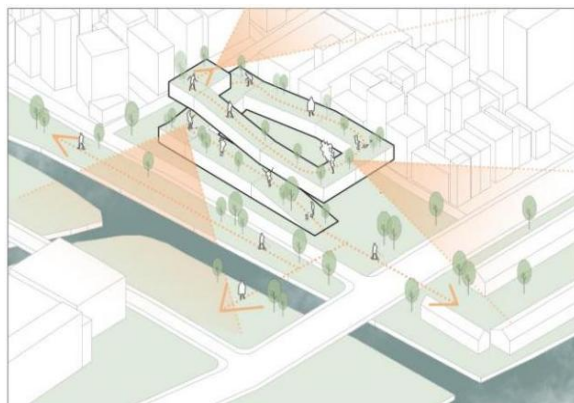
The design needs to consider how to introduce nature into the architecture and make the architecture more biophilic. Firstly, the stepped-back design guides the space more clearly and leads nature and people flow to the roof of the building. Based on this, a spiral ascending building form is formed, allowing people to walk unimpeded on the roof of the building and interact with each biophilic node around it, borrowing scenery from other network centers and Lijiao's natural landscape. Finally, various functions, mainly based on natural education, will be placed inside the building to create a Lijiao Ecological Center that integrates education, entertainment, and gatherings.



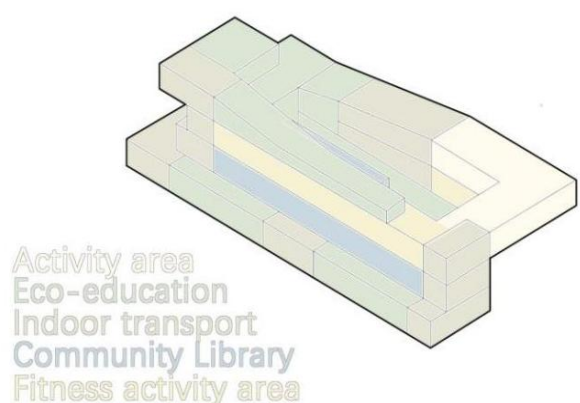
Respond to the surrounding biophilic elements



Biophilic elements and activities are introduced



Sensory design responds to surrounding elements



Multifunctional space placement

Fig 6-42 Design concept generation analysis

(4) Site detailed design

Based on the above analysis, the next step is to carry out specific design for the building and its surrounding environment. The theme of the design is to maximize the biophilic nature of the building, including shaping it in various aspects such as spatial layout, material selection, functionality, and form.



Fig 6-43 Axonometric view

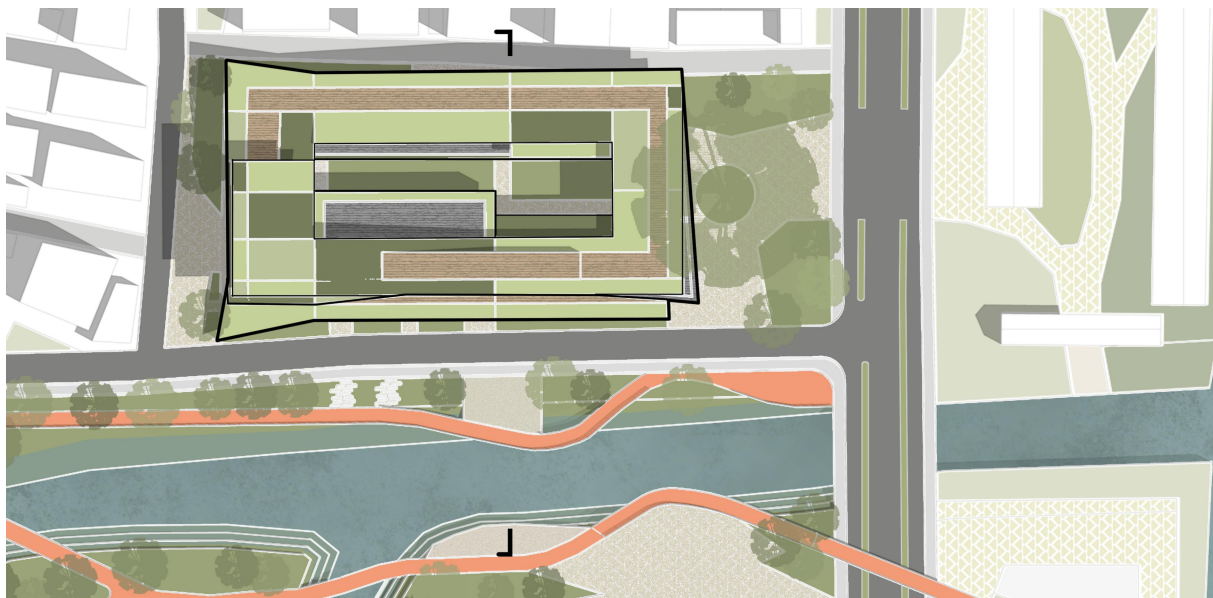


Fig 6-44 Ecological Centre Master Plan



Fig 6-45 Section of Ecological Centre

This section of the river originally did not have ancient stone embankments, so the hard embankments on both sides were removed. A stepped embankment design was used on the side near the ancestral hall, and a natural embankment mainly consisting of aquatic plants was set up on the other side, which is more in line with the ecological center's main purpose.

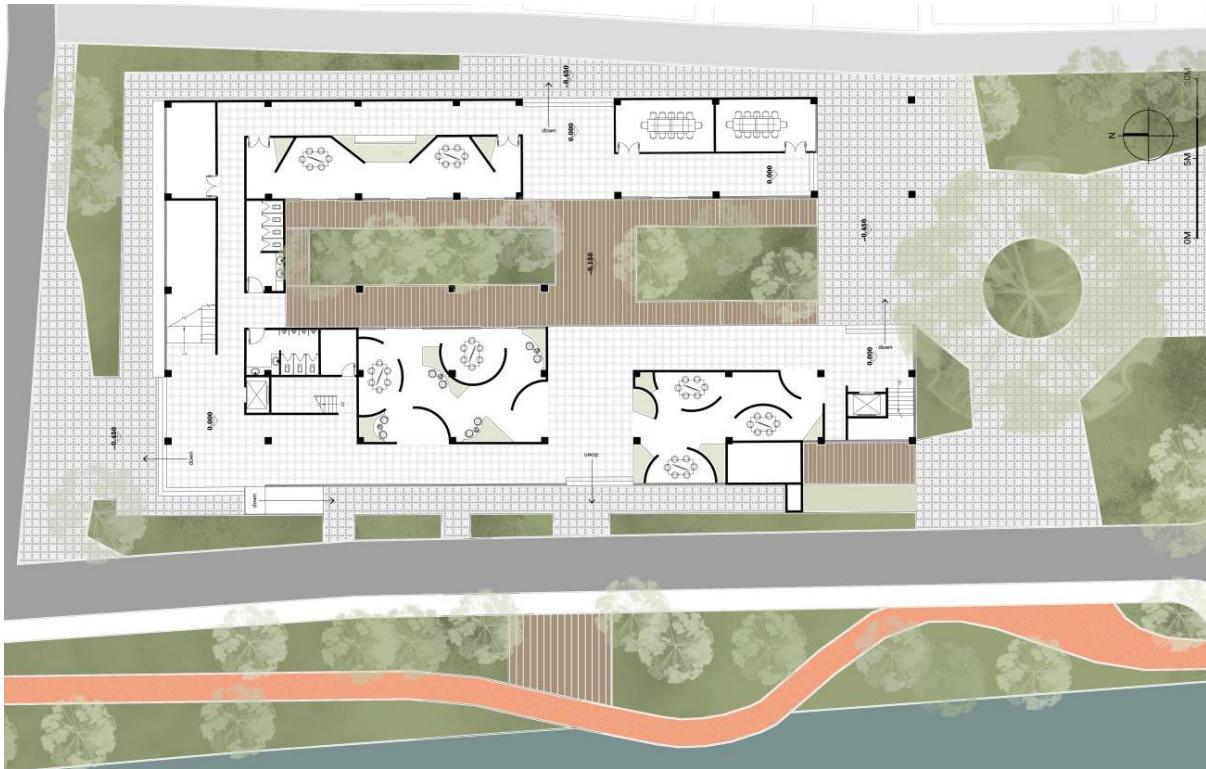


Fig 6-46 Ground floor plan of the Ecology Center

The main functions of the first floor of the ecological center are various ecological classrooms and conference rooms. The flexible spatial division creates a more diverse indoor education and social space, while the main function of the inner courtyard is to support natural education. At the same time, most of the space on the first floor is left as gray space to enhance the flow between the building's interior and the natural environment.

