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数字分析介入的城中村街道空间优化与活力与功能更新策略研究

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Spatial Optimisation and Vitality Enhancement Strategies for Urban Villages with the Intervention of Digital Analytics

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摘　要

长期以来，追求利益的建筑违章加建、多而杂的流动人口使城中村的空间问题与管理问题变得越来越复杂。这种情况不仅导致了空间质量的恶化，还对居民的心理状态造成了消极的影响。很多城中村地区都存在着街道活力不足的情况，具体表现为商业衰败、空间拥挤、街道使用不合理以及自然景观被破坏等问题。但常规的推倒重建的思路只是把城中村原本承载的功能和问题转移到了另一处，从城市的视角来看不仅无法从根本上解决这一问题，还造成了城市特色文化和服务人口的流失，不适用与存量背景下的城市更新。因此，当前需要一种城中村改造的新思路来应对城中村问题。

对于城中村而言，其空间与活动的复杂程度相比较于一般城市区域更高，一些问题也因此难以在常规的空间设计理论下发现并解决。而利用数字分析技术能够针对某一特定的空间特征指标进行客观的评价，综合运用多种技术便可刻画出片区客观层面上的特征。这为快速认知城中村片区、发现潜在的问题以及设计提供有力的数据支撑和指导。本文将着眼于广州市 Lijiao Village，在实地调研的基础上，从物理空间、拓扑空间、真实空间三方面入手，综合运用空间句法、POI、街景大数据以及传统的城市设计分析手段，来发现和评价 Lijiao Village 中的低质量空间并提出相关的设计策略。最后，在上述设计策略的基础上对 Lijiao Village 的空间结构进行整体优化、对城中村居民提供空间使用的引导，并对重点地区进行针对性的更新设计作为设计范例，提升整个地区的街道活力。

综上，本文希望能够通过上述理论的综合分析与指导，为 Lijiao Village 打造有温度的高品质生活空间，同时为城中村的更新设计提供新思路。

关键词：城市更新；城中村；沥滘；数字技术；街道活力

Abstract

The space and management problems of urban villages have long been complicated by the pursuit of illegal additions to buildings for profit and a large and diverse transient population. This situation has not only led to a deterioration in space quality, but has also had a negative impact on the psychological state of the residents. Many urban village areas suffer from a lack of street vitality, which is reflected in commercial decay, space congestion, unreasonable street use and the destruction of the natural landscape. However, the conventional idea of knocking down and redeveloping urban villages only transfers the functions and problems they originally carried to another location, which not only fails to fundamentally solve the problem from an urban perspective, but also results in the loss of the city's distinctive culture and service population, and is not applicable to urban regeneration in the context of stock. Therefore, a new way of thinking about urban regeneration is needed to deal with the problem of urban villages.

The complexity of space and activities in urban villages is higher than in urban areas in general, and some problems are therefore difficult to identify and solve under conventional space design theory. The use of digital analysis allows for an objective evaluation of a particular space characteristic, and a combination of techniques can be used to characterise the area at an objective level. This provides powerful data support and guidance for recognition of urban village areas, the identification of potential problems and design. In this paper, we focus on Lijiao Village, Guangzhou, and use a combination of space syntax, POI, street map and traditional urban design analysis to identify and evaluate low-quality spaces in Lijiao Village and propose relevant design strategies based on field research, physical space, topological space and real space. Finally, on the basis of the above design strategies, the space structure of Lijiao Village will be optimised as a whole, the residents of the village will be guided in the use of the space, and the core areas will be targeted for regeneration as design examples to enhance the street vitality of the whole area.

In conclusion, it is hoped that through the comprehensive analysis and guidance of the

above theories, the paper will create a warm and high-quality living space for Lijiao Village and provide new ideas for the regeneration design of urban villages.

Keywords: urban regeneration, urban village, Lijiao, digital technology, street vitality

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Chapter 1 Introduction

1.1 Research Background

1.1.1 Overview of Urban Village

The term "urban village" is a new concept that has emerged in recent decades and is a unique social phenomenon that has emerged after the large-scale urbanisation process in China. The 100 Years Dictionary of New Chinese Words and Expressions explains it as a settlement of residents that still exists in the process of urban expansion due to the expropriation of arable land. [1] After the introduction of China's reform and opening-up policy, urbanisation progressed rapidly and the demand for land in cities became more urgent than ever. Villages that were originally close to the cities were gradually surrounded by them. The villagers' land was expropriated and gradually only the residential function of the village was retained. For various reasons, cities tend to overlook urban villages in their planning, becoming relatively neglected territories. From the city's perspective, the urban village is an area that is backward in development and outside the city's management. Not only is the cost of demolition and relocation high, but the resettlement of villagers is also a huge challenge. For the villagers, land is the most important means of production. After losing their land, the urban village is almost the only place where they can survive, and their agricultural production is replaced by secondary and tertiary industries. The villagers took advantage of the village's prime geographical location and the lucrative compensation for land acquisition to set up workshops, provide accommodation for migrants and open shops for commercial services, which are an important source of income for the villagers. This change has given rise to the problems of bloated spatial forms, high population density and changes in the lack of natural landscape in a relatively short span of time, making the village both different from the traditional village and distinctly different from the city. This distinction also affects the speed of the transformation of the villagers' identity, as their belonging remains in the village rather than the city, seriously hindering their integration into the city. Due to the above-mentioned effects of physical space and the mentality of the inhabitants, it is difficult for villagers to integrate into urban life even though the urban village is very close to the city, and the urban

village gradually forms an isolated area in the city. [2]

It is undeniable that urban villages play an important transitional role for the transformation from rural to urban populations and for the settlement of urban migrants. However, the problems brought about by urban villages cannot be ignored. The pursuit of economic benefits through private construction and disorderly growth without planning has made urban villages synonymous with high building density, low spatial quality, mixed functions, complex demographics and insecurity. The most effective way to raise income for villagers in urban villages, who collect housing rents as an important source of income, is to build as many houses as possible, even squeezing out the space of existing roads, greenery and public facilities. The most intuitive impressions of urban villages to the outside world are therefore dark streets, narrow spacing between buildings, a chaotic spatial system and extremely high building density. This has also led directly to a deterioration in the quality of the space and the vitality of the streets. The lack of public services is also an important factor in the low quality of life. This comes partly from the difficulty of developing public facilities in a high-density built environment, and partly from the fact that the planning authorities' attitude towards urban villages is mainly to put them on hold or to knock them down for redevelopment, and are reluctant to do optimal design in urban villages. Today, there are a considerable number of urban villages located in the heart of the city, which not only have their own problems, but also affect the quality and safety of the surrounding city. The problem of urban villages can no longer be ignored.[3]

1.1.2 Current State of Urban Villages

1. At the urban level, the pattern of large-scale demolition and construction destroys distinctive areas of the city and brings social problems

Previously, for the sake of rapid urban development, the acquisition of economic benefits and to meet the growing housing and living needs of residents, many places chose to knock down and redevelop urban village areas and replace them with new residential communities, commercial complexes or office buildings. In the period of rapid urbanisation in China, this approach has enhanced the appearance of cities at a very high rate and has resulted in higher

land prices and fiscal revenues in the process of land transactions.[4]

There is no denying that this approach has played an extremely important role in China's urban development. However, in the process, the pursuit of efficiency has inevitably led to the neglect of many problems. For example, residents' wishes to relocate have been ignored, the culture and fabric of the area has been obliterated, and the natural environment has been destroyed. These neglected issues have led to an increase in social discontent, a crisis of urban character and a deterioration of the ecological environment. Particularly for the low-income groups living there, demolition means the disappearance of low-cost accommodation. As a result, they are forced to move to the periphery of the city, and their labour and commuting costs rise. At the same time, this pattern has led to a crisis of identity that is "Same Imagines of the City". As a result, cities are losing their distinctive spaces or cultural atmospheres that have a collective memory, not only losing their identity but also their citizens' sense of belonging. In addition, with the current increase in land prices, the amount of money required for land acquisition and demolition, especially in large cities, has become enormous, and is an extremely heavy burden for both the government and developers. [5] Therefore, this model is unsustainable in the current social environment.

2. At the level of the urban village, the space pattern is unreasonable and the street vitality need to be enhanced

Urban villages are often a neglected part of urban development, and their public facilities and commercial environment are often far inferior to those that are in cities. Urban villages are villages by nature, and their space structure is developed from villages. As such, their naturally occurring internal space organisation in an urban context is at an inherent disadvantage compared to rationally planned cities. In recent decades, the level of urbanisation in China has increased significantly, with a massive influx of people into cities. The rapid urbanisation process has led to villages, which were originally located on the periphery, being gradually surrounded by modern urban construction, forming a collapsed area of urban construction. Surrounded by cities, the villages have penetrated deep into the heart of the cities and have a privileged location while still maintaining low rents, which has

attracted a large number of low-income migrants to live there temporarily, resulting in a surge in the population of urban villages.

Another typical problem is that the space is overcrowded and lacks space for activities and interaction.

For the holders of residential land in urban villages, the construction of additional houses can greatly increase rental income, while the public environment is relatively discarded as it does not generate much economic value. As a result, villagers are driven by profit to blindly expand their original houses, magnifying the problem of inadequate carrying capacity of the original spatial structure and causing great space disruption. The original village landscape and activity space is often taken up in this way, not only destroying the interesting space available for rest and communication in the village, but also intensifying the feeling of crowded space. Under such conditions, it is difficult to create spaces in urban villages where people can stay quietly and where daily activities and interactions are difficult to take place. When there are fewer and fewer functions to be carried out in an urban village, until the village is only a place to live, it will become an uninteresting and unmanageable 'dwelling'.

The same is happening in the streets. In some urban village developments, the streets become narrower and narrower, most roads are unreasonably occupied and the space feels chaotic. This usually arises from two causes.

One is because of the building addition. There are two types of building additions. The first is the building addition in a vertical or horizontal direction to an existing building. A vertical addition makes the building taller and makes the street more crowded and depressing in terms of psychological perception, which is an indirect effect on the road; a horizontal addition expands the floor space towards the centre of the road, enlarging the use area on the building plan by means of an addition and squeezing the width of the road, which is a direct effect on the road. The second scenario occurs in streets with relatively wide road widths, where new buildings are built directly on both sides of the street. This divides the originally wider road into several narrower roads and the spaces are not necessarily continuous, creating a confusing space pattern.

Secondly, it is because of the problem of parking occupying the roads. The rising incomes of local villagers and the needs of modern urban life have contributed to the upgrading of consumption by residents of urban villages, with cars becoming a very important means of production and a necessity for residents. The proliferation of cars has made urban villages, which already lack space, even more crowded. Many urban villages have filled in their traditional rivers and streams or cleared their original public spaces and old trees in order to widen their roads or provide more parking spaces. And when the number of parking spaces is not sufficient to meet the current demand for parking, parking on the roadside is one of the easiest and most convenient practices. This practice makes the already inadequate roads in the urban village even more congested and seriously affects traffic flow. In addition, on-street parking inevitably creates an information overload within the visuals, reducing the comfort and tidiness of the space. Obviously, from a third party's perspective, all of these actions will only make an already poor quality of space worse; and for the realities of villagers' lives, meeting immediate needs is all that matters. This is a trade-off between the pros and cons of inadequate conditions.

The inappropriate use of space has also led to old and decaying ground floor commercial and public facilities and a deteriorating commercial appeal.

The proliferation of population in urban villages has led to a sprawling encroachment of space and a surge in demand. This has made it difficult for the commercial services and public facilities that used to serve the traditional village to adapt to current needs and lack the space to expand to meet them. At the same time, the growing material and spiritual needs of the inhabitants are exacerbating the problem. In the absence of development conditions and rational planning, it is difficult to systematically adapt the commercial space and functions of the village, let alone to the needs of the inhabitants. The few commercial services and public facilities in the villages are unable to meet the needs of the inhabitants, and the vicious circle of decay has led to a gradual loss of vitality in the streets.

In the process of disorderly addition of buildings or self-help of business, some natural and cultural resources are forgotten or destroyed. For the sake of immediate benefits, some

residents of urban villages choose to encroach on public landscapes or spaces with cultural value, which is undoubtedly quenching a thirst with poison for the development of urban villages. A good environment is fundamental to the quality of space and the vitality of a street, but a place that has lost its long-established landscape and culture is also giving up the common memories of its residents. When these memory-bearing landscapes and cultures disappear completely, it is difficult for residents to form a sense of belonging, exacerbating the irresponsible barbaric growth that is common in urban villages.

1.1.3 Urban Village Policy Background and General Regeneration Model

As a widespread phenomenon in China's cities, the treatment of the urban village problem varies from region to region. Here is an example of Guangzhou's urban village transformation policy. The transformation of urban villages in Guangzhou can be divided into three stages, each with different characteristics, reflecting the continuous adjustment and progress of the policy.

1. Early pilot transformation period

The earliest urban regeneration in Guangzhou dates back to the 1960s, but the focus on urban villages began in 2000, when the Guangzhou Urban Master Plan (2001-2010) was released, proposing the basic strategy of "expanding the south, optimising the north, advancing the east and linking to the west", at which time the core strategy of Guangzhou's urban spatial development was the core strategy of Guangzhou's urban spatial development was to "expand".[6] In the same year, the government-led initiative to deepen the reform of the rural system was implemented, providing policy support for the transformation of urban villages. In May 2002, the Guangzhou Municipal Government issued the "Opinions on the Conversion of Urban Villages" (Sui Ban [2002] No. 17), which emphasised the conversion of urban villages from agriculture to non-agriculture[1], the ownership of collective land and

[1] from agriculture to non-agriculture: A Chinese household registration system that converts agricultural accounts to non-agricultural accounts with the aim of facilitating the transformation of the primary sector population to the tertiary sector under certain policy guarantees.[7]

housing, the conversion of village committees to neighbourhood committees, the disposal of rural collective assets, and the transformation of the human environment. [8] This document defines the status of urban villages. This document determines that the agricultural nature of urban villages will be changed to non-agricultural nature, and that the transformation of "urban villages" will be mainly the responsibility of the municipal government, and that developers will not be allowed to participate in it.

At this period, there was a large-scale expansion of Guangzhou's urban space, and the city's infrastructure and public services became increasingly sophisticated, initially forming a polycentric city. In 2006, the plan added to the previous strategy of revitalising the old city, developing the service industry and enhancing the core competitiveness of the city, which became a turning point in the transformation of urban villages. The policy began to allow real estate developers to intervene in the transformation of urban villages.

2. "Three Olds" period

The "three olds" transformation refers to the transformation mode unique to Guangdong Province, which is the transformation of "old towns, old factories and old villages" respectively. Since 2008, the Guangzhou Municipal Government has issued a series of policy documents, compiled a planning system and set up the "Three Olds" Transformation Office, officially starting the "Three Olds" transformation period. In 2009, the Guangzhou Municipal Government issued the "Opinions on Accelerating the Transformation of the Three Old Villages", proposing the implementation of the "One Village One Policy, One Factory One Policy" model, encouraging market participation and independent regeneration, with the goal of completing the transformation of 138 "urban villages" on the city's register within 10 years. The target is to complete the renovation and transformation of 138 "urban villages" in the city within 10 years, and 52 "urban villages" in key functional areas within 3 to 5 years. The "Three Olds" policy has led to the renovation and regeneration of infrastructure in many urban villages, but the actual results have not met the expected goals.

3. Urban regeneration period

In 2015, the Guangzhou Urban Regeneration Bureau, the first urban regeneration agency

in China, was established and took over all the "three old" transformation work. In December of the same year, the "Guangzhou Urban Regeneration Measures" introduced the "micro-regeneration" model of urban regeneration, which focuses on historical and cultural preservation and improvement of the living environment, transforming economic benefits into social benefits and advocating "conservation + renovation", comprehensive renovation and micro-renovation. In 2018, during his visit to Yongqingfang in Guangzhou, General Secretary Xi Jinping emphasised that urban planning and construction should not be carried out for quick success or large-scale demolition and construction, confirming the policy of this period. In 2019, Guangzhou further optimised the set-up of its urban regeneration agency, handing over urban regeneration work to the Guangzhou Housing and Urban-Rural Development Bureau to take forward.

In addition, China's Ministry of Housing and Urban-Rural Development issued a Circular on Preventing the Problem of Large-scale Demolition and Construction in the Implementation of Urban Renewal Actions on 30 August 2021, implying that the problem of large scale demolition and construction is taken seriously from the national level. The circular clearly points out the current tendency to be in a rush for quick success and profit, demolishing old buildings, relocating residents and cutting down old trees at will in some areas, raising property prices and the cost of living, and creating new urban problems. At the same time, the following requirements have been put forward for the current problems: to strictly control large-scale demolition, additional construction and relocation; to ensure stable supply and demand in the housing rental market; to preserve the use of existing buildings and the pattern and scale of the old city, and to continue the characteristic style of the city; to strengthen integrated planning, explore sustainable regeneration models, accelerate the filling of functional shortcomings, and improve the safety and resilience of the city.

In general, this period has emphasised the systematic of urban regeneration and the importance of historical and natural cultural and ecological conservation, changing from an initial focus on simply expanding urban space and economic benefits to the current emphasis on quality development that enhances space quality, respects the wishes of residents,

improves public facilities and preserves culture and nature. [9,10]

1.2 Research Purpose and Significance

1.2.1 Research Purpose

In today's big cities, the issue of urban villages has increasingly affected the appearance and living experience of the city. In recent years, with policy changes, the attitude of cities towards urban villages has gradually shifted from abandonment to inclusion, hoping to integrate them into the city and improve their space quality and the living standards of their residents at a relatively small economic and social cost. Therefore, this paper will explore the idea of urban village transformation without major demolition and construction, starting from an urban regeneration approach. In the use of analysis and design methods, the tendency is to explore design ideas that combine traditional design methods and digital analysis tools to paint an all-round picture of urban village problems. Ultimately, the aim is to enhance the vitality of the streets in urban villages and to promote the quality of life of urban village residents.

1.2.2 Research Significance

1. The urban village is closely related to the city, and urban villages are an inevitable topic in urban development

Literally, "urban villages" are villages surrounded by cities. Although urban villages are within cities, they are not usually seen as part of them. The rapid urbanisation process in China has forced many urban villages to become part of the city before they can be absorbed, a result of a combination of institutional, national and economic factors. Due to the land use system and the urban-rural dualist system, as well as individual education, attitudes and sources of income, even when the industries and population of urban villages are no longer predominantly agricultural, it is difficult to transform the use and ownership of land, as well as the household registration and psychological status of villagers, to the city.[2,11,12]

The relationship between the urban village and the city is reflected in the fact that it is a transition zone from rural to urban, from nonlocal to local.

On the one hand, from a human point of view, urban villages, although usually isolated in the city, attract a large number of people from outside the city and the countryside who want to enter the big city to work. Often these people are not high-income earners and are price sensitive people, but they also provide relatively low-cost services to the city, forming an integral part of the city's health and inclusiveness. Villagers in urban villages are also about to complete their transition from rural villagers to urban residents. For farmers who have lost their land, which is the most important means of production, the transformation of urban villages requires appropriate work and financial compensation to build sustainable livelihoods and cannot lead to poverty. For low-income groups, the importance attached to the issue of urban villages reflects the humanistic concern of a city.[13]

On the other hand, from the urban perspective, too rapid urban development is the root cause of the formation of urban villages. However, the process of urbanisation should be discussed separately from the development of cities themselves. According to the census data of the National Bureau of Statistics of China, the urbanisation rate in China has steadily increased from 36.2% in 2000 to 63.9% in 2020, which is higher than the world average of 56% and equal to 68% in the upper middle-income countries, but much lower than the 81% in the high-income countries.[2] On the positive side, cities facilitate the urbanisation of urban villages and provide them with relatively ample financial, administrative and planning support. In an urban development where the focus is shifting from incremental to stock, the transformation and development of urban villages is an important part of quality urban development.

In general, both urban villages and cities are inescapable topics in China's urban development, and both have had an important influence on each other at certain historical periods.

2. The economic and social significance of enhancing the space quality of urban villages and avoiding large-scale demolition and construction

[2] Data source: United Nations Population Division. World Urbanization Prospects

At present, many major cities have the problem of urban villages, which have become an obstacle to the development of these cities. As the conflict between people and land in China has intensified in the last decade or so, the relationship between the government and the relocatees has evolved in contradiction, and the social problems brought about by the urban villages have become a very difficult issue for the city rulers, so the issue of governance and renovation of urban villages has become a topic that has received wide attention from the government, scholars and the public. From the earlier compulsory demolition by the government to the present model of renovation by various renovation subjects, we have witnessed the transformation of urban development from crude to refined, from compulsory to rational. It can be said that the existence of the urban village problem determines the lower limit of a city, but the way the urban village problem is solved reflects the upper limit of the thinking of those in charge of the city, and the proper solution of the urban village problem can reflect the tolerance and humanistic care of the city for different people.

However, although there have been significant advances in the way land acquisition, the unchanged land acquisition-sales model has led to the motivation by profit, with knock-down redevelopment being the most effective way to reap the benefits. There is no denying that redevelopment can give the city a new look and provide new opportunities for the area. But demand cannot just disappear, and what is knocked down in an urban village is bound to reappear somewhere if it is not properly rehoused. Villagers are forced to move again to the urban fringe or to integrate themselves into the city, but a significant proportion of villagers rely heavily on the village's original production conditions and methods, and the forced relocation will result in the loss of the industries on which they originally depended, leading to more serious poverty problems; in addition, the relocated villagers become migrants in another place, and the conflicts do not disappear, but rather create more segregation because they do not have equal access to the city's resources. The conflicts do not disappear, but rather create more barriers and confrontations because of the unequal access to urban resources. In addition, the blind expansion in response to the influx of migrants and the speculation on compensation for demolition and relocation have contributed to the tendency of the village to

develop more and more in a brutal way. The root causes of both are the new population that has no place to live and the mentality of the locals that the local space is far inferior to the city and must be demolished. For the incoming population in urban villages, the loss of cheap living space will raise their cost of living in the absence of complementary low-rent housing, continually relegating these people to the urban periphery and even sowing the seeds of new urban villages for the further future.[14] Such an approach also flattens the class composition of the city's population, ultimately raising the cost of running and living in the city as a whole, to the detriment of its healthy development. In addition, this design approach also exacerbates the problem of urban sprawl. Many of China's major cities are suffering from this problem, and the expansion of their scale has led to the disappearance of urban character, the loss of urban culture, and the phenomenon of a 'one-size-fits-all' city. Some urban villages with unique village culture and spatial characteristics can be transformed and integrated into the city, becoming part of the city and to a certain extent improving this uninteresting urban landscape, playing a unique functional, cultural and landscape role.

Therefore, solving the problem of urban villages requires a long-term management of supply and demand, resource allocation and spatial remediation in the light of the actual contradictions, and the exploration of a different model of urban village transformation according to local conditions, so that it can integrate itself and its residents into the city. For cities, urban villages can be a new entry point for repairing urban problems in a situation where the urban environment is deteriorating and difficult to repair, where rapid urban development has led to over-density of buildings, uniformity and lack of relaxing space, and where it is difficult to work on incremental growth within the city.

3. The significance of using digital analysis tools

After several industrial revolutions, human settlement patterns have undergone the most profound and complex changes in recorded history - an explosion of population and a significant acceleration of urbanisation, which are inextricably linked to changes in social relations of production. In this process, in which the size of the city grows, its complexity increases and the number of potential interactions is proportional to the square of the

interconnected elements, will bring about qualitative changes in the behaviour of all aspects of society and the economy. [15] This change will make design more difficult to achieve in all aspects. Any changes in human society will affect urban development and architecture itself, but traditional ways of thinking do not translate these changes into design, and we must use new technologies to create designs that are relevant to the times. Just as the term 'architect' has come to mean different things in different times, so too has the term 'architect'. From Marcus Vitruvius Pollio to Filippo Brunelleschi, from Le Corbusier to Zaha Hadid, they share the same way of thinking as architects, but with completely different means and tools. Architecture should not be equated with the construction of houses, it is an evolving concept, but what remains constant is the use of the tools and vocabulary of the times to think and create designs that are adapted to the needs of the times.[16]

Looking at the current state of research in architecture, we can see that urban and rural space and socio-economic culture have long been studied as relatively independent systems. Regarding the interrelationship between them, the traditional "spatial determinism" and "spatial mapping theory" either exaggerate the dynamic role of space or ignore the law of spatial development; the former has resulted in the purely material space research and design of "form on form"; the latter has resulted in the autonomy and self-consistency of space. "The former has led to a purely material spatial research and design that is 'form on form'; the latter has led to a loss of spatial autonomy and self-consistency, resulting in the uselessness of material spatial planning. It is clear that finding a way to quantitatively present the relationship between urban and rural space and socio-economic culture is crucial. [17] In this age, the increasing availability of big data and analytics for data can provide a valuable reference and basis for a scientific and objective design approach to uncovering potential problems and needs and guiding design.[18]

1.3 Street Vitality

Among the various problems currently existing in urban villages, the decline of street vitality is one of the most direct and wide-ranging issues. Especially in the context of the

current urban stock development strategy, the issue of street vitality is a necessary part of urban village transformation, and therefore this study becomes particularly important for solving the urban village problem. As the issue of street vitality in urban villages involves all aspects of the street space, it can directly improve the living environment and social atmosphere of urban villages at a relatively small cost in the transformation, and increase the happiness and sense of belonging of the residents.

1.3.1 Definition

Everyone has their own perception of the vitality of a street. In daily life, we can easily identify the level of vitality of a street, which is often referred to as the "popularity" of a street. From this it is easy to see that 'people' are the most crucial element in the vitality of a street. But a large number of people does not mean a high level of vitality. The large number of vehicles that carry a large number of people on the main roads that are common in China's major cities does not lead us to conclude that the main roads are 'vital'. The reason for this is twofold: firstly, these flows of people mainly occur in fast traffic and hardly ever stay in the street; secondly, these people do not have any positive effect in the street and hardly ever move. When we switch our perspective to some streets that are generally considered to be vital, we can see that these streets tend to have some common characteristics such as pleasant scale, slow moving traffic, abundant activity and good landscaping. These characteristics are usually pedestrian-driven streets, rather than motorised traffic-driven. In the urban transport system, the two above represent two different types: roads with a predominantly traffic function and streets that incorporate a variety of functions.

Therefore, we can define that 'street vitality' refers to the possibility and abundance of pedestrian stopping and movement in a street dominated by slow-moving traffic.[19]

1.3.2 Influencing Factors

Based on the above definition, the core of street vitality lies in street activities. The activities generated in the street can usually be divided into economic activities centred on commerce, social activities centred on daily interaction and entertainment, and cultural

activities centred on the pursuit of spiritual uplift. Therefore, the factors influencing the vitality of a street also tend to consist of economic vitality, social vitality and cultural vitality. [20] In perceptual terms, a vital street can be described as having one or more of the following characteristics: a thriving business climate, good landscaping and human relations, and a rich and well-regarded cultural life. The richer the street activity, the more vibrant the street is perceived to be. In a nutshell, the diversity of street activities is key to the vitality of a street.

1.3.3 Research Significance

During China's rapid development in recent decades, the urban landscape has undergone tremendous changes. Under scientific planning, China's urbanisation rate has increased significantly. In recent years, the rapid expansion of cities has brought about various new problems. As the aesthetic and spiritual needs of residents have increased, it has become apparent that the pursuit of efficient development has often resulted in less sophisticated street design, with the most immediate impact being the neglect of 'people' and the character of the city. As a result, urban design has become increasingly important. But the expansion of large cities inevitably leads to the creation of urban villages. Urban villages do not start out with a variety of problems. As a settlement that has developed from scratch, it must itself have developed its own identity over time. To a certain extent these villages, as peripheral areas of the city, are themselves a microcosm of a certain period in the long-term development of the city. But nowadays, under the pressure of urban development and driven by interests, they are gradually becoming lost areas in the city. With the introduction of policies to restrict large-scale demolition and construction and to protect the character of the city, quality enhancement of urban villages has gradually become a popular topic. In the process of quality enhancement, street vitality is one of the inextricable topics that deserves in-depth consideration by researchers and designers.[21]

1.4 Current Status and Review of Research

1.4.1 Status of Research

1. Overview of Theory Research and Practice on Urban Village Issues

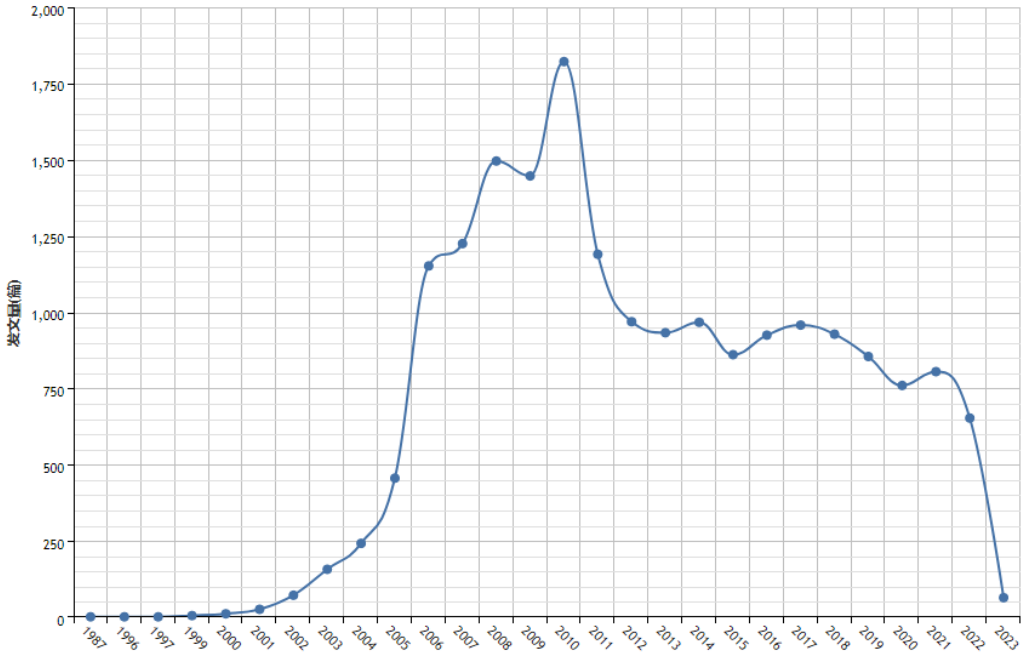


Chart 1-1 Number of papers on "Urban Village" (source: cnki.net)

The first stage (1993-2002), the stage of understanding and analysing the problems of urban villages and their reasons. The central theme is to reveal the various problems that exist in urban villages and the reasons for them. The main concern is the high concentration of non-resident population, which leads to a high level of filth and disorder, as well as to sexual crime, gambling and drug abuse. Li Peilin's research is a synthesis of the results of this phase of research, and became the academic starting point for a comprehensive study of urban village transformation. Through field research on urban villages, Li Peilin "felt a great shock in his heart and was astonished to lose his breath", as the planning, construction and management of these villages were extremely chaotic, the foreign population had swelled, and the rental houses inside had become hotbeds for gambling and drugs. In response to Zhuhai's proposal to "eliminate urban villages within three years" and Guangzhou's proposal to complete the transformation of urban villages in five years, Li Peilin profoundly pointed out that the transformation of urban villages was the result of the development of "survival rationality" to "economic rationality". In response to Zhuhai's proposal to "eliminate urban villages within three years" and Guangzhou's proposal to complete the transformation of

urban villages in five years, Li Peilin profoundly suggested that the transformation of urban villages is a historical process. He also proposes that urban village transformation is a process of gaming between the government, real estate developers and villagers.

The second stage (2003-2009). This stage focused on the conflict and coordination of interests among the government, real estate developers and village collectives in the research of urban village transformation paths and models. Urban villages are beginning to become an academic hotspot. Yan Xiaopei's many papers continue to study the transformation of urban villages, and on the basis of his analysis of the problems and successes of various urban village transformation paths, he proposes that the effective promotion of urban village transformation must establish a mechanism to balance the interests of the government, villagers and developers, and that the goal of urban village transformation should not only be the reconstruction of the physical environment, but also the construction of public space and functional reshaping. The study of the causes of urban villages in this period further deepened into the institutional realm, suggesting that urban villages are not only the result of farmers' impulses, but also of the government's "profit-seeking" and dualistic structure in pursuit of land finance, and that the lack of management has contributed to various problems. The government should change its policy orientation of 'profit-seeking' and establish a 'monolithic system' as the fundamental way out for the transformation of urban villages. Papers from this period began to call attention to the housing problems of migrant workers in the transformation of urban villages.

The third stage (2010-present). This stage elevates the transformation of urban villages to macroscopic significance, is a great breakthrough in urban village research since the 12th Five-Year Plan. The issue of urban village transformation and development has received unprecedented attention and has become a major topic of academic concern. Firstly, the pursuit of urban village transformation has gone beyond the early goal of "changing the dirty and disorderly" and has elevated urban village transformation to the level of success or failure of urban modernisation and China's new urbanisation. It is proposed that the uncontrolled spread of urban villages has become a constraint to urbanisation and industrialisation. It is a

strategic breakthrough for China's land system reform, upgrading the quality of cities and promoting new urbanisation. Secondly, the solution to the problem of the non-resident population is included in the framework of the study of urban village transformation, which has increased from the three major interests of the government, village collectives and developers to four major interests, including the non-resident population. Qin Hui suggests that urban villages are worse than slums because of the lack of housing rights, and that the treatment of "typical slums" is a dream for them, proposing that the main task of urban village transformation should be to provide low-cost housing for the non-resident population. The approach to the task of urban village regeneration will thus change dramatically. Thirdly, it compares the urban village transformation practices of the previous 10 years or so, compares various urban village transformation models, summarises the advantages and disadvantages of each, draws on domestic and international experiences, especially those of Japan, Korea and Taiwan (China), in urban regeneration, and proposes exploratory transformation models.[22] In addition to this, following Chairman Xi Jinping's visit to Yongqingfang in 2018, which proposed an urban regeneration model that attaches importance to historical preservation and does not involve major demolition and construction, as well as the Notice on Preventing the Problem of Major Demolition and Construction in the Implementation of Urban Renewal Actions issued by China's Ministry of Housing and Urban-Rural Development on 30 August 2021, the transformation model of urban villages has also gradually shifted from mere spatial governance to an increased emphasis on humanistic care for residents. That is to say, the development of refined design for specific groups of people, specific problems and specific spaces, while actively exploring the use of new technical means to explore and solve the problems of urban villages, so as to achieve the transformation of urban villages to high-quality and highly humanistic development.[23]

2. Street Vitality

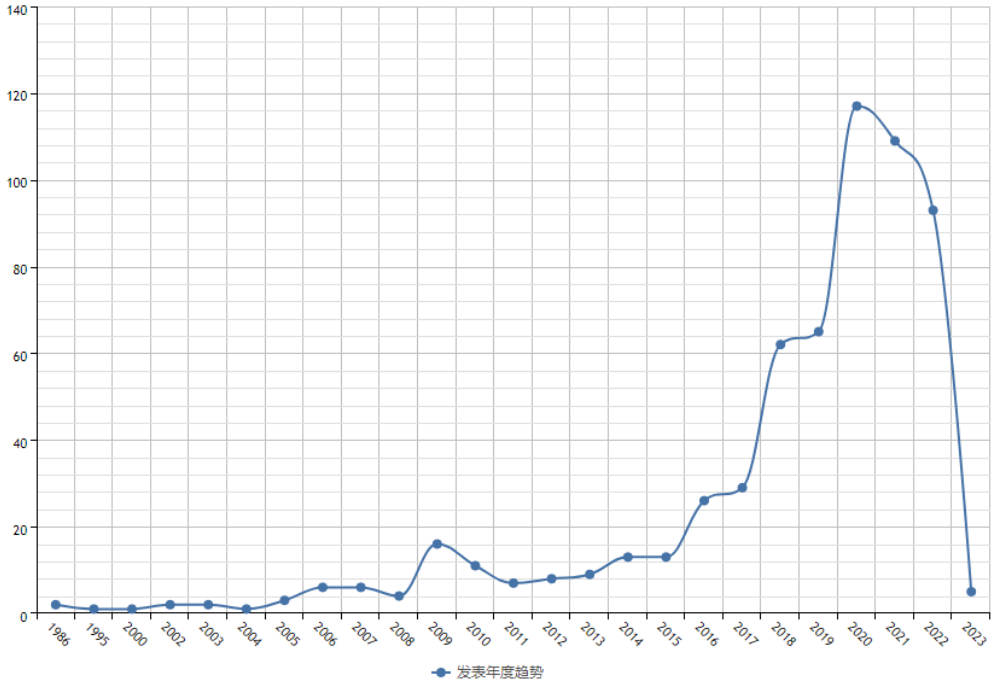


Chart 1-2 Number of papers on "Street Vitality" (source: cnki.net)

Research on street vitality has been a hot topic in academia over the last five years. It started in 2016 with a clear upward trend compared to previous years, and has since doubled in two consecutive years, peaking in 2020. As research on street vitality is highly relevant to urban regeneration, and is often associated with key words such as 'historic districts', 'stall economy', 'sharing', 'revitalisation', etc. "The study also culminates in 2018 when Chairman Xi Jinping visits Yongqingfang and in 2021 when the Ministry of Housing and Construction issues a circular to prevent large-scale demolition and construction. (Chart 1 2)

On the issue of urban vitality, Tong Ming, from the perspective of urban texture, suggests that "the lack of connectivity paths", "the breakage of functional links", "the neglect of behavioural scale" and "the loss of fractal characteristics" are the main reasons for the loss of vitality of man-made cities compared to natural cities. "He also points out that the top-down approach to planning has undermined the humanistic and pluralistic nature of cities, emphasizing large scale structures and neglecting small scale activities. It also suggests general principles for stimulating vitality, namely creating small-scale, rational road networks, maintaining the plurality of street activities, and respecting human creativity over time in the city. In relation to the main contradictions of contemporary cities and strategies to deal with

them, Tong proposes a 'fractal overlay of multiple scales' and 'effective connectivity of the urban fabric'.[21] Long Ying uses Chengdu as the research object to evaluate street vitality through quantitative indicators. The study uses road network data, mobile phone signalling, map POI, current land classification and current construction land to construct an evaluation system of mobile phone population density, nature of surrounding parcels, functional mix, functional density and own characteristics, and concludes that distance from the city centre, functional mix and functional density are the main factors affecting street vitality. It also proposes to combine space syntax, street map and data regression to enhance the accuracy of the study.[19]

3. The evolution of spatial analysis methods for urban design

In Digital Urban Design Based on Human-Computer Interaction: Discussion on the Fourth Generation of Urban Design, Wang Jianguo mentions that urban design is divided into four main stages: the first generation of traditional urban design is based on the basic principles of architecture and the three-dimensional organisation of the city; the second generation of modernist urban design is characterised by technological support, functional zoning and the abstract organisation of three-dimensional space; the third generation of green urban design is based on the principles of "ecological priority and environmental sustainability"; and the fourth generation of digital urban design is based on human-computer interaction.

The first generation of traditional urban design was dominated by basic architectural principles and classical aesthetics, with a focus on physical and geometric characteristics. The design approach was to control the three-dimensional form of buildings over a larger spatial area. Yoshiharu Ashihara is a representative of this, and in his writings, he provides a detailed description of the physical form of the street, and is able to describe the psychological feelings that a given street space may produce in terms of spatial proportions, thus providing a reference for the analysis and design of the street space. However, as this traditional approach to urban design requires the designer to devote a great deal of effort to a particular space, it is not efficient and therefore the scope of analysis and design is usually limited.

The second generation of modernist urban design was born in the wake of the industrial revolution, when the explosion of population and land use overwhelmed the capacity of previous generations of design approaches. At this stage urban designers began to think in rational, economic and technical terms, seeking solutions to a range of urban problems at a higher level. The rise of network analysis techniques gave birth to analytical methods such as space syntax, which sought a theory of spatial design that could be reduced to mathematical calculations in terms of abstract topological relationships. This approach eliminates most of the distracting information and focuses on spatial configuration, and enables the creation of topological models on a larger scale, which is much more efficient than its predecessors. At the same time, however, the pursuit of rational judgement inevitably leads to a lack of direct human perceptual thinking, and there are limitations in terms of the quality of the living environment and space.

The third generation of green urban design revises the previous purely machine-like and rational thinking, affirming the complexity and contradictions of urban planning and incorporating more ecological and liveable ideas into it. This period of urban design integrates all possible techniques and incorporates elements of human governance with public policy instruments. The overall promotion of ecological symbiosis, habitat optimisation and sustainable development has refined the ideological content of urban design.

The fourth generation of digital urban design is a design revolution that is currently taking place in the academy. The complexity of the city is being accommodated into various types of information models as computer computing power increases and many algorithms and technical paths that were previously limited by performance are being exploited. The key technology of this period is the use of Big Data, which is the dynamic description of urban areas through growing data, combined with other types of models to create a dynamic update of multiple dimensions of the city as a whole. In recent years, artificial intelligence and machine learning have developed significantly, allowing humans to build efficient analysis and design platforms through supervised learning that imparts human judgement to machines and unsupervised learning that generates a large number of iterations in multiple directions.

These flexible and precise tools allow for the refinement of urban design, while also providing human and adaptable strategies to support the development of urban guidelines and the management of resident behaviour. Typical analytical tools of this period include POI (Point of Interest), Street View Big Data, satellite imagery and digital twin information models, which not only allow for more accurate analysis, but also provide a means of integrating and generalising certain data that requires large-scale statistics, bridging the gaps of previous generations of analysis and design. [24–26]

4. Designing with digital technology tools

As mentioned earlier, digital analytics is an early and still rapidly evolving technical tool. The different directions of thinking at different times have led to different analytical emphases in the technology, and the integrated use of data tools has become a design trend. With the development of technology and the increasing complexity of cities, the needs of individuals are becoming more and more diverse and the connections among people more and more complex, directly affecting the form and function of cities. It is difficult for designers to accurately identify the intrinsic links between needs and problems and reflect them in their designs by relying solely on their experience and thinking. However, the increasing computing power of computers has provided us with the conditions to utilise data, and many designers are beginning to experiment with the analysis of objective data and the use of data design tools to inform and guide their designs. Objective data and design tools have many meanings, including big data, space syntax, ArcGIS tools, sDNA, POI, heat maps and so on. According to the data on the Internet, research on 'urban design' and 'big data' first started in 2014, and then increased year by year, with the number of relevant papers rising to an average of 60-70 per year after 2018.

(Chart 1 3)

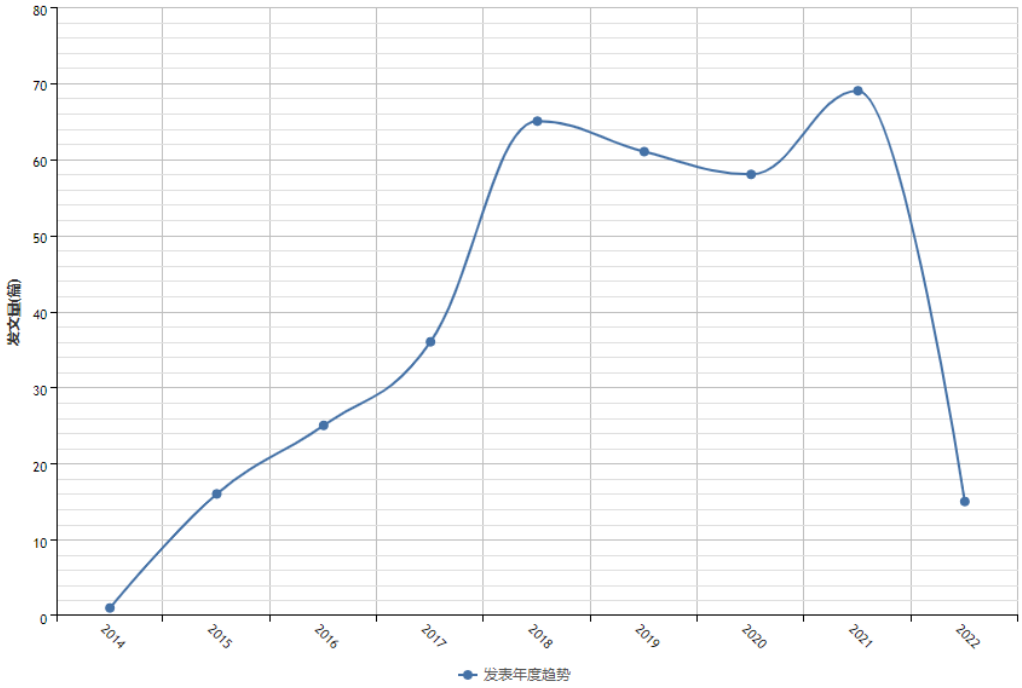


Chart 1-3 Number of papers on "Urban Design" + "Big Data" (source: cnki.net)

Wei Sijing compiled four major trends in the development of urban design after 2000, pointing to the new data environment as one of the trends.[27] According to Wang Jianguo, digital urban design based on human-computer interaction can be called the fourth generation of urban design. Its characteristics include: 'a full-scale design object that implements digital urban design based on human-computer interaction can be called the fourth generation of urban design.[24] In 'Architects' Guide to AI', He Wan Yu points out that "Big Data can be understood as "continuously increasing data", and its "bigness" is not only reflected in its volume, but also in its diversity. For example, the transaction data we generate when shopping online, the text and image data on social networking sites, mobile geolocation data, personal information entered on various platforms, company databases, etc. are all types of data. Data is like gold scattered in a vast web, collected, transmitted, processed and deposited all the time through local networks, the Internet, mobile Internet and the Internet of Things". [28] 杨 Yang Junyan and Cao Jun pointed out that urban design has the following demands on big data: "Demand for non-linear data processing", "demand for high-precision multi-data", "demand for high-frequency dynamic updates", "demand for regularity of citizens' life behaviour" and "demand for intelligent identification and monitoring and prediction". They

also classify the data, grouping the data types and characteristics corresponding to different types of data according to their frequency and sample data size. In addition, they propose data types based on application dimensions, namely dynamic big data with fine-grained temporal information, static big data with material spatial information, explicit big data with purely subjective perceptions of the city by the subject, and implicit big data which is objective and invisible.[22] (Figure 1 1, Figure 1 2)

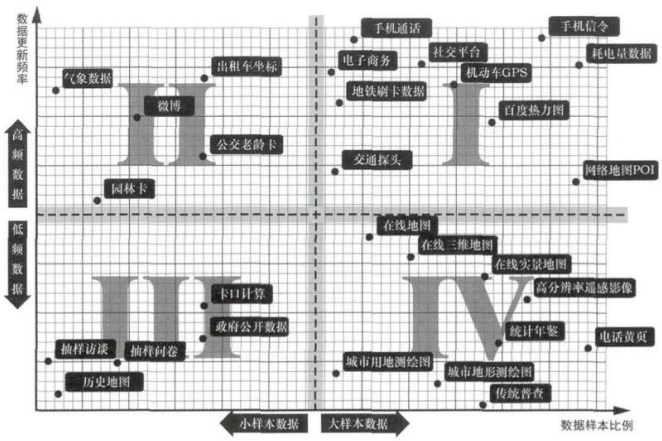


Figure 1-1 Data sample ratio- data update frequency 2D matrix map (source: Dynamic-Static-Explicit-Implicit: Four Applications of Big Data in Urban Design)

Figure 1-2 Four application dimensions of big data in urban design (source: Dynamic-Static-Explicit-Implicit: Four Applications of Big Data in Urban Design)

1.4.2 Review of Research

After the reform and opening up, China's urbanisation process has greatly accelerated

and the problem of urban villages began to emerge. Due to a long period of sloppy development in the pursuit of efficiency, the urban village was ignored in the process of rapid urbanisation and is now not only a very difficult problem for cities to manage, but also has a number of negative effects on them. The most obvious is the serious weakening of the city's image, with dilapidated, low-quality, high-density urban villages that do not fit in with modern cities.

The city is a complex organism and its construction is never completed in a short period of time. At the same time cities are built to take on functions that are given or transformed by their designers or users over time, and human needs are diverse, changing and unpredictable. As a result, there is an inherent lag and limitation in the design of cities. This stems not only from the rapidly changing needs of the times, but also from the inability to fully engage with available information due to limited energy. Design based on the subjective judgement of the architect is also often subject to uncertainty, with the outcome of the design often dependent on the experience and inspiration of the designer. Human energy is limited and designers tend to start with one apparent contradiction and then extend the design to the whole area. This often falls into the trap of local optimisation, ignoring the more potential and far-reaching problems and impacts. The demands placed on architects, particularly for complex plots, can also become very demanding.

The shift towards refinement of design has also become apparent in recent years, with traditional design tools unable to achieve more accurate analysis and resolution. The way we commonly work with drawings and models is highly simplified in terms of site information - we are constrained by the workload and the level of technology to create holographic models that reflect all the information on the site. Today, in the context of the information age, information resources have become more abundant than ever before, and although the level of fully informative modelling of a site has not yet been fully achieved, relevant design algorithms and analysis tools have developed considerably. It is possible to approach information from a number of perspectives and to address specific needs. In other words, we can adapt the traditional urban design paradigm, which is based on pre-defined functions or

forms, to the context of the times. The information can be used to analyse in depth the possible contradictions and needs of the design, to design the corresponding urban form and system structure for the "urban flow" using advanced technology, and to formulate a reasonable and forward-looking development plan for the designed area. It is also possible to adopt a digital twin approach for real-time simulation and optimisation in subsequent construction and practice. The establishment of an information-based urban design is also conducive to precise design management, urban management and co-creation of residents.

At a specific design level, we can use a variety of algorithmic tools and visual analysis methods to produce more rigorous design guidance for reference. Traditional analysis and design methods for shaping and revitalising street dynamics are sometimes ineffective in areas where conditions and situations are relatively complex. However, the abstraction of physical space into digital information and the use of computer-aided analysis and calculations may allow for the identification of difficult issues and potential trends. In terms of specific tools, spatial syntax and parametric methods can be used to obtain specific design indicators, examine spatial quality and generate site models; crawling and processing of big data using tools such as GIS and Python can extract streetscape and POI information from map information. Finally, the analysis is calculated and identified to form a visual map, transforming abstract metrics into a pictorial language that designers can easily understand. These methodological advances enable designers to more effectively and precisely locate problems and provide appropriate solutions.[29]

1.5 Research Method

1.1.1 Research Logic

In urban villages, the complexity of space and activities is higher than in urban areas, and some possible problems are hidden deeper. The use of digital analysis techniques allows for the evaluation of a specific spatial characteristic indicator. When used in combination, they can characterise the area on an objective level, which supports the rapid recognition of the urban village area and the identification of potential problems, providing more accurate

guidance for design. This paper will combine digital analysis techniques with traditional spatial analysis theories, separating volume relations, spatial configuration and spatial use, and portraying the spatial scale, psychological perception, spatial relations and functional use of the street from three perspectives: physical space, topological space and real space, to analyse the possible problems of street vitality and spatial quality in Lijiao Village from all angles and provide corresponding transformation strategies. Digital analysis techniques will focus on space syntax, POI analysis and semantic segmentation of street map data to analyse the spatial composition, functional distribution and the current situation of the street in its real state and to identify its strengths and problems, and to guide the relevant design together with traditional analysis methods. Through the comprehensive analysis and guidance of the above theories, a safe, comfortable, convenient and dynamic high-quality street space is created in Lijiao village.

1.5.1 Physical Space

The analysis of physical space is research on the space and environment created by the street itself and the buildings that make it up. In places where elements are complex and space is confusing, removing these distractions and abstracting the actual space into a spatial relationship between the building mass and the street can provide a more intuitive picture of the actual spatial conditions and identify potential spatial problems. In the analysis of physical space, the focus is on the relative and absolute scale of the buildings and streets, excluding the real conditions of use, and on the psychological perception and ease of use of these spaces themselves. The analysis of physical space is carried out in the following areas.

1. Relative scale: street width-to-height ratio

The theory of street aspect ratios is discussed in detail in Yoshinobu Ashihara's Aesthetics of the Street. The street width-to-height ratio refers to the ratio of the absolute width of the street to the height of the buildings on either side of it, and is a relative indicator of the proportion of space in the street. This proportional relationship directly affects the proportion of sky and buildings in the street that occupy the total view. The smaller the street width to height ratio, the larger the area occupied by buildings and the smaller the area

occupied by the sky, the more likely it is to give people the feeling of crowdedness and narrowness; the larger the street width to height ratio, the smaller the area occupied by buildings and the larger the area occupied by the sky, the more likely it is to give people the feeling of openness and expansiveness. However, both excessively wide and narrow streets can create a feeling of discomfort and inconvenience.

Although Yoshinobu Ashihara points out in his article that D/H = 1-2 is a more intimate and reasonable proportional relationship, there is no one optimal answer to the street width to height ratio. Different locations of streets, different cultural environments and different atmospheres of the whole neighbourhood can cause changes in perception. The design needs to be flexible and adapted to the local context.[30]

2. Absolute scale: street cross-section

Street cross-section analysis is a common form of analysis. Unlike the study of relative proportions of street width-to-height ratios, street sections focus on the absolute width of the street, the absolute height of the buildings and the spatial form of the street. Streets in urban villages are very different from urban streets. In most cases, the width of streets in urban villages is relatively narrow and the street pattern is more complex than that of urban streets. Street sections are more effective in identifying the street characteristics of urban village streets and complementing the street width to height ratio at the absolute scale level.

1.5.2 Topological Space

Topological space refers to the analysis of the relationship between space and space by ignoring some of the properties of the real physical space. In this way, the analysis of topological spaces allows the exclusion of redundant information and the more precise identification of the position and relationship of a particular space in the overall system, thus identifying the centre of traffic, publicness, etc. or deriving an optimisation strategy on spatial relationships for a particular space.

Space syntax is a research and analysis technique for quantifying complex spatial patterns researched by the Bartlett School, UCL, represented by Bill Hiller. Space syntax is

defined as a theory and method for studying the relationship between spatial organisation and human society through the quantitative description of the spatial structure of human settlements, including buildings, settlements, cities and even landscapes. It has two meanings: 1) space is an imaginary body enclosed by buildings and walls, a place for people's activities and daily interactions, which is self-consistent; 2) syntax is a complex connection between different spaces, which embodies social logic and is solidified in the built environment and can be perceived by people's intuition but is difficult to express. Space syntax is therefore the study of the complex connections between different spaces at different scales and the interrelationship of people's patterns of activity. It is a spatial structure understood from a topological perspective that does not require a geometric element.[31]

At the heart of the space syntax is the modelling of spatial relationships through spatial configuration, which assumes that the ideal urban spatial structure is consistent with urban function. Although it is sometimes evident that some functions do not fit perfectly with the physical space, given a certain amount of time, the daily activities of humans can significantly influence the functions or spaces. Ultimately, function and space will be aligned. This is very same at the heart of urban design, which is the design and reorganisation of urban spaces to improve their quality and accessibility. What urban designers do is to accelerate this process empirically and technically. The model created by the space syntax will therefore be able to reflect the objective laws of spatial perception from an objective perspective, providing technical support for urban design in a quantifiable and logical way.[32]

The theory of space syntax contains a number of important indicators that can reveal to us the underlying relationships in space from different perspectives. Some of the main space syntax indicators are described below:

1. Integration

Integration is a normalized measure of distance from any a space of origin to all others in a system. In general, it calculates how close the origin space is to all other spaces, and can be seen as the measure of relative asymmetry (or relative depth). See: Segment angular integration. Integration reflects the ability of a local space to gather the flow of travellers.[31]

In other words, the ability to gather people in this way reflects the natural movement and the to-movement of the space configuration. Such places are more likely to become destinations.

2. Choice

Choice measures how likely an axial line or a street segment it is to be passed through on all shortest routes from all spaces to all other spaces in the entire system or within a predetermined distance (radius) from each segment. See Betweenness and Segment Angular Choice.[33] The degree of choice reflects the through-movement that occurs in the city. When we think of each space as a path, some paths are more likely to be selected in natural movement. Spaces with a high degree of choice tend to develop into the main roads of the city.

3. Total Depth

Total depth is defined as the sum of the topological depth from any a node to all the others.[31]

The analytical method of space syntax used in this paper is Segment Analysis.

Urban space can be seen as a linear spatial network structure, with different forms of urban space layout, such as grid-like, radial and organic. In different urban spaces, different line segments between the various intersections in the grid assume different roles. Segment Analysis Tulip Analysis can be used to analyse urban spatial forms more precisely.

Tulip analysis is defined as the analysis of a list of diagrammatic turns. For example, an 8-bin tulip analysis means the analysis of this sort of categorisation: one bin for a turn of less than 22.5 degree, one for 22.5 degree to 67.5 degree, one for 67.5 degree to 112.5 degree and so on.[34] In Segment analysis, we use a 1024 bin tulip analysis approximate standard angular analysis in DepthMap. Segment Analysis. Segment Analysis uses the line segment between intersections as the basic unit, thus defining the distance between nodes to carry out different types of analysis, such as how far from point A to point B, the number of turns in a certain route, the actual path between two points and the focal length of the deviation formed by the straight line connecting the two points, all of which reflect the complexity of urban space in

different ways and provide a more accurate basis for the configuration of urban space.[35] These factors will be taken into account in the calculation of Integration, Choice and Total Depth to give a more realistic picture of real-world movement.

In the evaluation system of street vitality, the space syntax allows us to identify the ideal positioning of the street, to identify the possible effects of the orientation and arrangement of the street on the spatial configuration of the street, to modify the street structure of the village and to identify the potential for improving street vitality.

1.5.3 Real Space

The research of real space focuses on the use and appearance of the street in reality and complements the two relatively abstract research perspectives above. In the first two types of analysis, the focus is on abstract spatial relationships. The use of real conditions is removed from the first two. The use of space is the most vulnerable to change in relation to the first two and therefore needs to be stripped away and analysed separately. As a study of current use conditions, real space can synthesise the first two and provide a more complete description of space. There are two approaches to the study of real space.

1. POI (Point of Interest)

POI (Point of Interest) is a kind of point data representing real geographical entities, including geographical latitude and longitude, addresses, business categories and names, etc. It has the advantages of large number, accuracy and real time, which can greatly improve the efficiency of research, and can obtain more accurate and comprehensive information from the data level, and can help designers to quickly obtain an overall picture of the functions of the area. It can help designers to get an overall impression of the area's functions.

The POI research covers a wide range of categories, including: events, transport services, accommodation services, sports and leisure services, public facilities, companies, healthcare services, business housing, address information, indoor facilities, motorbike services, government agencies and social organisations, car services, car maintenance, car sales, lifestyle services, scientific, educational and cultural services, shopping services, access facilities, road accessory facilities, financial and insurance services, scenic spots, and catering

services.

From the POI data, we can divide an analysis area into a specific size raster, and then perform certain aggregate calculations on the data contained therein to obtain the density of POI per unit area and Shannon Weaver Diversity. By drawing a kernel density map of POI distribution, it is possible to visualise the distribution of each type of POI within the site. Interpreting the two indicators together, the distribution and diversity of commercial and public facilities can be derived, and possible problems in the type and distribution of street vitality can be identified.[36,37]

2. Street Map Big Data Semantic Segmentation

Street Map is a means of analysis based on real panoramic photographs taken by map providers at a particular location at a particular time. In large cities, Street maps can cover basically all streets where traffic is possible. Semantic segmentation is a machine learning method based on the street map to identify and segment different things in the dataset, which helps designers to quickly perceive the appearance and shape of the street. The model used here is MIT's ADE20K, the largest open-source dataset for semantic segmentation and scene parsing, implemented on Pytorch. The data for Street Map comes from Baidu Street Map, and the two are combined to produce the semantic segmentation results for Street Map.[38,39]

Semantic segmentation of street maps can guide design at multiple levels. At the tract level a relatively macro-level count of the overall and individual streets is made, identifying the street type and the comfort and attractiveness of the space in relation to the current situation in the urban village; at the street level key nodes in the street are identified and positioned, and the degree of openness and greenery of the street is counted; at the level of detailed design a reference to the current situation is provided, and problematic nodes are targeted for design.[40]

In Lijiao Village, because the street space is relatively cluttered, fine segmentation is not effective, but the grouping of broad categories is better, and the important types of spatial elements in the street can be better identified. Therefore, the main focus here is to evaluate the environmental indicators, street comfort and richness of the street, and to identify nodal

spaces with potential, and to propose targeted strategies based on a realistic perspective to enhance the street vitality.

1.6 Research Framework

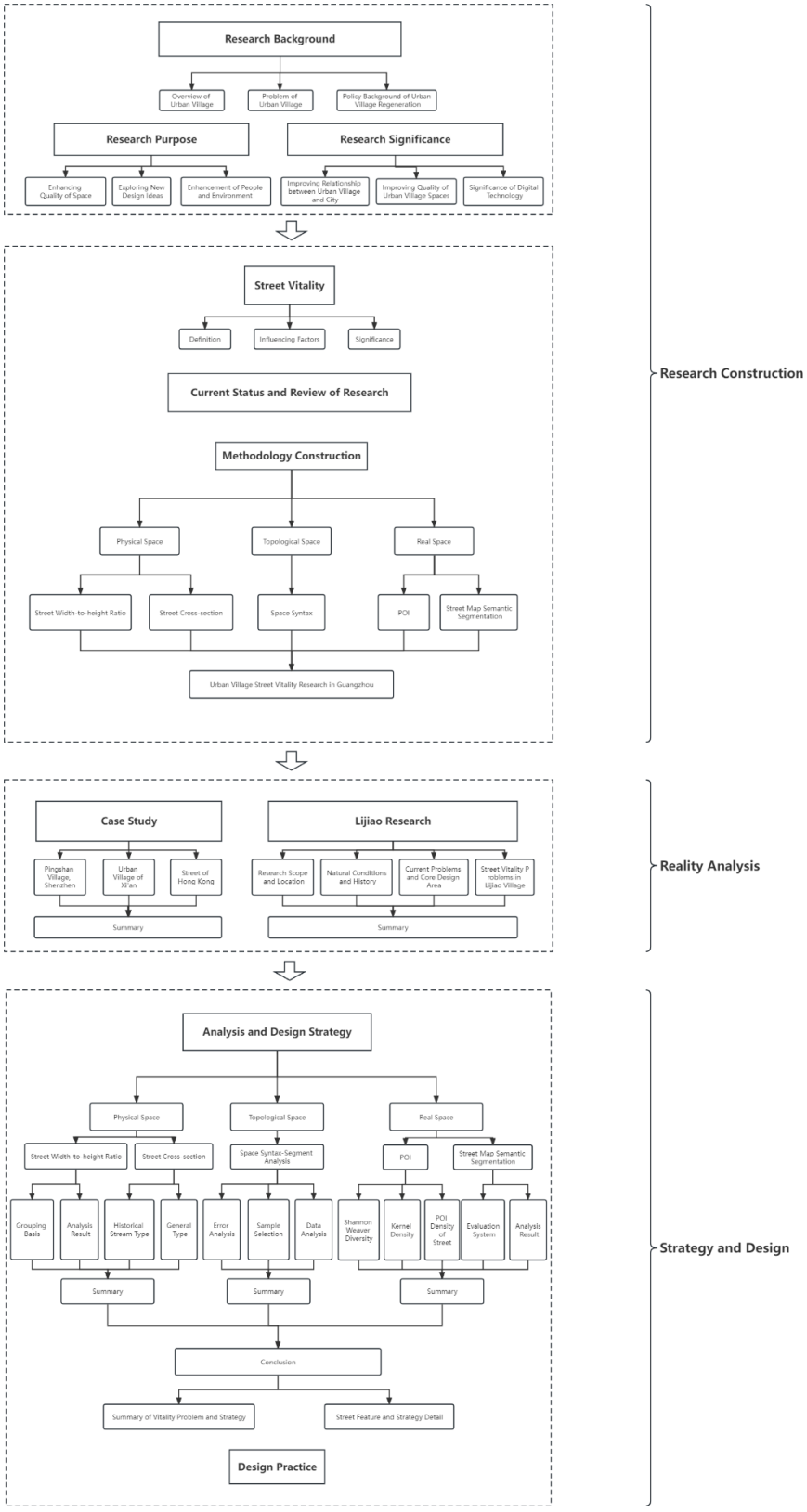


Figure 1-3 Research Technology Roadmap (source: made by author)

1.7 Research Innovation

1.7.1 Exploring new ideas for urban regeneration in urban villages with street vitality

Previously, the development of many urban villages was still dominated by wholesale demolition and redevelopment. However, with the increasing difficulty of demolition and relocation and changes in national policies, the development approach for urban villages has gradually shifted to urban regeneration. In this paper, we explore a design approach to improve space quality, cultural connotations and the well-being of residents in urban villages at a lower cost, using urban regeneration as a core approach to enhance the vitality of the streets.

1.7.2 Combining digital analysis tools to guide and validate designs

The current common approach to urban design and architectural design is dominated by space form and functional planning, and the effectiveness of these two directions is often strongly correlated with the level of the architect's design and the richness of the research material. But there is a question, which is that the ceiling of completeness limited by the thinking of humans. If digital analysis tools are used to aid design, problems can be identified from a third-party perspective, problems and needs can be uncovered from an objective point of view that designers tend to overlook or find difficult to identify, and to a certain extent, trends can be predicted to design the future. This approach offers more possibilities for design and new design ideas for plots that are difficult to design using traditional methods.

Chapter 2 Case Study

There are a considerable number of case studies on the enhancement of Street vitality and the use of digital technology to aid design practice for comparison and learning. In this paper, three relevant case studies are selected from Shenzhen, Xi'an and Hong Kong, with the aim of gaining insights from a variety of perspectives for methodological experiences and design strategies.

2.1 Ping Shan Village, Shenzhen

Ping Shan Village is an urban village located in Shenzhen, Guangdong Province. As with most urban villages, the act of self-build is the main construction behaviour within the village. This behaviour directly affects the spatial network and environment of the urban village and is often considered to be the most pernicious source of impact on the environment and spatial quality of the village. In the article 'Renewal Pattern of Urban Village by Space Syntax: Taking Shenzhen Pingshan Village as Example', the author analyses the logic of villagers' self-build behaviour and its subsequent effects through space syntax, and to propose targeted aims, implementation measures and evaluation criteria for urban village regeneration.

The authors summarise the act of self-build into two types: one is the act of constructing buildings and structures around residential buildings and blocking public space, by directing and controlling this act, the purpose of optimising the spatial network can be achieved; the other is the act of changing the function of the buildings on the ground floor of residential buildings, this act generates the majority of commercial and service functions in urban villages, bringing rich vitality and good security to the adjacent space. In turn, the improvement of spatial vitality and safety is an important criterion for the environmental enhancement of urban villages. It can be seen that villagers' self-build behaviour is both the root cause of urban village problems and an effective way to enhance the urban village environment. Research on the occurrence of villagers' self-build behaviour and its impact on urban villages will help to clarify the regeneration objectives and targets of urban villages.

In conjunction with the analysis of space syntax, the authors found that the first type of

new construction often unintentionally occupies areas far from the integrated core of space syntax, i.e., less accessible spaces that are less public, less accessible and relatively unobstructed by traffic. When this type of construction takes place in large numbers, there will be a large number of corner spaces and cut-offs blocked by fences and iron gates. This type of space will eventually be occupied by rubbish, creating a poor-quality space with no public character. (Figure 2 1) In the second category, especially in the business category, the space tends to want to be seen by more people, and the degree of spatial integration in the core axis area creates a certain correlation with the change of the underlying function. As the village evolves, the underlying functions adapt, resulting in a distribution that almost overlaps with the results of the visual field analysis. (Figure 2 2)

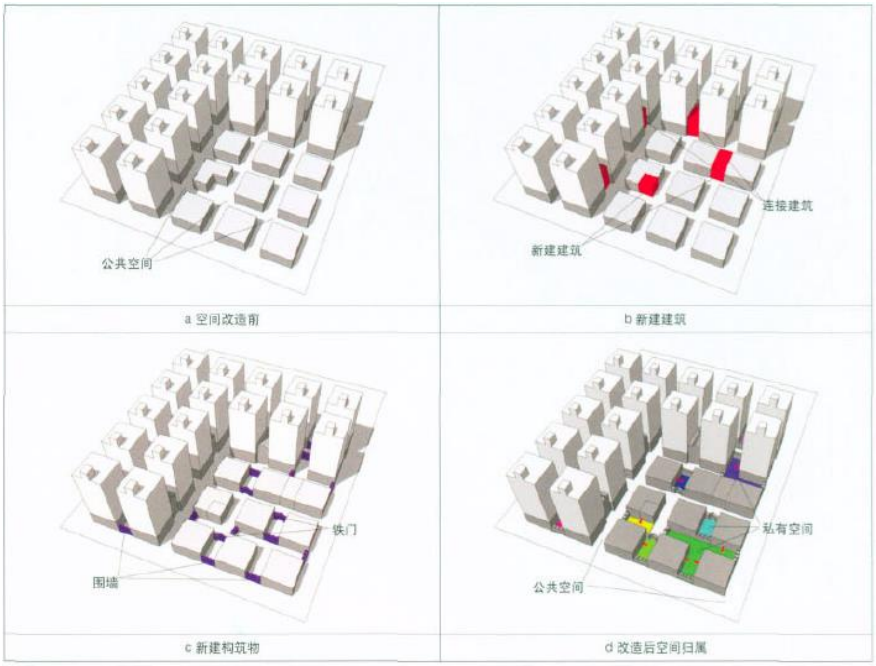


Figure 2-1 Diagram of the first type of construction (source: Renewal Pattern of Urban Village by Space

Syntax: Taking Shenzhen Pingshan Village as Example)

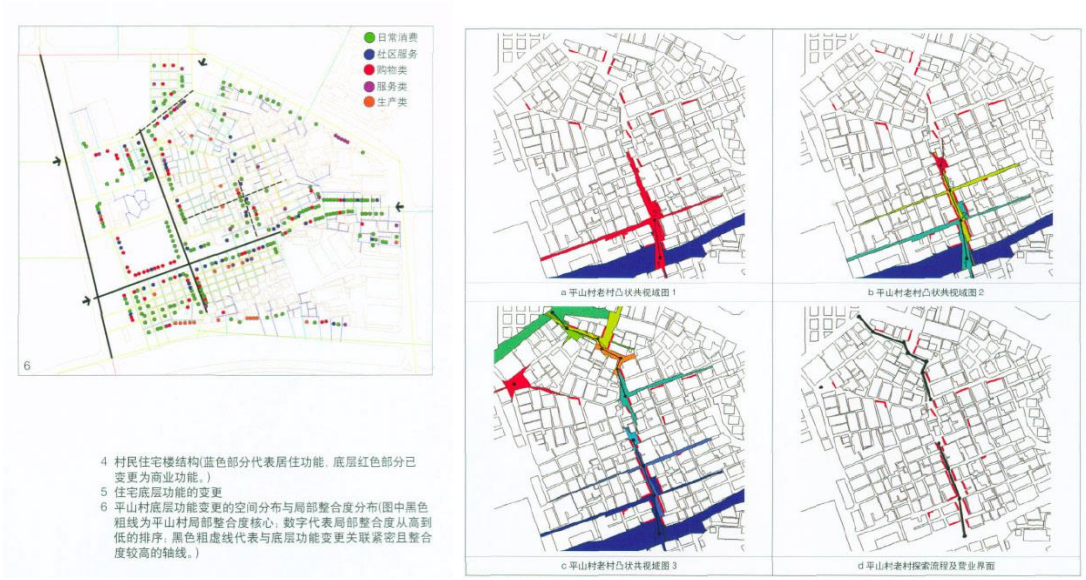


Figure 2-2 Diagram of the second type of distribution, core axe and isovist analysis (source: Renewal Pattern of Urban Village by Space Syntax: Taking Shenzhen Pingshan Village as Example)

In summary, the authors have come to the following conclusions.1. The spatial form of an urban village largely influences the villagers' ground-floor functional change behaviour. This means that it is possible to provide the required spatial conditions for villagers' function change behaviour by renewing its spatial form, thus allowing more villagers to be in a position to engage in business-type activities, and gradually improve the income and environment of villagers in urban villages. 2. The villagers' new building/structure construction is concentrated outside the core axis area, i.e., the core area controlled by the village self-management and the village clan culture of Ping Shan Village. This may mean that villagers' construction is not only influenced by space, but also constrained by villagers' self-management. 3. The villagers' self-build behaviour has greatly changed the spatial pattern of Ping Shan Village, causing the public activity centre of Ping Shan Village to be isolated from the old village area, directly resulting in the closure of the old village area. From another perspective, the localised spatial self-build behaviour of villagers has created a bad impact on a global scale. This proves that rational spatial planning and control is indeed important for optimising the spatial environment of Ping Shan Village.

For the regeneration model of urban villages, the author believes that instead of adopting

the strategy of demolishing every village, a differentiated regeneration model based on lot characteristics should be advocated: 1. Clearer objectives and evaluation criteria should be established for urban village regeneration. The core objective of urban village regeneration is to improve the accessibility and visibility of urban village spaces. The above research confirms that in urban villages, highly accessible and highly visible spaces have the advantages of sustaining the vitality of the area, promoting community exchange, maintaining neighbourhood safety, and activating communication between urban villages and the outside world, and have the potential to be self-renewed and optimised. 2. The comprehensive regulation of urban villages should establish more targeted objects and measures. The focus of comprehensive urban village remediation is on areas with low accessibility and visibility. The above research has confirmed that areas with low accessibility and visibility, as well as areas with weak natural surveillance, are prone to illegal self-construction and even anti-social behaviour, which are precisely the focus and difficulty of comprehensive urban village remediation. In areas of urban villages where accessibility and visibility are high, villagers will automatically maintain the quality of the environment there, without the need for excessive investment in facilities. Thus, the target of comprehensive urban village remediation is not the urban village as a whole, but these areas that lack natural surveillance, and the measures for comprehensive remediation should also focus on improving the supervision of these areas. The goal of sustainable regeneration is thus achieved at low cost.[41]

2.2 Urban Villages of Xi’an

The village of Taipingbao is a traditional village located outside the city of Xi'an that has been demolished. Geographically, the old city of Xi'an belonged to the Ming Dynasty urban area, which developed mainly within the Ming city walls; Taipingbao Village belongs to the Tang Dynasty urban area, which existed as a village before the rapid development of Xi'an. Taipingbao Village was part of a failed case of urban village transformation in the urban development of Xi'an. Prior to its demolition, the city administrators had made several

attempts to renovate the village, but were unable to achieve integration with the city and ended up with it. According to current urban planning, the area where Taipingbao Village once stood is currently part of the commercial and historical scenic area of the Xi'an Yanta Cultural and Leisure District, and the city managers eventually chose to demolish and redevelop it into a new function.

As a whole, the urban fabric of Xi'an was influenced by the 'Yecheng system' of Chang'an City in the Sui and Tang Dynasties, which had an inward and closed chessboard-like layout. During its long development, the city has largely retained its original transport system, and has been populated by 'square districts' divided by the transport network. Similarly, the village of Taipingbao was incorporated into this urban system in Xi'an's fourth master plan, and the village was confined to a single neighbourhood, with limited development and a degree of isolation from the city. (Figure 2 3)

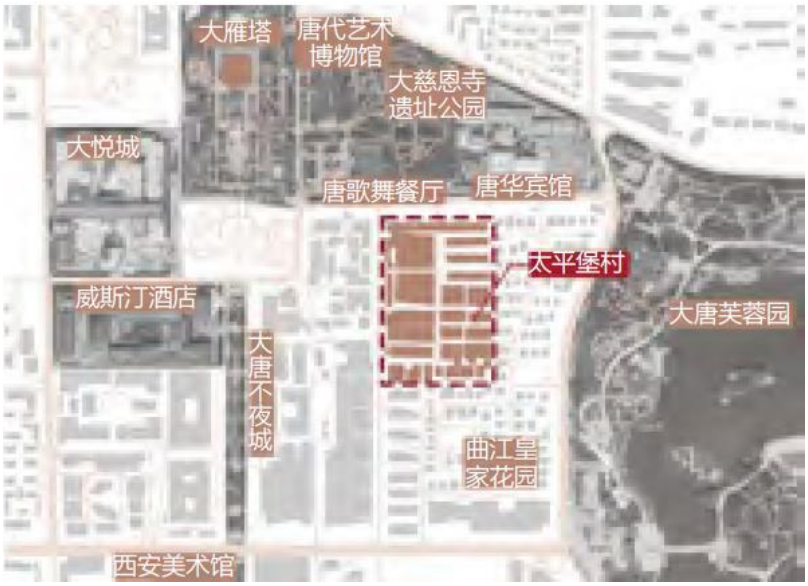


Figure 2-3 Masterplan of Taipingbao village (source: Research of Urban Villages Renewal Based on "Flexible Interface": a Case Study of Xi'an City)

The village is considered to be a negative element of the city in the city-oriented construction ideology, as the village fabric is very different from the city fabric and does not integrate with it. In response to the poor relationship between Xi'an and Taipingbao Village, the city managers adopted a reactive strategy of "covering up" the problems and reducing the impact on the neighbourhood. The transformation of Taipingbao Village lasted five years and

can be broadly divided into three phases. (Figure 2 4) In 2015, the village of Taipingbao was surrounded by a rough stone masonry wall with painted Xi'an imagery on the wall and buildings along the street, in a way that directly cut off the village from the surrounding city. In 2018, in order to further unify the interface of Taipingbao Village with the surrounding Tang-like commercial buildings, the city manager demolished the existing rough stone buildings and replaced them with new walls in the simple Tang style, so that only four openings remain in the interface of Ci‘en Dong Road and the interface is further "hardened". In 2020, after several failed attempts to integrate with the city, the village of Taipingbao was finally demolished. This approach clearly considers the problem of the village as a visual problem only, and does not address the root causes of the problem. The integration of the urban village with the city is further exacerbated by the use of walls to cover the original interface, making the village less and less able to interact with the city and thus affecting the street dynamics of its external interface.

Figure 2-4 Conversion process of Taipingbao village (source: Research of Urban Villages Renewal Based on "Flexible Interface": a Case Study of Xi'an City)

In the paper 'Research of Urban Villages Renewal Based on "Flexible Interface": a Case Study of Xi'an City', the author proposes his own transformation plan for the revitalisation of urban villages in Xi'an, taking into account the failure of Taipingbao Village and four typical urban villages (Luojiazhai Village, Shajing Village, Nankang New Village and Hezhishi Village). After analysing and summarising the reasons for the failure of Taipingbao Village, the author proposes the concept of "Flexible Interface", which is to make use of the permeability between the city and the urban village to enhance the vitality of the urban village

in a way that attracts urban people. In this regard, three issues need to be addressed: firstly, whether the street interface of the urban village has the material conditions for interpenetration with the city; secondly, whether the street interface of the urban village is attractive to the urban population; and thirdly, whether the street interface of the urban village can provide sufficient functional complement to the city. The authors describe the degree of flexibility of the street interface in terms of three indicators: "degree of void", "permeability" and "functional density".

The degree of void reflects the ratio of void interface to solid interface in the street, as an indication of the number of entrances and the degree of openness of the street interface. The formula for the degree of void is: degree of void = interface void / interface length x 100%. The higher the void, the easier the street is to be permeated by pedestrian traffic, thus bringing together more people. In the four urban villages studied by the authors, the degree of void varies from a low of 1.6% to 25.2%, with an average of about 10%, and the overall openness is weak and the streets are less vibrant. This is somewhat related to the historical fabric.

Permeability indicates the degree of accessibility of a physical interface. The authors categorise the ways of intervention into "visible" and "reachable", and five types of interface: fully traversable, freely accessible, well visible, moderately visible and not visible. The five types of interfaces are assigned impact factors of 1.5, 1.25, 1, 0.75 and 0 respectively, and the permeability scores were weighted by the total length of the interface to find the mean value. The difference in permeability was similarly large across the six street interfaces in the four urban villages, ranging from 20.9% to 91.1%. In addition, permeability needs to be considered in balance with privacy and a suitable place needs to be found in terms of the level of intervenability of the interface.

Functional density refers to the number of functional businesses per 100m in a street and reflects the richness of the functions offered by a particular interface. In calculating functional density, it is also necessary to consider the diversity of functional types and to take into account the impact that function brings to the street. Three main types of trends emerge in the text: streets with a certain level of functional richness (10 per 100m), streets with a single

function but with distinctive businesses, and walled interfaces with fewer functions.

For the evaluation of the above three indicators, the authors counted the number of crowd activities in the street and analysed the correlation between the three and activity, concluding that social activity vitality has a high degree of positive correlation with the degree of void and a certain extent of positive correlation with permeability; commercial activity vitality has a positive correlation with functional density and permeability and a certain degree of negative correlation with the degree of void.

An increase in the degree of void can provide places for social activities in the external space and easier access to the interior of the urban village, but too high degree of void can reduce the share of buildings along the street. On balance the authors give an optimum target of around 20%. There are two main ways to increase the degree of voids: demolishing some buildings to give way to squares, and elevating the ground floor of buildings. (Figure 2 5)

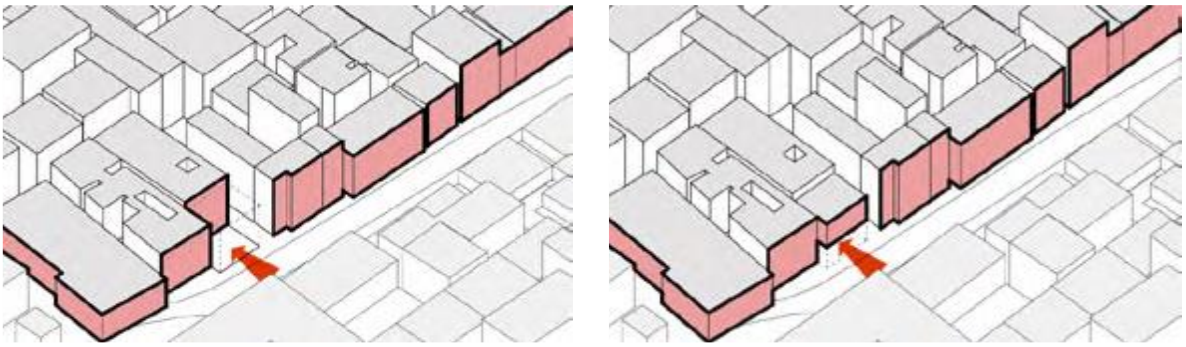


Figure 2-5 The degree of void enhancement strategy (source: Research of Urban Villages Renewal Based on "Flexible Interface": a Case Study of Xi'an City)

The level of permeability corresponds to the level of interactivity of the street and is related to its attractiveness to the crowd. A street interface that is not sufficiently open tends to create a sense of psychological isolation of the people along the street from the insecurity of the inner part of the urban village, increasing the heterogeneity between the city and the urban village. With privacy in mind, the authors give a reference of 60-70%. Among the influencing factors of permeability, the wall is a very crucial one. The removal of walls or the creation of large openings in walls can effectively soften the interface. As for the original building interface, it can be adopted to attract more pedestrian flow by means of outward display of shops along the street or window openings. (Figure 2 6)

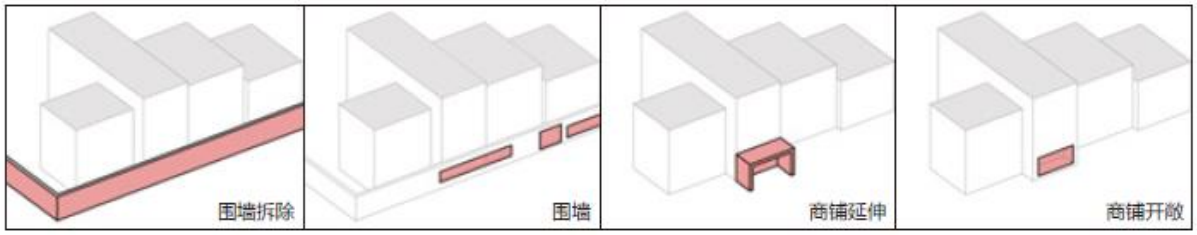


Figure 2-6 Permeability enhancement strategy (source: Research of Urban Villages Renewal Based on "Flexible Interface": a Case Study of Xi'an City)

Function can be considered in two ways in terms of its impact on commercial vitality. For street interfaces with rich functional businesses, they can usually attract more pedestrian flow; while in street interfaces with a single function, the formation of distinctive industrial functions can also generate relatively high street commercial vitality. There are two main ways to update the function of the interface: firstly, urban village interfaces that are in a general commercial and residential urban environment should be upgraded to a degree of functional complexity to complement urban functions; secondly, urban villages that are in special areas should be integrated with district development, such as cultural and educational and other special functions, to enhance the vitality of their commercial areas.[42]

2.3 Street of Hong Kong

As a major large city in the Pearl River Delta region, Hong Kong's high building density, high population density and tight land resources have led to the development of a distinctive street pattern.

Being on the streets of Hong Kong, the most immediate street character that can be observed is the emphasis on shaping the proximate human scale. Due to the tight land resources in Hong Kong, the proportion of high-rise buildings is high. In order to avoid the adverse visual and psychological impact of a large number of high-rise buildings on the street, Hong Kong's streets shift the visual centre to the relatively intimate lower floors, while at the same time setting back the upper floors to further increase the proportion of the lower floors in the pedestrian's vision and increase the sky area, so that the first few floors of the building act as the interface that defines the street. For example, the large number of shops and

windows in the street, with their well-designed entrances, signboards and advertisements, effectively draw the pedestrian's eye to the front of the street and to the details of the shops, ignoring the oppressive feeling of the high-rise buildings. This model is also followed in practice, for example, SOM's urban design in Shenzhen also provides relevant design guidelines, stipulating that "the height of the street wall façade of the design has different regulations in different ranges, there is no setback line in the height range of 40-45m, and the building parts beyond 45m must be gradually set back from the street façade line, and the degree of setback is controlled at 1.5-3m". [43]

Figure 2-7 Streetscape of Wellington Street, Hong Kong (source: Zhihu.com)

In addition, in a study of Tin Shui Wai in Hong Kong, Yin Ziyuan made the following points: 1. Demand, travel and facility distribution are coupled to form space vitality. Tin Shui Wai presents a situation where most pedestrians and activities are mainly distributed near bus

stops, within the group's internal slow-moving system, inside various integrated buildings and among various open spaces, with less activity on both sides of the motorway without stops. Street nodes are important pedestrian catchment areas, and commercial facilities also compete for clustering in areas of high travel activity. 2. Multi-modal accessibility works together to promote the clustering of travel activity. Accessibility, travel characteristics and the distribution of service facilities are mutually reinforcing, with multi-scale accessibility coupling promoting travel efficiency and attracting people's travel activities to form a virtuous cycle. 3. The mixing of multiple building function spaces facilitates the diversity of urban vitality. The mix of public facilities in other functional spaces is conducive to improving land utilisation and stimulating a diversity of activities, creating a diverse urban vitality.[44–46]

2.4 Summary

From the above examples, it is clear that the relationship between cities and urban villages is not the only way to deal with redevelopment. Designers and city managers should also change their attitude towards urban villages from one of dismissal to one of finding their own strengths and entry points for integration with the city, so as to obtain a healthy relationship between the city and the urban village and a distinctive urban cultural district at a significantly reduced social cost.