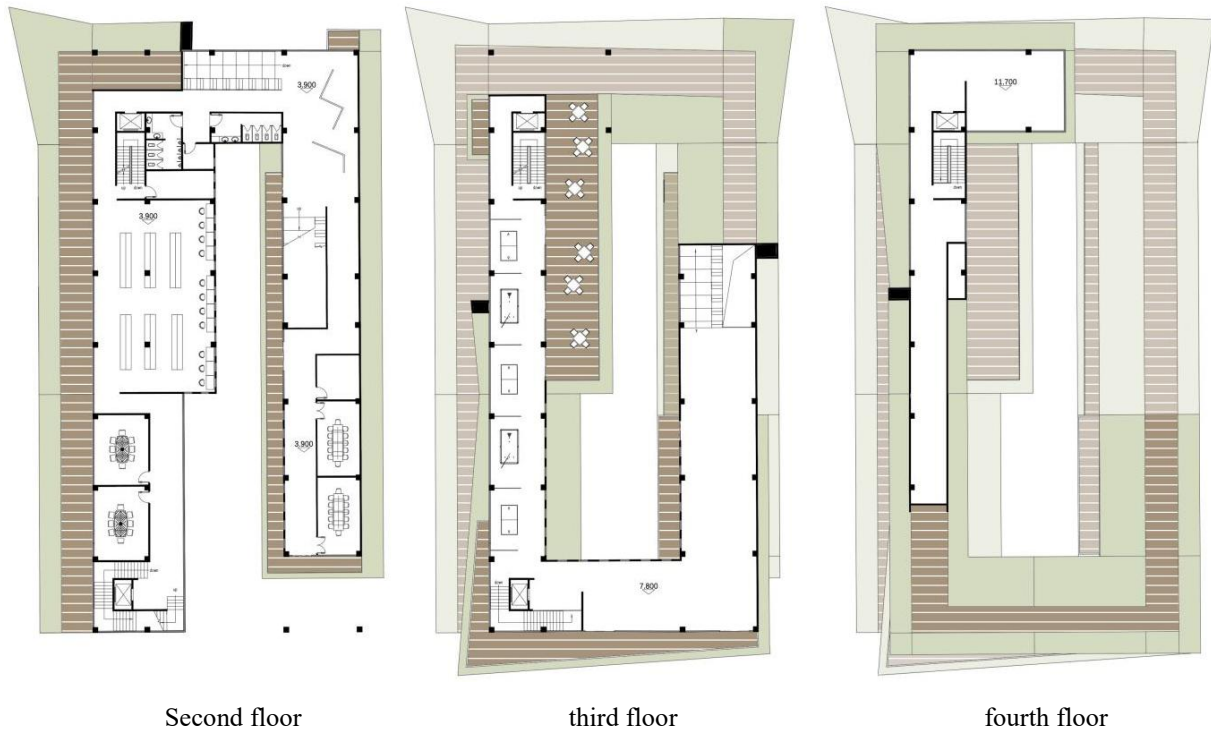


Fig 6-47 Floor plan of the Ecology Center

The main function of the second floor is for book exhibitions, providing people with a space for learning and self-study, supplemented by various seminar rooms for villagers to communicate and hold meetings. The third floor is mainly for activities, including table tennis, billiards, and a multi-functional activity room, providing a dynamic activity space for villagers. The main function of the fourth floor is for display and viewing, showcasing the updated design results of Li Jiao and offering a panoramic view of nearby natural landscapes such as Haizhu Park.





Fig 6-48 Perspective view of the Ecology Center

The ecological center's main design details also reflect a close connection to nature, including green roofs, indoor vertical green walls, and the use of natural building materials such as wood, creating a natural building environment inside and out.

6.3.4.2 Ancient Bridge Gathering Hall

(1) Context analysis

This plot of land is the most culturally significant area among the four nodes, featuring ancient trees and a historic stone bridge. It is also located in the center of the village and should have been the most densely populated area for villagers' activities. However, due to continuous construction of buildings and roads that have compressed the surrounding areas, the existing public space mainly relies on seats placed around the foot of the ancient trees. Although there is a continuous flow of people stopping here every day, it is difficult to support more activities, and cannot provide a better activity space. At the same time, the protective railing on both sides of the embankment and the significant height difference of the river interfere with people's interaction with the river, resulting in a severe disconnection between the overall space and natural elements.



Fig 6-49 Current site status

(2) Functional analysis

Table 6-8 Functional Analysis Table for Ancient Bridge Gathering Hall

Type	Analysis point	Ancient Bridge Gathering Hall
Space Type	Degree of openness	open
	Space shape	point
Spatial characteristic	Terrain	undulating
	Interface	no boundary
	Accessibility	strong
	Pavement design	No
Social Function	Dynamic function	Socialize/gather
	Static function	Resting
	Educational function	No
Ecological Function	Beautification function	Normal
	Service function	Normal
	Ecological protection	weak
Main Weakness	Lack of ecological design / public space planning /humanistic elements/Facilities/Multi-function...	

Through a functional analysis of the site, it can be found that there are many important biophilic elements in this area, but they are underutilized and not well utilized. Although there are many social activities that gather people in this area and have strong accessibility, the design of public space is insufficient to meet people's higher-level activity needs. Therefore, the focus in design should first be on shaping the space to make it more suitable for gathering activities, followed by enhancing the interaction between activity spaces and natural elements, effectively integrating nature and architecture, and making the building an important medium for promoting positive interactions between humans and nature.

(3) Analysing & utilising biophilic elements

The key consideration in the design of this plot of land is to create more spaces for people to gather and interact with the river. The first thing to do is to remove existing obstacles and surrounding abandoned buildings to provide enough space for the construction of public areas. Then, reshape the terrain of the riverbank and expand the river surface using a stepped natural revetment while designing green spaces to intervene in the area. Structures that can interact with various things in all directions should be placed to provide people with a gray space for gathering and activities while expanding their vision, enhancing their perception, and allowing people to experience natural elements with more senses.