For the design and management of urban villages, it is necessary to identify the underlying logic of the villagers' behaviour from their point of view, and to respond to their needs and limit undesirable behaviour. It is also necessary to provide good development conditions for urban villages, so that villagers can develop in a structured manner under certain rules and better realities, and avoid becoming a source of disorderly development again.

In terms of specific design, enlarging the street area, increasing the number of places for daily activities and improving traffic circulation are effective means of increasing the vitality of the street. In this regard, the dissolution of hard interfaces in urban villages and their transformation into interactive and flexible interfaces is a simple and effective design

approach in urban village regeneration. The ability to create more visual and behavioural interaction in the street will not only increase the vitality of the street, but will also increase the sense of security of being in an urban village in the form of a 'street eye', making the village more open to the city. In addition, for buildings along the streets that are more difficult to renovate, pedestrian attention can be diverted to the ground floor by attracting attention to the street, while creating a variety of commercial functions or special street businesses and increasing accessibility between streets, so that pedestrians can move from the oppressive feeling of the buildings to the freshness of the street interface.

Chapter 3 Analysis of the current situation of Lijiao Village

3.1 Scope and Location of the Research

The main scope of this paper is the core area of Lijiao Village and its surroundings in the Haizhu District of Guangzhou City, Guangdong Province, China, covering an area of approximately 58 hectares. Lijiao is in the southern part of Guangzhou, on the northern bank of the Lijiao waterway in the Pearl River, and is a clan village dominated by the Wei and Luo surnames. The name of the village accurately describes its topography, and the branching water system formed by more than ten thin springs makes Lijiao unique among the many water villages along the Pearl River. (Figure 3 1)

Figure 3-1 Research Scope (source: made by author)

Lijiao Village is also part of the currently planned Haizhu Innovation Bay, which is the intersection of Guangzhou's new central axis and the waterfront innovation industrial zone of the Pearl River back channel. As the "last one kilometre" of the southern end of the new urban axis, the Lijiao area of Haizhu Innovation Bay carries the planning mission of continuing and deepening the new urban axis and helping Guangzhou to realise the grand vision of the 12km urban axis. The area will be developed into a core gateway to the south of Haizhu, a waterfront ecological and technological innovation cluster in the southern section of

Guangzhou's new urban central axis. (Figure 3 2)

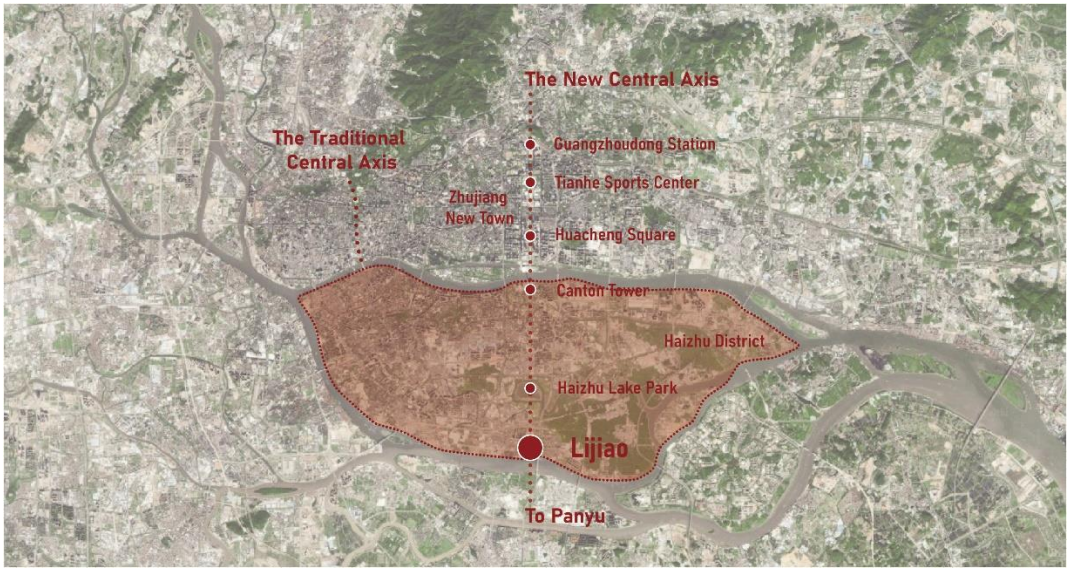


Figure 3-2 Research Location in Guangzhou (source: made by author)

In accordance with Guangzhou's comprehensive plan for the development and construction of the Pearl River Landscape Belt, Haizhu District has put forward a vision to enhance the quality of the three belts along the two sides of the river, forming an economic belt, an innovation belt and a landscape belt in the front and back channels of the Pearl River integrated with the development of the Guangdong-Hong Kong-Macao Greater Bay Area (GBA), and has carried out an overall development plan for the Haizhu Innovation Bay area. Lijiao is adjacent to Haizhu Lake to the north, the Pearl River Back Channel to the south and the Hua'nan Expressway to the east. It is located at the southern end of Guangzhou's new city centre axis and is the most important area in the Haizhu Innovation Bay area and will also play an important role in the construction of the Guangdong-Hong Kong-Macao Greater Bay Area. (Figure 3 3)

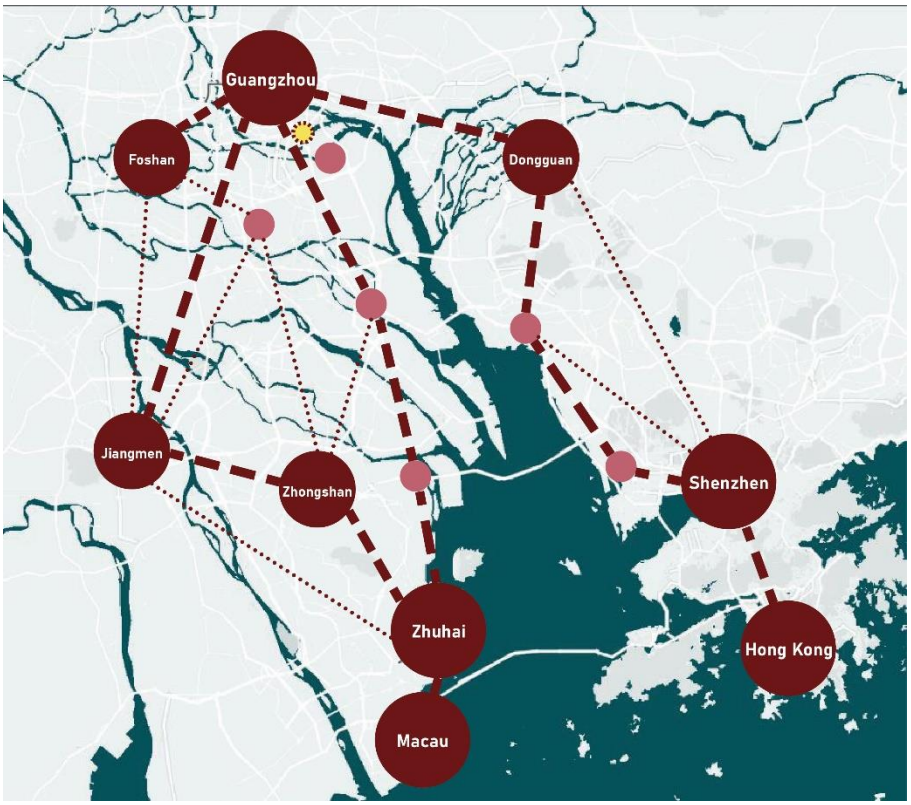


Figure 3-3 Research Location in GBA (source: made by author)

3.2 Natural Conditions and History

The Lijiao area is located at the southernmost point of Guangzhou's new central axis, adjacent to Haizhu Lake to the north, the Pearl River back channel to the south and the South China Expressway to the east, making it an important location with a total area of 172.97ha and over 21,000 villagers. The village of Lijiao, which began in the 12th century, is one of the oldest settlements on the island of Henan. (Figure 3 4)

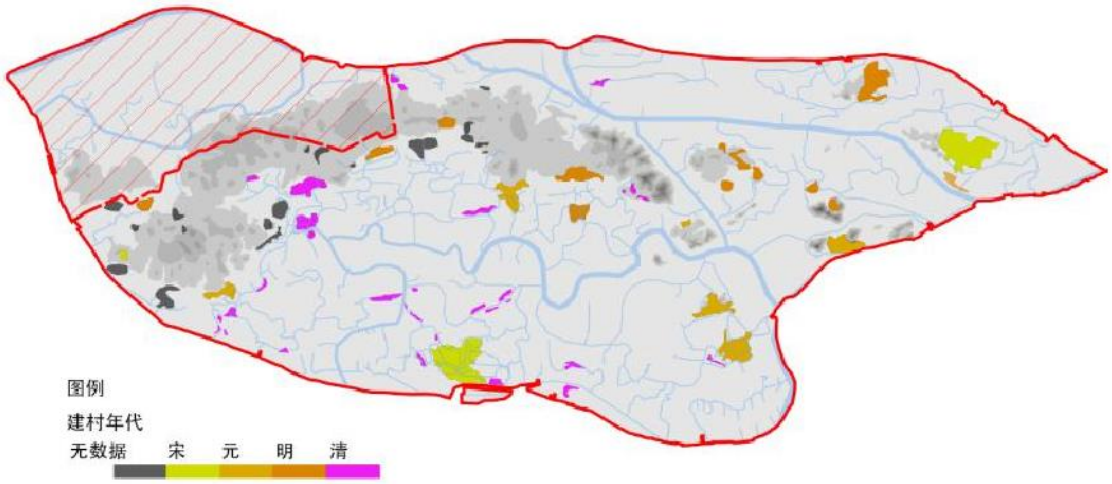


Figure 3-4 Chronological chart of the construction of the water village settlement on Henan Island (source: The Study of Morphological Characteristics of Traditional Waterfront Settlements in Henan Island of Guangzhou, Liuchang)

Once the boundary of Guangzhou, Lijiao has always held a certain cultural, geographical and historical position in the city, witnessing many historical events and preserving to a considerable extent the collective memory of the city. In addition, clan culture and the culture of the water village are very important components of the area. [47,48]

Lijiao still retains a strong sense of clan and is the only large settlement with a single surname in the area. Many ancestral halls are regularly distributed along the river gorge, including the Wei Clan's Grand Ancestral Hall, a protected cultural heritage unit in Guangzhou, which was built in 1615 AD and is by far the largest in size in the Guangfu area. A significant number of other ancestral halls are also protected cultural relics at various levels and possess high historical and cultural value. (Table 3 1, Figure 3 5)

Number	Name	Level of protection
1	Lijiao Wei Clan Ancestral Hall (沥滘卫氏大宗祠)	Guangdong Cultural Relics Protection Unit
2	Wei Guoyao's former residence (卫国尧故居)	Guangdong Cultural Relics Protection Unit
3	Boundary markers in Lijiao, Canton (沥滘广州市界碑)	Guangdong Cultural Relics Protection Unit
4	Xinhe Wei Ancestral Hall (心和卫公祠)	Registered and protected cultural heritage units in Haizhu District, Guangzhou
5	Yushi Wei Ancestral Hall (御史卫公祠)	Registered and protected cultural heritage units in Haizhu District, Guangzhou
6	Zhiyu Wei Ancestral Hall (志宇卫公祠)	Registered and protected cultural heritage units in Haizhu District, Guangzhou
7	Shiya Wei Ancestral Hall (石崖卫公祠)	Registered and protected cultural heritage units in Haizhu District, Guangzhou
8	Qizhou Wei Ancestral Hall (岐周卫公祠)	Immovable Cultural Relics in Haizhu District, Guangzhou City, Guangdong Province
9	Liming Wei Ancestral Hall (丽溟卫公祠)	Immovable Cultural Relics in Haizhu District, Guangzhou City, Guangdong Province
10	Yisuo Wei Ancestral Hall (义所卫公祠)	Immovable Cultural Relics in Haizhu District, Guangzhou City, Guangdong Province
11	Juelai Wei Ancestral Hall (崛崃卫公祠)	Immovable Cultural Relics in Haizhu District, Guangzhou City, Guangdong Province
12	Zhiyan Wei Ancestral Hall (芝岩卫公祠)	Immovable Cultural Relics in Haizhu District, Guangzhou City, Guangdong Province
13	Zhaochang House (肇昌堂)	Historic buildings
14	Former site of the repair workshop （修造厂旧址）	Historic buildings
15	House No. 4, Huanxiufang Street （环秀坊大街 6 号民居）	Historic building trail
16	House No. 4, East Street (沥滘东街 4 号民居)	Historic building trail
17	House No. 2, Ally 2, East Street (沥滘东街二巷 2 号民居)	Historic building trail
18	House No. 3, Ally 7, East Street	Historic building trail

	(沥滘东街七巷 3 号民居)	
19	House No. 3, 5, Ally 1, East Street (沥滘东街一巷 3、5 号民居)	Historic building trail
20	House No.1, Shuiji Street (沥滘水基大街 1 号民居)	Historic building trail
21	House No.11, Wuyue Street (沥滘五约大街 11 号民居)	Historic building trail
22	House No. 12, Wuyue Street (沥滘五约大街 12 号民居)	Historic building trail
23	House No. 4, 6, Ally 10, East Street (沥滘东街二巷 4、6 号民居)	Traditional style architectural clues
24	House No. 4, Ally 10, East Street (沥滘东街十巷 4 号民居)	Traditional style architectural clues
25	House No. 15, Ally 10, East Street (沥滘东街十巷 15 号民居)	Traditional style architectural clues
26	House No. 7, Ally 5, East Street (沥滘东街五巷 7 号民居)	Traditional style architectural clues
27	House No. 5, Ally 2, Central Leach (沥滘中区二巷 5 号民居)	Traditional style architectural clues
28	House No. 6, Ally 2, Central Leach (沥滘中区坊 6 号民居)	Traditional style architectural clues
29	Chengzhai Wei Ancestral Hall (诚斋卫公祠)	Traditional style architectural clues
30	Dafu Wei Ancestral Hall (大夫卫公祠)	Traditional style architectural clues
31	Lijiaonan Temple (沥滘南庙)	Traditional style architectural clues
32	House No. 5, Ally 10, East Street (沥滘东街十巷 5 号民居)	Traditional style architectural clues
33	Beidi Temple (Lijiao Village 北帝庙)	Traditional style architectural clues
34	House No. 3, Ally 2, Fusiyue Street (沥滘副四约北二巷 3 号民居)	Traditional style architectural clues
35	House No. 9, Ally 2, Sanyue Street (沥滘三约北街九巷 2 号民居)	Traditional style architectural clues
36	House No. 17, Ally 1, Central Leach (沥滘中区一巷 17 号民居)	Traditional style architectural clues
37	House No. 4, Ally 10, East	Traditional style architectural clues

	Street (沥滘东街 5 号民居)	
38	Former site of the repair workshop (交通部四航局船舶修造厂旧址	Traditional style architectural clues

Table 3-1 Immovable Cultural Heritage and Cultural Heritage Protection Units in Lijiao Area (Source: collected and made by author)

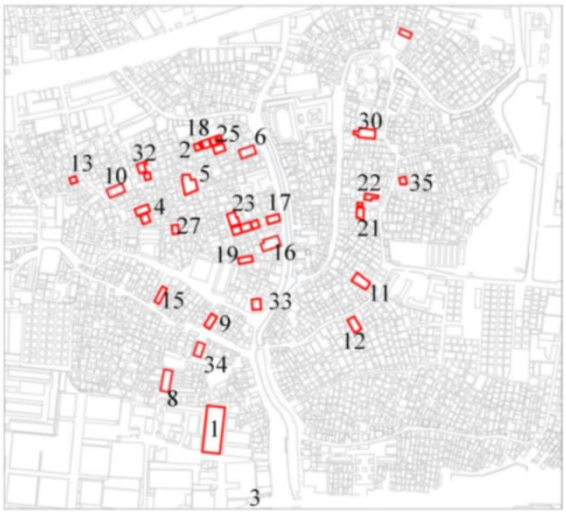


Figure 3-5 Map of Immovable Cultural Heritage and Cultural Heritage Protection Units in Lijiao Area (Source:

collected and made by author)

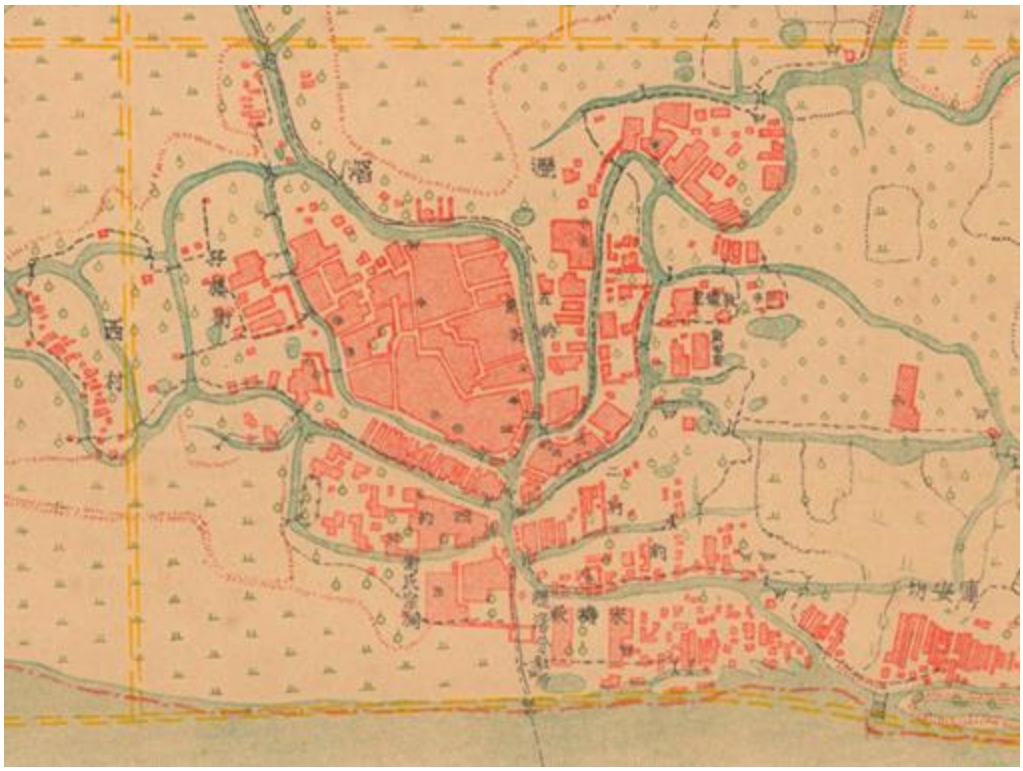


Figure 3-6 Map of Lijiao Village in 1929. (Sources: Map of Guangzhou City 1929)

Lijiao is a typical southern Lingnan water village with a wide range of water systems. (Figure 3 6) Until modern transport systems were built, water was an important resource for traditional agricultural societies as a means of subsistence, production and economy. Henan Island, which is typical of the Pearl River Delta plain, was an important base for food production in ancient times, and its extensive waterways provided great convenience and excellent conditions for agricultural development. The village of Lijiao, which is located in the back channel of the Pearl River, has a very important geographical position. For ancient farming societies where roads were relatively undeveloped and railways did not exist at all, transport was an important constraint on the development of a region. The waterway, as a natural and somewhat powered road, could greatly enhance the connection between a certain area and other areas. Not only did it facilitate travel for villagers, but the agricultural and handicraft products produced in the village could be sold quickly to the outside world, enabling the accumulation of wealth. In China, areas with a good waterway location have almost always had periods of prosperity throughout history, and the phenomenon of budding

capitalism even appearing early in the water towns of Jiangsu and Zhejiang is a testament to this idea. The proximity to major waterways also posed certain safety risks for the village, with flooding from typhoons and flood tides at one point inundating Lijiao. However, through long-term management, Lijiao has developed a pattern of a core area away from the Pearl River and a network of small rivers within the village, enhancing the natural conditions and accessibility of the village as much as possible while keeping flooding under control.[49]

The village pattern in Lijiao has changed dramatically in recent times as a result of social change and urban development. The earliest transformation of the village of Lijiao began as early as 1967. Following the policy of reform and opening up, the rural economy began to transform. As the demand for land began to rise rapidly, villagers began to convert various non-building spaces in the village into building spaces in order to expand more space. River surges became less and less available, gradually transforming into rental houses and roads. (Figure 3 7)In 1987, the two committees of Lijiao Village, the Village Communist Party of China Branch Committee and the Village Autonomous Committee, discussed the urban regeneration of the village. It was not until 2001 that the old transformation of Lijiao was formally put on track, becoming one of the earliest pilot villages for the transformation of urban villages.

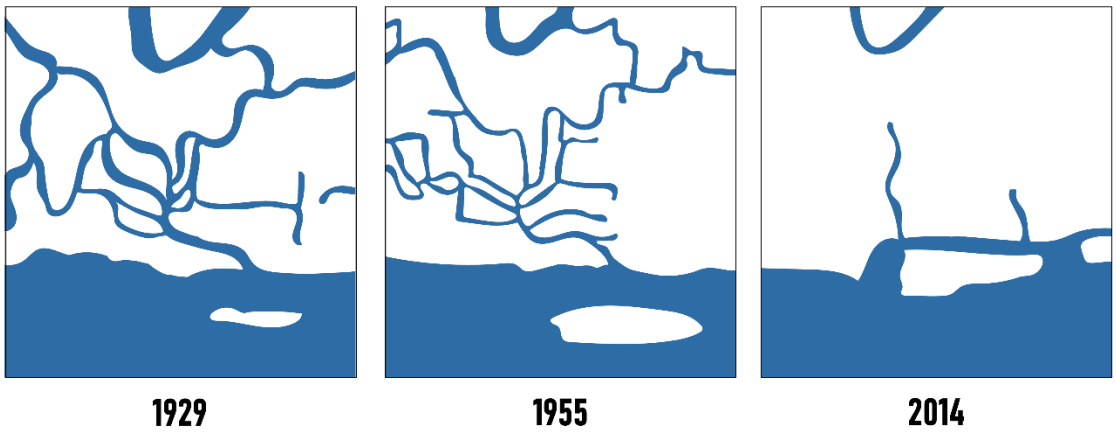


Figure 3-7 Changes to the river at Lijiao Village. (Source: made by author)

3.3 Current Use and Design Scope of Lijiao Village

The results of the field research show that the current village of Lijiao has both problems and strengths.

The greatest strengths of Lijiao Village are the good living atmosphere and landscape conditions, but they are basically limited to the two sides of the only existing river. The western bank of the river is the main road within Lijiao Village, with its wider streets, rich variety of businesses and pleasant natural environment. In addition to the river, there are a number of old trees that provide some places for villagers to cool off and have fun. This road also concentrates the most important services and commercial shops in the village, such as the clinic, primary school, post office, bank, telecommunications, retail, entertainment, restaurants, handicraft workshops and the police station, so it can be said that most of the village's needs can be met here. At the northern end of this road is the Lijiao Pai Fang (Figure 3 8), a landmark in the village. Also, what we can see on this road are the staff organised within the village of Lijiao to clean the water bodies and maintain law and order and fire protection. This scene on both sides of the river can be described as the upper limit of the urban village environment and atmosphere, with good street vitality and landscaping.

Figure 3-8 Lijiao Paifang（source: photo by author）

However, in the same Lijiao Village, the street vitality in other areas is far less than the

level of streets on both sides of Lijiao River.

In field research we focused on Lijiao West Street, Lijiao Dashi Street and Lijiao Huanxiufang Street. (Figure 3 9) These three streets and their surrounding plots are part of a branch of the historic water system that radiates outwards from Lijiao Village, which is also a traditional commercial, transport and cultural area. In their current state of use, however, only the closed gates and dilapidated buildings reveal some traces of the commercial and cultural history of the area. Similarly, the road traffic has been complicated by the building additions, causing inconvenience and insecurity to residents and drivers.

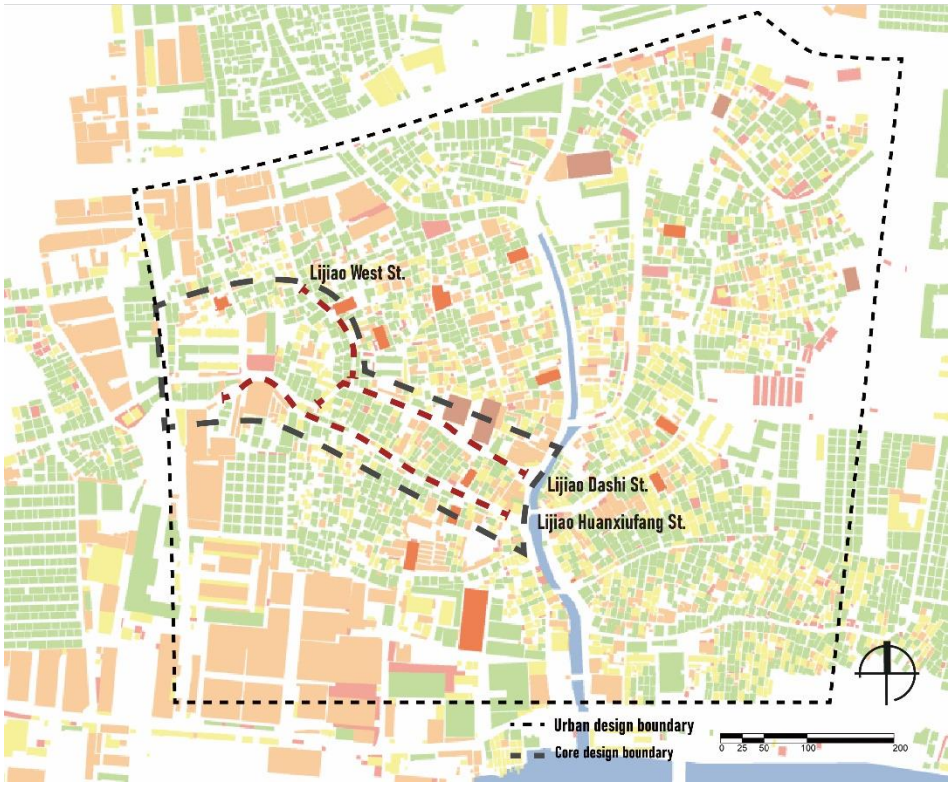


Figure 3-9 Core Design Scope (source: made by author)

3.4 Vitality issues of Lijiao Village

As mentioned earlier, street vitality is made up of three aspects: economic vitality, social vitality and cultural vitality. In all three areas, the streets within the core design area have decayed to varying degrees.

3.4.1 Economic Vitality

In terms of economic vitality, the most intuitive feeling is that with the development of the last decade, the number of commercial shops closing has gradually increased and the business environment is getting worse.

From the perspective of the whole street, the situation of the shops is also not good, with Lijiao West Street, Lijiao Dashi Street and Lijiao Huanxiufang Street, the main commercial and service streets of Lijiao Village, currently having a serious problem with more than half of the shops closing. This is a significant difference compared to the main road in the centre of Lijiao Village (Lijiao Street - Lijiao East Street - Lijiao Fusiyue Street). (Chart 3 1) The historical street map does not show a positive trend in the commercial situation of the three streets. For example, when comparing the same points over a period of approximately three years, it can be seen that the majority of shops have not changed or even deteriorated, and that the obsolete businesses have not been updated. (Figure 3 10) Take the intersection of two important streets, Lijiao Dashi Street and Lijiao Huanxiufang Street, as an example, (Figure 3 11) as the intersection of two important streets, it has a strong role in gathering people and should have had a strong edge in terms of commercial operations. However, between 2013 and 2019, there were still cases of poor shop operations, an increasing number of shop closures, overly dated businesses and unreasonable occupation of public space.

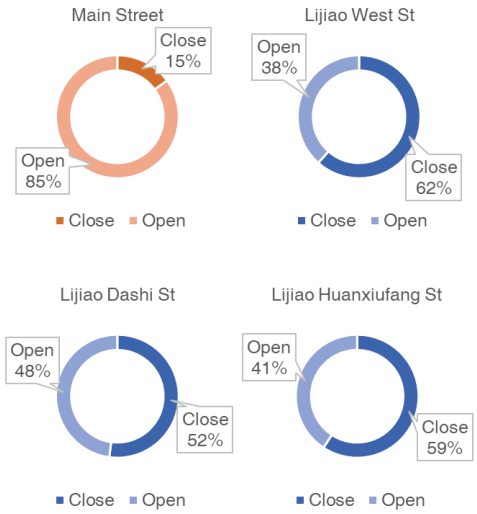


Chart 3-1 Shop operation status (source: made by author)

Figure 3-10 Commercial Points in core design area (source: Baidu Street Map)

Figure 3-11 Junction of Dashi Street and Huanxiufang Street (source: Baidu Street Map)

3.4.2 Social Vitality

In terms of social vitality, daily activities and the appearance of the street are the typical reference points. Often the occurrence of daily activities requires places as a basis, such as corner spaces, recessed spaces in the street, park landscapes and partially open architectural spaces. In other words, places where daily activities take place need to be interactive and

attractive, and roads with traffic and non-interactive hard interfaces cannot be places where daily activities take place. In Lijiao Village, the lack of regulation and planning has led to a desire to claim space on the street, which is gradually filling up and making the street uninteresting. As in Figure 3 12, in Lijiao Dashi Street, the once existing market complex has been replaced by a car park, as the demand for parking has increased and no new parking spaces have been planned. The market complex consists of a time-sharing food market and various shops. Outside of business hours, these spaces could accommodate temporary recreational activities for the elderly and children, such as playing cards and chatting. However, after the change of use to parking, the parking function essentially denies these activities from happening. Not only does parking take up these spaces for long periods of time, it also brings air pollution and a sense of insecurity among people. The surrounding cultural activity centre has chosen to close down in parallel. The building on the other side, which was open to the street, has also been converted into a wall, and the loss of interaction has reduced the desire for people to stay in the area.

Figure 3-12 Former general market on Lijiao Dashi Street (source: Baidu Street Map)

In recent years, there has also been destruction of the daily landscape. In Lijiao Village, the space under the old trees in the street often becomes a place of daily recreation for the residents. (Figure 3 13) The same type of old trees is present in the three streets within the core design area, but there is a lack of protection for the old trees and the surrounding

landscape. As in Figure 3 14, this old tree, which in 2013 was still used as a daily resting place in the street, was pruned back in 2017 with most of the trunk remaining, and was completely removed in 2019. The streetscape in the same location has also changed, and the elevated building that was originally used as a frontage has been blocked off for a convenience store. While this contributes to some extent to the commercial shops on the street, it is a significant loss from a landscape perspective. There are also parking and rubbish taking up frontage space, narrow streets, low quality temporary building additions, space being blocked by walls, to name but a few.

Figure 3-13 Daily leisure under the ancient tree (source: photo by author)

Figure 3-14 Ancient tree and building (source: Baidu Street Map)

3.4.3 Cultural Vitality

Cultural vitality is most typical of Lijiao Village in terms of the ancestral hall, the river system, and the use of the area around both.

As a village dominated by the 'Wei' and 'Luo' surnames, the ancestral hall is a central

place of clan culture, not only carrying the spirit of the clan, but also acting as a centre for clan-based activities. However, with the emergence and development of social media, the influx of foreigners and the exodus of local residents, social relations between people have become extremely complex. Blood ties within the clan are gradually being diluted, and the form of social organisation centred on the clan shrine is no longer sustainable in Lijiao Village. It is easy to understand this phenomenon in Lijiao Village, where even the ancestral halls, which are protected cultural heritage units, are falling into disrepair or are left unused. (Figure 3 15) A small number of ancestral halls have also been buried in architectural additions of low quality, making access and refurbishment extremely difficult. This is a great disservice to the local clan culture.

Figure 3-15 Current use of one ancestral hall (source: Baidu Street Map)

Even more damaged is the river system in Lijiao Village, one of the typical Lingnan water towns of Guangzhou's past, with its dense network of rivers and buildings built next to the water. The river system was the core of the water village ecosystem and the carrier of many activities. Nowadays, Lijiao Village only has the only one river left in the centre of the village, while all other waterways have been filled in or converted into culverts, losing their traditional water town character and natural environment. As the city's approach to urban villages has previously been based on the idea of knocking down and rebuilding, and a lack of attention to village conservation, it has not invested a lot of money and design resources into improving the living standards of the residents of the village. The lack of financial and design capacity has led to self-interested development of villages for their own benefit, resulting in a

loss of public benefit. The most typical example of this is the filling in of rivers to create new housing and roads. The destruction of the river system, which is the core of the water village ecosystem, has inevitably led to the destruction or removal of other things surrounding it, such as old trees, wells, bridges and traditional places of activity. The character of the village is gradually disappearing, and all water-related activities are dying out with the river system. (Figure 3 7) If this trend continues, Lijiao Village will eventually be reduced to an ordinary urban village with a low quality of life.

Chapter 4 Analysis and Design Strategy

4.1 Physical Space

Physical space consists mainly of the absolute scale of road width, building height and the relative scale of ratio of the two, examining the spatial experience of being in the built environment alone without external attractions.

4.1.1 Relative scale: Street Width-to-height Ratio

1. Basis of grouping

There are certain characteristic indicators of street width-to-height ratios (hereinafter referred to as D/H) that are important in determining the perception of space. (Table 4 1)

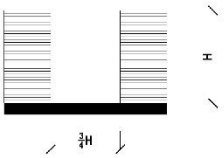
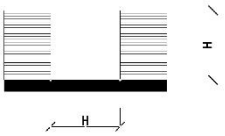
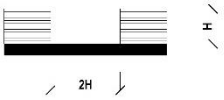
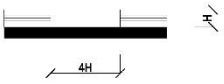
Indicators	Illustrations	Feeling of space
D/H<0.75		With no view of the sky in the field of vision, people will lose their judgement of the height of the building, which can create a sense of fear.
D/H≈1		The sky view is severely restricted. Street creates a sense of enclosure and make people focus on the walls.
D/H≈2		The sky is of equal size and secondary to the wall in the view, and building is more closely related to the street.
D/H≈4		The sky area is approximately three times the size of the wall, the sense of enclosure is weak and people tend to appreciate the details of the space.
D/H>5	Usually as a street junction.	/

Table 4-1 Basis of grouping of D/H (source: made by author)

Based on the above basis of grouping, the data are grouped as 0-0.75,0.75-1.25,1.25-2, 2-5 and road junctions.

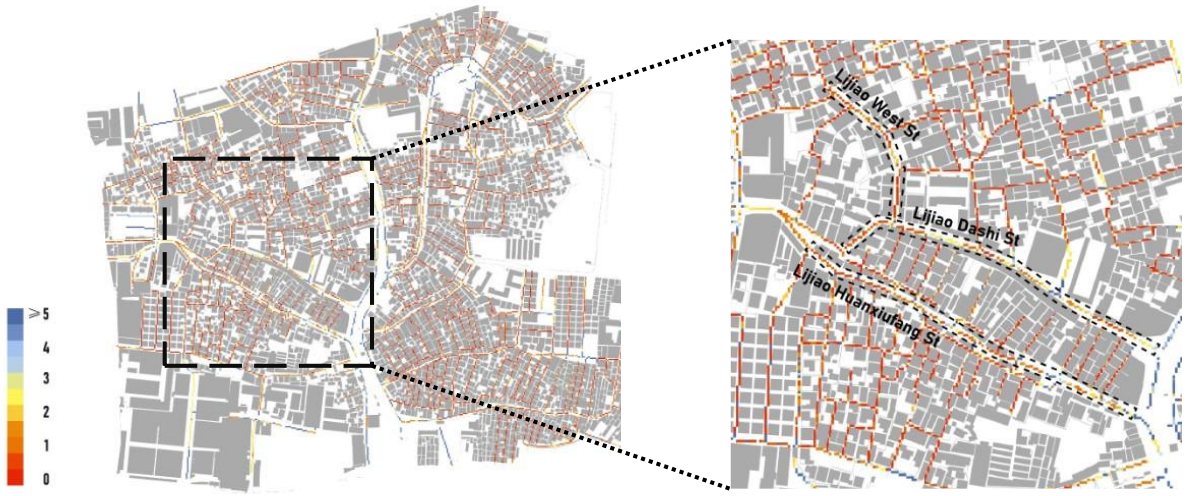


Figure 4-1 D/H map in Lijiao village (source: made by author)

In the analysis of physical space, the visual perception of relative scales in three-dimensional space is first investigated using Yoshiharu Ashihara's theory of width-to-height ratios. The red to blue colour in the diagram is a reflection of the transition from low to high D/H and from a narrow and crowded to an open spatial perception. Figure 4 1 shows that the overall spatial perception of Lijiao Village is also close to the hierarchy of its road network: the most open spatial perception is the central main road, followed by the streets that evolved from the historical water network, and the most crowded are the residential lanes.

The central main road in the first tier, consisting of a river surge and two roads, is the widest overall, with most of the street space having a D/H index higher than 2. The sky occupies a secondary or even primary position in the street, and is the street with the widest spatial feel in Lijiao Village.

The second tier of streets are those where the original river channel has been filled in and converted. More than half of the spaces have a D/H index higher than 0.75, but there are few spaces smaller than 0.75. They are characterised by a width between the first and third tiers and often have houses added to the original street. Due to the uncertainty of the location of the

additions, the location and area of the occupied streets are not fixed, so there is a discontinuous main road interface with a large variation in width; the secondary roads are short, narrow and partly disconnected, or the additions are directly adjacent to the original interface directly.

The third level is the path between the buildings, with a D/H indicator of less than 0.75. This type of path can only be used almost exclusively for walking or pushing bicycles, making the space feel extremely narrow.

2. Analysis of result

Pie charts and bar charts with the location of the sampling points as the horizontal axis and the width and width-to-height ratio of the street as the vertical axis were created for each of the three streets by the percentage of the above street feeling categories, and the width-to-height ratios of the three streets were transformed into visual charts and analysed.

Lijiao West Street：

The pie chart shows that spaces less than 0.75 make up about half of the total street space on Lijiao West Street, and 0.75-1.25 makes up about a quarter of the street space, with more psychologically perceived narrow sections. 1.25-2.0 and 2.0-5.0 make up 14% and 5% respectively, and the street junction/degree of void is about 10%. There is less open space for stopping and for daily activities to occur. The overall impression of the street is dark and congested. (Chart 4 1)

In the context of field research, Lijiao West Street is the most problematic street. There are hardly any businesses on this street, and the existing ancestral halls are not open on a daily basis and already used as a car park in front of it. The distribution of D/H shows that the most depressing street, less than 0.75, occupies almost half of the street space, while the relatively crowded 0.75-1.25 occupies about three quarters of the street. In terms of road width most spaces are around 3m, which is quite narrow in a street with motorised traffic. The bar chart shows that although there is little variation in the perception of space, there is still a lack of relatively wide and pleasant spaces, which contributes to the lack of public activity and spatial

experience. (Chart 4 2)

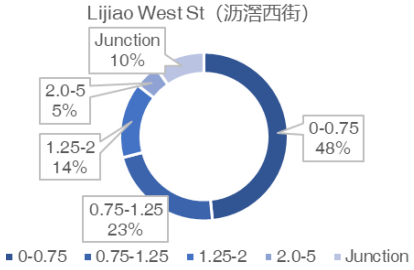


Chart 4-1 Lijiao West Street Distribution of D/H Indicators (source: made by author)

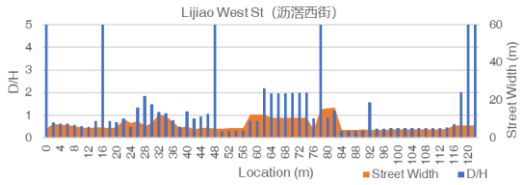


Chart 4-2 Lijiao West Street D/H and Street Width (source: made by author)

Lijiao Dashi Street：

Spaces less than 0.75 make up 29% of the total street space on Lijiao Dashi Street, and 0.75-1.25 makes up 14%. Both together account for close to half of the street space. 1.25-2 accounts for 17%, 2.0-5 accounts for 23 and the junction/degree of void accounts for 17%. The distribution of D/H shows the presence of some larger open spaces. Absolute widths remain largely consistent with the exception of a few open spaces. The overall spatial experience is moderate, but there is a large variation in spatial experience. (Chart 4 3)

The distribution shows that Lijiao Dashi Street has some open spaces that can be used as activities, on the eastern side of the street centre and at the eastern entrance to the street (points 140-154, 182-196, 212-222 and 258-280 in the chart). A part of the west-centre section has a relatively open space feel (points 78-102), but in practice there is a non-interactive wall on one side of the street and poorly-run shops on the other. The middle of the road is also not a suitable space for activities because of the need for traffic. Other locations are generally more even, with the width of the road being around 5m. However, the open spaces identified by the map are not well utilised, and in practice are mostly used for parking, car returns and rubbish deposition, resulting in a poor experience and inefficient use of space. (Chart 4 4)

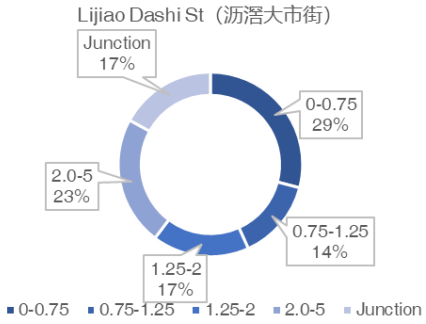


Chart 4-3 Lijiao Dashi Street Distribution of D/H Indicators (source: made by author)

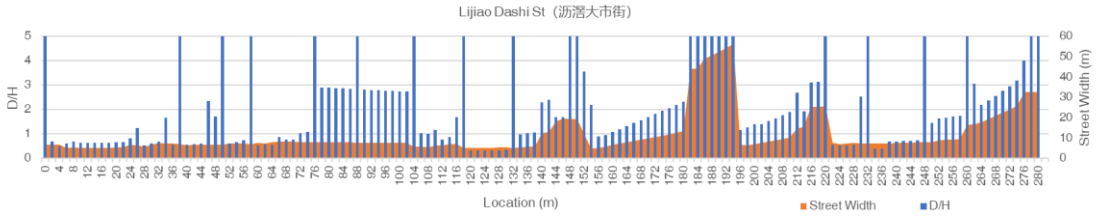


Chart 4-4 Lijiao Dashi Street D/H and Street Width (source: made by author)

Lijiao Huanxiufang Street：

Spaces less than 0.75 and 0.75-1.25 make up 25% and 26% of Lijiao Huanxiufang Street respectively, and together they occupy about half of the street space. 1.25-2.0 and 2.0-5.0 make up 19% and 13% respectively, and junctions make up 17%. (Chart 4 5)

The distribution chart shows very small values for both D/H and absolute width, and the existing open space of the street is relatively small compared to Lijiao Dashi Street. The variation in street perception and absolute width is smaller compared to Lijiao Dashi Street, but the number and magnitude of variations is slightly greater, which is related to the discontinuous building additions over the last decade or so. The overall spatial experience is moderately crowded, but the junctions are more frequent and evenly distributed, providing a good exchange of pedestrian flows. Similar to the situation on Lijiao Dashi Street, the potential space for activity in the street is occupied by parking and rubbish, and there is potential to improve the quality of the public space. (Chart 4 6)

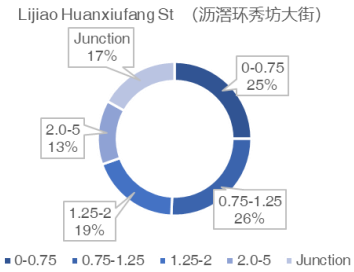


Chart 4-5 Lijiao Huanxiufang Street Distribution of D/H Indicators (source: made by author)

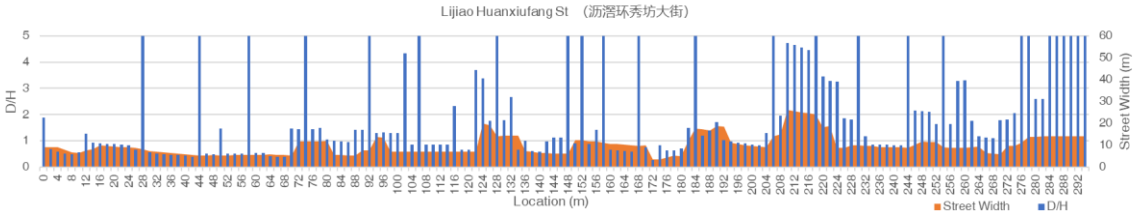


Chart 4-6 Lijiao Huanxiufang Street D/H and Street Width (source: made by author)

4.1.2 Absolute scale: street cross-section

The existing main roads in Lijiao Village have evolved largely from the historic water system, and the results of this evolution currently exist in two main types, which relate to the sum of the width of the river before it was filled in and the width of the streets themselves running parallel to it. The three main streets within the focus design area all fall into this evolutionary category.

The first is the type developed from the wider river. Typical of these is Lijiao Huanxiufang Street. (Figure 4 2) It is characterised by the good condition of the historic river or original road width and the filling in of the river to provide plenty of space for new buildings, which usually divide the original space in two or three, creating a street section with one main road and one or two secondary roads.

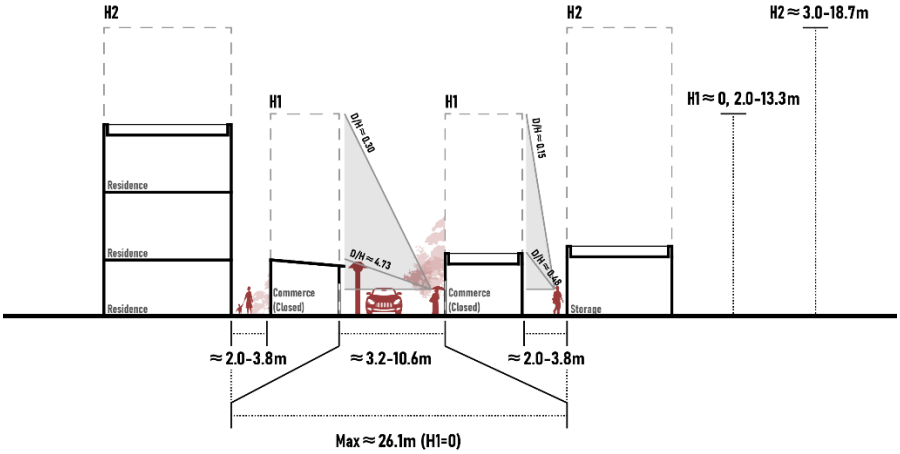


Figure 4-2 Section of Lijiao Huanxiufang Street (source: made by author)

In the case of Lijiao Huanxiufang Street, for example, due to the conditions, the number of storeys and the size of the addition are relatively low (up to about 13.3m, whereas the original buildings on both sides can be up to 18.7m), and the first floor is mostly used as commercial shop space, while the higher floors are usually used for residential purposes. There are also some simple sheds for storage or parking space. The addition compresses the entire width of the road, making some of the narrower spaces particularly compact in the main road after the addition, while the wider parts without the addition leave a larger space, which varies from 3m to 10m. The narrowest part can only accommodate one car, making it a bottleneck in the street, and the width-to-height ratio also becomes disparate compared with city road, making the spatial experience extremely different and jumpy, easily causing confusion in spatial experience and traffic. The first floors of the buildings on Huanxiufang Street are currently mainly related to commercial and lifestyle services, the phenomenon that is detrimental to current daily and commercial activities.

In addition to the central road and the addition, the remaining space forms a secondary road that serves as an entrance to the buildings on both sides of the original road. As the space is not continuous, it is almost exclusively used by residents for daily access, and although it is close to the main road it is a marginal space due to the poor spatial experience and low footfall.

There are also cases on this road where there are no additions on one or both sides, up to

a maximum width of 26.1 m. These spaces are not usually used for access and, apart from the space reserved for the ancestral hall, are mostly occupied by rubbish and parking, which also has some negative impact on the surrounding environment.

The second type is the type that developed from narrower river channels. Typical of this type of street are Lijiao West Street and Lijiao Dashi Street, both of which are characterised by the lack of space to form secondary roads after the river has been filled in due to the inadequate width conditions left by the historic river channel, and new buildings are often built close to the original buildings. In addition to the simple buildings erected for parking and storage, some of the new buildings will be built up to 5-6 storeys, exacerbating the narrow spatial experience.

As in Figure 4 3，the overall width of Lijiao West Street is narrower than that of Dashi Street at approximately 3.9-7.3m, with new building heights ranging from approximately 9.6-15.7m, with a greater proportion of width to height ratios less than 0.75 and a smaller proportion of open spaces higher than 2. The widest point of the street is approximately 16.1m. Lijiao West Street was mainly used as a road for the daily movement of residents and currently has very few businesses and services. However, it is assumed from the closed shops and the remaining shop signs that at some point in the past Lijiao West Street would have existed in a relatively prosperous state. There are also a number of small garment factories on this street and the street can be heavily disturbed by vehicles when access is required for transport vehicles. In Lijiao West Street, the movement and parking of transport vehicles has become the current daily behaviour that has the greatest impact on the street. Only one vehicle is allowed to pass in some narrow sections of the street, which not only affects pedestrian walking, but also places a significant restriction on the development of businesses and the daily activities that take place.

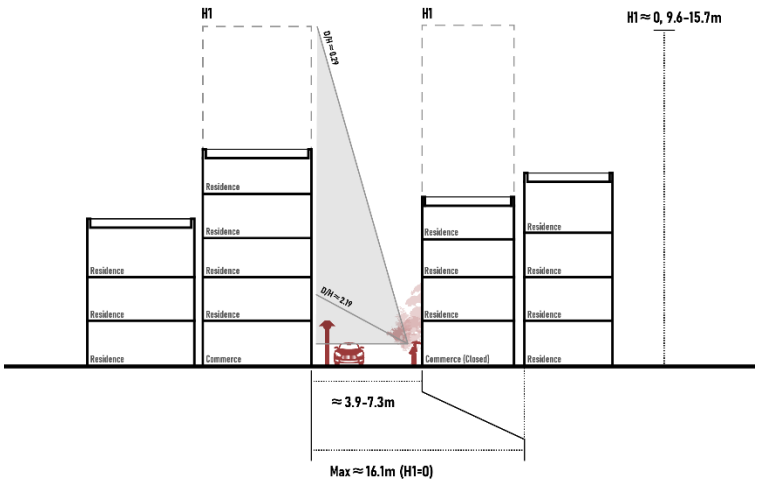


Figure 4-3 Section of Lijiao West Street (source: made by author)

As in Figure 4 4, the street width of Lijiao Dashi Street ranges from 4.7 to 8.2 m, with a maximum width of 26.5 m and a building height of 3.0 to 18.3 m. There is some open space in the street for daily activities, but currently it is mainly used as an access and return area for warehouses. In the middle section of Lijiao Dashi Street, there was once a market complex that included a food market, restaurants and daily entertainment. However, it has since been completely converted to parking and none of these activities can take place. For Lijiao Dashi Street, which is not a very wide street, parking requires a certain amount of space for reversing and returning, which has a greater impact on the street. On the other side of the street, which has currently been converted to a wall and occupies a large proportion of the street interface, there is less interaction. Combined, such a feature in the street not only affects the perception of space, but also amplifies the effect of near-human scale buildings and structures on the street due to its width, deepening the sense of disinterest and insecurity.

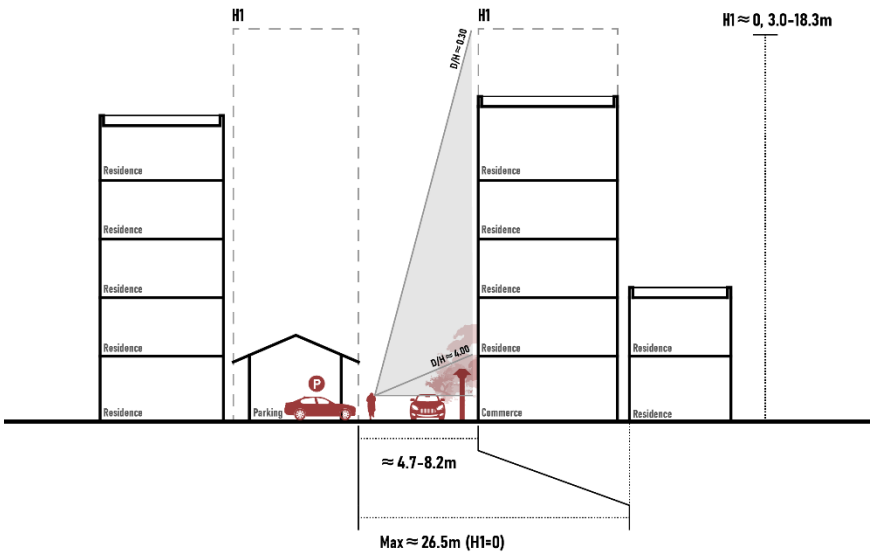


Figure 4-4 Section of Lijiao Dashi Street (source: made by author)

4.1.3 Summary

The spatial perception of the streets in Lijiao Village is also closely related to the hierarchy of the street structure, i.e., the central road of the existing river - the historical waterway - the paths between the houses. The width of the central road is made wide by the presence of the river, and the combination of the larger trees along the river and the river makes it the most pleasant and vital street in Lijiao Village. With the exception of the central road, the street space of most of the roads that have evolved from the historic river system is of a relatively crowded type, as the historic river has been filled in and many buildings have been added in the middle of the road, making the road space chaotic. However, these additions tend to avoid the frontage of the ancestral hall, which also has some space left in front of it, and these spaces become rare street recesses that can accommodate activities, but are currently used as parking and rubbish dumps and are in poor condition. The paths between the houses are mainly gaps between buildings and are extremely narrow, generally used only for access by the inhabitants of the buildings in the neighbourhood, and the feeling of space is extremely narrow.

For the core design area, all three roads have varying degrees of buildings that are too high relative to the street, too many jumps in street width changes, and unreasonable use of street space.

A large number of streets with low width-to-height ratios result in sections of continuous congestion except at junctions, with high building density and a lack of recessed spaces for respite. Such spaces are often the main source of the feeling of congestion that we experience in urban villages. This crowded spatial pattern not only reduces the amount of usable street space, but in some of the more severe cases deprives the pedestrians in the street and the inhabitants of the buildings of access to natural resources such as sky, sunlight and natural ventilation. Taller buildings block much of the sun and sky, and the complex and narrow street spaces make it difficult to create convection of air, resulting in negative spaces that are dark and damp. Such spaces are often difficult to dwell in, let alone carry daily activities and outward-looking businesses.

In other sections or open spaces where space feels relatively uncrowded, unjustified occupation of space becomes the norm. The open spaces in the streets of Lijiao Village are often used as spaces for rubbish and parking. This is not only a direct occupation of physical space, but also a visual and olfactory nuisance to the surrounding residents. As there is no planning for the path of traffic, almost all the street space, even at the lower end of the street width, is used for traffic. However, the impact of traffic on the street is significant, not only in terms of noise and air pollution, but also in terms of safety for pedestrians in the middle of the street. These street spaces become unsafe or difficult to use, whether as commercial or residential entrances.[50]

4.2 Topological Space

The main tool used in the analysis of the topological space is the Segment Analysis of the space syntax, which includes elements such as angles and distances on the basis of topological relationships and therefore highlights the characteristics of the street in terms of spatial configuration in terms of complexity of transitions and physical distance in terms of traffic costs. The Segment Analysis of the space syntax was carried out for Lijiao Village at 500m, 1000m, 1500m, 3000m and global scales, taking into account the scale of the village, the overall scale of the model, and the range of transport and residential activities.

4.2.1 Segment Analysis

1. Error Analysis

As a topological analysis tool, space syntax focuses on structural relationships, but lacks consideration of real-world factors such as physical distance and terrain, human psychology, the attractiveness of a location (not the objective point of attraction in space syntax), and the true ease of reaching a location. The results also vary between tools depending on the algorithm used. Some data checking and correction by the user is therefore required.

Firstly, space syntax emphasises topological relationships and there are diminishing marginal benefits. When the space syntax model incorporates only the object of research, the boundaries of the study scope become naturally less accurate due to the lack of outside influence, as they themselves are at the boundaries and are only influenced internally. The correct approach is to select a suitable buffer zone according to the modelling depth within the study area to ensure the credibility of the calculation results. Depending on the study, the choice of the buffer area extent varies. It is necessary to focus on transportation, travel time and other information in a comprehensive manner. It also can be considered to be limited with the help of some artificial and natural boundaries, such as rivers, city walls, high speed roads, etc. [51]

The space syntax focuses on the movement flow of natural travel but does not reflect the subjective will of individuals. In other words, an area with a high realistic attractiveness may not exactly match the results of the space syntax calculation. Space syntax is only one of a number of location strategies, and even if it is used, it needs to be considered in conjunction with other data and realities. For example, it can be combined with map POI data and review applications such as Dianping, Yelp and TripAdvisor to identify hotspots and evaluate the consistency of urban functions, or it can be combined with heat maps and traffic congestion to evaluate the consistency of traffic flow and urban space. [31,52–54]

The level of modelling detail also needs to be considered in the context of the research. If one wishes to study the accessibility of the road network at a small scale, then it is certainly not appropriate to build only a large-scale urban skeleton, and vice versa. In addition, in the

real world there is a distinction between public and private space and a large number of regulated areas such as housing estates, schools, internal roads and areas that are temporarily or permanently closed for various reasons. These areas pose a trade-off for modelling space syntax without differentiating between people who can access them, as they restrict access and movement. This requires the selection of a reasonable level of modelling granularity, taking into account the object and content of the study prior to analysis.

In addition, the user's personal experience and habits often contribute to a certain amount of error.

The space syntax model is a highly generalised model that discards most of the information in real space and only requires basic spatial shapes and connections between different spaces. For the segment map it is further reduced to the connection relationships between straight lines. However, modelling is still an extremely time-consuming and labour-intensive task due to the often-large scope of the research. Differences in modelling habits and personal understanding can lead to different results when modelling the same area using space syntax for different users. This is often reflected in the simplification and trade-offs of axes and the level of detail of the model. For example, for a curved path, some people will simplify it to a straight line because of the permeable view and human psychology, others will change it to a bend depending on the actual spatial form and human movement, while others will discard it as a path that is too internal and has minimal impact on the wider space. What is more likely to happen in practice is that the modeller will not be able to fully understand all spatial patterns, and the model may conform to the rules of space syntax, but not to the actual situation.

Some errors caused by human factors can be controlled to some extent. In this regard, the responses in this paper are as follows: 1. Completely one person completes the modelling work to ensure the consistency of ideas; 2. Treating some specific difficult-to-handle areas by making rules to treat them equally to ensure the balance of model details; 3. Simplifying the model uniformly through grasshopper software programming, merging axes with minor transitions that do not affect the calculation results; 4. The core spatial calculation results are

guaranteed to be correct by conducting on-site research in advance for key areas and checking through street maps; 5. The analysis of space syntax needs to be viewed in conjunction with other data and analysis tools, and conclusions are drawn after comprehensive consideration of the data derived from it.

2. Sample Selection

As mentioned earlier, occupying a position against the edge of the map tends to introduce a large bias into the calculation when we use space syntax. Therefore, in order to minimise the impact on the main research object, Lijiao Village, the axial map can be extended appropriately outwards until a relatively regular and somewhat isolated artificial or natural boundary, making it more difficult to reach the core of the research beyond that boundary and minimising the impact on the core of the research. The choice here is to extend west and north to Xinjiao Road and along it, east to the Hua'nan Expressway(in Chinese: 城市快速路) and south to the Pearl River. Xinjiao Road is an urban expressway (in Chinese: 城市快捷路[3], lower than Hua'nan Expressway) with eight lanes in each direction and a design speed of 60km/h. Because the main road has no level crossings and passes at higher speeds, it limits traffic on both sides to a certain extent; the Hua'nan Expressway is an urban expressway with a higher road classification than Xinjiao Road and has a stronger barrier effect. The Pearl River (Back Channel) is a wider river immediately adjacent to Lijiao Village and is connected on both sides mainly by large bridges which are difficult to cross without motorised transport such as cars, so it can also be considered a natural boundary with a stronger separation.

[3] 城市快捷路：Urban roads with a combined grade between urban trunk roads and urban expressways. An urban road with a central barrier, two or more lanes in each direction, full or most grade separation junctions and optimised access on both sides of the main road, for uninterrupted or less interrupted traffic on the main road. The main function is to reduce or eliminate the light-controlled intersections on the main road so as to ensure the smooth and continuous movement of vehicles and improve the efficiency of transport within the city.

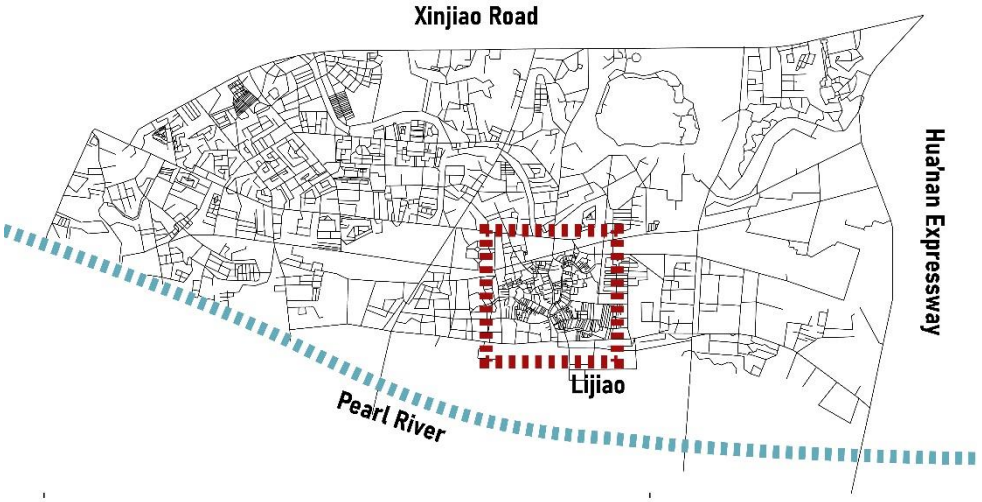


Figure 4-5 Segment map and research scope (source: made by author)

In addition, the choice of metric search radius for the space syntax model is also an important element in data analysis. In this paper, five search radii of 500m, 1000m, 1500m, 3000m, n (global search) is selected for the actual situation and design requirements of Lijiao Village to meet the different needs of different analyses. (Figure 4 8)

3. Data Analysis

Integration Core is one of the key concepts in the analysis of computational data and refers to a model in which the first 5%, 10%, 25%, or 50% of the space is most integrated. Integration Core + 1 refers to the model line segments directly connected to the Integration Core. Together these two form the high Integration value region which forms the theoretically easiest to reach and most communal region within the model. As the space syntax Segment Map built in this paper is bounded by the geographical barriers and road traffic barriers around Lijiao Village, with a range of up to 3000m or more, the top 5% of high integration value road segments are selected as the integration cores in this analysis.

Firstly, a comparative analysis of different scales of the same analytical indicator is carried out. As in Figure 4 6, The red line in the graph shows the top 5% of spaces for Integration at each scale of analysis. In this figure it can be seen that Lijiao Huanxiufang Street, Lijiao Dashi Street and Lijiao West Street within the core design area are in descending order in terms of Integration: Lijiao Huanxiufang Street at 500m, 1000m and 1500m are the

core of integration, with the main area of influence being within Lijiao Village and a portion of the surrounding area. Lijiao Dashi Street at 500m and 1000m is the core of integration and at 1500m is the core of integration + 1. The main area of influence is within the village. Lijiao West Street is more complex, with an integration core or integration core+1 at different sections at 500m and 1000m respectively, and is lower than Lijiao Dashi Street in overall terms. However, the section of Lijiao West Street that meets the urban road outside the village is always the integration core at scales below 3,000m, so the impact of Lijiao West Street on the urban area outside the village should also be taken into account and strategies should be made for the pedestrian flows entering from the north. At a global scale, none of the three streets fall into the Integration Core and Integration Core+1 types of streets. Thus, Lijiao West Street and Lijiao Dashi Street have service areas largely confined within Lijiao Village, while Lijiao Huanxiufang Street has a slightly larger service area and can provide some services to the surrounding area.

From Choice perspective, Lijiao Huanxiufang Street has an important position in Lijiao Village at every scale and is one of the main roads in Lijiao Village; Lijiao West Street and Lijiao Dashi Street have a secondary position at the 500m scale to Lijiao Huanxiufang Street at the 500m scale, but both have no direct connection to the main road and the road alignment is relatively rugged, making a clear but short break in the connection between the two at the 1000m scale, and thus can only be served at a smaller scale (500-1000m).

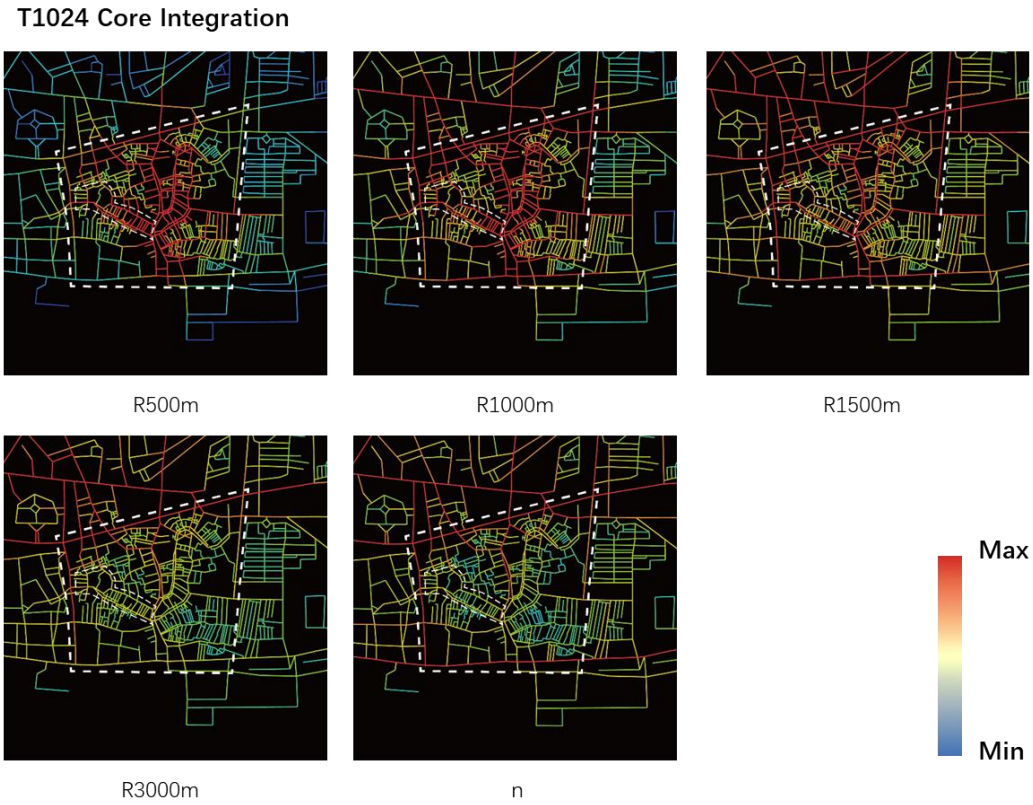


Figure 4-6 T1024 Core Integration Segment Map of Lijiao Village (source: made by author)

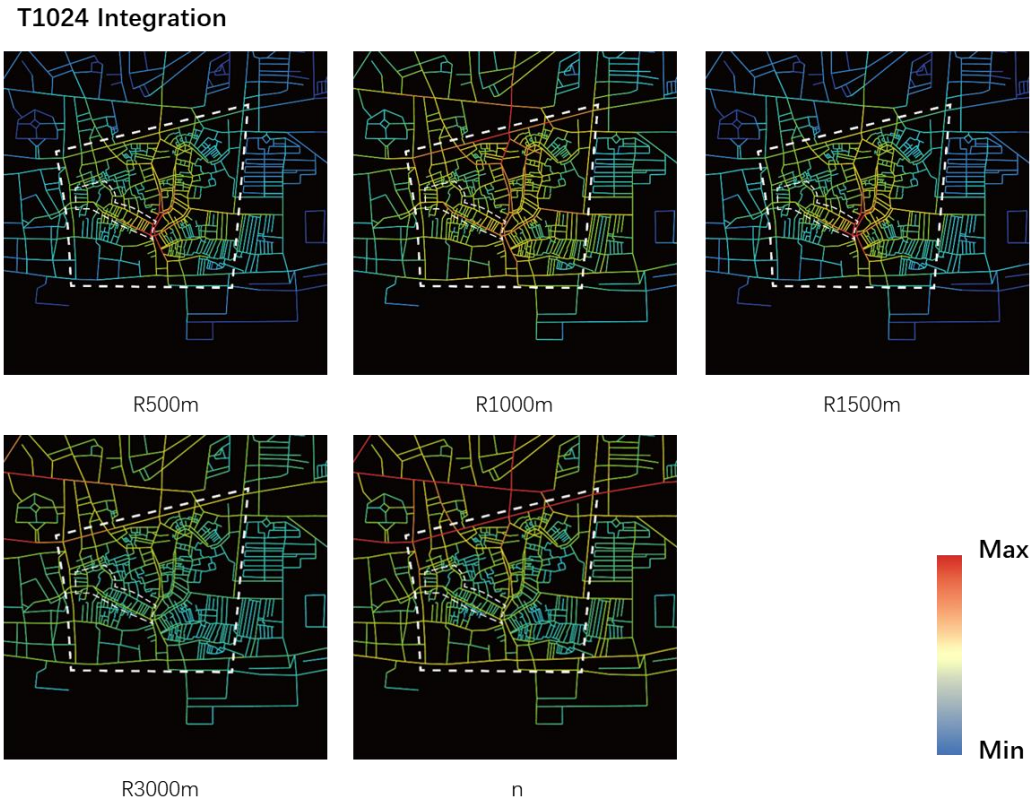


Figure 4-7 T1024 Integration Segment Map of Lijiao Village (source: made by author)

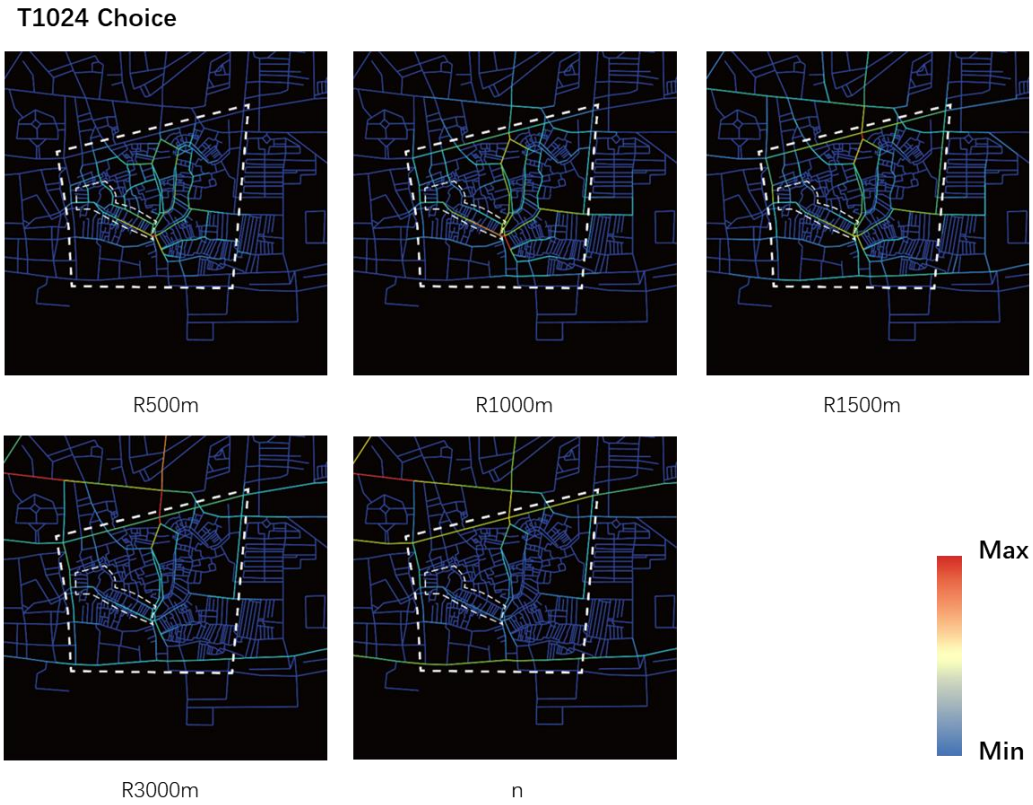


Figure 4-8 T1024 Choice Segment Map of Lijiao Village (source: made by author)

From the perspective of Lijiao Village as a whole, the structure of the tree-like water system is clear on the small-scale Integration and Choice diagrams. (Figure 4 7, Figure 4 8) As the radius of the study increases, both Integration and Choice show a shift in the hotspot area from the inner historic river system outwards, from a street structure formed by a tree-like river system to a more urban main street pattern. This also shows that for Lijiao Village, the spatial structure formed by the historic water system is more internal, a localised spatial structure that is clearly differentiated from the urban scale and is not coherent, lacking direct connection, linkage and integration with the urban roads, which tends to isolate the urban village from the city and is not conducive to the exchange and development of the two. The current street structure around the historic tree-like river system gradually loses its integrated core from a distance of more than 1500m and is therefore more suitable for the internal services of Lijiao Village.

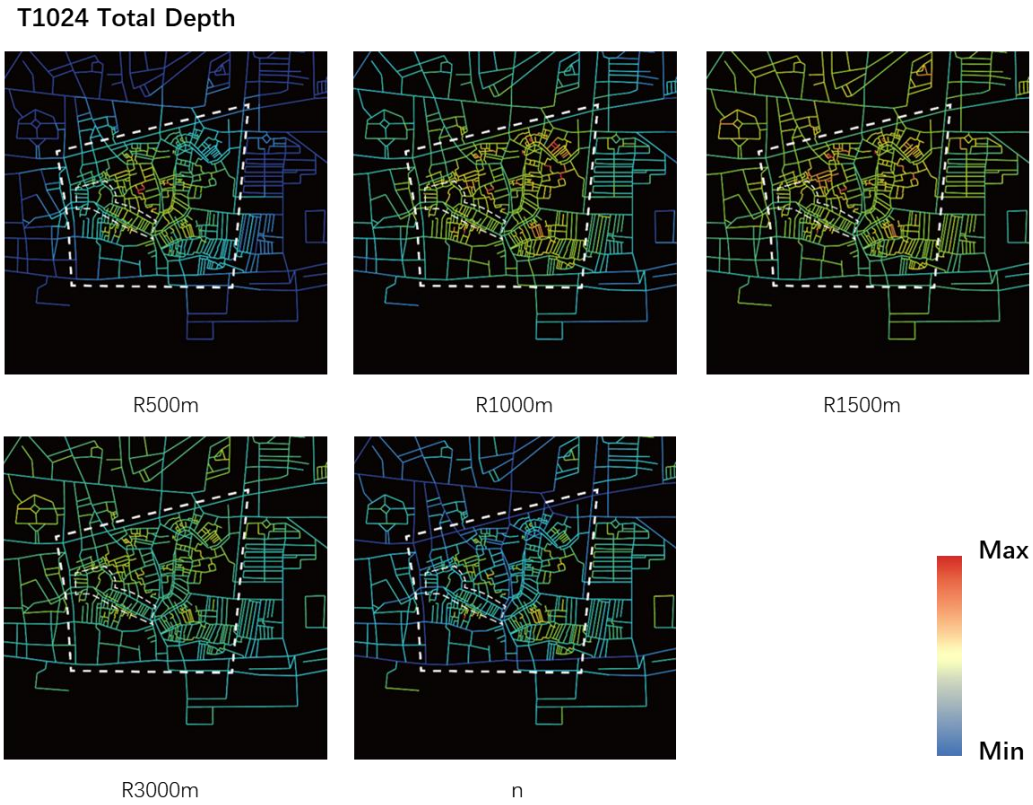


Figure 4-9 T1024 Total Depth Segment Map of Lijiao Village (source: made by author)

From each scale comparison, it can be seen that the depth variation within the village shows a four-level structure (Figure 4 9): Exterior urban roads - historic river structure or exterior urban road + 1 place - road directly connected to historic river structure - deepest inter-house road. As the historic river system is entirely natural, it is inevitable that it is not evenly distributed in certain plots and that the waterways are not directly connected to each other. The need to change from the historic river system to the roads between the houses several times creates inconvenience in terms of access and egress, and also makes the choice of routes for the internal inhabitants too dispersed, making it difficult to concentrate them in a few main streets under the current conditions. From this point of view, the potential to unleash the vitality of the larger internal neighbourhoods can be achieved by creating streets that are more traversable and in which the integration of these streets is equally possible.

Figure 4-10 Map of Immovable Cultural Heritage and Cultural Heritage Protection Units in Lijiao Area (Source: made by author)

Combining the distribution of ancestral halls and conservation buildings (Figure 4 10), it is clear that many current ancestral halls are hidden in places with high total depth values, making them costly to reach. This has set the stage for the decline of the ancestral halls: the difficulty of access has reduced the flow of people, repairs are difficult, purposeful access has become more costly and less valuable to most people in modern times, and the ancestral hall has gradually declined. Ancestral halls have an extraordinary significance in Lijiao Village, and with renovation and development can become an important source of vitality in the village. It is therefore equally important to provide easier access to the ancestral hall, unlocking more street life while providing convenience, and providing the basis for the regeneration of the ancestral hall and its surroundings.

Next a cross-sectional analysis of Integration, Choice, and Total Depth at the same scale was carried out.

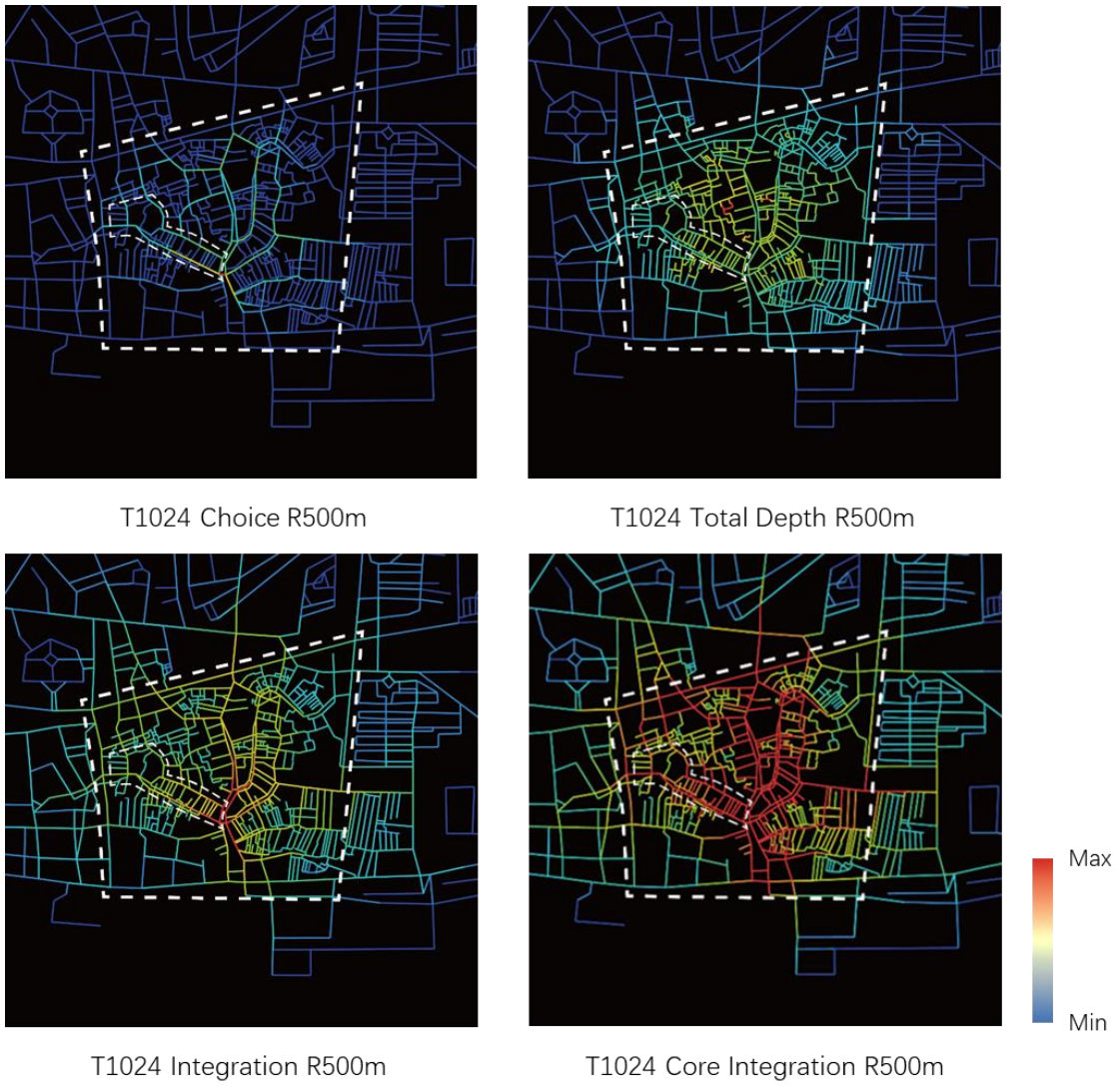


Figure 4-11 R500 Segment Map of Lijiao (Source: made by author)

500m (Figure 4 11): 500m is approximately the radius of the outer circle of the extent of Lijiao Village, at this scale it is possible to reach any point within the village from the centre of Lijiao Village and conversely from any point to the centre of Lijiao Village, the most important result is that it is possible to obtain a pattern of behaviour for the backbone of the street structure of Lijiao Village and the centripetal nature of the village.

Firstly, the Choice figure shows that the street structure of Lijiao Village is basically a central radial pattern, which largely coincides with the distribution of the historical river network, validating the pattern of Lijiao Village based on the development of the river network and leaving the potential for subsequent regeneration.

Secondly, in combination with the three, the main street structure is not entirely

homogeneous, with the four corners being connected mainly by a tree-like network of historic rivers, and a lack of interconnected streets, which can cause areas of high Total Depth to expand and areas of high Integration to shrink, making these areas less accessible for travel and less likely to form vital street spaces, and where most urban village problems, such as fire and crime, tend to occur.

Thirdly, the integration core of Lijiao Village largely coincides with the historic river network, with Integration Core +1 continuing to spread outwards along the river network. During the field research, it was found that the most vibrant and popular road in Lijiao Village is the middle section of the west bank of the central existing river, followed by the road where the historic water network is connected to it, as shown in the analysis. However, the large number of signboards, closed shops and underutilised public spaces indicate that the vitality of these streets has not been fully released, but has been declining in recent years, falling short of previous levels of vitality.

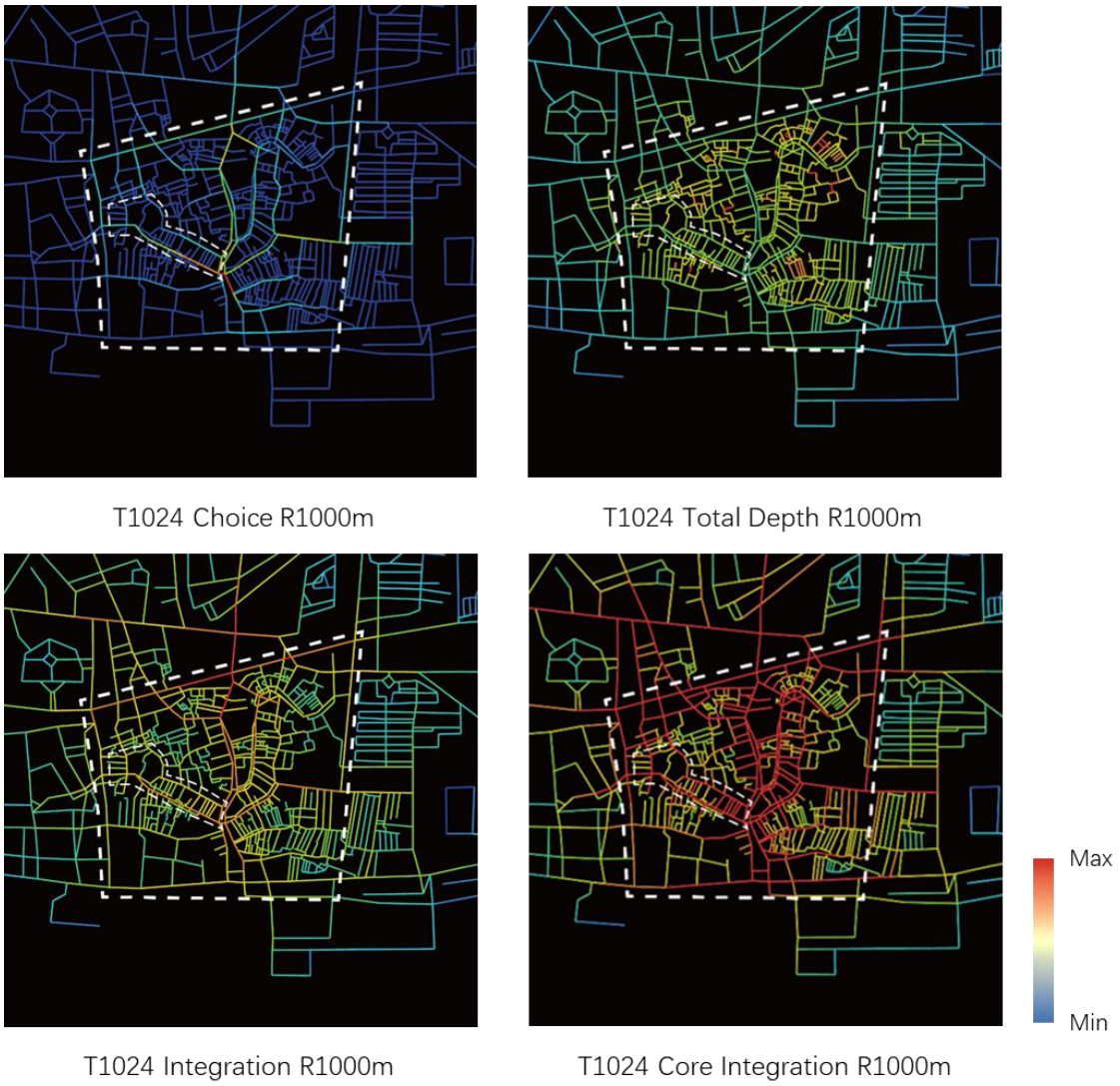


Figure 4-12 R1000 Segment Map of Lijiao (Source: made by author)

1000m (Figure 4 12): 1000m is approximately the longest linear distance within Lijiao Village. At this scale it is possible to reach any point from any point in the village and can also be used as the extent of Lijiao Village's ten-minute living circle, encompassing a wider range of peripheral interactions.