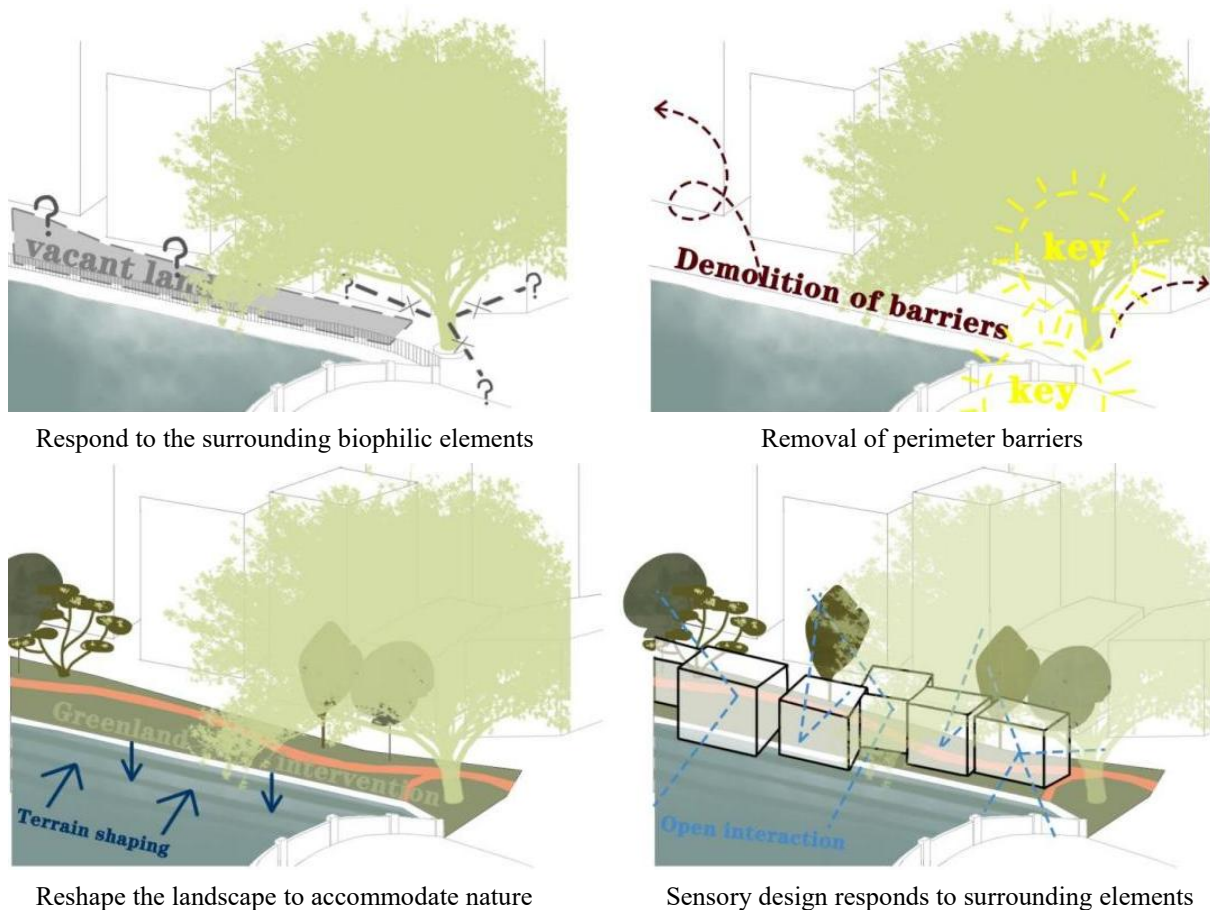


Fig 6-50 Design concept generation analysis

(4) Site detailed design

Based on the above analysis, the key to the design of this site is to use biophilic architecture to provide gathering places for people while maximizing interaction with nature. It also responds to the climate of the site, which is the tropical climate characteristic of Guangzhou, by setting up more open and shaded gray spaces.

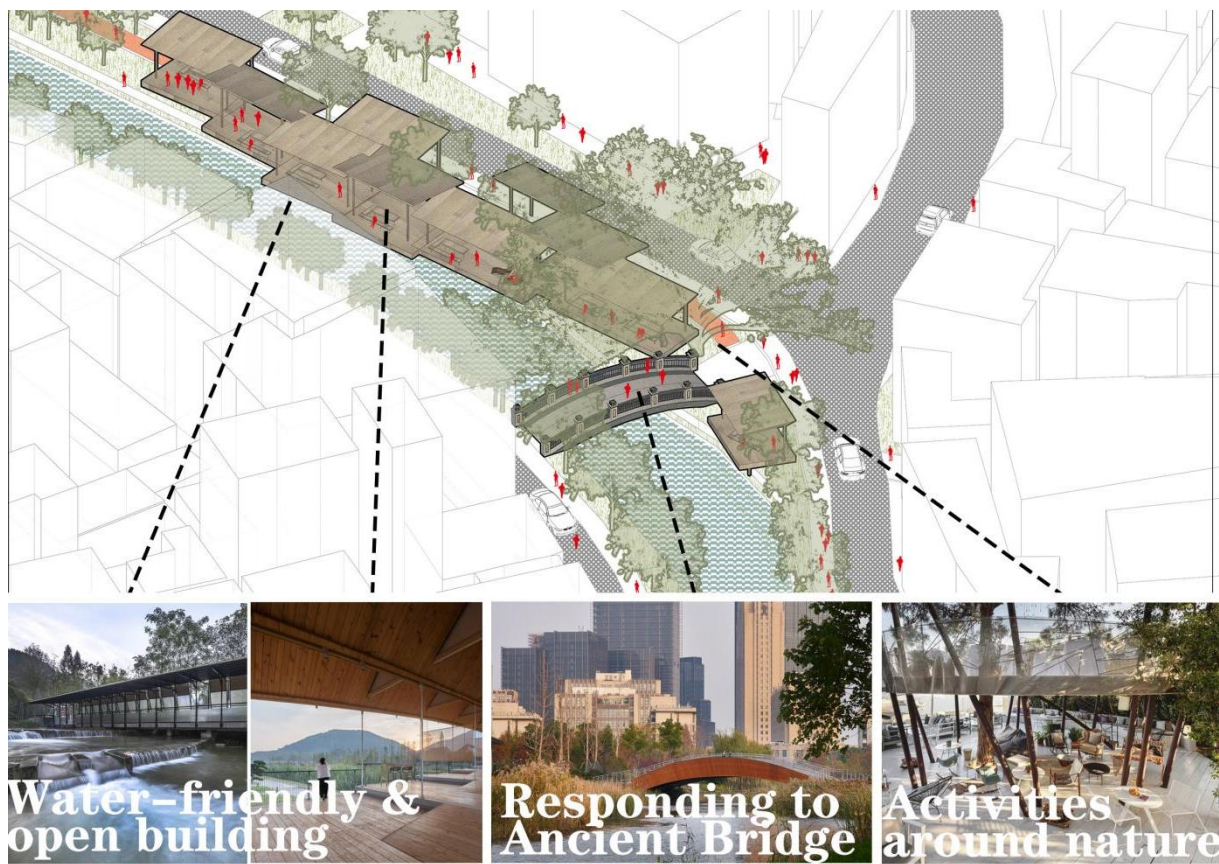


Fig 6-51 Axonometric view



Fig 6-52 Ancient Bridge Gathering Hall Master Plan

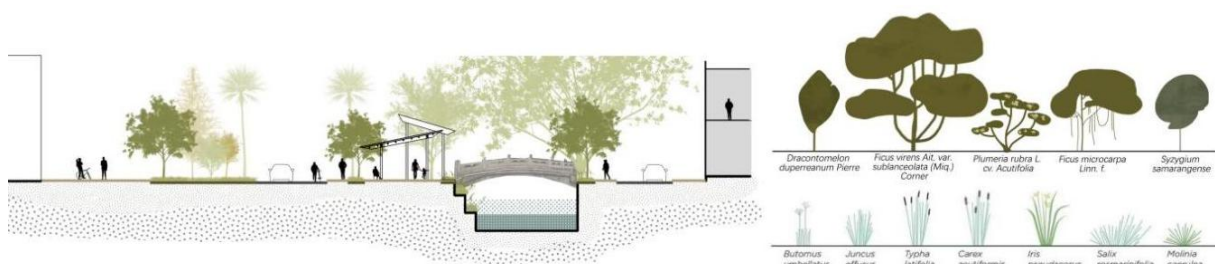


Fig 6-53 Section of Ancient Bridge Gathering Hall

The design of this section of the river also preserves the ancient stone embankment on the west bank, allowing people to visually experience the echo between the ancient bridge and the ancient stone embankment while they are engaged in activities within the site. In addition, the huge ancient trees and a large number of local plants are used to complement the scene, creating a natural environment that enables people to appreciate the long history of Lijiao River through the remaining fragments.



Fig 6-54 Perspective view of Ancient Bridge Gathering Hall

6.3.4.3 Waterfront commercial area

(1) Context analysis

This plot of land is located in the northern part of the entire village and currently serves as a transitional neighborhood between the commercial and residential areas. There are some small shops selling groceries, clothing, and other items, but the streets and public spaces in

front of them are very narrow and mostly occupied by parked cars, which disconnects them from the river.



Fig 6-55 Current site status

(2) Functional analysis

Table 6-9 Functional Analysis Table for Waterfront commercial area

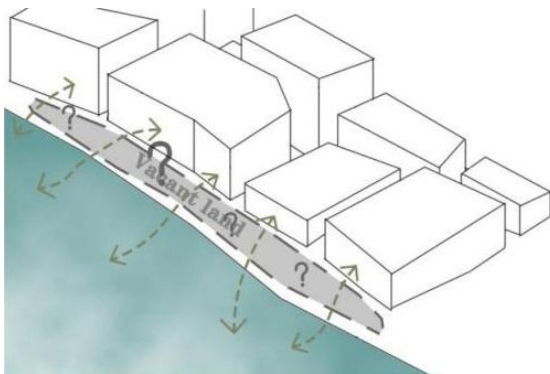
Type	Analysis point	Waterfront commercial area
Space Type	Degree of openness	open
	Space shape	point
Spatial characteristic	Terrain	undulating
	Interface	no boundary
	Accessibility	strong
	Pavement design	No
Social Function	Dynamic function	Socialize/gather
	Static function	Resting
	Educational function	No
Ecological Function	Beautification function	Normal
	Service function	Normal
	Ecological protection	weak
Main Weakness	Lack of ecological design / public space planning /humanistic elements/Facilities/Multi-function...	

Through functional analysis of the site, it can be found that although the area is adjacent to the river, there is insufficient use of natural elements and inadequate public space design, which results in a lack of space for people to stay and engage in biophilic activities in the area. In order to address the ecological issues, it is necessary to introduce more native species to create a more diverse natural environment and promote positive interactions between people

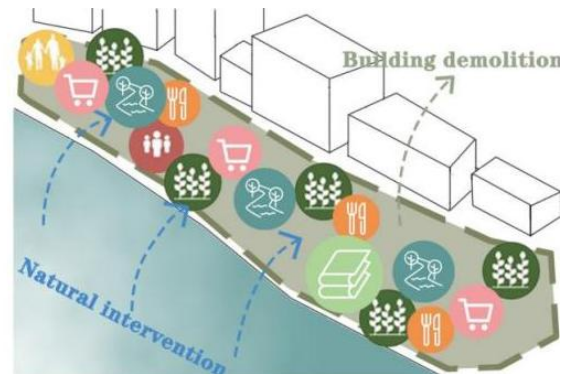
and nature. For the functional issues, there are many commercial demands for the site, but the shops are too homogenous. Therefore, it is important to introduce commercial and service functions to achieve a one-stop, diversified shopping experience.

(3) Analysing & utilising biophilic elements

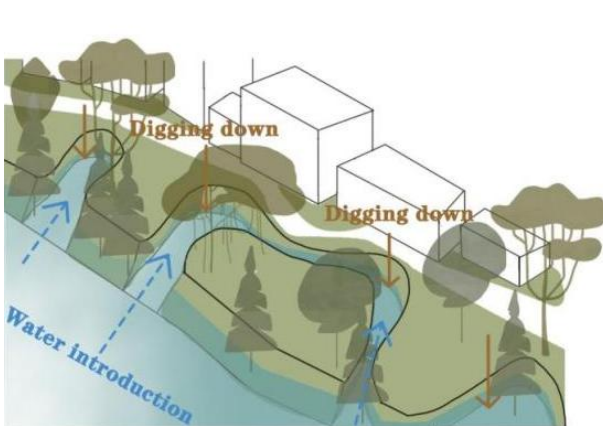
For this site, it is necessary to demolish and rebuild the commercial buildings adjacent to the river, while allow site for more interaction with the water by allocating the roadway out of the site. Next, natural elements need to be introduced to the site while considering the integration of multiple functions, including shopping, leisure, and natural interaction. By reshaping the terrain, the river can be brought into the site to create a more diverse waterfront that not only enhances the site's biophilic but also effectively increases the river's capacity to accommodate water during strong rain events. Finally, buildings and plants should be incorporated into the site to create a waterfront commercial area with the flavor of the Lingnan water village, in line with the intentions of a water town.



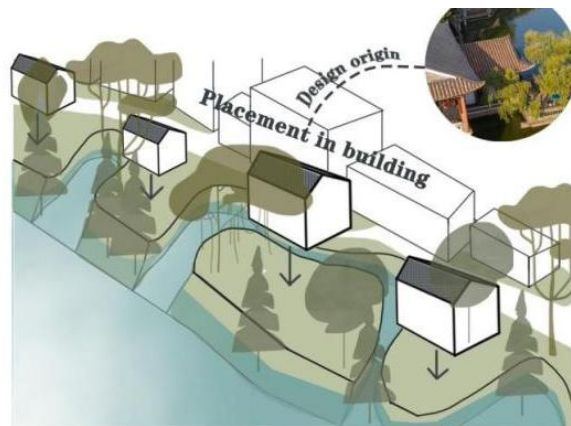
Interaction with the river



Expanded site to accommodate multifunctional



Reshaping the terrain to introduce nature



Regional architecture creates a water village

Fig 6-56 Design concept generation analysis

(4) Site detailed design

Based on this, the site should be carefully designed with a biophilic approach. The design should focus on maintaining the existing commercial functions while creating a series of biophilic buildings and spaces, in order to achieve a unique Lingnan commercial water town with regional characteristics that meets the diverse commercial needs of people.



Fig 6-57 Axonometric view



Fig 6-58 Waterfront Commercial Area Master Plan

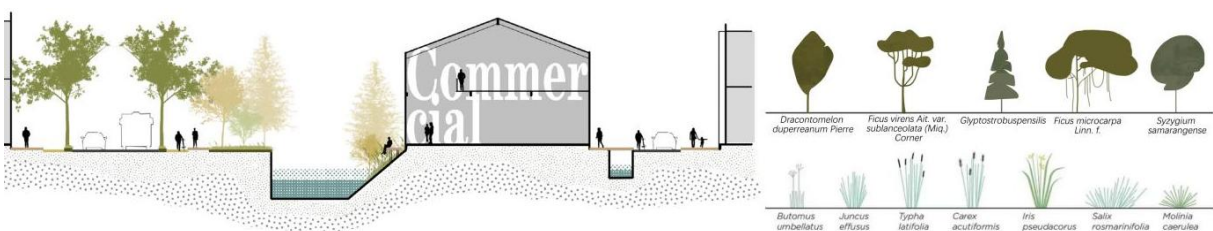


Fig 6-59 Section of Waterfront Commercial Area

When designing the embankments of the land, soft transformation measures were taken on the east bank, which is close to the commercial district. Wetland plants were planted on the basis of terrain reshaping to create a more natural shoreline. The trails weaving through it provide more opportunities for people to get close to nature in their daily leisure. On the west bank, the original ancient stone embankment was preserved and echoed with the ancestral temple on the shore. Local plants such as *Ficus virens*, banyan trees, and *dracontomelon duperreanum* were planted to create a stronger sense of humanistic region.



Fig 6-60 Perspective view of Waterfront Commercial Area

6.3.5 Multifunctional green corridor

Whether it's a park or a building, updates are made in a point-like form within the site. In

order to achieve the goal of forming a biophilic network, the most important step is to connect the various update nodes mentioned earlier through the update of a Multifunctional green corridor. Through the results of microsite design screening within Lijiao, it can be seen that the Lijiao River on the central axis can become the Multifunctional green corridor. Therefore, a detailed update design has been carried out for the Lijiao River.

(1) Context analysis

The former Lijiao River was not just a single small stream, but had countless tributaries crisscrossing, propping up Lijiao like a spiderweb. Most of the residents in the town could see the flowing water from their doorstep or windows, which was a natural resource that was fully experienced and utilized. However, due to the rapid development of the urban village, the river was filled and narrowed, both banks were covered with densely-packed residential buildings, and a large amount of parking space occupied both sides. The natural attributes and public space of the river were eroded, and people's activity needs could not be met. According to the research and analysis of the site, the problems are shown in the table.

Table 6-10 Analysis of the base conditions of Lijiao river

Basic conditions		Issues that need attention
Beginning in Nature	Natural Resources	The river has been remediated and the water quality is good; there are a large number of vegetation elements on both sides of the river, including ancient trees, which have great use and conservation value, but are currently underutilised and people are unable to interact with the water.
	Public Space	The public spaces along the river are occupied by other functions, but there are still some very small social spaces that are used very frequently. These spaces are scattered on both sides of the river and are not only unplanned but also unconnected.
	Transport Location	The river is the main artery of Lijiao, but due to a lack of proper transport planning, there is no public transport access to the site and pedestrians can only reach the river by slow-moving or non-motorised means.
	Architectural Properties	The site is surrounded by residential buildings, which form a barrier interface that reduces the openness of the site, and all lack natural interaction with the site and the ability to experience natural elements in the architecture.
	Human Resources	As the birthplace of Lijiao village, the site is a place where memories are passed on and links the various spaces and folklore activities of Lijiao.
Beginning in Humanity	Psychological Needs	Because of the lack of public space, the river is mainly used by the middle-aged and elderly population, whose main activity is socialising and chatting, but they are concentrated under the trees and do not interact with the river.
	Physiological Needs	The elderly would like to walk along the river, the youth would like to rest along the river and children would like to have more opportunities to enjoy the water; however, the current Lijiao does not meet the needs of a wide range of sports.
	Cognitive Needs	The river can be an important medium for experiencing nature, but this function is currently missing in Lijiao river.
	Crowd dynamics	Older people gather at the river for socialising and fishing around the clock, while young people and children do not spend time at the river, just commuting to school, and the overall activity of the river is low.



Fig 6-61 Current Issues of Lijiao river

The main problems of Lijiao river currently include: the insufficient use of natural resources, which have good ecological genes but are overshadowed by economic development, leading to neglect and the inability to achieve sustainable development and meet people's physiological and psychological needs for nature; inadequate planning of public spaces, with many open spaces but a lack of effective activation, making it difficult for people to stay by the river and unable to enhance the vitality and value of the village or provide a venue for nature-based activities; and the formation of barriers in the building layout, making it difficult to incorporate natural elements into the village and preventing the river from playing a network function for nature, thus unable to improve the overall living environment. These are the areas that Lijiao river urgently needs to change.