There is a clear tendency for the centre of the space syntax analysis to shift northwards compared to 500m. This is due to the fact that the northern side is close to the hinterland of Henan Island while the southern side is adjacent to the Pearl River, which has a greater range of influence for the space syntax model. The Choice figure shows the peripheral roads beginning to be chosen more often, with the highest streets of the Integration shifting to the junction of the peripheral roads and the central road on the north side. The central road and

most of the streets formed by the historic river network to which it is connected become the Integration core. The Total Depth impact is not significant. From a village as a whole perspective, the western part of Lijiao Village is not as dense and distributed as the eastern part with roads crossed by high Choice and high Integration, making it one of the largest blocks in the village in terms of area. This inevitably causes inconvenience in terms of living and transportation, and the absence of arterial roads prevents the full potential within this area from being stimulated and affects the vitality of the surrounding area.

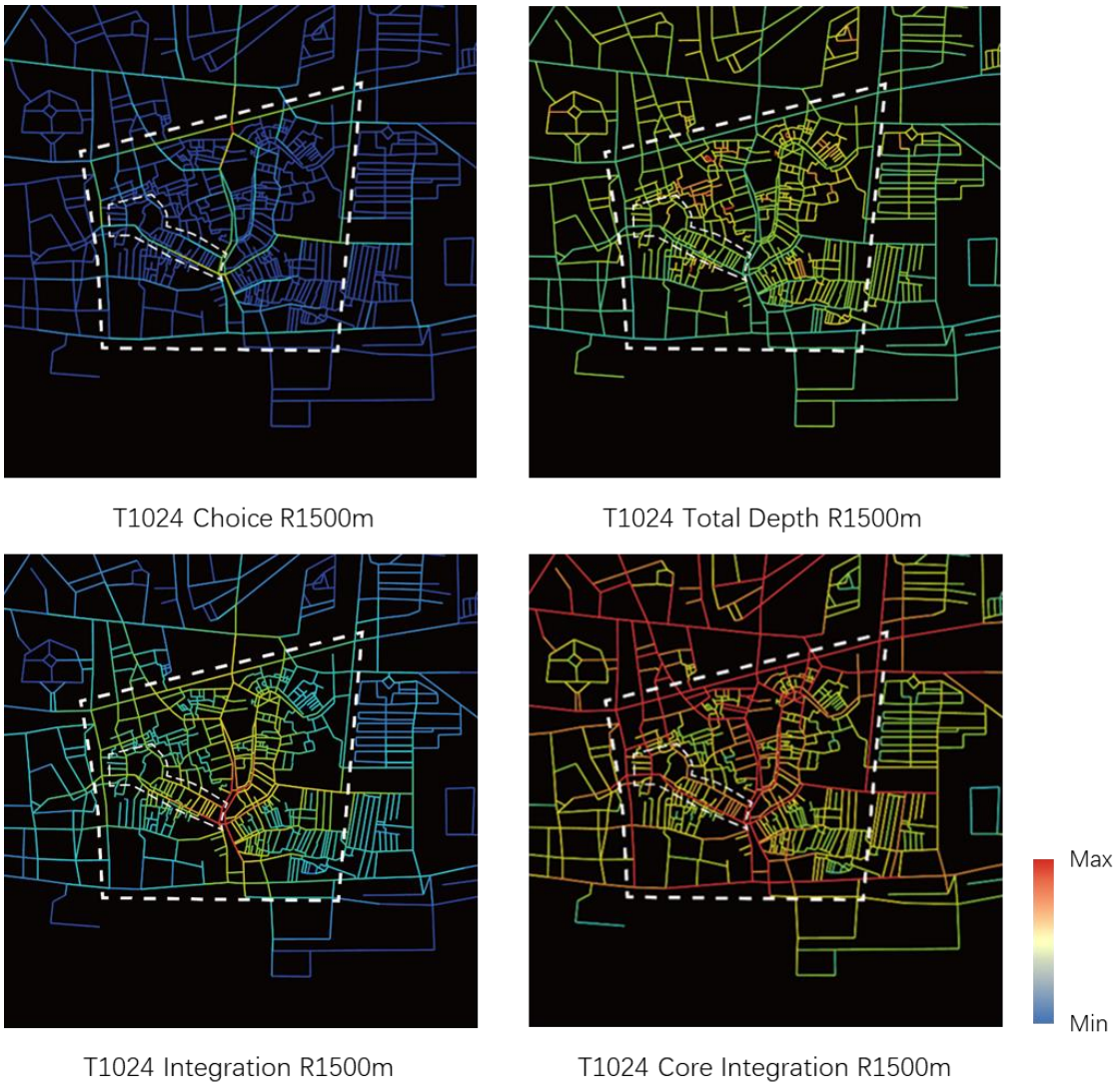


Figure 4-13 R1500 Segment Map of Lijiao (Source: made by author)

1500m (Figure 4 13): The 1500m acts as an expansion of the 1000m, serving as a complement and observation of trends.

Here it can be observed that there is an increasing tendency for Choice and Integration to

shift towards the periphery, gradually forming a closed pattern. However, the absence of an urban road to the south-east and the lack of connection of the eastern peripheral road to the southern peripheral road negatively affects the connection between the streets in each of the analyses.

The integration core continues to shift outwards and towards the main cross within the village. Ideally, therefore, highly public streets at this scale might result in a cross structure on the periphery or within Lijiao Village.

Similarly, Total Depth has some high depth patches within the village. Where there are large concentrations there are usually more serious traffic and travel problems and are areas of potential improvement.

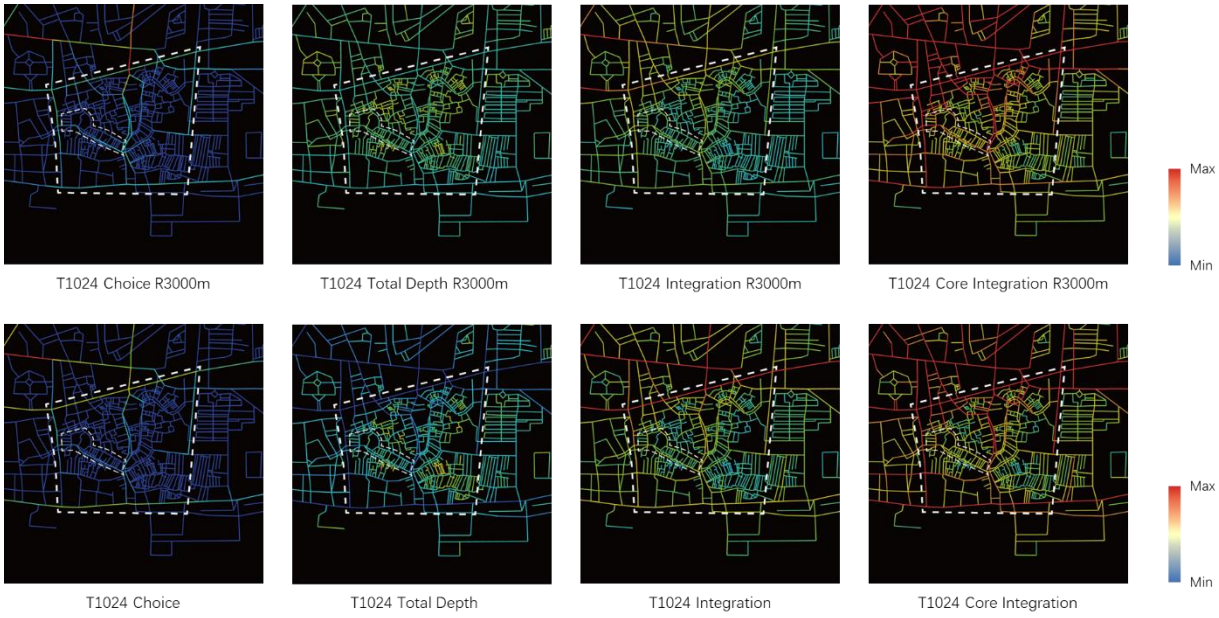


Figure 4-14 R3000, n Segment Map of Lijiao (Source: made by author)

3000m, n (Figure 4 14): 3000m is the shortest distance from Lijiao Village to the opposite model boundary and is the distance easily accessible to slow moving traffic. The global scale, on the other hand, covers the most comprehensive range, but there are many similarities between the two. There is still an outward shift in Integration for both, with the high values of Integration shown in the global analysis ultimately concentrated on the urban arterials, and the integration core within the Village concentrated entirely on the central road from the middle to the northern section. Choice forms a hierarchy of urban arterials -

peripheral roads - internal central roads - other connected roads. At both scales, the high value sections within the village become largely north-south and east-west oriented roads, forming a cross structure centred on the consolidation core at a smaller scale. As the northern side of Lijiao Village is the hinterland of Henan Island, which is also crossed by the more accessible east-west urban arterial road, it is possible to strengthen the connections between the roads within the village and the northern side, increasing the connectivity between the village and the urban space.

4.2.2 Summary

In general, the village and road structure developed from the historical water system still plays an important role in the village. However, the lack of integration between the new urban plan and the road network within Lijiao Village, the lack of strength and capacity to renew the traditional village structure and the disorderly construction have produced problems such as the lack of strong links with the city within the village, the irrational structure of the village roads and the fact that the theoretical high values of the space syntax are not as effective as they should be.

Some of the plots lack easy road access through them, creating large patches of high total depth values. This has two consequences: firstly, the residents within the patches are extremely inconvenienced. With no major roads running through them, residents rely on the gaps between buildings to get around. These roads are usually spread throughout the site but are very narrow, which not only makes it difficult to identify the roads, but also does not allow for a variety of commercial and service functions to be located within them, making it difficult for residents to access goods and services and to get around. Secondly, it causes problems for the organisation of traffic and functions on the main roads outside the area. On roads with vehicular traffic, such a road system may allow pedestrians to enter and exit through any gaps, creating a complex traffic situation that makes pedestrians feel insecure and drivers need to be constantly alert. From a functional point of view, junctions are important nodes and a rational road arrangement can effectively enhance the perception of street business area and focus, but the current cluttered and non-mainline road system in some areas

will cause confusion in locating shops and will not organise pedestrian flow well, weakening their street vitality.

The three streets within the focus area are all legacy roads of the historical river system, inheriting the strong influence of the river system on the accessibility and public character of Lijiao Village. However, on the one hand, they do not achieve the corresponding ideal state in actual use, and on the other hand, there is some room for optimisation in terms of road connections and alignments. As mentioned earlier, space syntax is a representation of the spatial structure in an ideal situation, but it is likely that the ideal state in real space is not synchronised with time and space. In other words, it takes time to achieve the unification of the ideal state of the space syntax and the function of the physical space, which may come from the long practice of the people living here. As an ancient village with a very long history, the original spatial structure of Lijiao Village is most likely to be very compatible with the needs of village life, when the influence of later disorderly additions is excluded. Of course, as modern life has increased in terms of spatial quality and functional requirements, the original structure alone may not be able to meet the needs of the present. The nature of uncontrolled additions also stems from the sudden change in the acceleration of demand and development, making it difficult for Lijiao Village to withstand such a drastic impact. Therefore, the design needs to be more rational, forward-looking and connected to the city in order to meet the needs of the present and the future. While the overall pattern is maintained, new roads are created or the alignment and width of roads are optimised where there is a need for renovation. Where the conditions for renovation are relatively limited, the existing obstacles to access will be repaired, for example by removing part of the walls, raising the width of the road and removing obstacles.

The following conclusions can be drawn from the above analysis. Lijiao Huanxiufang Street, with its better accessibility (road width, space syntax choice, road straightness), can be defined as an important access and public road with a radial coverage inside and outside the village, and is suitable as the main access road in Lijiao Village. Services or commercial facilities on both sides of the street that can also face the village and beyond, with some

distinction between pedestrian and vehicular traffic for efficiency and safety. Lijiao West Street and Lijiao Dashi Street need to be optimised for road alignment, adapted to functional planning and street attributes, primarily serving within Lijiao Village as a complement and supplement to Lijiao Huanxiufang Street. Lijiao West Street has potential but relatively limited conditions for renovation. A new parallel street could be considered to increase its efficiency and vitality when it is difficult to renovate the street. It is also possible to create an attraction through the installation of special facilities and the restoration of the ancestral halls, which would create a richer space with better space syntax.

4.3 Real Space

4.3.1 POI (Point of Interest)

In this paper, Lijiao Village and its surrounding areas are selected as the POI crawl area, and classified according to the main functions and business types of the urban village as restaurants, living services, shopping, leisure places, community institutions, community clinics, schools and training institutions, transportation facilities, landscape ancestors, and companies and factories. Among them, restaurants, community services, shopping and leisure are represented as the commercial category; community institutions and government, clinics, schools and education institutions, and facilities of transportation are represented as the public category; and landscape and ancestral halls, and factories and companies are analysed separately as the two distinctive functions of Lijiao Village. The two main analysis tools used in the analysis are degree of mix and kernel density.

1. Degree of mix (Shannon Weaver Diversity)

The degree of mix, or Shannon Weaver Diversity, refers to the number of species counted in a unit area, with the higher the number of species the higher the value, and the opposite the lower. In practical terms, this indicator reflects the relative abundance of functions in the corresponding unit area. Shannon Weaver Diversity is equal to 0 when the number of species equals 1. This is expressed by the formula:

$$H(X) = -\sum_{i=1}^{n} P_i log Pi$$

where H(X) denotes the entropy of the random variable X; P_i is the probability that X takes X_i.

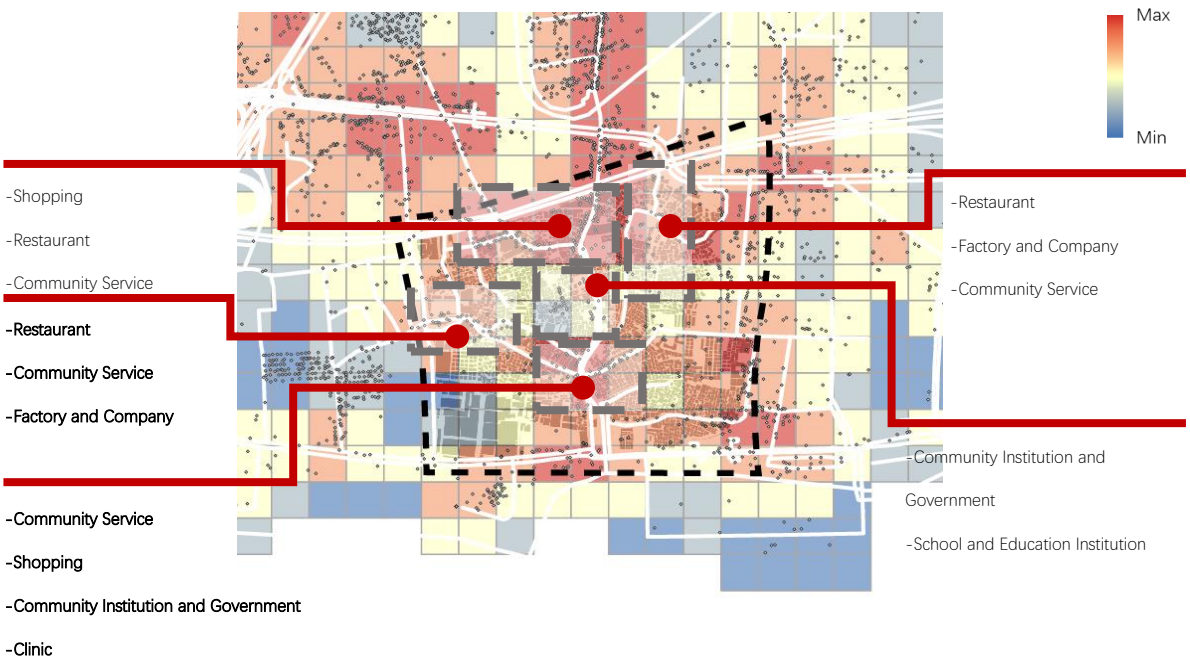


Figure 4-15 Shannon Weaver Diversity of POI (Source: made by author)

In this paper, the POI data of Lijiao Village and its surrounding area were selected for the study, and the variation of Shannon Weaver Diversity in Lijiao Village was plotted with a fishing net size of 100m x 100m. The change in Shannon Weaver Diversity from low to high is reflected in the graph from blue to red. (Figure 4 15)

For the majority of urban spaces, functional diversity often leads to a high level of street vitality, while streets with a relatively homogeneous function are usually efficient in one way or another, but can also be boring and unable to gather people. This is because a single-function street space generally seeks to concentrate on one function, but for most people, any point in the street is either undifferentiated or highly purposeful for people themselves, and the street thus becomes a point. There is more coherence in the streets than complementarity between them, and instead they move to an extreme of separation. But the operational dynamics of an urban area are driven by the need for complementarity between differentiated

activities. From a spatial point of view, a street with a high degree of functional mix, where different individuals in the crowd can find their desired goal and at the same time quickly find the next goal after having accomplished the original one, allows the pedestrian to slow down and stay in the street. After a certain number of individuals have accumulated in the crowd, the Bandwagon Effect can take over as an important behavioural reference, attracting more people to the area. From a temporal point of view, the time of activity varies from function to function. For example, daytime is the main activity time for most street functions, while in the evening, bars, night markets and residential entertainment become dominant. The different functions therefore tend to expand the hours of use of the street, bringing it closer and closer to full time. Together, the two form a sustainable source of vitality.

In general terms, the two most mixed areas within the village are currently the radiating centre of the historic river system and the junction of the central road with the urban road to the north, which is similar to the Integration Core at each scale shown in the space syntax.

Road junctions and denser sections of junction tend to produce areas of high mix. In plots divided by main roads, the closer to the interior of the plot, the lower the functional mix, which is more evident within the key design areas, particularly at Lijiao West Street and at the junction of Lijiao West Street and Lijiao Dashi Street. This is similar to the total depth analysis of the space syntax. In the field research it can be observed that the plots covered in yellow and blue in the map are usually dominated by a single residential and factory function.

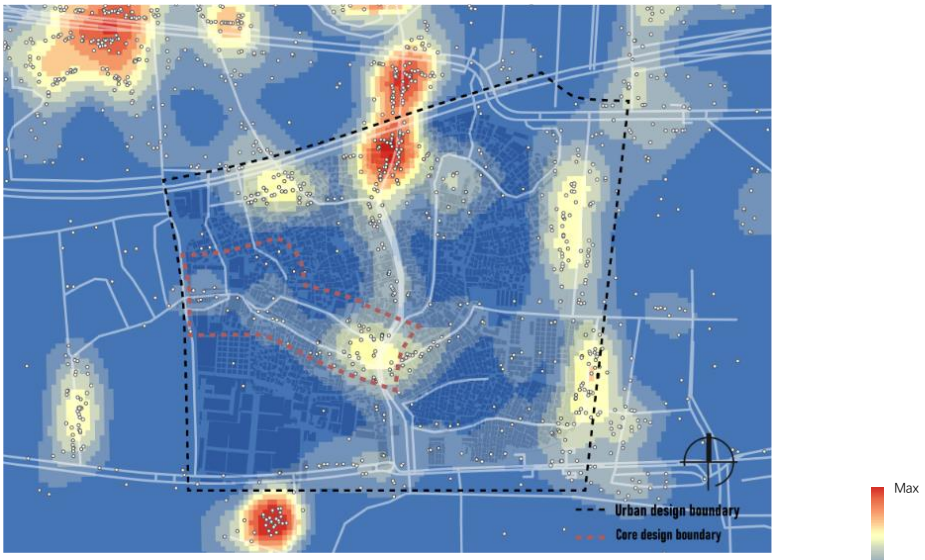
In terms of the content of several of the higher functional mix blocks, the different areas within the village also result in a different distribution of functions. Those towards the outside of the village are more likely to be relatively common and easily substitutable functions such as shopping, restaurants and community services, while the central areas are highly functional, with more emphasis on service elements that radiate throughout the village, such as community and government institutions, street offices, clinics, schools, etc.

In the analysis of degree of mix, it is easy to see that there is a correlation between the mix of functions and the distribution of streets and street junctions. In Lijiao Village, the majority of street junctions have relatively wide street spaces and street frontages, which

allow for the retention of pedestrian traffic while allowing for the convergence of pedestrian traffic. Where there are fewer major streets, there tends to be less mix, again due to a lack of space to accommodate street activity. Thus, increasing the density and surface area of streets can, to a certain extent, provide the conditions for an increase in functional mix, which in turn affects the vitality of streets.

2. Kernel Density

The POI data of Lijiao Village and its surrounding area were also selected for the research and visualised in the form of a kernel density heat map for the overall and functional density of each type of business. The kernel density heat map is a good visual representation of the clustering and functional density of POIs in an area. In general, as the kernel density map shows higher values, the more commercial and public functions are present in the street. It is also possible to make comparisons by item to find preferences and deficiencies in the distribution of certain functions in the area and to target the repair of functions.



Overall

Figure 4-16 Kernel Density of Overall (Source: made by author)

From a general point of view, (Figure 4 16) the density of POI outside Lijiao Village and on the peripheral roads is significantly higher than within Lijiao Village. Within Lijiao Village, POI is largely distributed on both sides of the historic water network road, with the hotspots of aggregation remaining areas of high integration at all scales. The POI hotspots

within the Village are located on the northern side of the road near the city road, followed by the radiating centre of the historic river system. This location is directly at one end of Lijiao Dashi Street and Lijiao Huanxiufang Street. A small distribution of POI exists at the other end of both. There is less POI distribution in the middle section of Lijiao Dashi Street and Lijiao West Street, which is a break in the POI distribution.

Combined with the analysis of the space syntax, the north side is a hotspot of 1000 and 1500m in the space syntax of integration, which is the passenger flow from all areas of the village and the surrounding urban arteries, while the radial centre is a hotspot of 500m in the integration, which is the gathering place of the pedestrian flow covering the whole village.

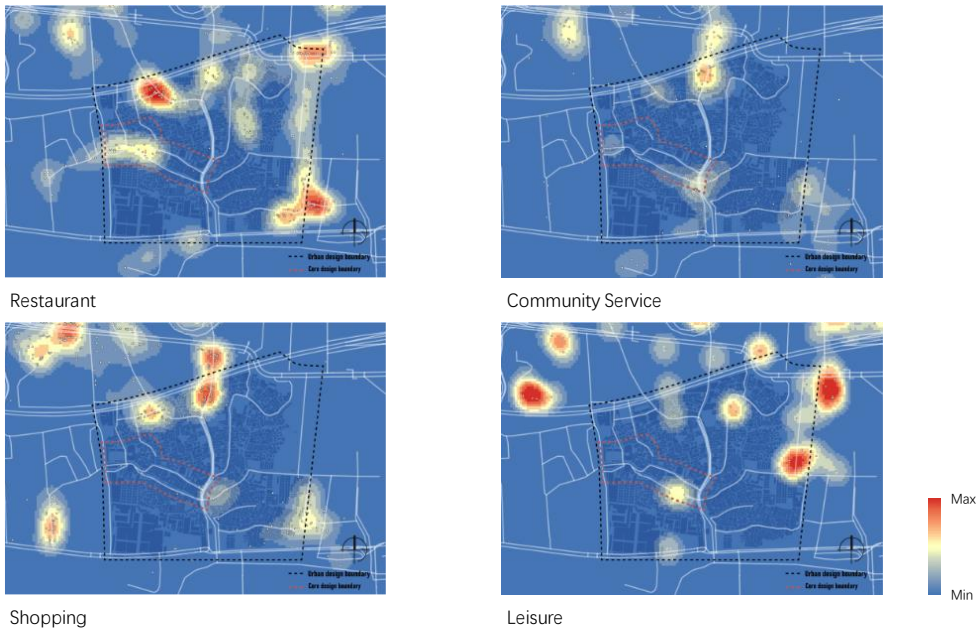


Figure 4-17 Kernel Density of Restaurant, Community Service, Shopping and Leisure (Source: made by author)

Restaurants, community service, shopping and leisure are in the commercial category and can be analysed comparatively as one category.

Restaurant: mainly in the periphery, less so in the centre.

Community services: including banks, logistics, beauty salons, maintenance, intermediaries, business offices, post offices, etc. The distribution is similar to the overall distribution pattern, again mainly concentrated in a few hotspots.

Shopping: Mainly retail and department stores, Lijiao Village has a high proportion of shops on the periphery, with a higher proportion of shops with a larger service area, such as

department stores, compared to the interior, and a relatively fragmented distribution of convenience stores and fresh produce shops, mainly serving the neighbourhood.

Leisure: mainly containing chess, cards, billiards and other business venues, located around the ancestral halls, the park and in the northern commercial area. (Figure 4 17)

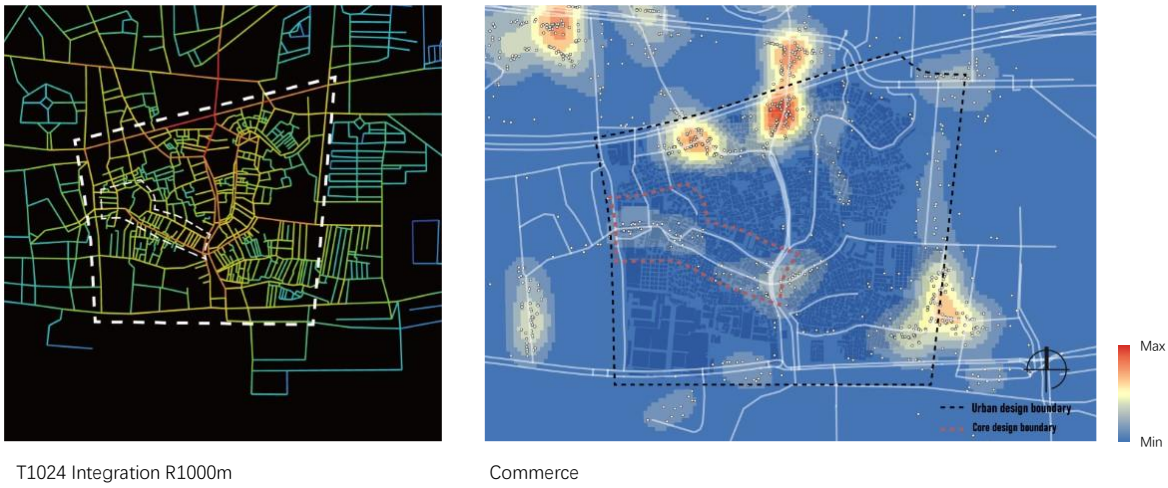


Figure 4-18 Kernel Density of Commerce (Source: made by author)

Summary of the commercial category: When the above restaurants, community services, shopping and leisure are combined and viewed as a commercial category, they are essentially the same as the overall distribution and space syntax integration of the hotspot areas, especially at the 1000m scale. It can be seen that the core design area is a relatively important area of commercial activity, and is in the second tier within Lijiao Village. (Figure 4 18)

For the three streets in the core design area, Lijiao Huanxiufang Street has the largest distribution of businesses, but decreases inwards from both ends, with commercial shops at both ends of Lijiao Dashi Street but none in the middle, and almost none in Lijiao West Street. There is a positive correlation between the perception of space and the width of the street as revealed by the street width-to-height ratio; the wider the street and the more spacious the perception of space, the greater the distribution of commercial shops within a certain range. In the case of Lijiao Dashi Street, the street alignment does not intersect directly with other streets to form a coherent route. The long wall and the parking function in the middle section replace the original market complex, resulting in a psychological perception of the street being too long and a lack of functional distribution in the middle.

From a space syntax perspective, most commercial shops have a high degree of substitutability and therefore need to be easily accessible to customers in a completely random movement and able to attract a high level of traffic, increase their exposure and develop regular consumption habits. This behavioural model is best represented by a high integration and relatively low total depth values. On balance, the middle section of Lijiao Dashi Street and Lijiao Huanxiufang Street is suitable to be interrupted to form new street intersections, linking more residents and public facilities.

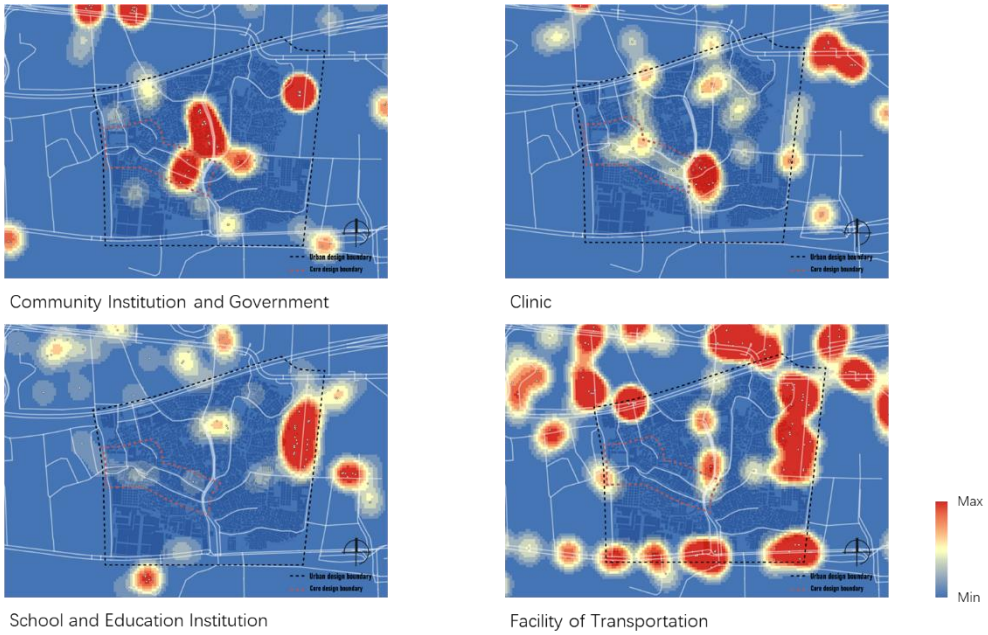


Figure 4-19 Kernel Density of Community Institution and Government, Clinic, School and Education Institution and Facility of Transportation (Source: made by author)

Community institution and government, clinics, schools and education institution, and facility of transport can be analysed comparatively as a whole in the public category.

Community institutions and government: These include government agencies, public security, social groups, etc., and are the basic service and security facilities in the city. These functional points are heavily concentrated in the centre of Lijiao Village, mainly in the middle section of the central road and at the end of the key design area near the central road. In addition, the junction of the road formed by the river of Lijiao Village and the city road is also a place of high distribution, and there is little overlap with the commercial hotspots.

Clinics: mainly located in the river network radiation centres. Other clinics in the village

are located at some distance from the central hotspot and are mainly located near various important junctions.

Schools and education institution: Lijiao Village is dominated by primary schools and kindergartens, which are relatively evenly distributed; to the east, a large number of education and training institutions are located on the road shared with the Roman home community, meeting the common needs of both. There was a school on the west side, which has since been relocated.

Facility of transportation: Includes parking, bus stop and metro station. The bus stop and metro stations are located on the outskirts of Lijiao Village, with only a few car parks inside. In addition to the car park in the central road shown in the figure, it was found during the field research that many carriageways and corner spaces throughout Lijiao Village are used as parking spaces, which are not designated as car parks and belong to the individual villagers. This is another indication that the current parking facilities do not meet the needs. (Figure 4 19)

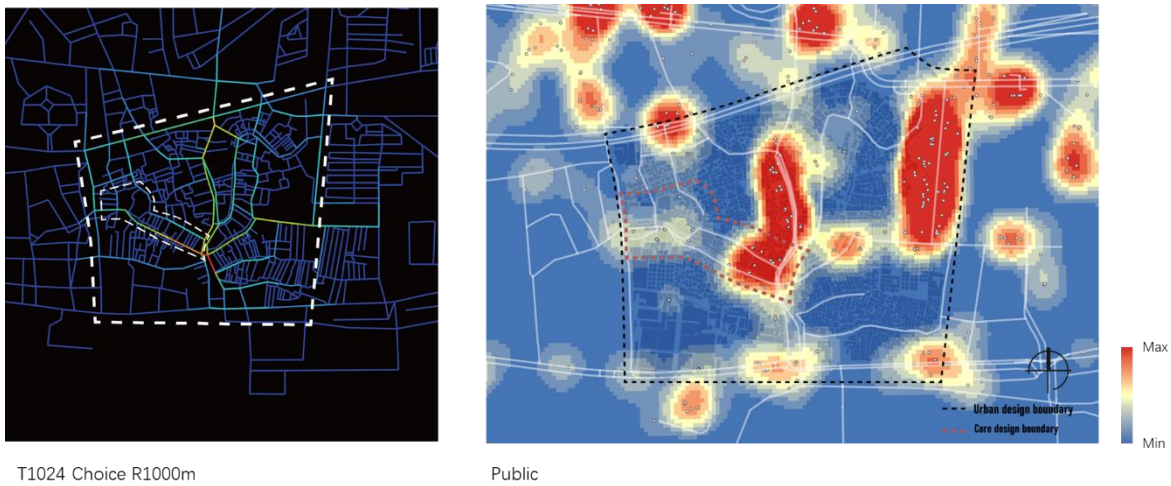


Figure 4-20 Kernel Density of Public (Source: made by author)

Summary of the public category: Combining the above community institution and government, clinics, schools and education institution, and facility of transportation into the public category analysis, it can be seen that the middle section of the central road becomes the most important hotspot, and does not overlap at all with the commercial category hotspots. (Figure 4 20)

Lijiao Village has a significant number of POI distributed in all four directions from east to west, north to south, and at major junctions with the city. Together, this state of distribution is more similar to the space syntax in terms of Choice. Public facilities do not require much footfall to increase usage. Strongly purposeful activities are intrinsically attractive, whereas random use facilities simply need to be set up where pedestrians are most likely to pass, so Choice associated with through movement may be a more important indicator; Total Depth values cannot be too high and correlate with the tendency to have fewer POI the closer one gets to the middle of the street.

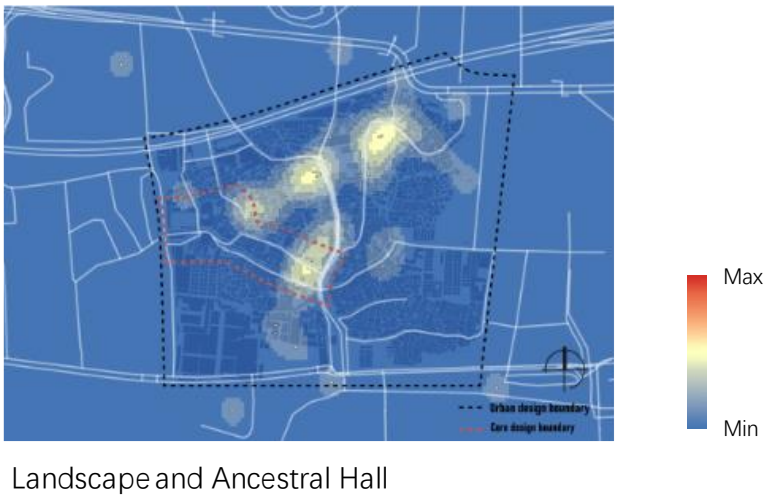


Figure 4-21 Kernel Density of Landscape and Ancestral Hall (Source: made by author)

Landscape and ancestral hall: The majority of landscape nodes within Lijiao Village are in the form of ancestral halls, with isolated parkland areas. The distribution pattern of the ancestral halls differs from that of the other POI and is largely related to the historic river system. Other ancestral halls that are not on the historic river system have been buried in gaps in the buildings over many rounds of additions, and are also present at higher depth values in the space syntax total depth analysis, making them not only difficult to reach but also difficult to protect. As an important landscape and activity site in Lijiao Village, this situation will accelerate the process of decay. (Figure 4 21)

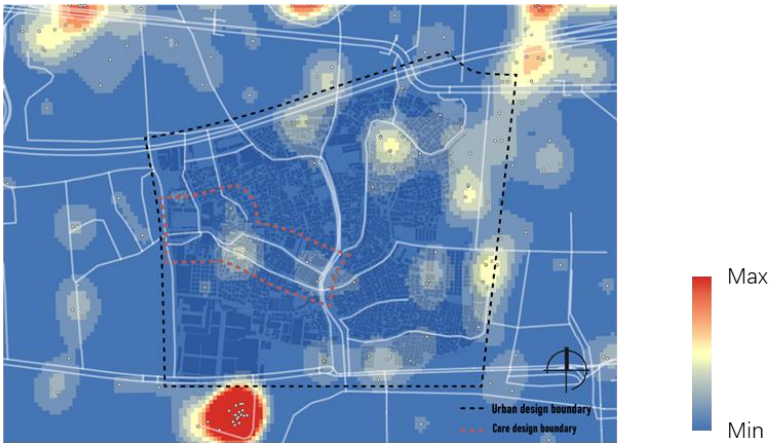


Figure 4-22 Kernel Density of Factory and Company (source: made by author)

Factory and Company: the distribution is similar to that of the commercial category and there may be some symbiosis between the two. (Figure 4 22)

3. POI Density of Street

POI Density of Street refers to the number of functional businesses per 100 metres in a street, and reflects the density of functions in the street, which is calculated as follows：

POI Density of Street = Quantity of POI / Street Length × 100

Street	Street Length	Quantity of POI	POI Density of Street
Central Street	743m	102	13.7
Lijiao Huanxiufang Street	439m	27	6.2
Lijiao Dashi Street	276m	16	5.8
Lijiao West Street	146m	5	3.4

Table 4-2 POI Density of Street (source: made by author)

The three streets within the core design area differ significantly from the central street in terms of POI Density of Street. Central Street is approximately twice as large as Lijiao Huanxiufang Street, Lijiao Dashi Street and approximately four times as large as Lijiao West Street. This is strongly linked to the current situation of shop closures. In addition to this, all three streets have their own shortcomings. The common problem with Lijiao Huanxiufang Street and Lijiao Dashi Street is that there is less functional distribution the closer you get to

the centre, possibly related to the relatively long length of the uninterrupted street and the lack of people passing through. Another problem with the central part of Lijiao Dashi Street is that it is dominated by walls and parking, with the consequent removal of other functional businesses; the street scale of Lijiao West Street is not pleasant enough and the relatively complex condition of the intersection makes it difficult to attract people to this area for commercial activities or daily activities. (Table 4 2)

4.3.2 Street Maps with Semantic Segmentation

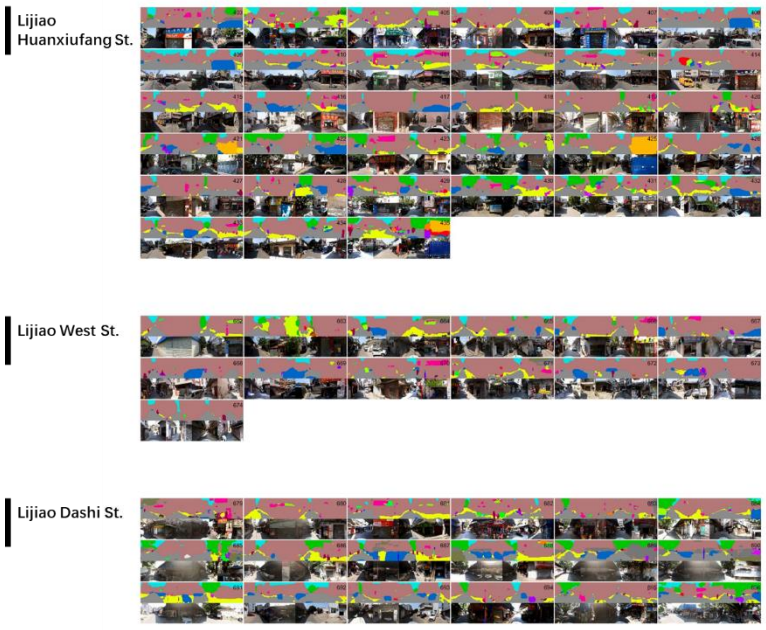


Figure 4-23 Street maps with semantic segmentation results (source: made by author)

The semantic segmentation of street map data allows the recognition of street map to quickly sort out the perceptual impressions and environmental characteristics of travelers in the area. Here we analyse the semantic segmentation of the street map of the core design area, compile the overall impression of the street space based on the analysis results, identify the potential negative influencing elements and propose corresponding design strategies. (Figure 4 23, Table 4 3)

Number	Contents
id1	Wall
id2	Building; Edifice
id3	Sky
id4	Floor; Flooring
id5	Tree

id6	Ceiling
id7	Road; Route
id8	Bed
id9	Windowpane; Window
id10	Grass
id11	Cabinet
id12	Sidewalk; Pavement
id13	Person; Individual; Someone; Somebody
id14	Earth; Ground
id15	Door; Double; Door
id16	Table
id17	Mountain; Mount
id18	Plant; Flora; Plant; Life
id19	Curtain; Drape; Drapery; Mantle; Pall
id20	Chair
id21	Car; Auto; Automobile; Machine; Motorcar
id22	Water
id23	Painting; Picture
id24	Sofa; Couch; Lounge
id25	Shelf
id26	House
id27	Sea
id28	Mirror
id29	Rug; Carpet; Carpeting
id30	Field

Table 4-3 Content of semantic segmentation (source: made by author)

1. Evaluation System

There is a reference to Zheng Yi's 'Research on Formation Pattern of Urban Image Based on Streetview Data: from the Perspective of Subjective Perception and Objective Environment Deviation". The main metrics are as follows (Table 4 4): [40]

Indicator	Formula	Description
Environmental Green Vision Indicator	$GVI_Q = \frac{G_P}{I_P} = \frac{\sum_{i=1}^{i} G_n}{\sum_{i=1}^{i} I_n}$	GVI_Q refers to the Green Visibility Index of the street environment, representing the visual share of the green landscape in the street; G_P is the share of the number of pixels of the identified green landscape elements (including turf, trees, etc.) in the street view image; I_P is the share of the total number of pixels of

		the corresponding face domains in the street view. G_n is the sum of the pixel share of the n green visual landscape face domains in the street view, and I_n is the sum of the pixels in the horizontal and vertical face domains of the street view.
Environmental Openness Indicator	$OVI_Q = \frac{S_P}{I_P} = \frac{\sum_{i=1}^{i} S_n}{\sum_{i=1}^{i} I_n}$	OVI_Q refers to the openness factor of the street environment, where the sky viewable area is used to reflect the openness of the landscape character of the street environment; Sp is the percentage of pixels of the sky elements identified in the street view image; Ip is the percentage of the total number of pixels in all face fields of the street view image.
Crowd Vitality Aggregation Indicator	$CAI_n = \frac{P_q}{I_q}$	CAI_n means the crowd activity aggregation index in the street environment; Pq is the percentage of pedestrian pixels identified in the street view image; Iq is the total amount of pixels in the vertical and horizontal interface of the street environment in the street view image.