If conduct research and organize the current situation of Lijiao River, in terms of natural elements, the current situation of Lijiao River shows a single type of vegetation with low ecological benefits but a large number of them, which should be preserved and utilized. In terms of function, the surrounding buildings are mostly residential with a rich flow of people, but the riverfront areas are mostly idle and do not undertake any biophilic activities. In terms of human flow, the activities of the elderly are concentrated in the south, which is the estuary area; the activities of children are concentrated in the north, and the youth frequently engage in linear activities such as commuting.



Fig 6-62 Existing plants at Lijiao River

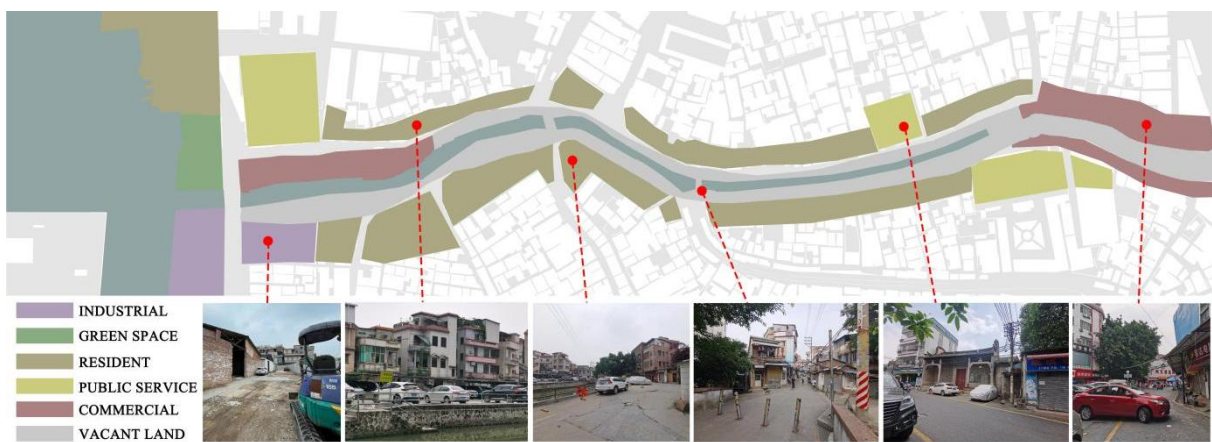


Fig 6-63 Existing land use planning of Lijiao River

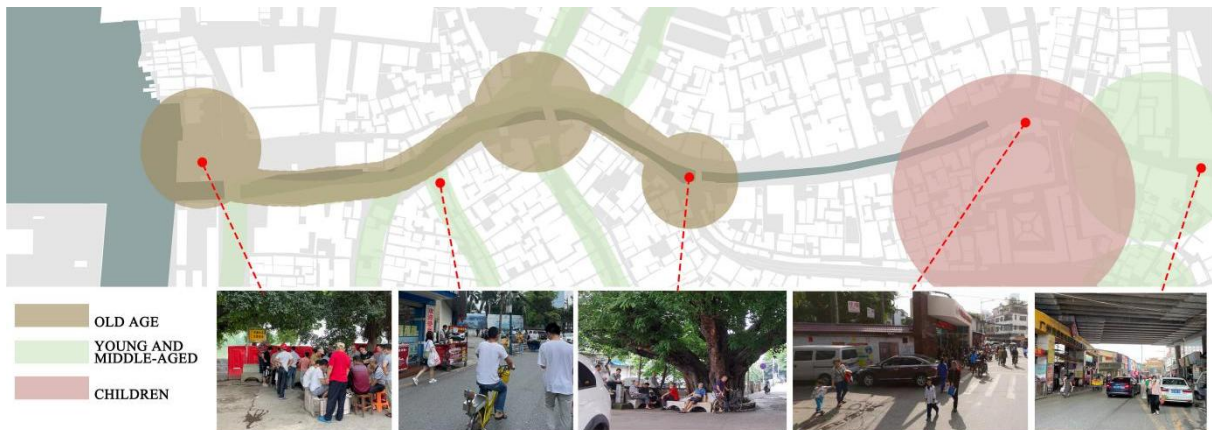


Fig 6-64 Current population flow

(2) Functional analysis

Through the functional analysis of Lijiao river, more problems in the design and planning of the rivers can be identified. These include poor ecological quality, insufficient use of natural elements, weak accessibility, inadequate public space design, and insufficient functional complexity. These problems need to be addressed in updated designs. Regarding ecological

issues, existing natural resources should be preserved, various nature-based elements should be fully utilized, and the maximum value of these elements should be realized to make the river a crucial medium for promoting positive interaction between people and nature. In terms of public space issues, openness and accessibility of the space should be enhanced, pedestrian access and visibility should be improved, and obstacles to reaching the river should be removed. Additionally, multiple levels of experiential space should be created to allow people to enjoy the natural environment of the river with multiple senses. Regarding functional issues, the current functionality of the river is weak, lacking both ecological and social functionality. Therefore, a new functional plan should be developed based on the natural environment of the river and the different functional demands of various groups, to achieve a integration of social and ecological vitality in the design.

Table 6-11 Functional Analysis Table for Lijiao river

Type	Analysis point	Lijiao river
Space Type	Degree of openness	semi-open
	Space shape	point & line
	Terrain	undulating
Spatial character-istic	Interface	no boundary
	Accessibility	normal
	Pavement design	No
Social Function	Dynamic function	gathering
	Static function	No
	Educational function	No
Ecological Function	Beautification function	weak
	Service function	weak
	Ecological protection	weak
Main Weakness	Lack of ecological design / public space planning /humanistic elements/Facilities/Multi-function...	

(3) Analysing & utilising biophilic elements

The overall design principle followed for the Lijiao River is based on four aspects of the principle of natural design, which are centering on nature, integrating development, equitable participation, and locality. Based on these principles, along with people's various needs, including games, sports, socializing, healing, etc., the design takes these as the starting point to build a more biophilic urban space that is closer to people's lives.

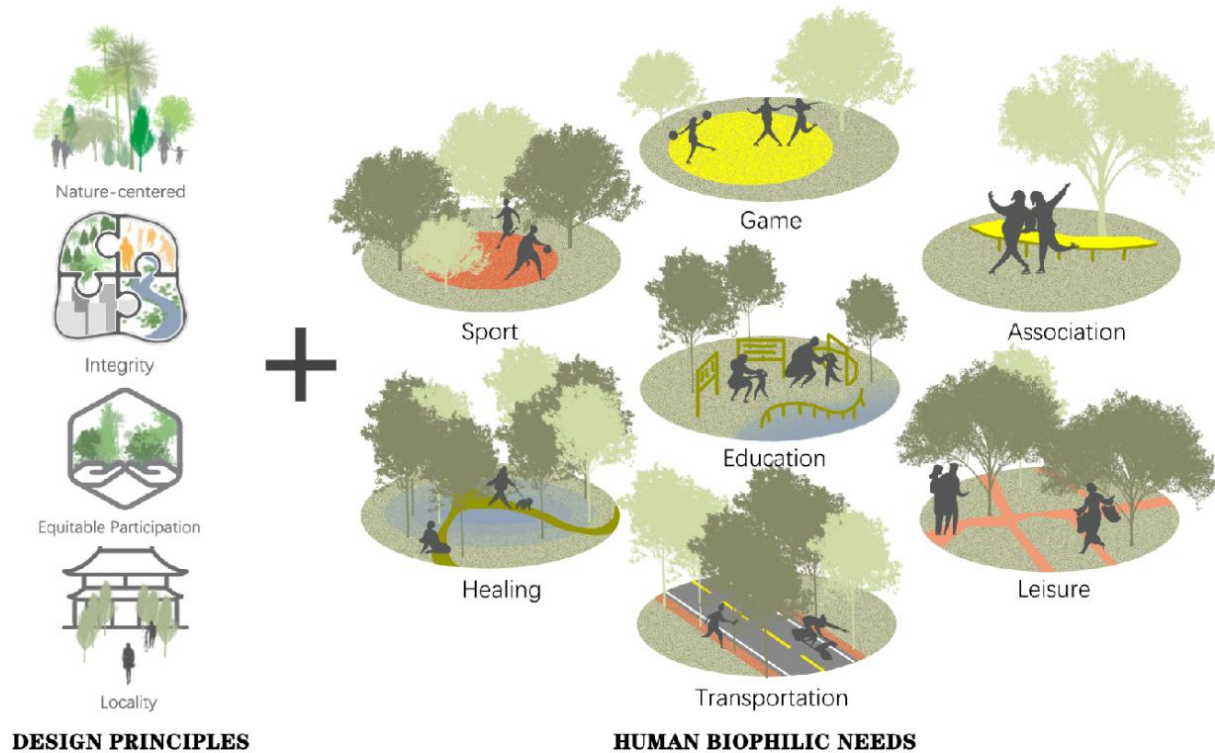


Fig 6-65 Design concept starting point

(4) Site detailed design

The design process mainly includes four steps. Firstly, conduct research on the distribution of public spaces such as natural, cultural, public services and commercial areas around the river, as well as the locations of various renewed nodes, which are important elements for the design foundation. Next, use pathways, streets, etc. as the biophilic framework to connect each important element and form an interconnected network structure. Then, based on the location and relationship of each node, design with biophilic principles, such as park and green space planning, to diffuse the functions of each node to all sites, in order to achieve a pattern of multifunctional integrated development. Finally, the biophilic network should spread around the perimeter, enhancing the spread of natural elements from the Lijiao River to the surrounding natural areas, such as connecting with Lijiao Park on foot to achieve network connectivity and enhance the overall ecological resilience of Lijiao.

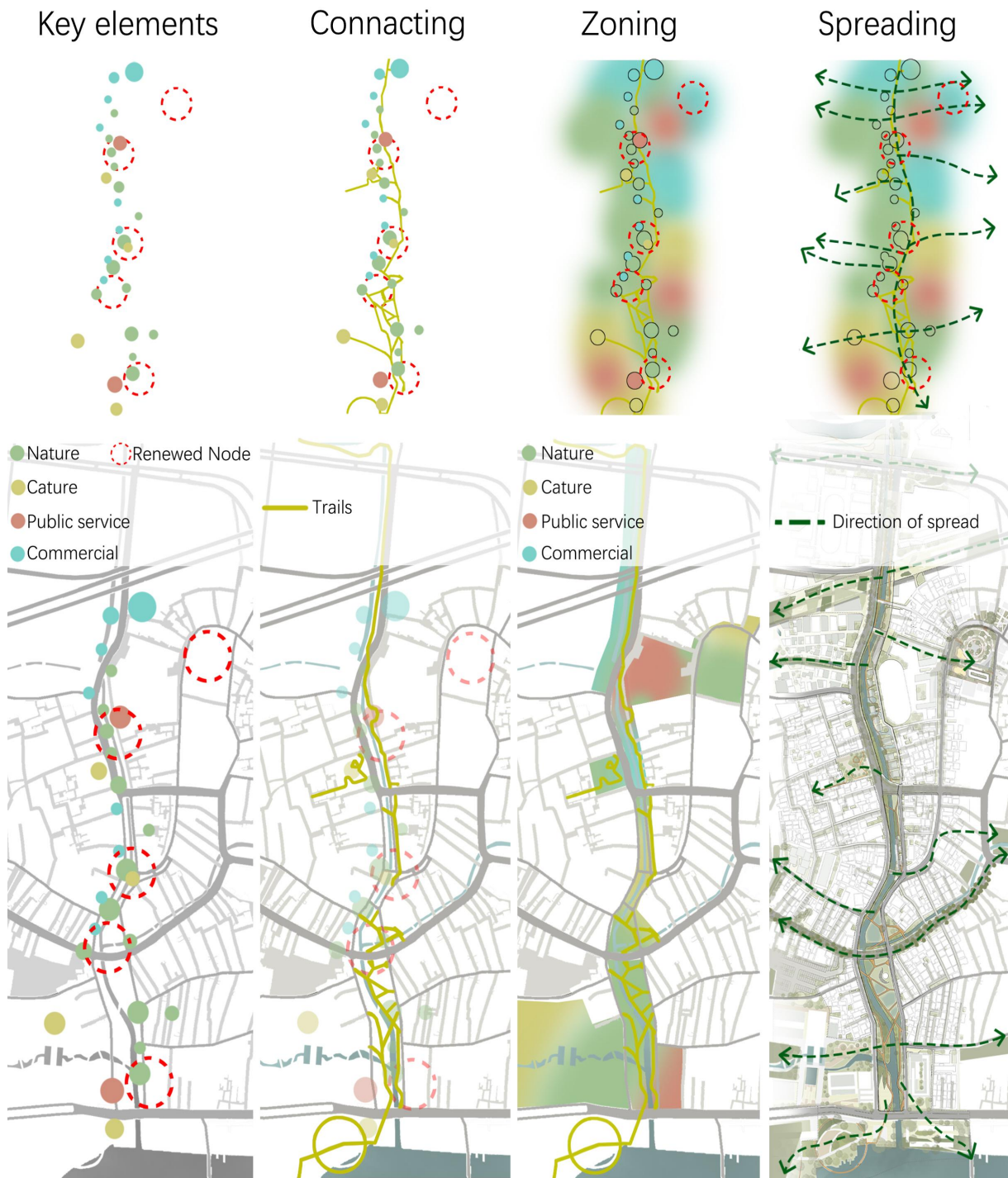


Fig 6-66 Design generation concept illustrations

Based on the above, this article proposes a renewal plan for the entire Lijiao River. The overall design goal for the Lijiao River is to create a main axis of public space that integrates human and natural elements, making it the green backbone of Lijiao Village and driving the village's subsequent development.