Table 4-4 Indicators of Semantic segmentation (source: Research on Formation Pattern of Urban Image Based on Streetview Data: from the Perspective of Subjective Perception and Objective Environment Deviation, Zheng Yi)

2. Analysis Result

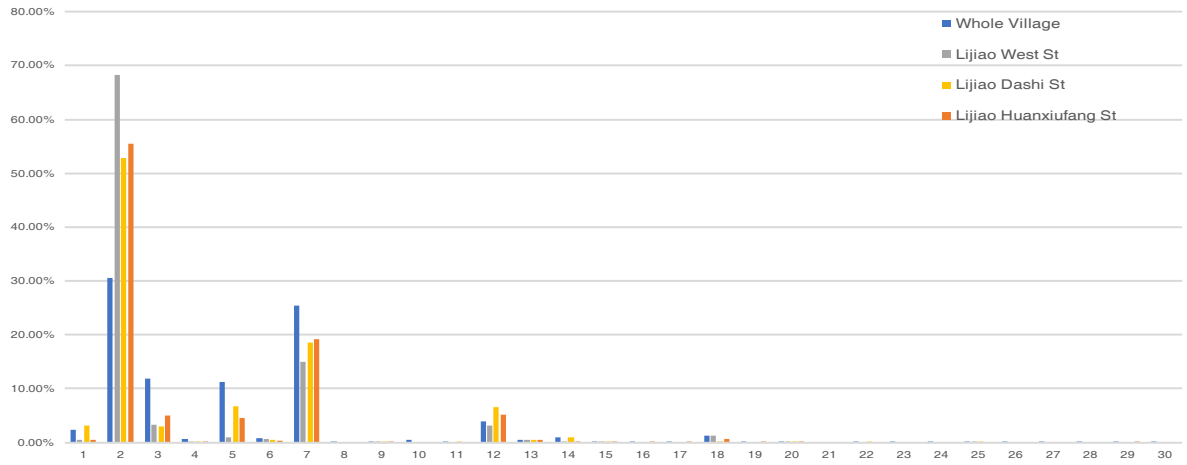


Chart 4-7 Percentage of resultant content for semantic segmentation (source: made by author)

id	Content	Whole Village	Lijiao West St.	Lijiao Dashi St.	Lijiao Huanxiufang St.
1	wall	2.3129%	0.4375%	3.1360%	0.4144%
2	building;edifice	30.4924%	68.1973%	52.8855%	55.4466%
3	sky	11.8238%	3.2021%	2.9844%	4.9139%
4	floor;flooring	0.5753%	0.2002%	0.2190%	0.0752%
5	tree	11.2026%	0.9454%	6.6902%	4.5125%
6	ceiling	0.7829%	0.5753%	0.4915%	0.3477%
7	road;route	25.4405%	14.9029%	18.5042%	19.2153%
8	bed	0.0024%	0.0000%	0.0000%	0.0000%
9	windowpane;window	0.0157%	0.0044%	0.0438%	0.0045%
10	grass	0.4775%	0.0000%	0.0000%	0.0000%
11	cabinet	0.0018%	0.0000%	0.0056%	0.0000%
12	sidewalk;pavement	3.8534%	3.0869%	6.5784%	5.1848%
13	person;individual;someone;somebody	0.4949%	0.4890%	0.4455%	0.4225%
14	earth;ground	0.9407%	0.1253%	0.9411%	0.0110%
15	door;double;door	0.0190%	0.0029%	0.0124%	0.0261%
16	table	0.0527%	0.0000%	0.0000%	0.0180%
17	mountain;mount	0.0055%	0.0000%	0.0000%	0.0105%
18	plant;flora;plant;life	1.1809%	1.2568%	0.0241%	0.6824%
19	curtain;drape;drapery;mantle;pall	0.0051%	0.0000%	0.0000%	0.0137%
20	chair	0.0447%	0.0825%	0.0238%	0.0068%
21	car;auto;automobile;machine;motorcar	0.0000%	0.0000%	0.0000%	0.0000%
22	water	0.0475%	0.0000%	0.0015%	0.0000%
23	painting;picture	0.0016%	0.0000%	0.0000%	0.0000%
24	sofa;couch;lounge	0.0007%	0.0000%	0.0000%	0.0000%
25	shelf	0.0132%	0.0063%	0.0005%	0.0000%
26	house	0.0045%	0.0000%	0.0000%	0.0000%
27	sea	0.0012%	0.0000%	0.0000%	0.0000%
28	mirror	0.0000%	0.0000%	0.0000%	0.0000%
29	rug;carpet;carpeting	0.0003%	0.0000%	0.0000%	0.0083%
30	field	0.0002%	0.0000%	0.0000%	0.0000%

Table 4-5 Percentage of resultant content for semantic segmentation (source: made by author)

The overall percentage of the semantic segmentation results by street is calculated for the

whole village and the three streets in the core design area and plotted in a chart, which shows that buildings, sky, trees and roads together occupy the overall impression in the streetscape. In comparison, there are three main differences between the three streets in the core design area and Lijiao Village as a whole: 1. The proportion of trees and the sky, which represent the environment and openness, is lower, i.e., the overall Environmental Green Vision Indicator and Environmental Openness Indicator for the streets are lower. 2. The proportion of buildings is high. This, combined with the fact that most of the shops in the field study were closed, gives the impression of being uninteresting and depressing. However, if the shops were in good condition, the results would be very different. 3. Relatively low road share. A lower road share generally means a lower road width at the same camera angle. (Chart 4 7)

Almost all 30 semantic segmentation elements are present throughout the village, but the three streets do not have all element types, and the design range is significantly less rich in streetscape elements than the whole. Within a certain range, the diversity of street elements can accentuate the interest of the street and stimulate pedestrian interest and exploration. After averaging, some elements make up less than 0.1% of the impressions in the street, and can no longer even be shown in the chart, and some elements can be considered almost non-existent in the overall impression. (Table 4 5)

In addition, the building and wall interfaces occupy the majority of the streetscape content within the core design area. As most of the businesses on the ground floor of the buildings are no longer in operation, these two types of interfaces can be considered as hard and non-interactive, giving a psychological sense of disinterest and rejection. Within the three streets, Lijiao Dashi Street has a much higher proportion of walls than the other two, which is the category of street element that needs to be focused on. When this type of element dominates the visual sphere, it seriously affects the user's perception of the space. It is also an important source of disinterest and low vitality.

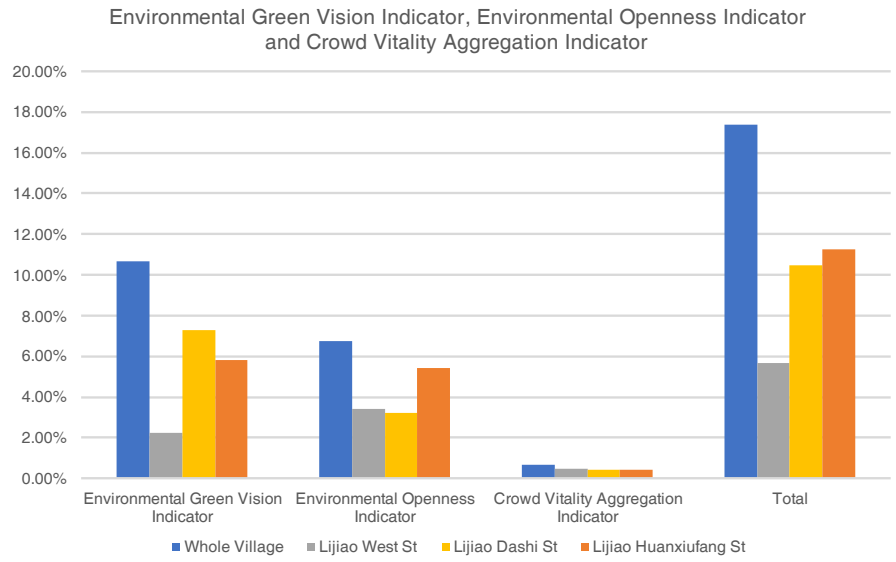


Chart 4-8 Environmental Green Vision Indicator, Environmental Openness Indicator and Crowd Vitality Aggregation Indicator (source: made by author)

The Environmental Green Vision Indicator, Environmental Openness Indicator and Crowd Vitality Aggregation Indicator for the main design area were all found to be lower than the overall level of Lijiao Village. (Chart 4 8) The Environmental Green Vision Indicator is 10.64% for the whole village; Lijiao West Street is significantly lower than the other two streets at 2.25%; Lijiao Dashi Street and Lijiao Huanxiufang Street are close, at 7.28% and 5.83% respectively. The Environmental Openness Indicator is 6.74% for the whole village; Lijiao West Street and Lijiao Dashi Street are only about half of the village level, at 3.41% and 3.21% respectively; Lijiao Huanxiufang Street is close to the village level, at 3.41% and 3.21% respectively; Lijiao Huanxiufang Street is close to the village wide level at 5.41%. the Crowd Vitality Aggregation Indicator village level is 0.67%; Lijiao West Street, Lijiao Dashi Street and Lijiao Huanxiufang Street were 0.49%, 0.45% and 0.42% respectively.

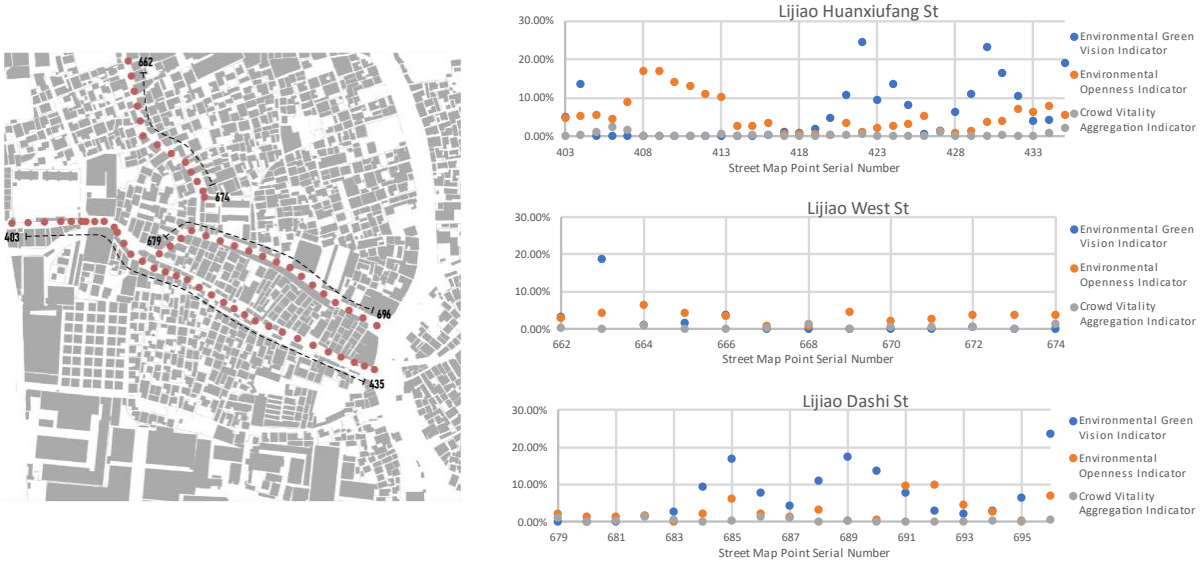


Chart 4-9 Environmental Green Vision Indicator, Environmental Openness Indicator and Crowd Vitality Aggregation Indicator by Street Map Point (source: made by author)

Comparison of each street map spot in the three streets within the core design area. (Chart 4 9)

For all three streets, the Crowd Vitality Aggregation Indicator is at a low level. Very little congregational activity occurs in the streets, and the people in the streetscape are generally individual pedestrians in the street or people resting in shops.

Figure 4-24 Extreme value Points of Environmental Green Vision Indicator (source: made by author)

The Environmental Green Vision Indicator has a number of poles in all three streets. These poles in the streets are mostly provided by old original trees. (Figure 4 24) The location of these old trees is usually found at junctions in the street, in front of ancestral halls and in some of the open spaces or recessed spaces in the street that currently exist. In the street affects the shaping of the space. However, the use of these spaces is relatively poor. As there is usually a rare space of relatively large scale in the village under the old trees, the piling up of rubbish and parking is relatively common, which in turn has a negative impact on the surrounding space. Some of the spaces under the trees in Lijiao Village are currently important activity areas for the villagers, and these spaces should be fully utilised.

Figure 4-25 Extreme value Points of Environmental Openness Vision Indicator (source: made by author)

The Environmental Openness Indicator is low overall on Lijiao West Street; in the other two streets the extreme values are found at the street intersections and at the current wall and parking shed on Lijiao Dashi Street. (Figure 4 25) At the street junctions, the buildings are usually low and have a large street width; the wall and parking shed at Lijiao Dashi Street are relatively low in width, but the height of the wall and parking shed does not exceed the height of the single-storey building, so there is also a relatively large sky area. These spaces have good inherent conditions and are located at important traffic nodes within the village, making them easy to transform to good effect and are important nodes for transformation in the design.

4.3.3 Summary

In general, the results derived from the POI are highly correlated with the space syntax, and it is also possible to find a similar trend in the street width-to-height ratio reflecting the overall impression of the street and the distribution of the POI, the street view map. This reflects a preference for the siting of urban functions in two main categories, commercial and public:

1. Most commercial shops have a high degree of substitutability and therefore need to be easily accessible to customers in a completely random movement and attract a high level of traffic, increasing their exposure and creating regular consumption habits, with high levels of integration being the best expression of this behavioural pattern. This pattern also justifies the

radial centre of the village water network as having the highest level of integration on a 500m scale and being a POI hotspot within the village, while longer stretches become less vital due to reduced accessibility.

2. Public services and facilities, on the other hand, do not require more footfall to increase usage and have a requirement for integration but are not as urgent as commercial shops. As an institution or facility serving residents, it is more important to be able to readily provide services to those served in need on a larger scale and therefore Choice may be a more important indicator.

3. Both of the above need to be at lower total depth values, correlating with the trend of a lower number of POI the closer to the middle of the road and at higher total depth values within the core design area.

4. Spatial perception also affects the distribution of POI, with streets with a dark and narrow spatial perception having poorer functional density and vitality than streets with a wide spatial perception.

In addition, in terms of the subjective perception of streetscape, Zheng Yi pointed out in his research that the objective environment of the street has three dimensions on the subjective environment perception, which are safety, comfort and attractiveness.[40]

In terms of safety, the pedestrian paths and the fences that distinguish the movement routes of people and vehicles are the key elements that influence subjective perceptions, not the presence of motor vehicles in the street. The subjective perception of street safety is not significantly altered by the increased visual presence of motor vehicles in the street, but rather by the presence or absence of key altering or influencing elements of the overall street perception. In the context of Lijiao Village, it can be concluded that clear pedestrian-vehicle separation is key to improving the perception of safety on the street, without the need to add too many possible street elements. All three streets within the core design area have mixed pedestrian and vehicular traffic, and a reasonable separation of slow and fast traffic is key to improving safety, as well as providing safe spatial conditions for the development of street activities and street vitality.

In terms of comfort, natural landscape elements such as sky, rivers and lakes, trees and turf, as well as amenity-related elements such as walkways and permeable fences, are generally given higher visual impact weightings than the perception labels of clutter and dirt and no clear perception. Elements with a potential negative impact on comfort, such as open spaces, solid walls and small cars, were given lower visual impact weights than the other two labels for the perception of 'pleasant and aesthetic' streets. In Lijiao Village, the river and the old trees are important landscape elements. The restoration of the river and the preservation and use of the old trees can give full play to their own landscape advantages. Spatial elements that have a negative impact, such as walls and open spaces, should be renovated or given full play to their advantages, turning disadvantages into advantages. Likewise, the subjective perception of 'pleasant and aesthetic' can be enhanced by the separation of pedestrian and vehicular traffic, and the rational arrangement of traffic rights of way is also an important part of enhancing comfort. In combination with the above, landscape enhancement can be considered as an important part of street vitality, while the landscape as a functional element can take on the role of suggestion and distinction in the division of street space, clarifying the boundaries of activities.

In terms of attractiveness, the solid wall is the element that produces the most obvious divergent dynamics to this subjective perception. The solid wall in the street reflects the interactivity of people with the street, but the elements associated with interactivity in the street are not only the solid wall. The openness of the ground floor businesses, the playability of the open spaces of the street and the pleasantness of the dwellable spaces integrated with the landscape are all important references that influence the interactivity of the street. The importance of creating street ambience is evident. In Lijiao Dashi Street, the apparently high proportion of solid walls and the difficulty of interactive parking are key influences on the attractiveness of the street and need to be modified accordingly. The other two streets also require a focus on the control of the ground floor interface, the use of space under trees and the relationship between the water body and the street. The flexibility of the street interface and its accessibility and interactivity are therefore key to the transformation in order to

increase street vitality.

Within the core design area, the Lijiao West Street POI is sparsely distributed and, when observed in conjunction with the Street map, is primarily used as a location for access and some factories, but the narrow street has no redundant space prepared to provide functions such as parking, which could paralyse the entire street in the event of congestion. The central POI of Lijiao Dashi Street and Lijiao Huanxiufang Street is vacant. In the middle of Dashi Street, the original market complex has been replaced by a parking shed and the opposite side of the street is occupied by a large fence and warehouses, making it easy to feel monotonous and difficult to stay.

The above analysis shows that the POI distribution, street amenity and richness of the three streets within the core design area lag behind the village average. In particular, the Environmental Green Vision Indicator and Environmental Openness Indicator, which have a direct impact on visual and psychological perception, are both far below the village average. However, the existing old trees suffer from poor use of space underneath and lack of protection, and the historical river system has been shrinking in recent decades, all of which have a negative impact on the subjective perception of comfort. In streets, non-interactive elements such as solid walls, parking and poorly open ground floor interfaces can have a serious impact on the attractiveness to pedestrians and reduce their willingness to stay, which also contributes to the loss of street vitality. Conversely, increased open space, urban furniture and distinctive attractions in the street can increase the attractiveness and variety of activities on the street. In terms of safety improvements, the possibility of diverting slow traffic from fast traffic can be considered. At the same time, there is potential for the three streets to be developed, and a series of activities and designs around the ancestral halls is a possible idea.

4.4 Summary of Vitality Problem and Strategy

Based on the above analysis, the vitality issues and design strategies for Lijiao Village and within the core design can be summarised in three specific points.

4.4.1 The street structure is derived entirely from natural forms and is not adapted to current development needs

1. Defining Space Division

The streets within the village can be divided into two types: the passable street structure with strong connections to the urban roads and the slow or living street structure within the village that is not directly connected to the urban roads. Using a space syntax analysed at different scales, the streets facing the interior of the village and those connected to the outside city are clearly separated according to the different scales of activity, and the activities and functions that occur on them are programmed separately. While promoting the integration between the city and the village, the intersection between the two types of road has a reduced impact on the places and activities within Lijiao Village. At the same time, it is important to note that integration with the city is not an exact replica of the urban spatial structure. This would not only be inappropriate to the existing village pattern, but would also weaken the village's distinctive fabric and further destroy its culture. The current Lijiao Village still has the residual influence of the historic river system. It is also a better means of designing a street network with the characteristics of the village by taking advantage of the evenly distributed and clearly defined structure of the historic river system. This would not affect the overall spatial structure and would also allow for greater accessibility with as little demolition as possible.

2. Improving Street Alignment and Connections, Adding Through Passages to the Original Street Structure

In the practice of space syntax, it can be observed that roads with more connections, relatively straight alignments and good views are more likely to gather footfall. Streets that need to be more public, commercial or accessible need to be enhanced from this point. It is expected that streets with more traffic attributes will be better served by enhanced connections to the city and to the streets running through Lijiao Village.

In addition, the original street structure makes it difficult to create easy access corridors in the current urban environment. Within Lijiao Village there are also larger blocks that need to be broken up to free the residents and ancestral halls within. Currently the peripheral roads

have played a significant role in connecting Lijiao Village to the surrounding city. However, some roads are still affected by the new construction or traditional layout of Lijiao Village and are not easily accessible. If integration with the city is to be accelerated, then the road system needs to be brought closer to the city and the spatial network integrated with the city. Therefore, it is necessary to demolish low-quality buildings that impede access and to simplify the routes to the various destinations in order to make access smoother. From the realities of Lijiao Village, it is also possible to add to the historic river network and the existing street network - using a network of small neighbourhoods and dense roads, using the historic river network as the 'artery' and the deeper internal roads as the 'capillaries' of Lijiao Village. This hierarchical approach to making everywhere quickly accessible will improve both safety and accessibility. It also meets the needs of residents for modern urban living and promotes the integration of Lijiao Village with the city.

On a larger scale, Lijiao Village is located to the south of Henan Island, adjacent to the Pearl River. The hinterland of Henan Island, on the other hand, lies to the north of Lijiao Village and needs to be strengthened with urban roads to the north.

3. Optimising Street Space and Increase Street Node Spaces

Street node spaces are important places to accommodate activities and gather people together, and street junctions with large pedestrian flows and spatial areas are one of the most effective forms. New public centres or open spaces in different small areas can also be effective in improving spatial quality. In the centre of small areas where the influence of the river network is difficult to reach, part of the spatial structure is chaotic and difficult to solve by modifying the roads. However, the central areas can use their geographical advantage to form spatial nodes and turn themselves into a source of regional communality. This improves the spatial chaos and at the same time drives up the quality of life in the whole area. This type of spatial node can effectively organise the flow of people in a district and, together with other street spatial nodes, form a spatial network that identifies the village, which can effectively reduce the total depth indicator of the area and thus improve the accessibility and recognisability of the whole area.

In areas with large block sizes or longer streets that are not interrupted by a main street, new main streets need to be created in suitable locations to break the status quo, increase the street surface area and reduce the social cost of arrival.

4.4.2 Serious building additions, unreasonable use of street space and problematic distribution of functions on the ground floor

1. Optimising Street Scale

In the case of urban villages, the narrow spatial experience with a relatively low width-to-height ratio brings more adverse effects. Due to the high population density, the dense space compresses the psychological distance between people and makes them feel insecure. The narrow absolute width, on the other hand, brings inconvenience in daily activities and an increase in safety hazards. It is therefore important to control the absolute scale of streets in urban villages and to manage the relationship between traffic, pedestrian movement, landscape and activity in the streets by releasing or optimising the space occupied by building additions. Additions are the biggest obstacle to street vitality. The quality of additions varies greatly and a significant proportion of them are temporary; they occupy space in the street where the river used to be and make part of the space narrow. The reconversion of these buildings into the river and the redesign of the road cross-section will not only improve the accessibility of the street, but will also increase the richness of the street elements and provide the basis for an increase in street vitality.

2. Improving Richness of Street Interface and "Soften" Ground Floor Space

Unlike the neat and tidy street pattern of European city blocks, the buildings on both sides of the Chinese streets often do not fit exactly into the street boundaries, creating blocks with a concave and uneven street interface.[55,56] Such spaces are more conducive to the creation of flexible and variable spaces that flexibly accommodate more landscaping as well as social and commercial activities, contributing to the vitality of the street.

Most of the current ground floor interfaces directly adjacent to the street lack interaction, and there are a significant number of walls and buildings that do not relate to the street, creating a sense of psychological isolation for residents and passers-by. By adding recessed

spaces or penetrating and interactive ground floor spaces to the overall flush street interface, and by adding urban furniture and shop fronts to provide places for pedestrians to stay and interact, a neat and dull 'hardened' interface is avoided.[57] The generally neat street interface defines the impression of the street, while the varied and interactive street detailing enhances the interest of the space and the possibility of unexpected events.

For taller buildings, this approach can also optimise the perception of space and reduce the oppressiveness of taller masses. It can also be used to emphasise the visual focus of pedestrians by strengthening the first floor of the building and reducing some of the building masses. For streets where this is possible, it is also possible to extend the building partially outwards to draw the eye closer, avoiding a sense of overwhelm. [43]

3. Creating Points of Attraction, Expanding Street Surface Area

In areas where the POI is missing, there is a need to provide easy access for pedestrian traffic in the first place. Especially in areas where there is a clear disconnect, such as the middle section of Lijiao Dashi Street and Lijiao Huanxiufang Street, a new street that can run through a larger number of settlements is needed to break the current pattern of long and uninteresting streets. In addition to the creation of a new street, it is necessary to plan the function of the street on the basis of the previous analysis, to provide attractive functions or spaces for the residents, to increase the surface area of the street by means of spatial design, and to bring about the street vitality of the whole area in the form of highly attractive points.

4.4.3 Landscape elements have been destroyed and lack pleasant spaces and visual attractions

1. Restoring Part of the River and Restoring the Ecological Environment

The optimisation of the spatial structure with reference to the historical river network is a feasible and effective idea that not only improves the global integration, but also provides a good landscape element for Lijiao Village, which, as a traditional Lingnan water village, has not only the reality of restoring the river, but also the collective memory that exists in the minds of the villagers. Water was an important means of production and survival before modern times, and waterways were also an important means of external contact and trade. In

order to survive and produce, villages naturally revolved around water, creating a high level of integration in its vicinity. The current state of affairs is that the historical river system has been largely removed and the roads left by the river system have been crowded by unauthorised buildings, so that the legacy of the historical river system is currently hardly playing its spatial role. Of course, although the role of the river system has been completely replaced by running water and land transport, the positive impact it has had on the formation of the village structure and on the surrounding area remains unchanged. This can also be seen in the partial results of space syntax. Furthermore, water as a landscape element has a significant impact on the psychological perception and spatial comfort of people. On a psychological and physical level that space syntax cannot take into account, water not only soothes people but also improves the thermal comfort of the surroundings. Selective restoration of the river according to realistic conditions and functional needs can effectively enhance the spatial quality of Lijiao Village and reflect its water village culture. At the same time, many of the activities surrounding the river can be restored here, making it a landscape with a strong local identity in Guangzhou.

In addition, the village's ancient trees have also been destroyed during the development of Lijiao Village. The trees in Lijiao Village provide shade from the undesirable street environment and serve to regulate the microclimate of the street space. At the same time, the village's characteristic banyan trees provide a large area of shade, creating a natural and comfortable space for rest and activity. The design of the streets therefore requires attention to the conservation and use of trees, the design of pocket parks around the existing old trees, and the formation of micro-landscapes on the river banks in combination with trees.

2. Remediation of Depressed Street Spaces and Transfer of Undesirable Functions

Some of the current marginal or recessed spaces in the street are occupied by parking and rubbish that have a negative impact on the quality of the space. These have a multi-sensory impact on the space itself and on the people living around it. However, as far as the space itself is concerned, these spaces often have a good quality to them and should be reused through design. The functions that have an impact on the quality of the space should also be

deconstructed at the same time, reducing the impact on the street space by shifting or hiding it and making the most of the interesting recessed spaces.

3. Repairing and Reopening the Ancestral Halls to Make It a Centre of Cultural Activities for the Surrounding Area

In order to break the isolation of the village from the city, it is necessary to bring the city's residents into the interior on their own initiative. Therefore, from a functional point of view, it is necessary to go beyond the needs of the residents of Lijiao Village and to plan functions that are more attractive to tourists and guests. For example, Wuzhen has been transformed by the World Internet Conference to go beyond its tourism attributes and create more opportunities for development; the historical river system and clan culture of Lijiao Village is a very distinctive highlight for Guangzhou, but currently most of the ancestral halls are not performing their original functions and are closed or used for other purposes because they are not managed. It would be a special development opportunity if the river system could be used to restore a distinctive water district in the city, and if public cultural venues such as the ancestral halls could be used to develop creative cultural activities, making them an important activity venue and attraction for the district, and activating the street through regular cultural activities to drive the development of the district.

4.5 Street Feature and Strategy Detail

4.5.1 Lijiao West Street

1. Accessibility:

The low absolute width (3.9-7.3m) and mediocre condition of Lijiao West Street makes it a poor vehicular experience and prone to congestion, although it connects the main urban road with the main roads in the village. Car traffic is a necessary mode of transport on this road and has a negative impact on the daily slow traffic.

From a space syntax perspective, Lijiao West Street has a certain degree of choice at the scale of Lijiao Village (500-1000m), and the status of integration is between integration core and integration core+1; the northern section near the outside of the village has been the

integration core below the 3000m scale, and it is necessary to consider the influence of external traffic on Lijiao West Street. Overall, Lijiao West Street has the smallest service area of the three streets.

Overall accessibility is slightly poor.

2. Functionality:

Apart from housing, the function of the street consists mainly of the landscape provided by the factory and the ancestral halls, but public facilities are non-existent. Because the spatial experience is poor and not conducive to commercial activity, Lijiao West Street is almost devoid of shops, except for a few simple shops run by residents using the ground floor living space. The traffic function of passing through is dominant on Lijiao West Street.

The POI density of the street is 3.4 per 100 metres, a very low density, about a quarter of that of the central street.

3. Street type and character:

Lijiao West Street is the narrowest and congested of the three, with a low width-to-height ratio, environmental openness indicators and environmental greenery indicators, making it the most problematic street. Most of the buildings on both sides of the street are taller villagers' houses, and the lack of maintenance of the streets and buildings over time makes the streets feel run-down and dirty. The general feeling is rather depressing.

4. Type and character of activity:

Lijiao West Street is relatively homogeneous, with three main types of activity: residential daily life, traffic movement and goods transport. The conflict between the transport of goods and the absolute width of the street is difficult to reconcile, and together they have a serious impact on the use of the road and interfere with other activities.

5. Key imagery nodes:

Two ancestral halls exist in the middle of Lijiao West Street, which are currently out of use and lacking in maintenance. Both have room for renovation and could be reused.

6. Design strategy:

1) Due to the relatively close relationship of the buildings in the street, there is a relatively high degree of difficulty in demolition. It is also difficult to reconcile the demand for vehicular traffic with the width of the street. Therefore, in order to improve the efficiency of the street and to ensure that slow traffic and motor vehicles do not interfere with each other, it is a better strategy to create a new street parallel to the original street. At the same time, the new road can be combined with other well-connected roads to form new fast-travel roads. The buildings can be used as a separation between the two, reducing the potential for interference.

2) The two ancestral halls and the curving historic river form a centripetal form, which can be used to develop a distinctive design for the street, emphasising the role of the ancestral halls in Lijiao West Street. The river system can be restored where appropriate, and combined with the landscape and the ancestral halls to form an important landscape node.

3) Control the height of buildings on both sides of the street, especially the building form opposite the ancestral halls. For buildings that are difficult to demolish, reinforced ground floors can be used to shift pedestrian appeal to easily accessible ground floors and reduce the psychological discomfort caused to pedestrians by taller buildings.

4) In terms of functional programming, the original Lijiao West Street is mainly responsible for recreational functions in conjunction with the ancestral halls and the river system, while the new parallel road is responsible for the original rapid traffic functions.

4.5.2 Lijiao Dashi Street

1. Accessibility:

Lijiao Dashi Street is a direct connection to the central road and has a slightly lower absolute width (4.7-8.2m) and is in generally good condition, although there are some problems with standing water. Most of the road is adequate for two vehicles and slow-moving traffic is not easily affected.

As Lijiao Dashi Street is not directly connected to many of the more accessible streets, it is parallel to and closer to Lijiao Huanxiufang Street, which runs east-west through Lijiao Village, diverting some of the traffic flow. Therefore, from space syntax point of view, Lijiao Village is moderately selective and an integrated core at the internal scale (500-1000m) and

an integration core +1 at the scale of 1500m, with the overall status decreasing as the scale of analysis gets larger.

The main service and use area are within the village and accessibility is good.

2. Functionality:

Apart from housing, the street functions mainly as medical clinics, a small amount of shopping, restaurants and community services, most of which are located at either end of the street, with the shops that currently have signs but are closed accounting for approximately half of the overall. The former shops and markets in the middle section have been replaced with walls and parking spaces, both of which roughly overlap in the street, making it a homogenous and uninteresting area, and severely diminishing the richness and number of functions in the street.

The POI density of the street is 5.8 per 100 metres, which is low and about half that of the central street.

3. Street type and character:

Lijiao Dashi Street is a moderately wide street with a very neat street interface due to the current long single storey parking sheds and walls that occupy half of the street length, making the street slightly uninteresting though. However, the spatial feel is relatively open, with views of the sky and greenery in most locations, and there are some existing empty sites that can be easily converted and are in good condition. There is a high level of shop closures. The streets have a problem of narrowing from the side near the village centre towards the periphery, eventually intersecting with Lijiao West Street and Lijiao Huanxiufang Street respectively, requiring attention to the junction treatment.

4. Type and character of activity:

The main activity on Lijiao Dashi Street is concentrated in the dense POI area at both ends, which is dominated by daily shopping, restaurants and pharmacies around the clinic, with a few factories present. The central part is relatively homogeneous in function, lacking conditioned activity spaces and commercial shops where activity is less likely to occur, and

where parking access perpendicular to the street is somewhat disruptive to daily activities. Residents' daily life, access to warehouses and car parks for motor vehicles, passage and medical related are the main types of activities with a strong purpose.

5. Key imagery nodes:

There is no ancestral hall on Lijiao Dashi Street, but there is still some potential for development of the longer, non-interactive road in the central section. In addition, the large trees at the intersection with the central road have great shade cover but are currently used as a dumping site in the middle of the junction and could be adapted for use as an important event venue.

6. Design strategy:

1) The current central section is inefficiently utilized, and Lijiao Dashi Street is one of the longer streets in the village that is not crossed by a more connected street. The insertion of a new road in the middle to break the current street structure, replace the original warehouse wall and parking function could effectively increase the interaction between Dashi Street and other streets and the area of the street interface, bring in more pedestrian flow, and increase the exposure and utilization of the street. This will increase the visibility and utilisation of the street. At the same time, the eliminated parking function and waste disposal should be decanted to other suitable locations.

2) Make full use of the trees in the street and the space around them, and design a better landscape environment and base conditions for activities to occur around them. Use urban furniture, recreational facilities and ground paving to suggest their attributes of carrying activities and prevent open spaces from being occupied by rubbish and parking.

3) In terms of access, Lijiao Huanxiufang Street is the main road within the village, and Lijiao Dashi Street complements Lijiao Huanxiufang Street. When there is little demand for daily traffic, Lijiao Dashi Street is used as a slow-moving road, providing a place for shops and activities to take place while undertaking slow-moving traffic, forming a striped square within the village. In the event of increased demand, Lijiao Dashi Street will be a

supplementary road to Lijiao Huanxiufang Street, regulating the flow of traffic within Lijiao Village.

4) In terms of function, Lijiao Dashi Street will be strengthened with new commercial businesses and open spaces that will attract young people. Cultural activities such as exhibitions and fairs can also be developed in the open space, enhancing the commercial activities within the service village and creating more interaction with the parallel Lijiao Huanxiufang Street.

4.5.3 Lijiao Huanxiufang Street

1. Accessibility:

Lijiao Huanxiufang Street is the most accessible of the three streets. Lijiao Huanxiufang Street is directly connected to another street running through Lijiao Village in the eastern half of the village, and together they run east-west through Lijiao Village and connect to the city road, which is the horizontal structure of the main cross structure of Lijiao Village. It is second only to the central road that runs directly north-south throughout the village.

The absolute width of Lijiao Huanxiufang Street varies considerably (3.2-10.6m), limiting the efficiency of vehicular traffic at its narrowest point. The road condition is generally good.

From a space syntax perspective, Lijiao Huanxiufang Street has high values of choice and integration at all scales, with integrated cores at the 500m, 1000m and 1500m scales. The service area is relatively larger, covering both inside and outside the village.

2. Functionality:

The street function is almost all inclusive and is the most mixed of the three. The problem, as with Lijiao Dashi Street, is that the various types of functional shops and facilities are still concentrated at the two ends of the street, with relatively few in the middle, but the situation is better than on Lijiao Dashi Street. Current shop closures are also more serious, with around 59% of all shops closing.

The POI density of the street is 6.2 per 100 metres, which is low and about half the density of the central street.

3. Street type and character:

Lijiao Huanxiufang Street has a particular street section that is typical of Lijiao Village. This cross-section was formed by the addition of buildings after the historic river was filled in, and the buildings are located on both sides of the street about 2-3.8m in front of the original buildings, creating a building-side road-buildings-main road-buildings-side road-buildings cross-section. However, the secondary roads are not meant to be completely connected and the buildings are not completely continuous, but are left empty in places where there are no conditions or special needs, such as when they are occupied by trees, when the original building is an ancestral hall, when parking is needed and so on. Most of the additions are of a lower height than the original buildings that are obscured in the street, and most of the additions maintain a continuous commercial frontage to the street. Excluding the current state of unsatisfactory business conditions, Lijiao Huanxiufang Street is an important street for intra-village access and commerce.

4. Type and character of activity:

Although Lijiao Huanxiufang Street also suffers from a decrease in the number of POI distribution from the ends to the middle, and a high rate of commercial shop closures, it is still an important commercial street with a concentration of factories in the village and has a relatively important role in Lijiao Village as a whole. As the ancestral halls on this street is currently closed or temporarily used for other purposes, activities related to the ancestral halls are temporarily non-existent. As a result, the activities of the crowd consist mainly of movement, shopping and factory shipments, and there is potential for the transformation of leisure and cultural activities associated with the ancestral halls.

5. Key imagery nodes:

The key nodes are Chengzai Weigong Ancestral Hall and Liming Weigong Ancestral Hall, as well as the intersection of the river at both ends of the street after the restoration of the historic river system.

6. Design strategy:

1) Lijiao Huanxiufang Street is the most important access road within the core design area. Lijiao Huanxiufang Street contains both fast traffic and slow traffic road types and is one of the main roads within Lijiao Village that connects east to west. The low-quality buildings added to the street were removed to create a new fast traffic street and the alignment was controlled to reduce the twists and turns and create a gentle road alignment with the streets that meet at either end. There is also a need to strengthen the linkage with Lijiao Dashi Street, starting with the functional and traffic connections to form two complementary streets.

2) Restoring the river and its natural elements, so that the river interacts with the buildings and life, creating a good living environment. By distinguishing between slow and fast traffic through the river, and by setting up traditional commercial businesses and cultural facilities in the slow-moving streets in conjunction with the ancestral halls and original buildings, the collective memory of long-standing residents is restored and a sense of belonging and responsibility is enhanced. The reintroduction of the river will improve the efficiency of traffic flow, improve the microclimate and reduce the impact of traffic on business and daily activities.

3) Using the ancestral halls as a starting point for change and attraction in the street, making the street space rhythmic and a vital point of street space. there are several ancestral halls in Lijiao Huanxiufang Street, combining the ancestral halls with the water body to form an integrated cultural node and public activity space, improving the street landscape. In addition, most of the ancestral shrines will exit the front plaza in the middle of the street and should form a space for daily activities together with the street; while for those without front plazas, the connection with the street needs to be strengthened through renovation, so that the ancestral shrines become more open and easier to attract pedestrians in the street.

4) Remediate side spaces and reduce street dead ends. The typical two-storey structure of Lijiao Huanxiufang Street tends to create a visual and traffic dead zone, which can easily become a negative space due to the difficulty of access and observation. This space should be used wisely and transformed into a pleasant and attractive space with an outward orientation to the street. For spaces that are often used for parking, rubbish and debris, these functions

should be decontextualised and their spatial properties should be implied through the design of these recessed spaces to avoid the creation of negative spaces.

Chapter 5 Design Practice

5.1 Overall Objective

5.1.1 Optimising road structure of Lijiao Village to promote city-village integration

The current structure of the main roads in Lijiao Village suffers from large block sizes and excessive density within the blocks. Some of the main roads are relatively long in scale within the village, with relatively few junctions, which can lead to inconvenience and spatial tedium. It is possible to optimise the existing roads and add new roads to the existing village structure, further dividing the village into larger blocks and interrupting the longer roads within the village. The new and optimised roads will also need to be integrated with urban roads or fast-tracked to facilitate the integration of Lijiao Village with the surrounding city.

5.1.2 Creating a special industry in Lijiao Village and emphasising ancestral halls' cultural effect

In the context of the current crisis of urban identity, the preservation of distinctive cultural areas in cities is a very important measure. Lijiao Village should emphasise the important role played by its water village culture and clan culture in the development of the city, using the river and the ancestral halls as potential and central points to unleash the vitality of the streets of Lijiao Village. In addition, exhibitions and creative industries can be developed around these distinctive cultures, optimising the cultural atmosphere of Lijiao Village, attracting more people, optimising the living environment and enhancing its spatial vitality in a comprehensive manner.

5.1.3 Creating flexible and versatile street spaces by street interfaces, flexible interfaces and shop outposts

For narrow spaces where the conditions for transformation are not sufficient, flexible interfaces can be effective in providing functional flexibility and interest in spatial perception. By limiting access to fast transport and increasing the number of slow-moving spaces the flexible interface is provided for the street as well as the conditions for shop outstands, making the street a linear plaza space to accommodate more activities to take place. At the same time, this flexible space does not completely restrict access to other traffic. By using the

street in a time-sharing manner, it can be retracted into a normal passable street at times when it is not required to use the street space or when there is a high volume of traffic demand, balancing the needs of both uses.

5.1.4 Respecting original life trajectory of the residents and allocate the rights of way reasonably

The fabric of Lijiao Village is very different from that of the surrounding city. This relatively small-scale fabric is different from the urban scale and the roads within the village are more suitable for slow walking. When human needs are neglected, the slow-moving network will become redundant and vitality will not be possible. But as part of the city, the needs of modern car traffic also need to be addressed. Slow and fast traffic need to be designed in such a way that they are both accessible and minimise interference with each other, and that the routes between fast and slow traffic, and between village and urban traffic, are appropriately distributed. In addition, parking has a major impact on traffic in the village. In road planning, it is necessary to divert fast traffic in a timely manner and to direct motor vehicles through the least disruptive streets, to reduce parking in the village and to provide less disruptive parking areas.