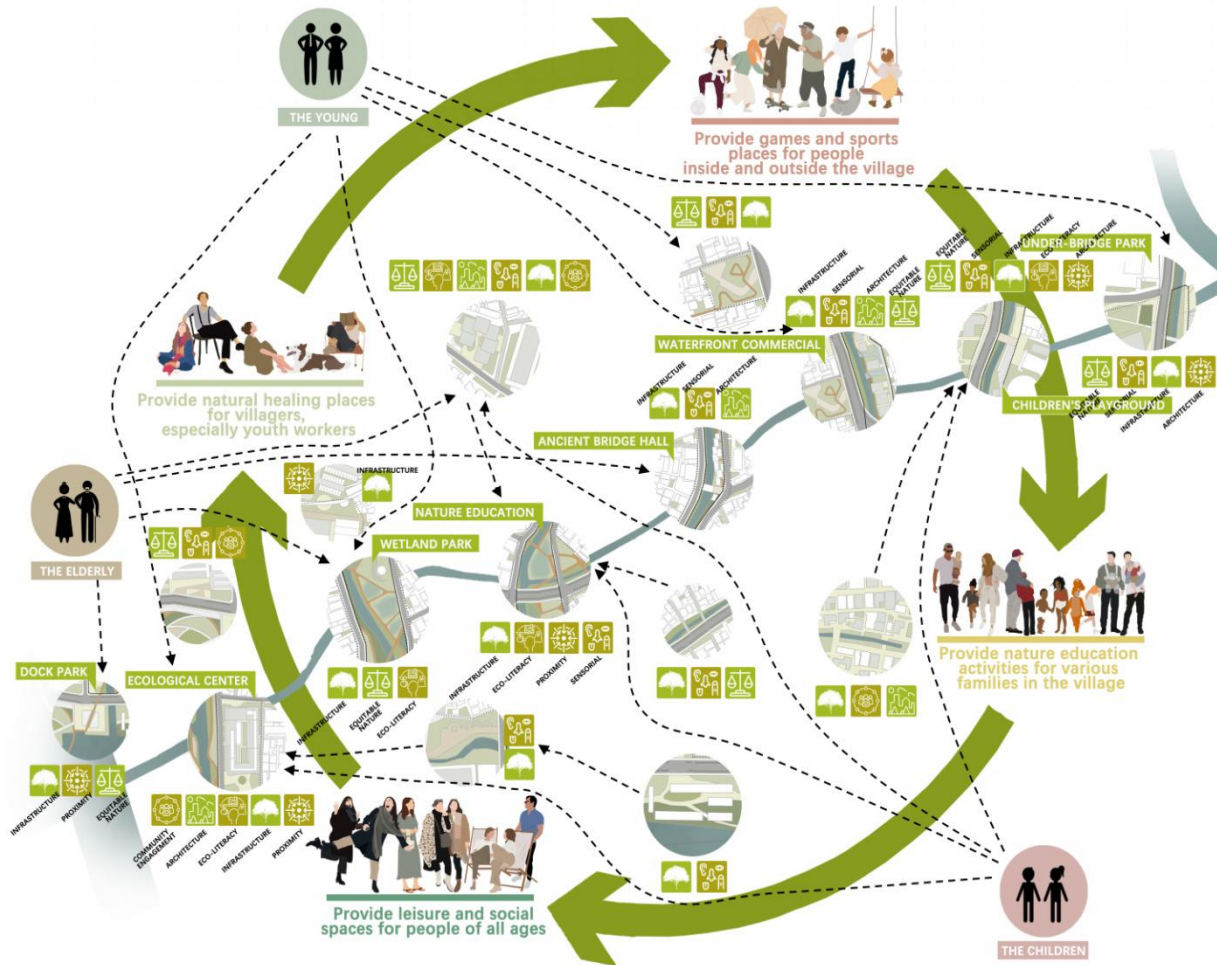


Fig 6-67 Biophilic design of Lijiao River

Based on the analysis of the current situation, it is necessary to conduct on-site design for different site of the river in a biophilic manner. The specific content of the design is to incorporate the seven major design elements proposed in section 2.2.3, including infrastructure design, biophilic architecture, equitable nature design, accessibility design, community involvement, sensory design, and educational planning, based on the site conditions and the needs of the people. This is to achieve the effective integration and development of the four main functions required for biophilic urban public spaces in this area. After the overall pro-nature planning is conducted, the following sections will provide more detailed conceptual design and related analysis for the four main nodes mentioned above, which are the Waterfront Commercial Area, the Ancient Bridge Gathering Hall, the Wetland Ecological Area, the Ecology Centre.

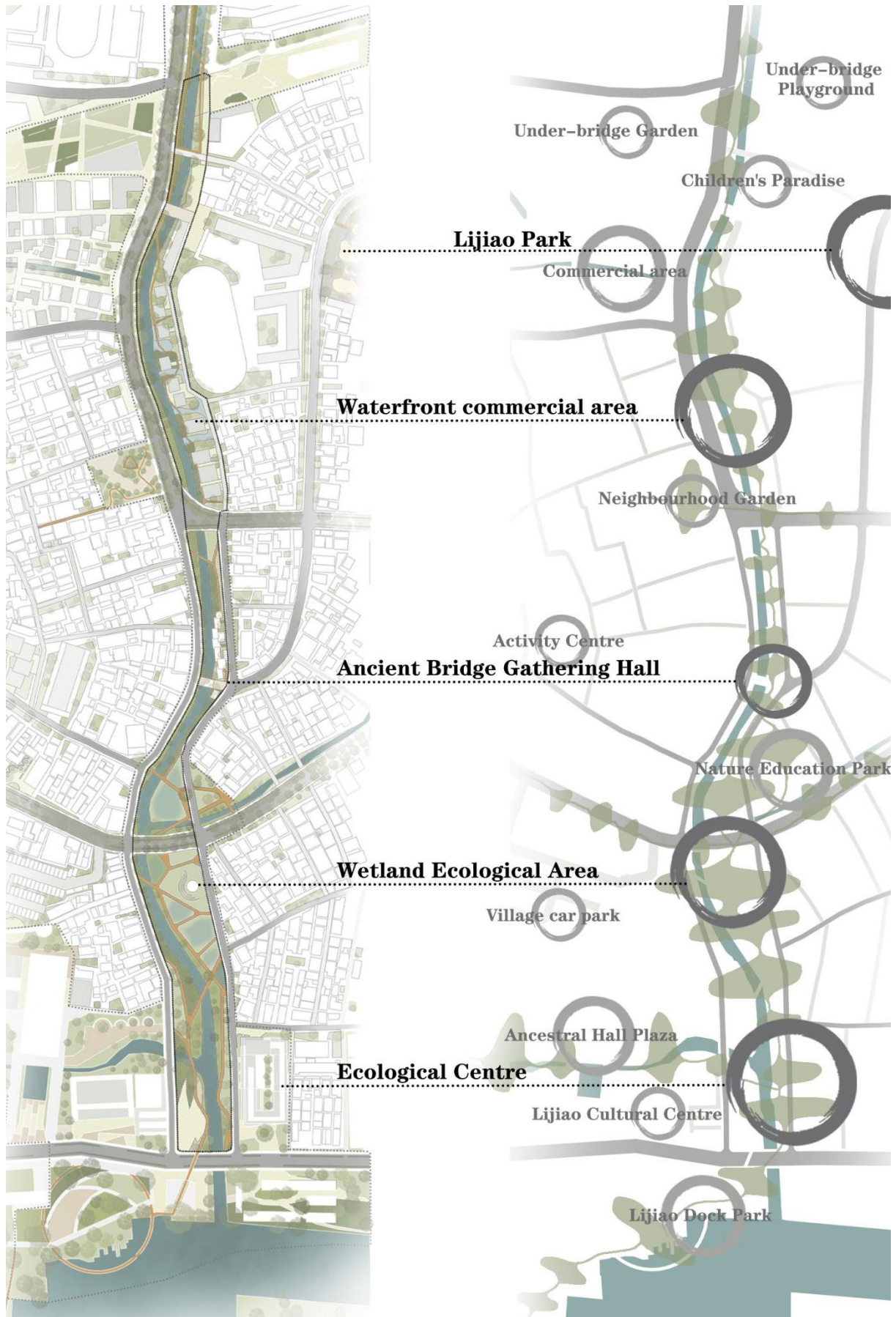


Fig 6-68 Master plan and functional layout of Lijiao river



Fig 6-69 Overall axonometric view and section of part of the river

6.4 Summary

This chapter takes Lijiao as the design object, applies the biophilic design strategy mentioned earlier to practical design, and plans a livable biophilic community vision for Lijiao. First, at the urban scale, by shaping Lijiao's natural environment and public space through the integration of the biophilic development of public space axis and the biologically friendly corridor, the natural environment and public space of Lijiao are introduced into the urban nature-based network, breaking the barrier between Lijiao and the city, integrating Lijiao into the urban fabric, and seeking subsequent common development.

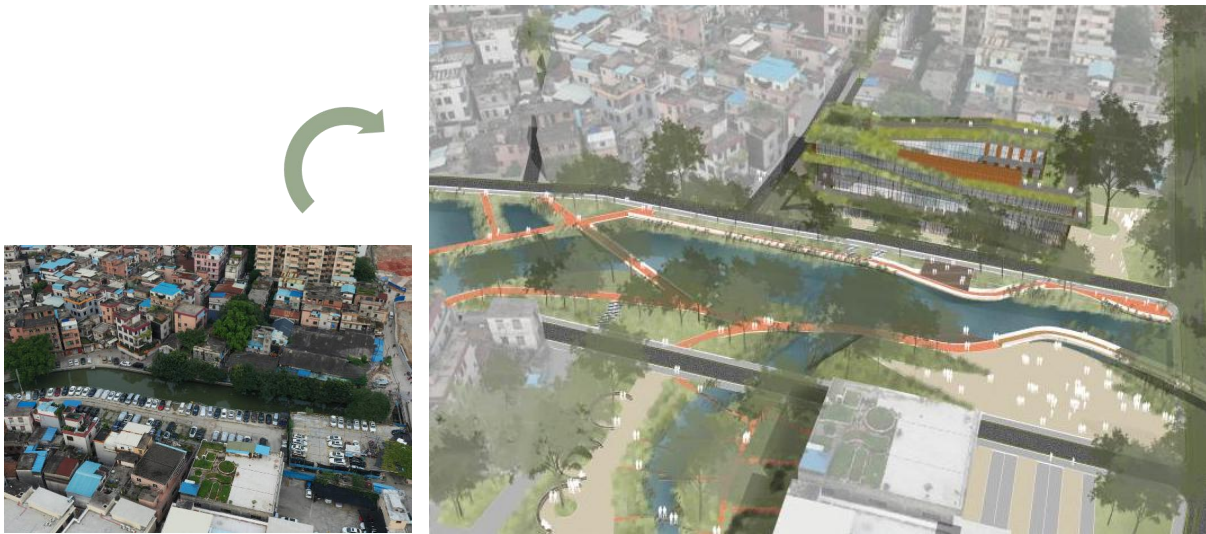


Fig 6-70 Comparative perspective view of the renewal of Lijiao

Next, at the mesoscale, the public spaces within the urban village community and the service scope nearby are evaluated and analyzed for accessibility. Based on this, the need for where and what types of public spaces to be supplemented is determined to improve the accessibility and equity of biophilic spaces within the entire community and establish a complete internal biophilic network, allowing every resident in Lijiao to enjoy natural resources fairly and conveniently within the community.

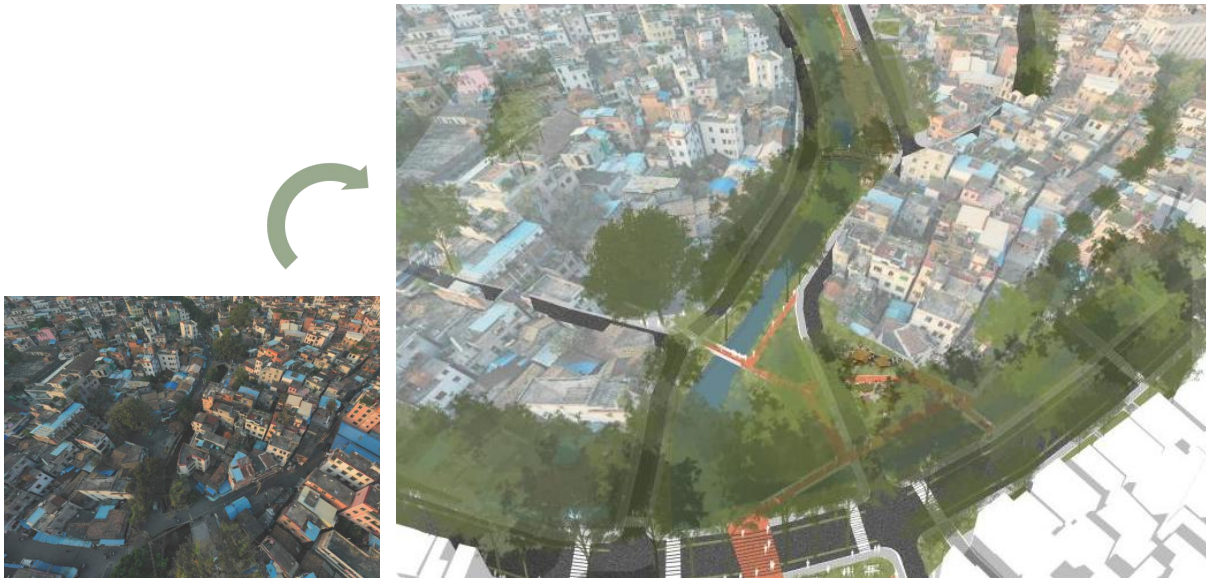


Fig 6-71 Comparative perspective view of the renewal of Lijiao

Finally, the micro-design of Lijiao Park and Lijiao River, which are the most feasible and beneficial for transformation within the village, is carried out. From a more human perspective, these areas that have lost natural vitality are transformed to have more nature-based characteristics, allowing people to experience and learn from nature and thus respect and protect nature, truly achieving a harmonious coexistence between humans and nature in the development vision.



Fig 6-72 Comparative perspective view of the renewal of Lijiao

Conclusion

Regarding the research and practical methods for the transformation of urban village, from large-scale demolition and reconstruction to organic updating, from micro-updating to acupuncture therapy, there are many feasible methodologies. However, the issue of achieving harmonious coexistence between humans and nature always seems to be relegated to a secondary position in urban village construction. In fact, most urban village has rich ecological resources due to the historical background of the village, which used to be the center of people's lives, but is now buried in rapidly developing cities. Therefore, this article is based on the biophilic urbanism design and analyzes urban village's renew as a research object, focusing on the design practice of Lijiao Village in Guangzhou. This thesis attempts to renew and transform urban village from the perspective of exploring biophilia to enhance residents' sense of well-being, construct a new type of urban village community that is naturally harmonious and livable, and the main research results are summarized as follows:

- (1) Explore the principles of constructing a biophilic city. Based on literature research, five main principles are proposed, including making nature the design center; considering all elements of the city comprehensively; using multi-scale and multi-level design techniques; ensuring equitable and diverse public participation in the construction of biophilic cities, avoiding gentrification of urban landscapes; paying attention to the regional development of cities to create livable environments with regional characteristics.
- (2) Sort out the design elements and strategies of a biophilic city. Biophilic design has entered the field of urban design, but specific design elements and methods are still in the exploratory stage. This article explores relevant literature and summarizes existing research on biophilic urban design, explains the necessity of building biophilic spaces, and organizes design elements, proposing corresponding design strategy recommendations.
- (3) Based on the multi-scale principles of building a biophilic city, renewal strategies for urban villages are proposed at the macro, meso, and micro scales. At the macro scale, starting from the perspective of the city as a whole, the various elements of the urban village and surrounding areas are identified and systematically integrated. Suitable combinations of development approaches are selected according to the situation of the elements, and the urban

space is connected to the urban village. The purpose of this scale of renewal is to incorporate the urban village into the urban network, break down development barriers, and form an integrated biophilic network. At the meso scale, starting from the perspective of the community as a whole, the public spaces of the community are identified by their functions and types and a map of public spaces is drawn. Each space is then analyzed for its biophilic characteristics and accessibility, in order to determine the types of spaces and locations that need to be supplemented, and to obtain an overall optimization plan for the space. The purpose of this scale of renewal is to build a biophilic network within the community, creating a resilient and equitable environment for residents, and enhancing the overall living environment. At the micro scale, starting from the site itself, the basic conditions and functions of the site are analyzed, and the site is classified and designed accordingly. Biophilic design is created at the human scale, making it more integrated into people's lives. The purpose of this scale of renewal is to truly bring nature into people's lives and allow nature to reach the last mile of people's lives.

(4) Using the renewal design of Lijiao urban village as an example, the multi-scale design strategies proposed are applied to practical design. Through data research and field investigations of Lijiao, the connection between Lijiao and the central green space of the city is improved at the macro scale, and Lijiao's ecological axis is connected to the city's biophilic network. At the meso scale, the existing public spaces in Lijiao are analyzed and re-planned. Partial demolition and reconstruction of areas requiring additional public space create a complete biophilic space service system within the village. At the micro scale, the two most effective sites for transformation, Lijiao Park and Lijiao River, are selected, and detailed designs for their transformation are made through three levels of design, with the aim of creating a harmonious and symbiotic urban community that is livable and joyful, for both people and nature.

Innovation points of the thesis:

(1) The extension study of the theory of biophilic cities. Biophilic cities have been mainly used in architectural designs in Western countries in the past, and in recent years, it has entered the field of urban design. However, research in the Chinese context and specific spatial implementation methods are still lacking. This paper focuses on the unique product of

China's development - urban villages - and provides a more targeted and localized research object. Based on this, a series of complete design strategies are proposed, which expands the research and application of biophilic cities in China.

(2) Providing practical design references for biophilic city updates in urban villages. This study proposes principles for multi-scale biophilic city spatial construction, elaborates on the process and methods of construction at each scale, and deeply explores specific implementation strategies. Taking the Lijiao renewal design in Guangzhou as an example, the proposed strategies are transformed into operational design language, and biophilic city design practices are conducted based on the high-density urban background. The results provide a reasonable design strategy and specific feasible space pattern suggestions for the renewal design of China's urban villages, which has practical research significance.

Limitations and prospects:

As research on the concept of biophilic cities is still in its early stages in China, there are many issues that have not been thoroughly explored. The overall scope of this study is broad, and there are still many shortcomings. First, the multi-scale system proposed in this paper lacks a theoretical basis for different levels of methods. The process still relies heavily on traditional planning methods and the perspective is not comprehensive enough, which requires further deepening and improvement. Second, due to the richness and complexity of the biophilic concept and the lack of research on the application of biophilic urban design methods in China, the design methods proposed in this paper still have certain limitations and lack support from data and quantitative simulation, which stay at the surface level of design and have not been fully considered. Third, the sorting of design elements is not sufficient. The elements that need to be transformed in urban villages are not only public spaces, but also how to transform the buildings in urban villages into biophilic ones and how to implement strategies for more biodiversity, which require further exploration.

Harmonious coexistence between humans and nature is the trend of future development, and biophilic city construction will receive more and more attention in the future. It may be widely applied in different cities and spatial scales, providing opportunities for people to understand biology and get close to nature. In future research, it is necessary to further apply it under the Chinese context, develop biophilic city construction methods with Chinese

geographical characteristics, and also further research on methods for quantitative evaluation of benefits to ensure the rationality and usability of the design. In addition, it is necessary to promote interdisciplinary cross-verification of related research results to form systematic guidance, so as to find biophilic urban construction methods suitable for China's modern and high-density urban development background. Although biophilic urban design cannot solve all urban problems, it is hoped that this study can provide new ideas for the renovation of urban villages and the construction of biophilic cities in China and provide references for future research on biophilic design.

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