5.1.5 Designing new Lijiao Village which is open to urban dwellers outside.

Street vitality requires a great deal of human involvement. In addition to the residents within Lijiao Village, residents of the surrounding city are also important targets for being attracted. In addition to planning relevant and distinctive attractions within the village, they should also be easy to find and reach. Roads should be planned in such a way that they are clear and well defined, and at the same time able to link up the landscape and activity nodes within the village at appropriate distances, providing a good basis for accessibility to the landscape and activity nodes.

5.2 Overall Spatial Optimisation of Lijiao Village

5.2.1 General Design

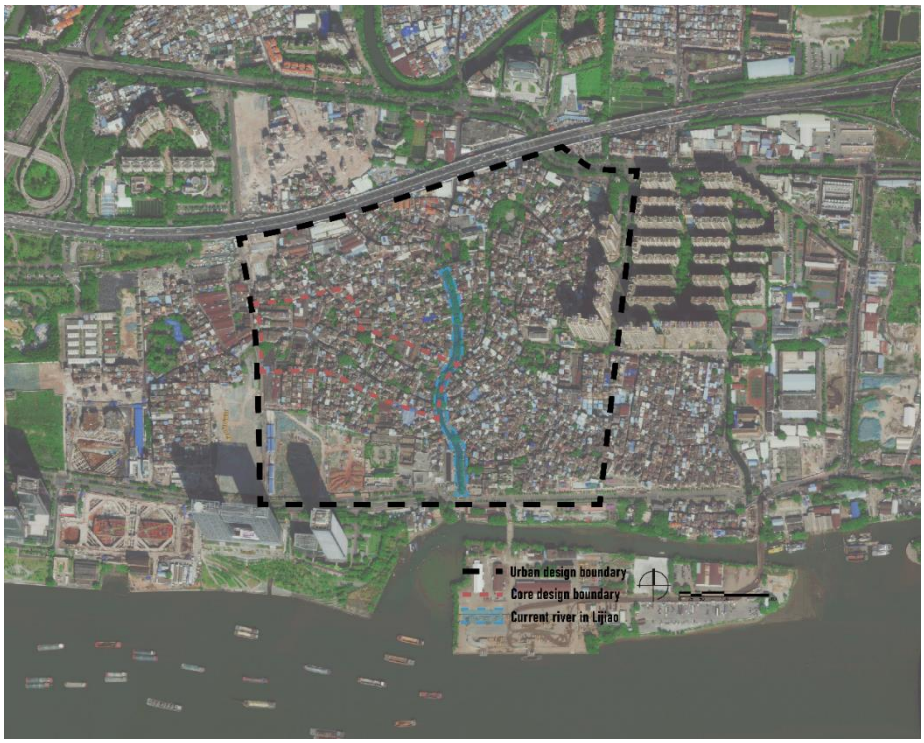


Figure 5-1 Current satellite photograph of Lijiao Village (source: amap.com)

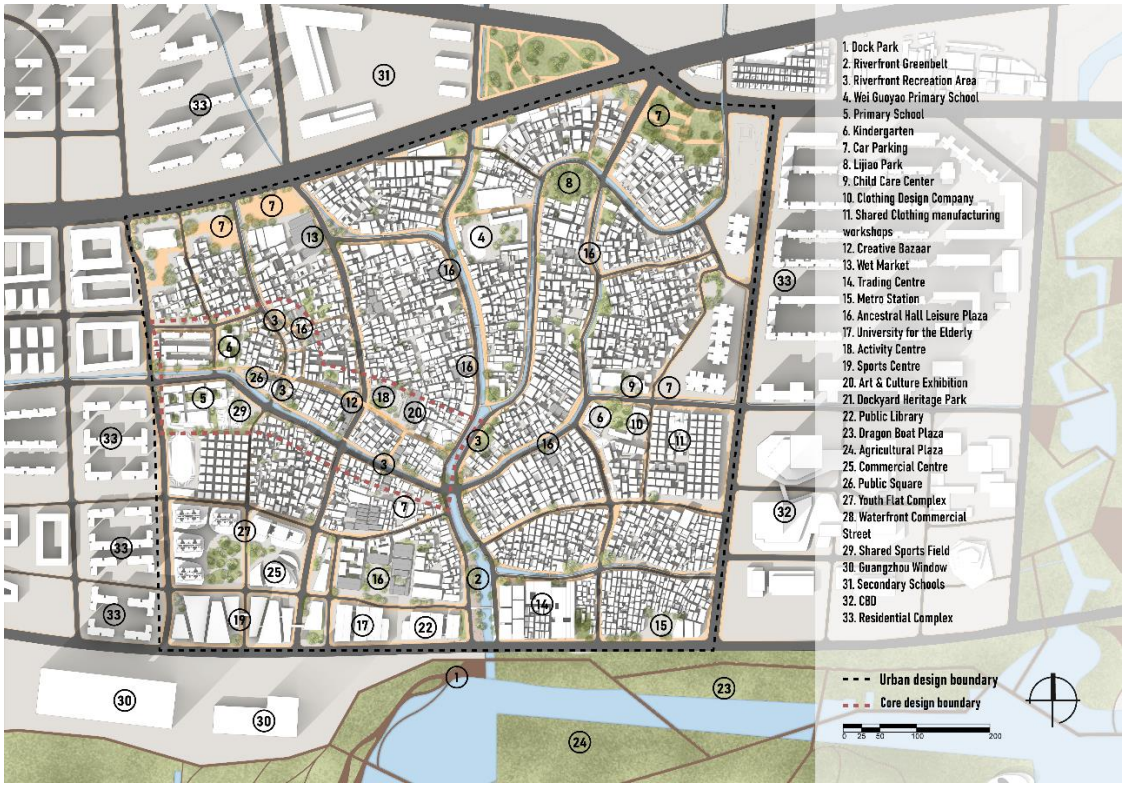


Figure 5-2 Masterplan (source: made by author)

Based on the above objectives and the previous analysis, the design of the core design

area was preceded by the optimisation of the road system, river network, architecture and functions of Lijiao Village as a whole, in order to establish the basic external conditions for the core design area. (Figure 5-1, 5 2)

5.2.2 Road system

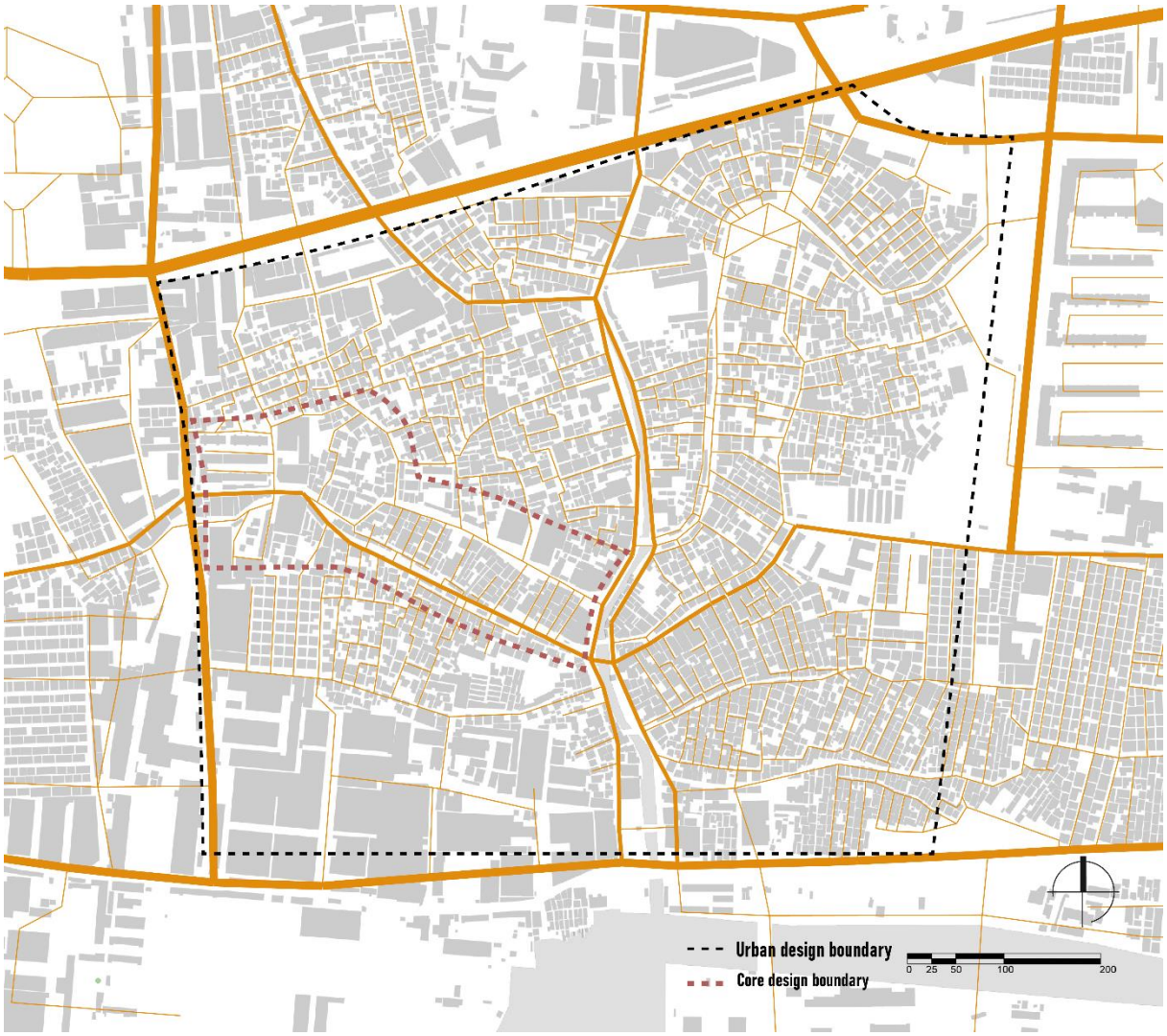


Figure 5-3 Current road system (source: made by author)

Within Lijiao Village, the original street system revolves around a tree-like river system. The main street is accompanied by the river and the village has developed a deeper internal road based on the main road. This street system can basically be considered a more convenient street system in the traditional village perspective, able to be distributed in a natural form throughout the village. In urban areas, however, such a street system is often difficult to interface with the urban street system and tends to be fragmented and isolated from

the city. This is reflected in the fact that roads are difficult to identify, do not flow smoothly enough and tend to cause congestion.

In the field research, it was found that the street along the west side of the existing Lijiao River is the main street for traffic within the village. This street has good conditions and a straight north-south alignment, making it the most important street linking the north and south sides of Lijiao Village. However, the direct impact of the high traffic volume is the increase in parking on both sides of the road, which not only affects the original two-way single lane traffic, but also affects the landscape on both sides of the river. At the same time, the current situation of Lijiao Village, with the demolition of land to be built on to the west and the residential area and some urban village buildings to the east, leaves insufficient demand for access. Although Lijiao Huanxiufang Street exists in the east-west direction connecting the two sides, the road has relatively little traffic. This main north-south street carries too many functions and needs to be decongested elsewhere. (Figure 5 3)

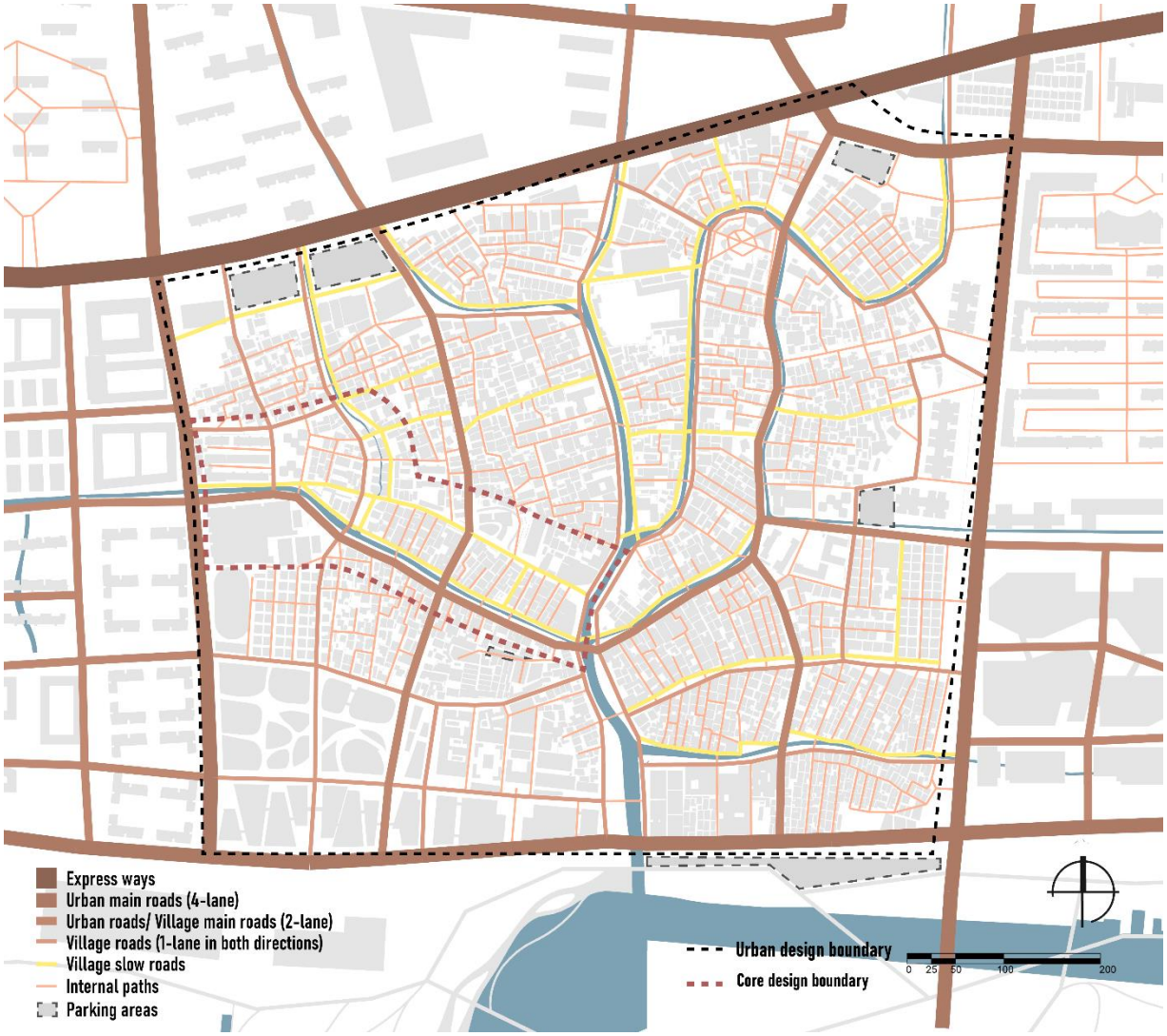


Figure 5-4 New road system (source: made by author)

In the design of the new street system, the above problems are solved by adding new streets to the existing street network and optimising the existing ones. The original street structure is retained as a whole, while existing problematic streets are dealt with by adjusting the width of the street, optimising the street alignment and modifying the street elements. Problems that are difficult to solve with the current street system, such as oversized blocks, inconvenient access and difficulty in connecting with urban roads, are solved by creating new roads along the architectural fabric.

The following classes of roads exist around Lijiao Village: express ways, urban main roads(4-lane), urban roads (village main roads, 2-lane), village roads (1-lane in both directions), village slow roads, internal paths.

The outer perimeter of Lijiao Village is made up of urban main roads, the northern side of which has elevated express ways. The highest-level road in the village is the two-lane village main road, which consists of one east-west and two north-south roads in the form of two crosses, running through the village separated by Lijiao River on each side. The east-west road is served by Lijiao. The east-west road is optimised from Lijiao Huanxiufang Street, the north-south road is a new road to the west, the east road is an existing road to the north and a new road to the south. This street structure focuses on less disruption of the architectural fabric, creating more communication with the city, breaking up larger blocks and liberating parts of the ancestral halls from the high density of buildings. Parking areas are provided at the entrances to these roads to provide for the parking needs of the village.

The second level of village roads within the village has been developed mainly from the original road structure. These roads are single lane in both directions, in keeping with the original traffic system. The original Lijiao West Street has been split into vehicular and slow-moving roads, separated by buildings and landscaped waterways. The carriageway is combined with other roads to create a more fluid alignment, while the slow-moving road uses the original road and retains the ancestral hall, focusing on historical memory and spatial experience.

The slow walking system is mainly based on the course of the historical river system. The combination of the street and the water system creates a good spatial experience. (Figure 5 4)

5.2.4 River system

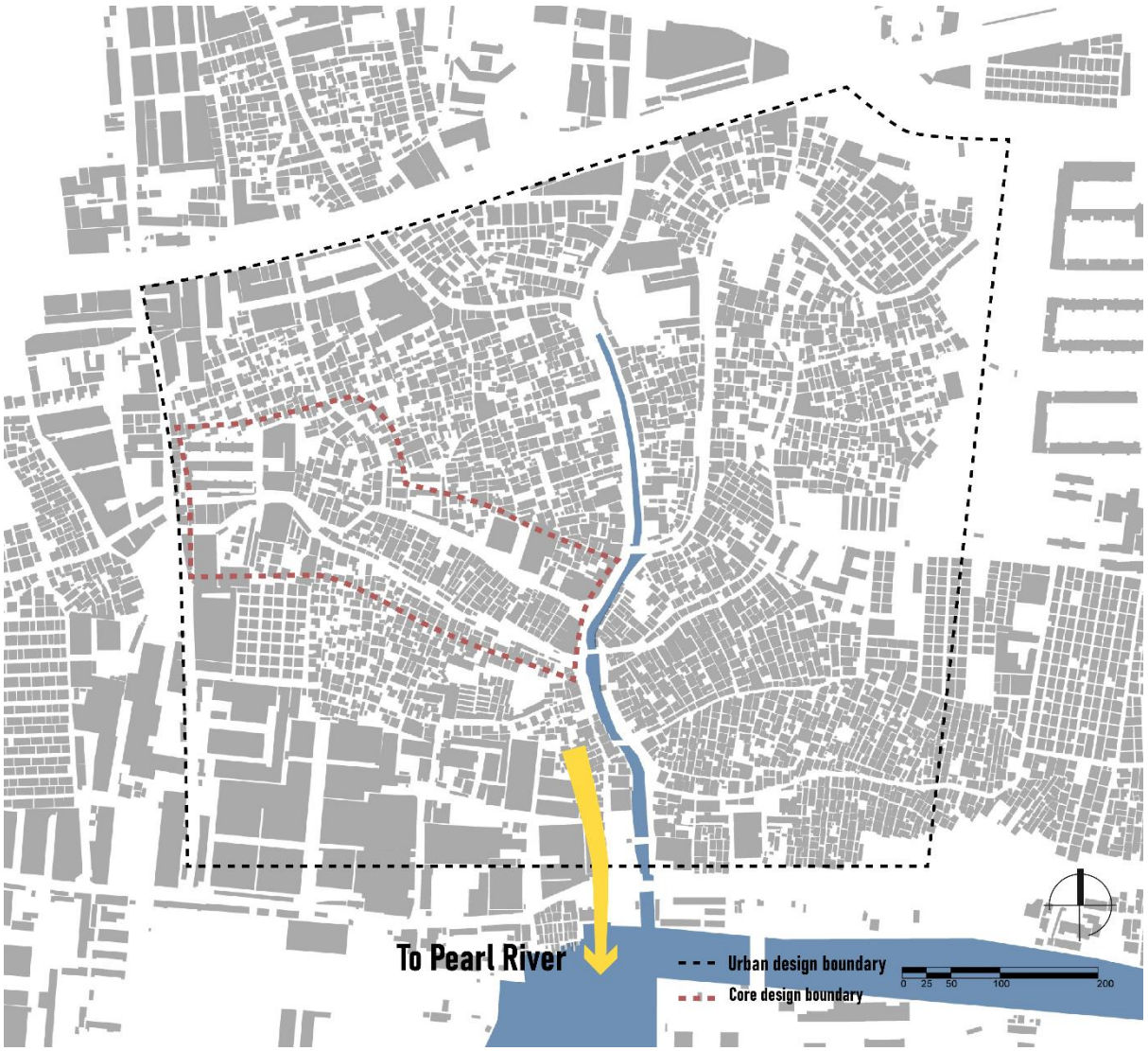


Figure 5-5 Current river system (source: made by author)

It is clear from the research that Lijiao Village has been developed in recent decades by filling in the river in order to gain more road space and building space. The only remaining river in the centre of Lijiao Village is Lijiao River. The river network plays a key role in Lijiao Village as an important part of the culture of the water village. Lijiao River is directly connected to the Pearl River, which effectively increases the resilience of Lijiao Village to flooding. The water body is also a very important landscape element, providing a beautiful living and microclimate environment for Lijiao Village. (Figure 5 5)

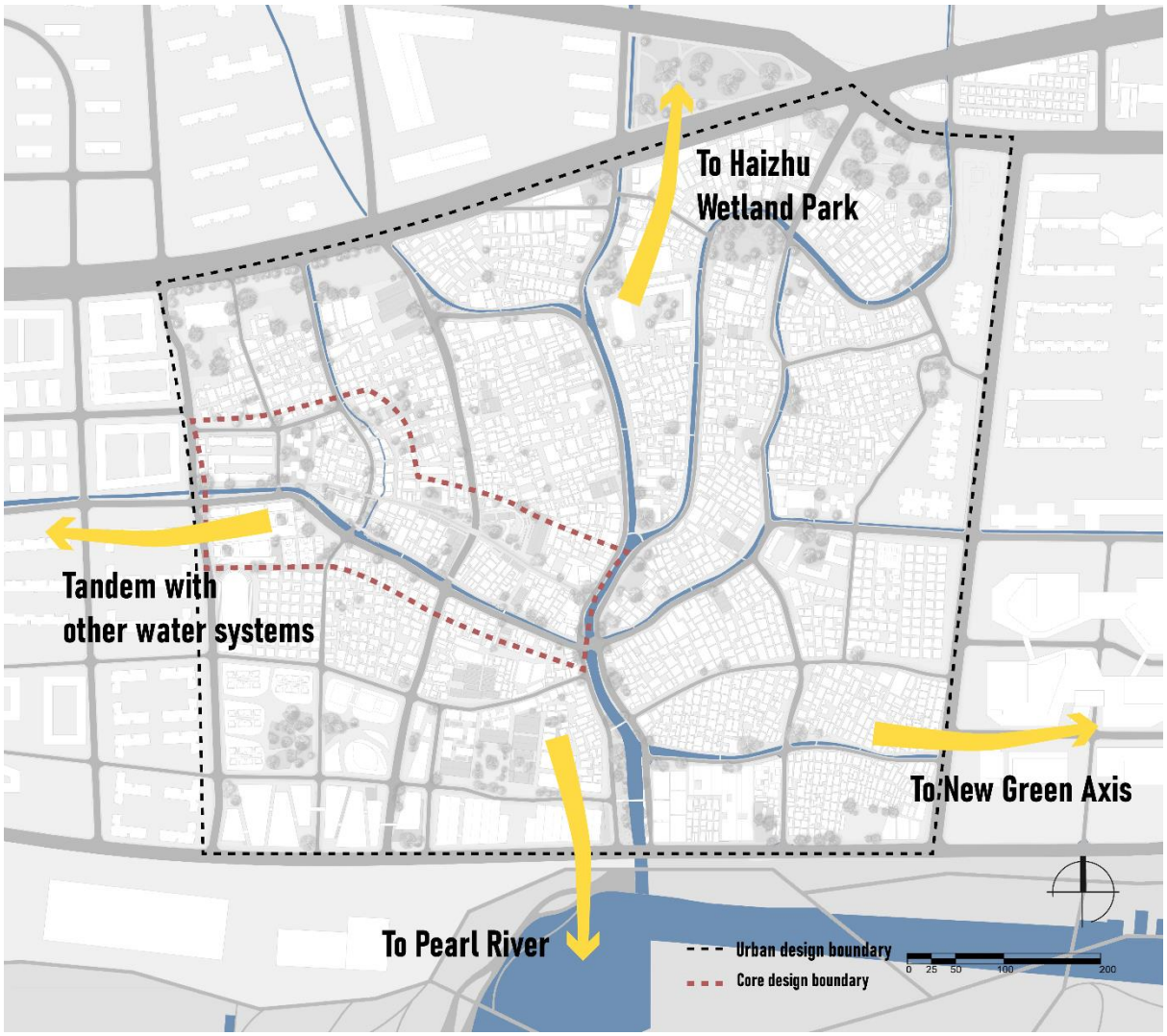


Figure 5-6 New river system (source: made by author)

Integrating the efficiency of modern life, the resilience and landscape role of the river and the cultural considerations of the water village character, the design partially restores the original river system and establishes a connection with the surrounding water system. In addition to its landscape and environmental role, the river assumes the role of distinguishing slow traffic from fast traffic in the more important traffic links. This reduces the probability of vehicles unknowingly entering the slow-moving path, enhances the safety of pedestrians and residents on the slow-moving path and enables the street to become a place that carries activity. (Figure 5 6)

5.2.6 Green system

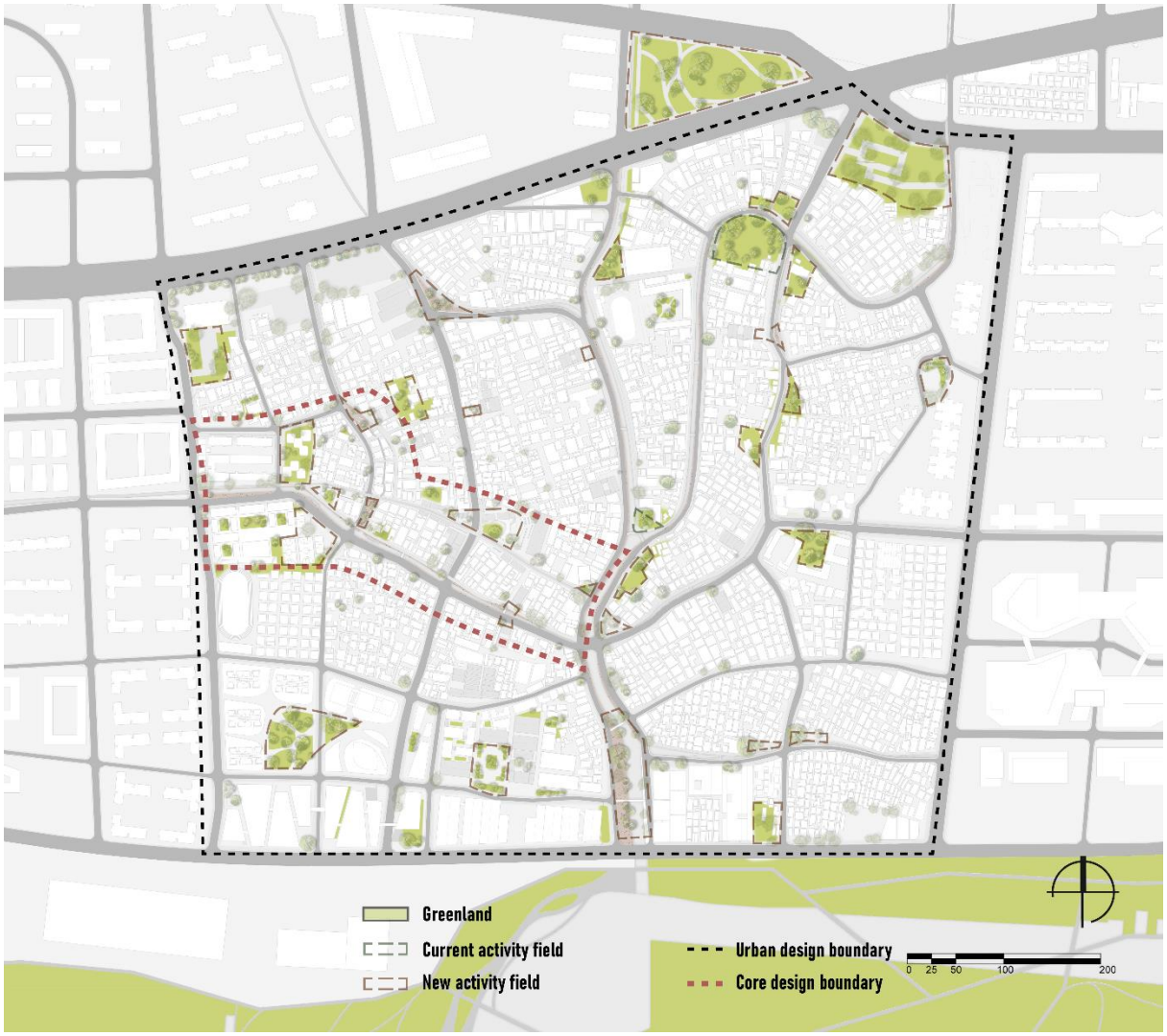


Figure 5-7 Distribution of green lands and activity fields (source: made by author)

Around the river, the creation of the riverbank is also an important part of the blue-green system. In the space-constrained Lijiao Village, there is little space available for a landscape system. The use of the riverbanks to create water-friendly spaces and ecological green spaces is a viable and systematic way of restoring the river. It is also important to make use of the original trees. The old trees in the village, especially the banyan trees with their large canopy coverage, can not only improve the environment but also provide a place for recreational activities in the village. In the current Lijiao Village, there are very few places for daily activities, the two most important being Lijiao Park and the largest banyan tree in the village. There are even fewer green spaces that could improve the quality of the space. In conjunction

with the new river network and some of the easily adaptable corner spaces, the overall area and distribution of green space has been improved by protecting existing trees, planting new trees and adding water-friendly spaces to create a better landscape environment. (Figure 5-7)

5.2.7 Conservation buildings

Figure 5-8 Conservation buildings with new river and roads (source: made by author)

The protected buildings in Lijiao Village are mainly ancestral halls. In the process of building additions, many conservation buildings have been buried in the additions and many have fallen into disuse and become dangerous. In response to this situation, a strategy was first adopted to open up the surrounding traffic, so that the buildings could be directly connected to the road, be more easily accessible and exposed, and provide the basis for conservation and restoration. Research in similar water towns and studies of the history of

Lijiao have shown that there is a connection between the ancestral hall and the river. Where possible, ancestral halls will be linked to the reopened river, restoring the historic landscape. In addition, the ancestral hall itself can be used as a place of activity and a source of vitality. The ancestral hall can be combined with the surrounding landscape to form a wider attraction, providing Lijiao Village with more places for recreation and festivals. (Figure 5 8)

5.2.8 Strategy of Demolished buildings

Figure 5-9 Building classification by materials (made by author)

The buildings in the village can be classified into four categories: Frame construction buildings, Mixed structure buildings, Brick and wood/steel construction buildings and Temporary buildings. These four types of buildings have different characteristics and therefore different strategies for demolition, restoration or retention. (Figure 5 9)

Frame construction buildings are usually of a relatively new age and of good quality, and are often the type of building in Lijiao Village that has a high number of storeys and accommodates a large number of residents. This type of building is mainly reserved. However, new buildings of this type that occupy road space will be demolished.

Mixed Structure buildings have been in existence for a relatively long time and many of

the current buildings in this category are at risk. These buildings are often of low storey and relatively poor quality and are therefore a priority for renovation. Where possible, these buildings will be transformed into new activity spaces or new street spaces.

Brick and wood/ steel construction buildings need to be discussed in various contexts. The steel construction type of buildings are mainly factory buildings, which in their current state are mostly abandoned or demolished. The demolition of these buildings would provide a significant amount of land for development in Lijiao Village, while reducing the negative impact of the factories on the surrounding environment and improving its quality. The brick and wood buildings are partly ancestral halls and partly ordinary dwellings that have existed for much longer. According to the List of Protected Buildings in Lijiao Village, these buildings of conservation value will be the focus of attention. The necessary spatial optimisation will be provided around these buildings of high cultural value, and they will be used as the core to create cultural attractions. For the ordinary dwellings, the option of renovation and upgrading or demolition will be needed to create a better spatial environment, depending on the actual situation.

Temporary buildings are almost always of low quality and have a high impact on the street environment and should be demolished.

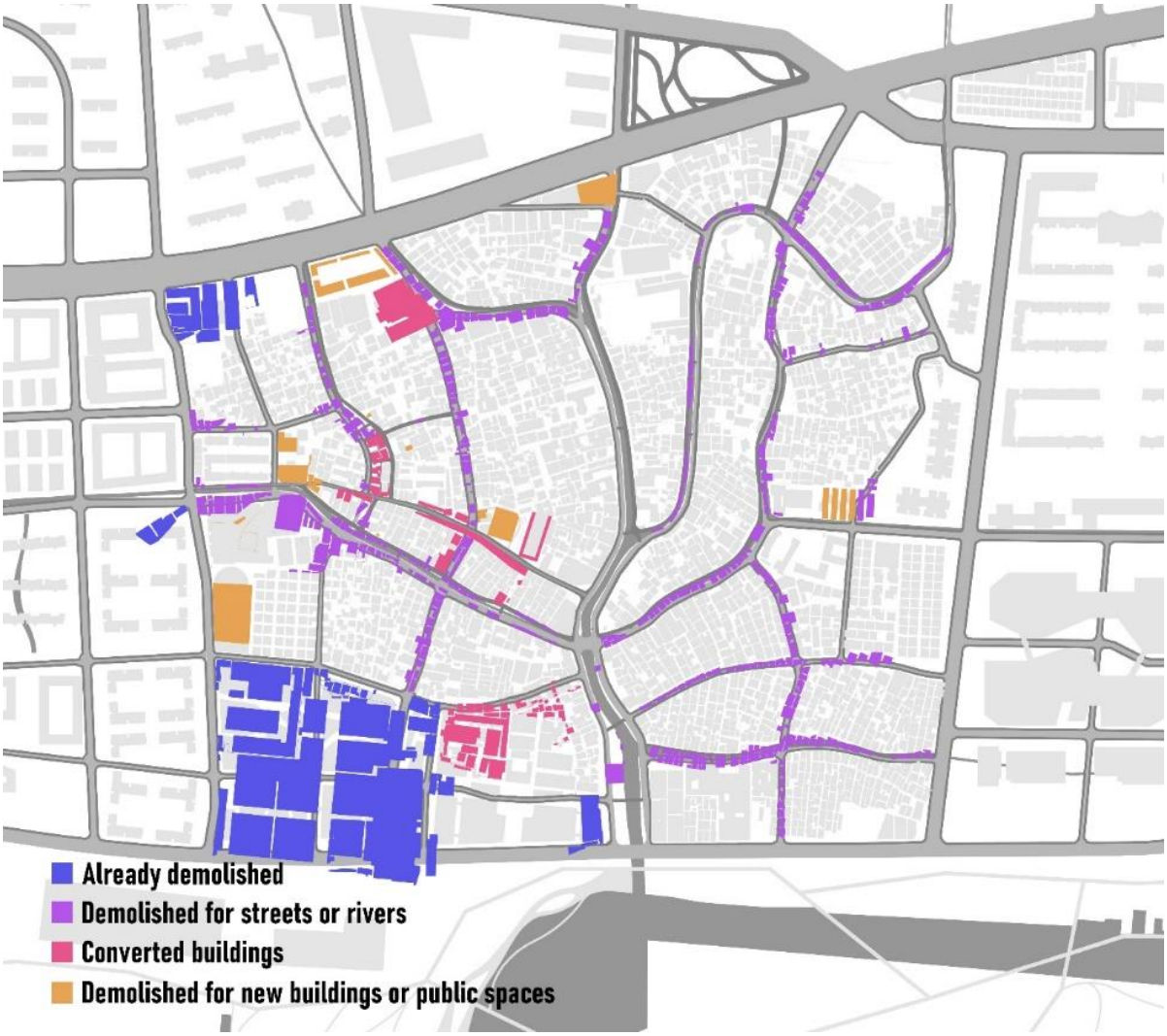


Figure 5-10 Demolished buildings (source: made by author)

Following the principle of minimising the amount of demolition, the design includes three types of converted or demolished buildings: demolished for streets or rivers, converted buildings and demolished for new buildings or public spaces, in addition to the current demolished buildings. The demolished for streets or rivers type of building is mostly an addition to an existing river. These buildings are usually of low quality and value and are relatively easy to demolish. For some of the ancestral halls and buildings that have a certain impact on the surrounding area, retrofitting measures are taken to repair the negative impact on the surrounding area and improve their quality of use. For some buildings of poorer architectural quality that are not easily renovated, demolition and new construction or public space are adopted to improve the overall appearance of the area and public services. (Figure 5

10)

5.2.9 Function Programming

Figure 5-11 Function Programming (source: made by author)

Based on the above analysis and design of roads, rivers, conservation buildings and modified buildings, the functional planning of the entire Lijiao Village was further completed. (Figure 5 11)

The exterior of Lijiao Village incorporates part of the existing planning and built-up buildings. A landscape ecological corridor is formed along the Pearl River and forms a continuous ecological network with the water system within Lijiao Village. To the west and north of Lijiao Village are mostly residential areas and the corresponding public services, to the east are existing residential areas and the planned new CBD, and to the south is the

Window of Guangzhou complex under construction.

What has been demolished and work started in Lijiao Village is the industrial area in the south-west corner. In the current plan the area is used for flats. As such, the design is structured around the two key functions of the area, namely the flats and the Wei Grand Ancestral Hall, with associated sporting and cultural functions. The treatment of the water system within the village mainly assumes the functions of a landscape and recreational area, the regulation of microclimate and the differentiation of roads at different speeds. Most of the protected buildings in the village have certain cultural attributes and values, and therefore mainly undertake traditional cultural activities in the village and provide venues for cultural promotion, art exhibitions and festivals. In the plots where traffic converges, a reduction in building density and the creation of public spaces are adopted to gather more people and create interesting spaces. Finally, the village's existing public facilities, such as the wet market and school, will be adapted to improve their efficiency and comfort.

5.3 Space Syntax Verification

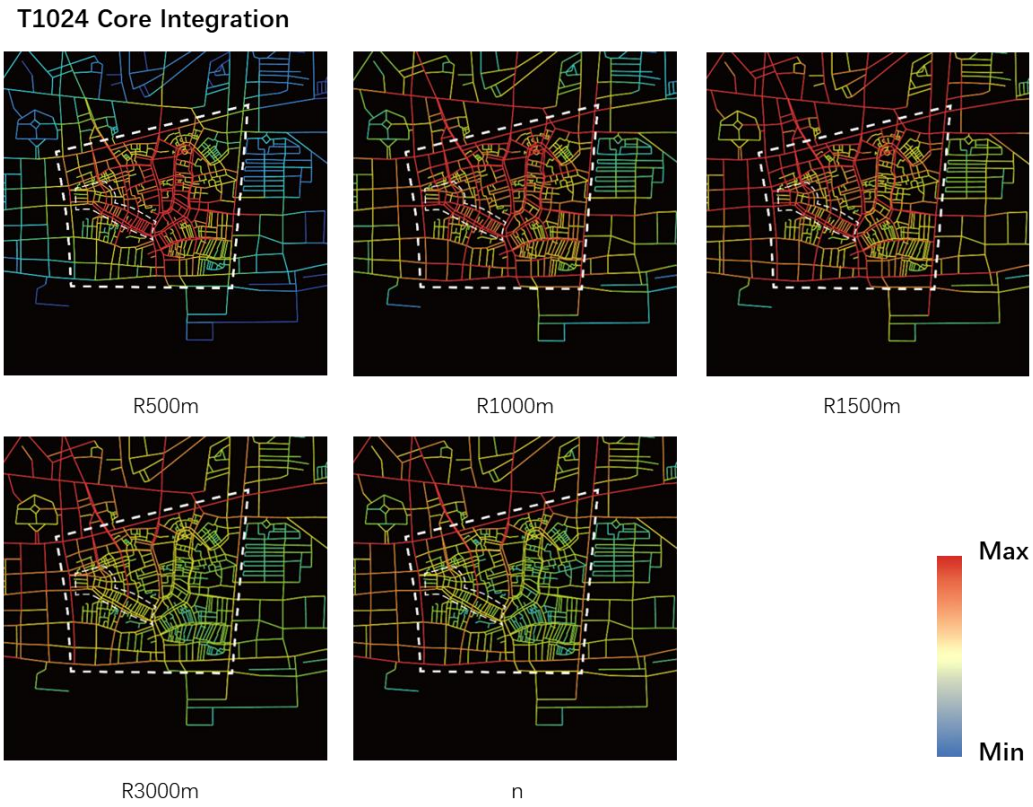


Figure 5-12 T1024 Core Integration Segment Map of New Design (source: made by author)

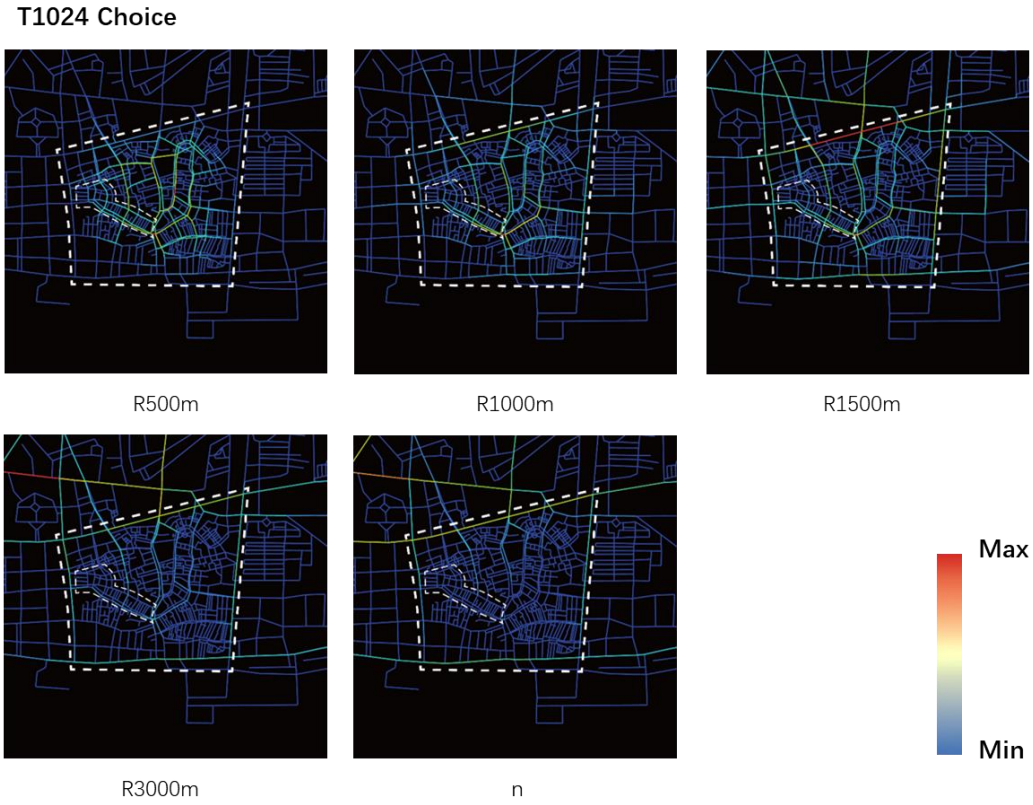


Figure 5-13 T1024 Choice Segment Map of New Design (source: made by author)

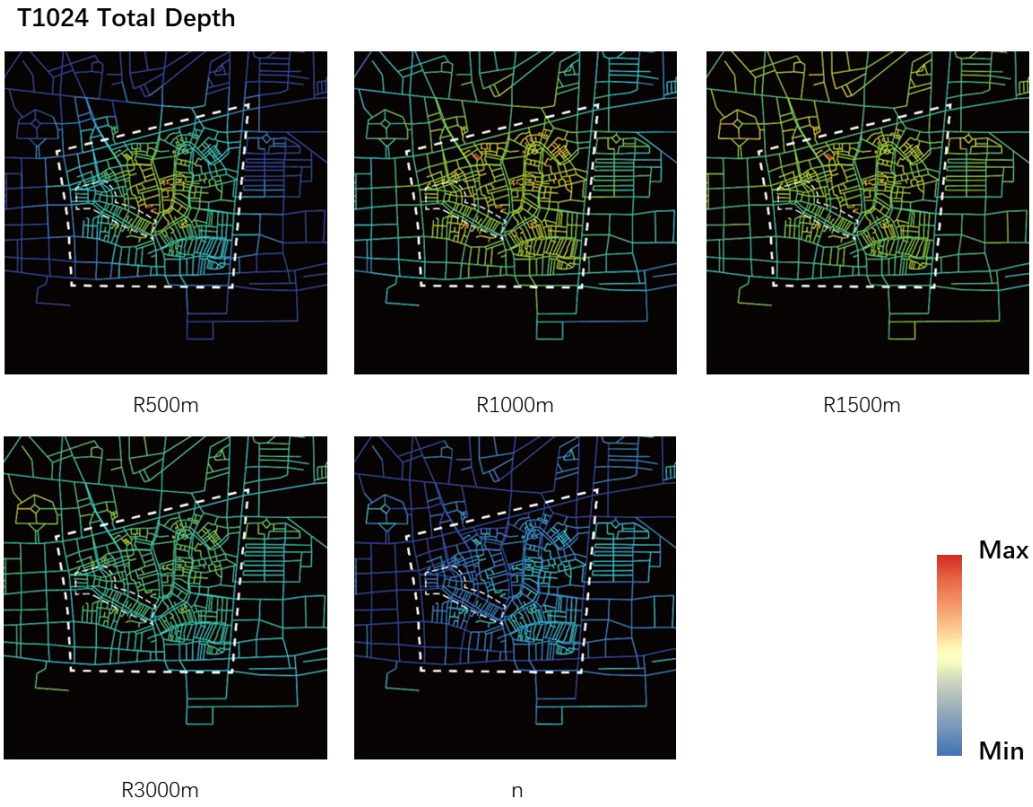


Figure 5-14 T1024 Total Depth Segment Map of New Design (source: made by author)

		T1024 Integration R500 metric		T1024 Integration R1000 metric		T1024 Integration R1500 metric		T1024 Integration R3000 metric		T1024 Integration	
	Number of Axe	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Original	5147	250	4.77%	186	3.55%	90	1.72%	13	0.25%	13	0.25%
New Design	5239	256	4.89%	222	4.24%	158	3.02%	24	0.46%	32	0.61%

Table 5-1 Comparison of the number of Core Integration axe (source: made by author)

Segment Analysis was performed again on the designed road network and it was seen that there was a better improvement in the individual analysis scales and analysis content

In terms of integration, the number and percentage of integrated cores on each scale of analysis has increased. (Table 5 1) The enhancement is most evident at 1000m and 1500m, reflecting to some extent the increased integration of Lijiao Village with the surrounding city. For the three streets within the core design area, all 1500m and smaller scales become Integration Core streets, which is a significant enhancement. The additional streets that cross the core design area are Integration Core or Integration Core+1 at all scales, and also make Lijiao Dashi Street Integration Core+1 at higher scales, and cross at key nodes in the design. (Figure 5 12) Taken together, the design has a good chance of improving accessibility and public realm within Lijiao Village and the core design.

There is also a clear indication of the new road structure at all levels in terms of Choice. (Figure 5 13) At the scale of 1500m and below, the most important cross structure formed by the original river system is visible, followed by the new north-south road and finally the vehicular part of Lijiao West Street becomes a high choice area. Overall, a hierarchical system of access is created. In addition, the new roads perform well at a higher scale, effectively taking on the fast traffic from the city.

In terms of Total Depth, the most visible change also comes from the addition of new roads running north-south. (Figure 5 14) The addition of this road has resulted in a significant reduction in depth at all scales of analysis in the surrounding area. Compared to the original structure, the distribution of depths within the village is flatter and the area of high depth patches is reduced. This manifests itself spatially in the form of lower transport costs within and outside Lijiao Village, making it easier to travel within Lijiao Village and to access the city from outside.

5.4 Core Design Area

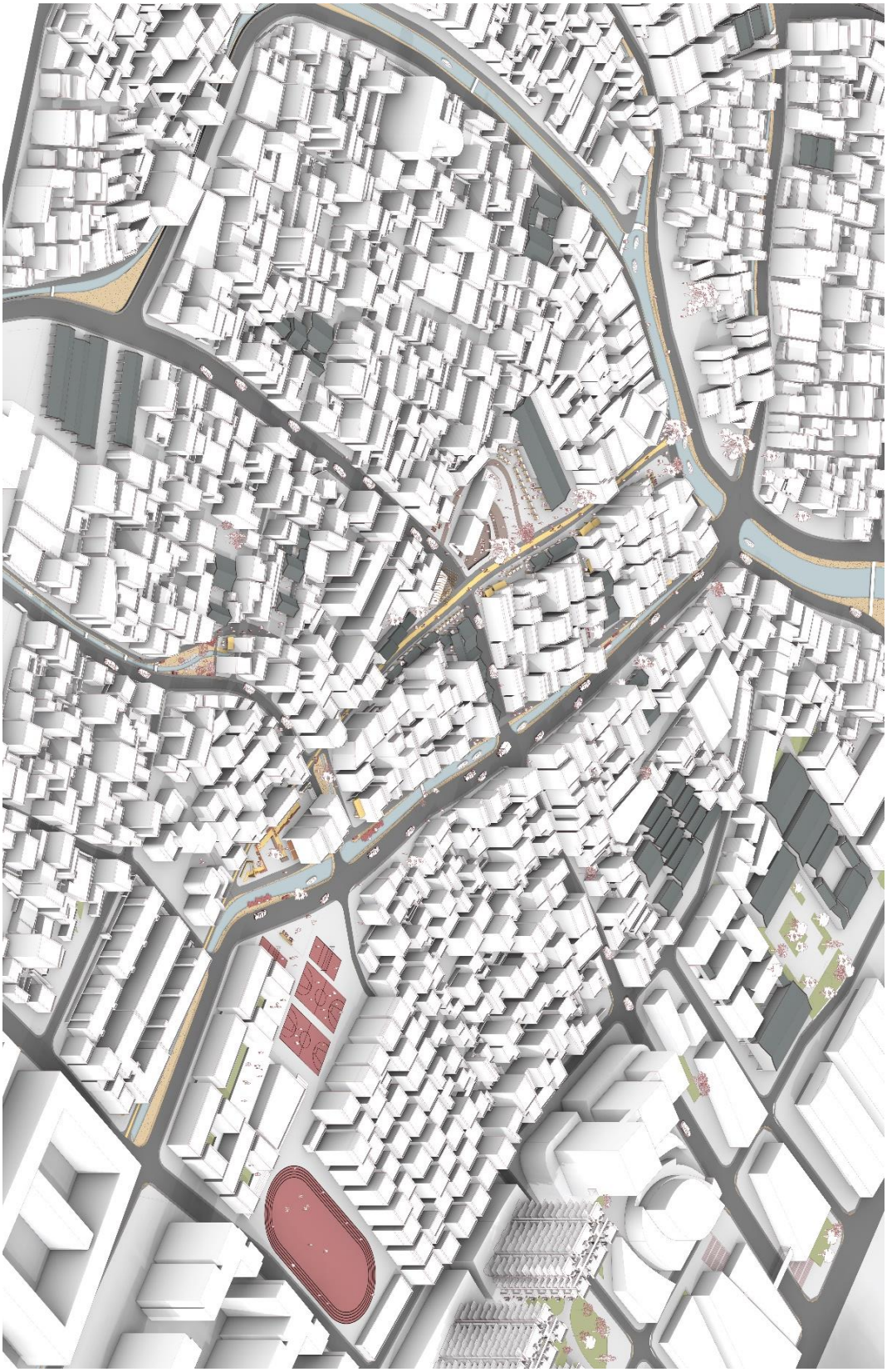


Figure 5-15 Aerial view of core design area (source: made by author)

5.4.1 Overview

There are three main streets in the Core design area, Lijiao Huanxiufang Street, Lijiao Dashi Street and Lijiao West Street, and as mentioned above, there is a serious lack of vitality in and around these three streets. The design focuses on the following aspects of the lack of vitality. Firstly, based on the findings of the research and analysis of each street, a reasonable new positioning and regeneration of the three main streets was developed; secondly, on the basis of the above positioning, the street sections were redesigned to optimise the basic conditions of access and function, taking into account the conditions of the streets; thirdly, based on the characteristics of the current street interface, a general regeneration strategy for the buildings along the streets was derived to restore the street form and improve the overall level of vitality of the streets; fourthly, key elements were inserted into the streets. Fourthly, key nodes will be inserted in the street to create attractive street vitality points, which will improve the vitality of the surrounding area in a from-point-to-area manner. (Figure 5 15, 5-16, 5-17)

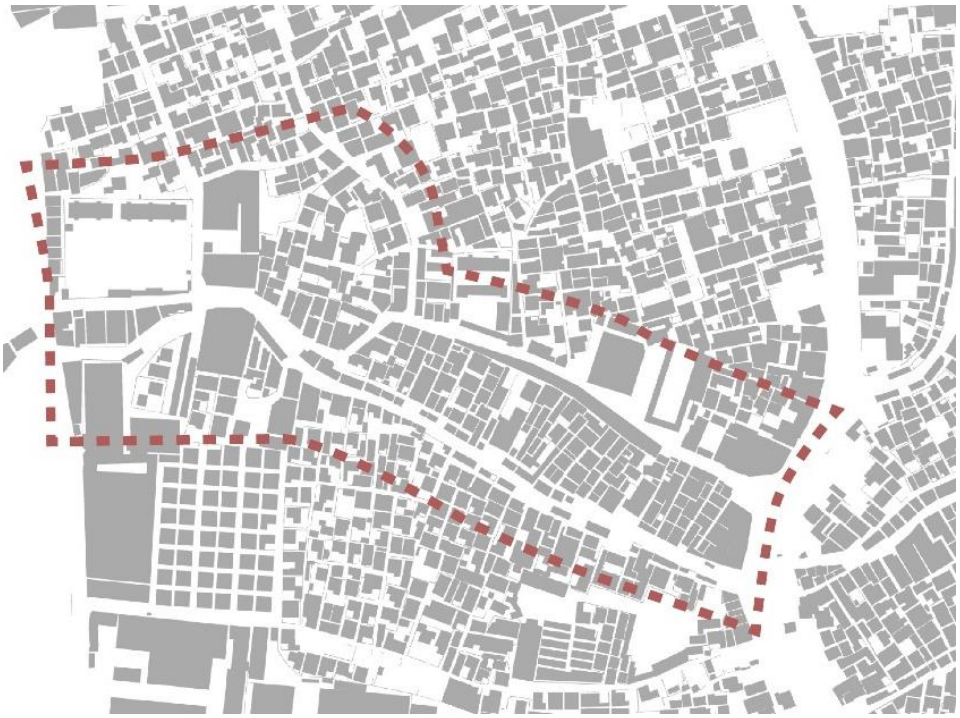


Figure 5-16 Current context of core design area (source: made by author)

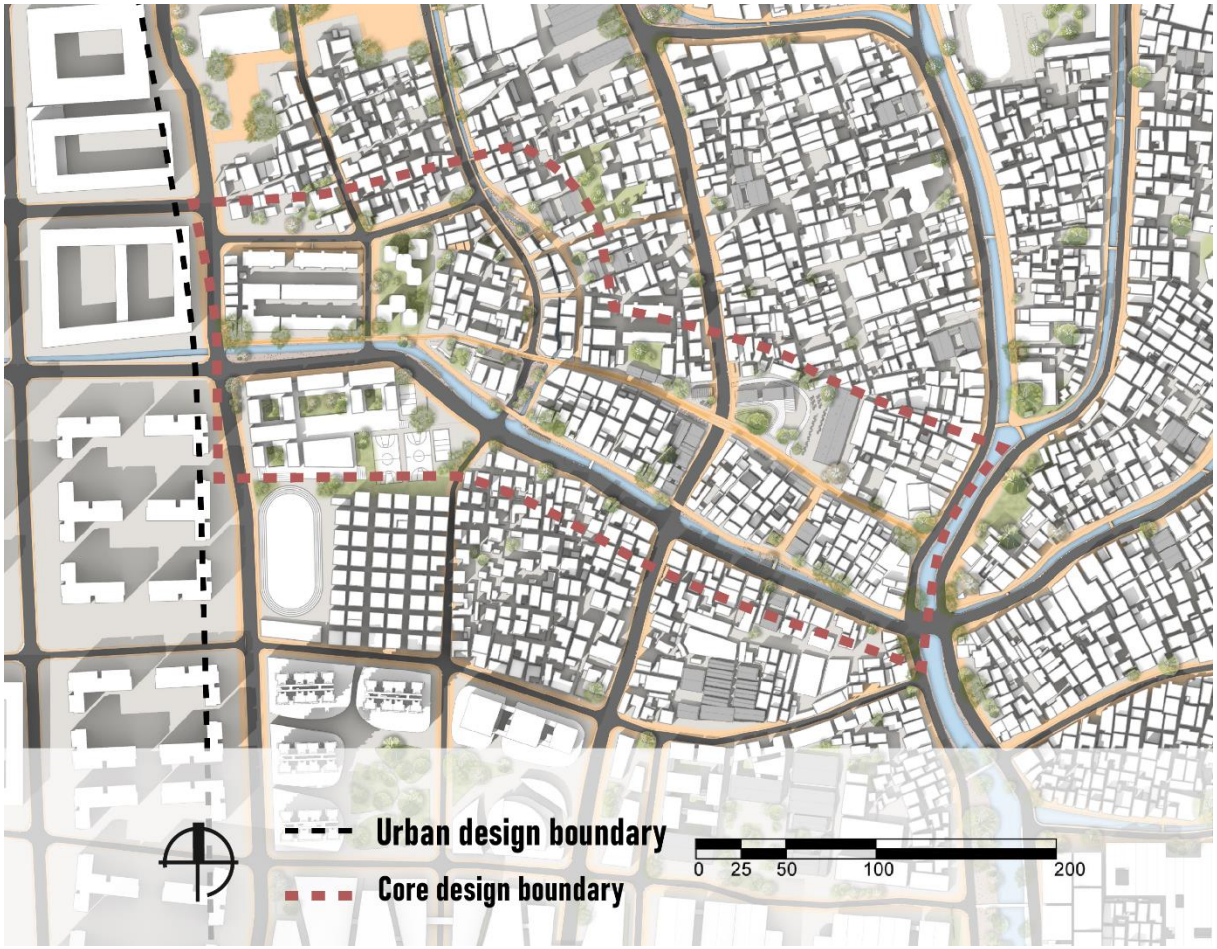


Figure 5-17 Masterplan of Core Design Area (source: made by author)

5.4.2 Planning Structure

At present Lijiao Village is not planned or differentiated in terms of road use and vehicles can drive on any street that is accessible. In the case of poor access and narrow street widths, this type of access greatly affects the daily life of the residents and is one of the reasons for the spatial confusion of the streets. It is therefore necessary first of all to demarcate the rights of way and to adjust the street alignment and width appropriately.

The fast system is closely related to the Choice indicators of the space syntax. In conjunction with the previous space syntax analysis, Lijiao Huanxiufang Street, which has a high Choice index at all scales of analysis, and the new road that intersects it, which cuts through Lijiao Village in the east-west and north-south directions respectively, are positioned as the two most important fast roads. The southern section of Lijiao West Street, where the Choice Indicator is slightly lower, is relatively difficult to widen due to the density of buildings and the presence of two ancestral halls. In addition, the original street tends to form a complex road alignment when connecting with other roads in the village, which is not conducive to the movement of motor vehicles that are sensitive to road corners. Taking all these factors into account, the original road on Lijiao West Street will be positioned as a slow-moving road and a new road will be opened parallel to it to provide access for motorised traffic, separated by the original buildings and the river landscape, forming a diversion and then merging road pattern from south to north, reducing the negative impact of motorised traffic on the activities in and around the Ancestral Halls.

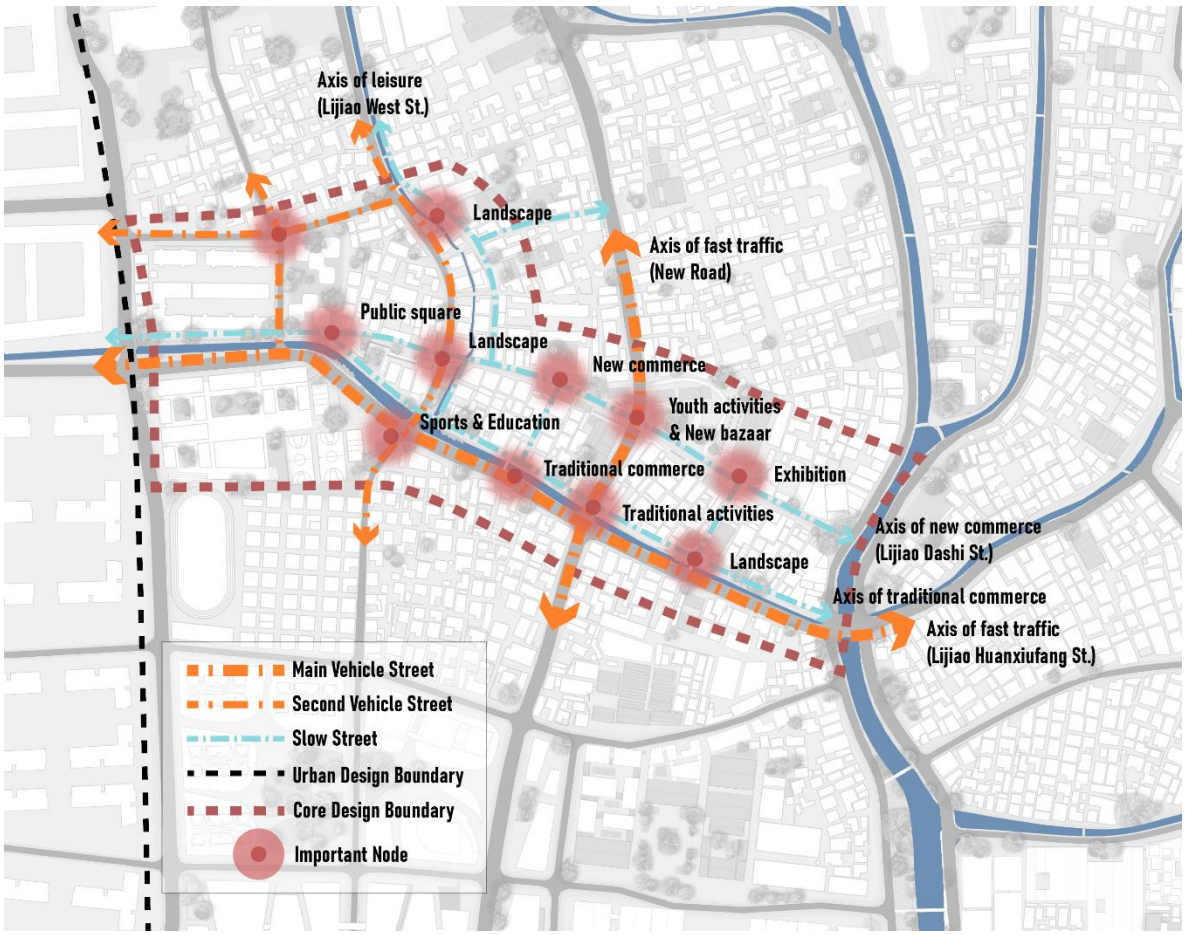


Figure 5-18 Planning structure (source: made by author)

The slow system also needs to be considered in conjunction with the fast system. Of the three streets, Lijiao Dashi Street and Lijiao Huanxiufang Street are with commercial history and conditions in Lijiao Village, and these two streets have the potential to rejuvenate the streets with businesses and activities. In the space syntax analysis, the slow-moving system with purposeful businesses is more concerned with Integration. Lijiao Huanxiufang Street was the integration core of the former 5% before and after the renovation, and it is natural that the renovation continues the commercial potential of the former. Lijiao Huanxiufang Street therefore adopts a strategy of restoring the original river to evoke the traditional collective memory and separating fast and slow traffic by means of the river to enhance the safety of slow traffic and commercial activities. In summary, Lijiao Huanxiufang Street has been positioned as an axis of traditional commerce. Lijiao Dashi Street was a type of integration core + 1 before the renovation and became an integration core after the renovation. At the

same time, due to its proximity to Lijiao Huanxiufang Street, which carries the main fast traffic, the need for fast traffic can be reduced and it will only be used as a complement to Lijiao Huanxiufang Street when necessary. This street can be used as a main street for new commerce and new businesses, while at the same time expanding the business area and attracting young residents by means of shop fronts and open-air events, becoming an axis of new commerce. Lijiao West Street is positioned as an axis of leisure in the design context. Lijiao West Street and its route, although relatively congested in its original street condition, can be fully transformed into a slow-moving pathway intersecting with Lijiao Dashi Street by shifting the route of motor vehicles, taking full advantage of its landscape advantage of having two ancestral halls within a relatively short distance. It is also possible to combine the new river to create a meandering landscape walkway, transforming its poor accessibility. Directly adjacent to the southern end of Lijiao West Street is a public square and shared sports field. Together, these buildings and facilities form a leisure flow. (Figure 5 18)

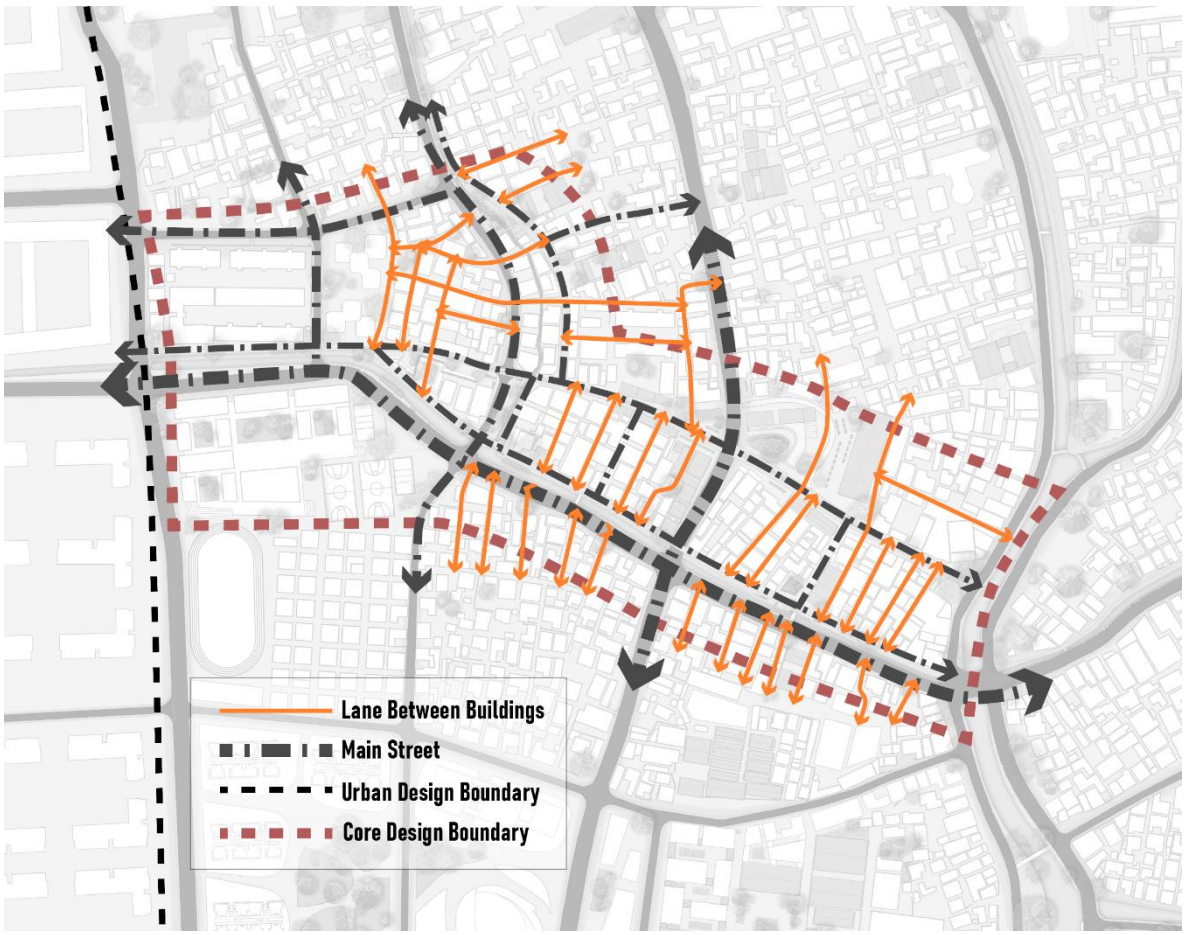


Figure 5-19 Lane between buildings (source: made by author)

The high density of buildings in Lijiao Village requires a large number of internal lanes between the main streets to meet the travel needs of the residents. In the new traffic system and functional layout, there is also a need for pathways through the neighbourhoods to provide good permeability through the main streets. Within the core design area, the building fabric is predominantly striped. In accordance with the existing building fabric and the gaps between them, some of the temporary buildings and structures that interfere with the flow of traffic are removed to create lanes that meet the needs of travel and connectivity. This approach creates regular pathways and links between them, increasing the scope of influence of the streets. (Figure 5 19)

5.4.4 Street Section View

Figure 5-20 Street planning (source: made by author)

Within the core design area, due to the limited space available, the road properties can be divided into three basic categories: Road, Bicycle Road and Sidewalk, which are distributed differently for the different functional properties and traffic zones of the streets. (Figure 5 40)

1. Lijiao Huanxiufang Street

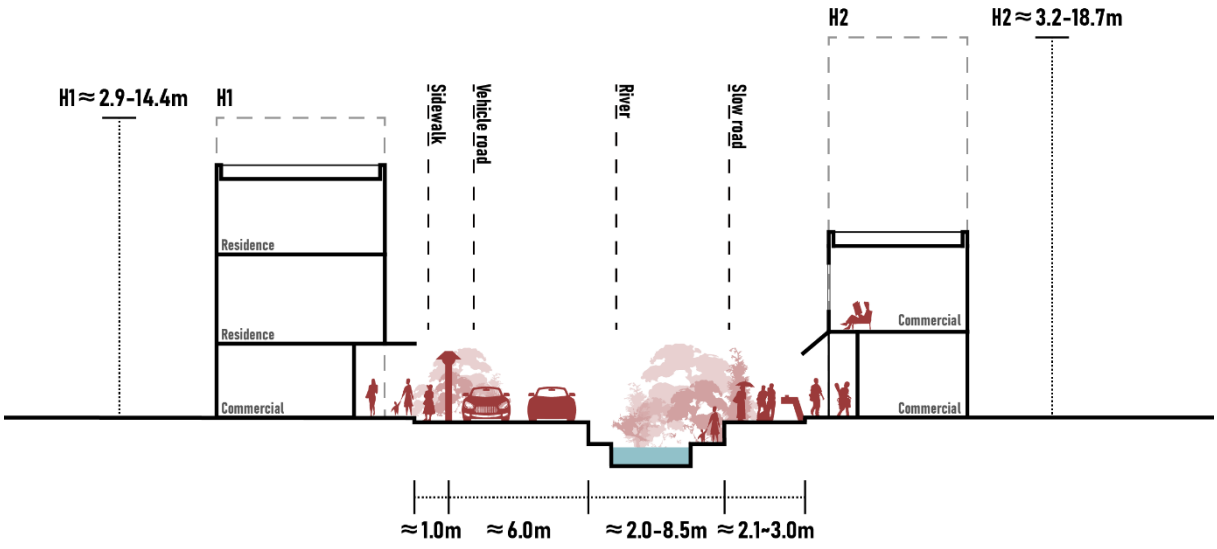


Figure 5-21 Lijiao Huanxiufang Street section view (source: made by author)

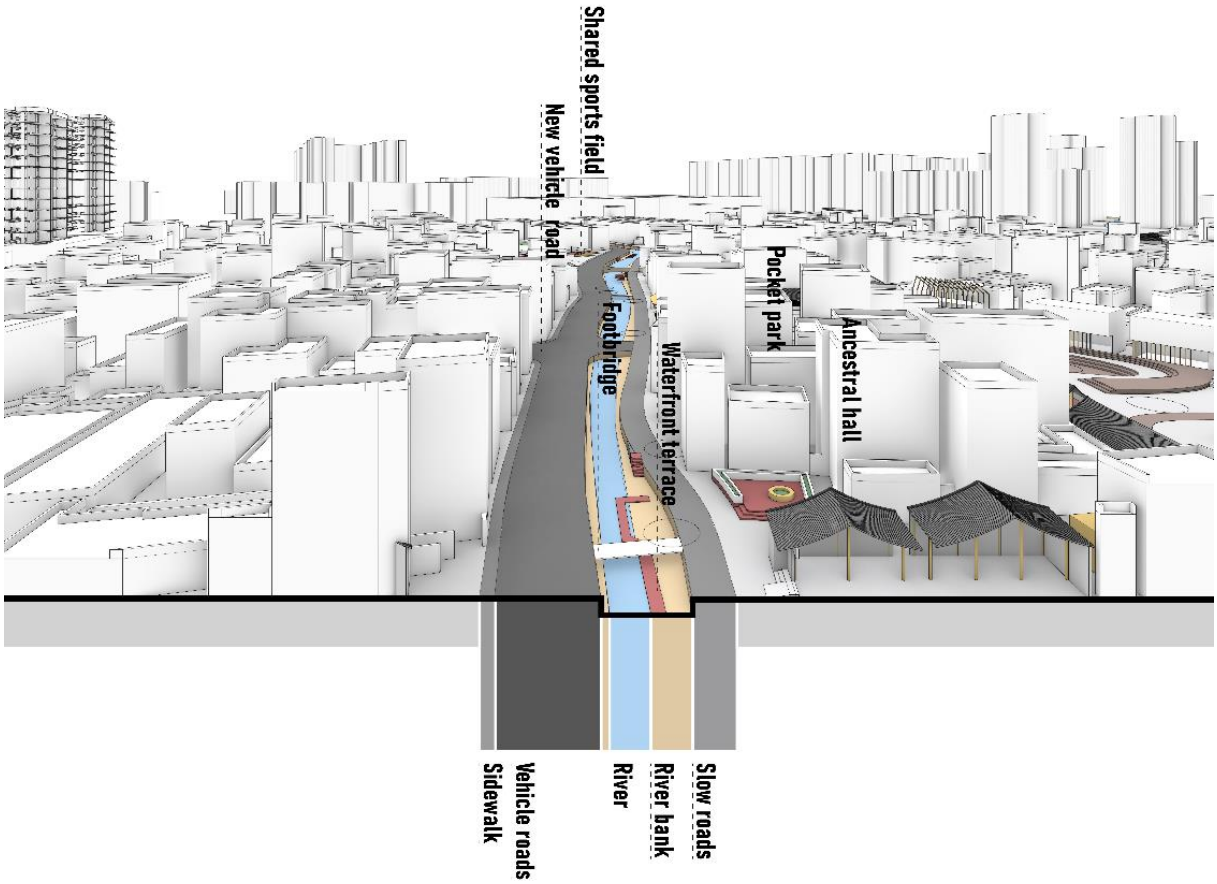


Figure 5-22 Lijiao Huanxiufang Street sectional perspective view (source: made by author)

Lijiao Huanxiufang Street is one of the most important streets in Lijiao Village. The buildings that were added to the street as a result of the river filling were demolished to restore the river and widen the road, solving the problem of confusion and congestion in the original street space and providing more landscape elements and better access to the street. The new street section of Lijiao Huanxiufang Street consists of original buildings, sidewalk, vehicle road, river and river bank, and slow road. Vehicle road and slow road are separated by the river, with the northern bank serving as the main commercial slow street and the southern bank as a fast traffic route; vehicle road is approximately 6m wide and can accommodate two lanes of traffic in opposite directions; the width of slow road is relatively flexible, varying between 2.1m and 3m as the architectural texture and access needs dictate. The river and its banks vary according to the needs of the landscape and the original trees, usually extending

the area available for movement in front of the ancestral hall's gates. The buildings on either side are suitably modified to make them more adaptable to the changes in the street. (Figure 5 41, 5-42)

2. Lijiao Dashi Street

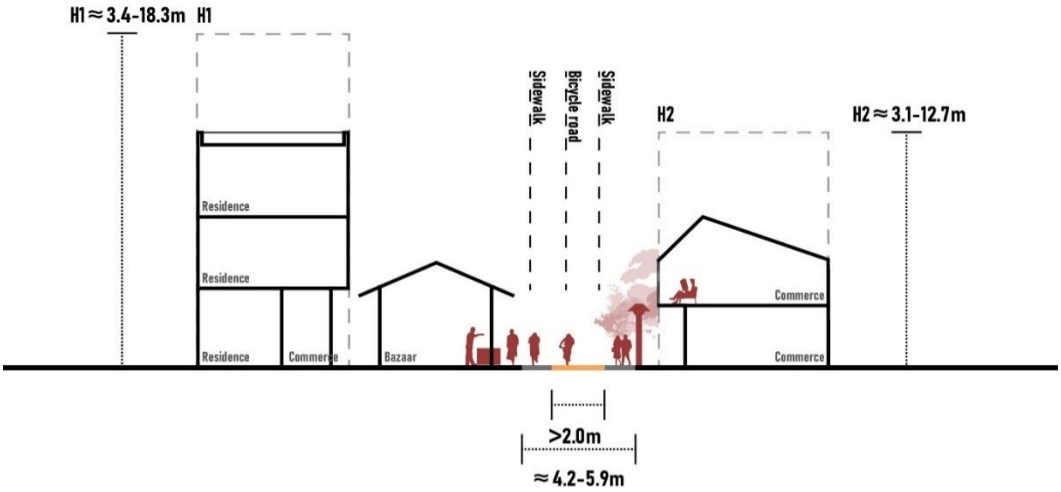


Figure 5-23 Lijiao Dashi Street section view (source: made by author)

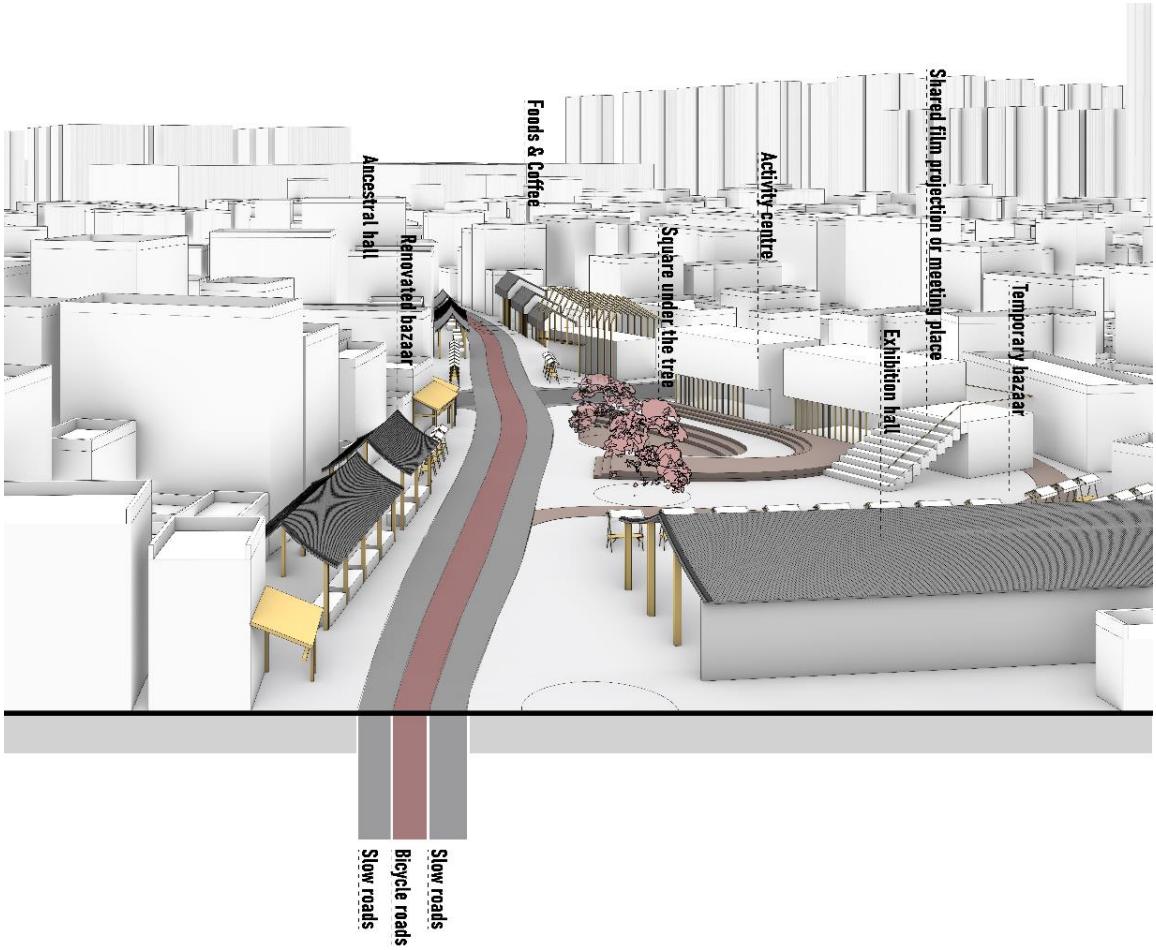


Figure 5-24 Lijiao Dashi Street sectional perspective view (source: made by author)

Lijiao Dashi Street, as the nearest parallel street to Lijiao Huanxiufang Street, is not only

an important street for new commercial businesses, but also an important slow-moving path in the core design area. The width of this street is relatively narrow compared to Lijiao Huanxiufang Street (4.2-5.9m) and is not suitable for the introduction of a river in the same way. There are more new businesses and activities on both sides of this street, which require a greater connection between the two sides of the street to create more space for activities, so the full width of the street section is designed to be converted into a slow road. Unlike normal slow roads, this one retains a minimum of 2m of cycle lane in the centre, the rest of which can be occupied by festivals, shop fairs, cultural and creative fairs etc. for a certain period of time. This gives more space for street shops and marketplaces to be displayed while ensuring street access, creating an overall linear plaza space. The long walls, low quality buildings and temporary parking sheds on both sides of the street are transformed into open spaces, market places or buildings open to the public, using the pedestrian traffic provided by the new motorway that crosses them to create opportunities for daily and festive events to take place on the street and increase its attractiveness. (Figure 5 43, 5-44)

3. Lijiao West Street

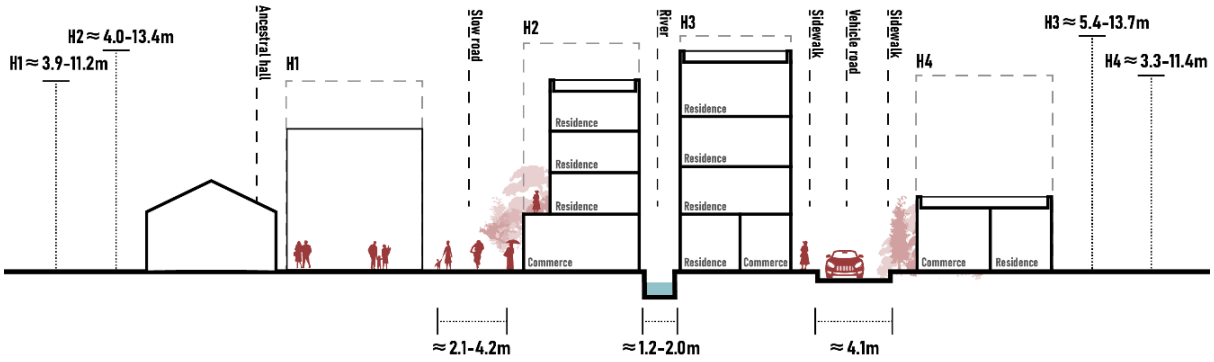


Figure 5-25 Lijiao West Street section view (Southern part) (source: made by author)

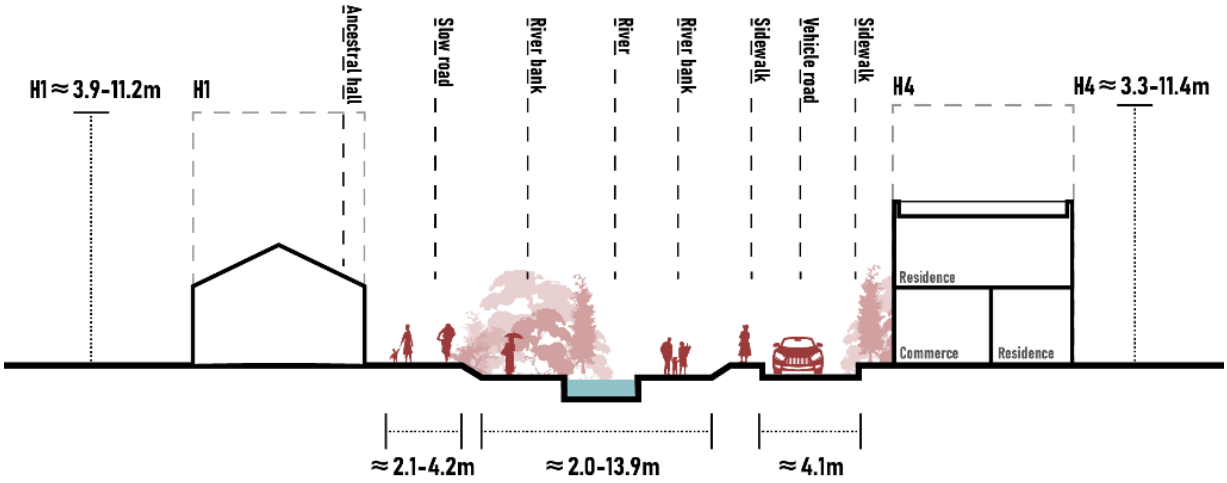


Figure 5-26 Lijiao West Street section view (Northern part) (source: made by author)

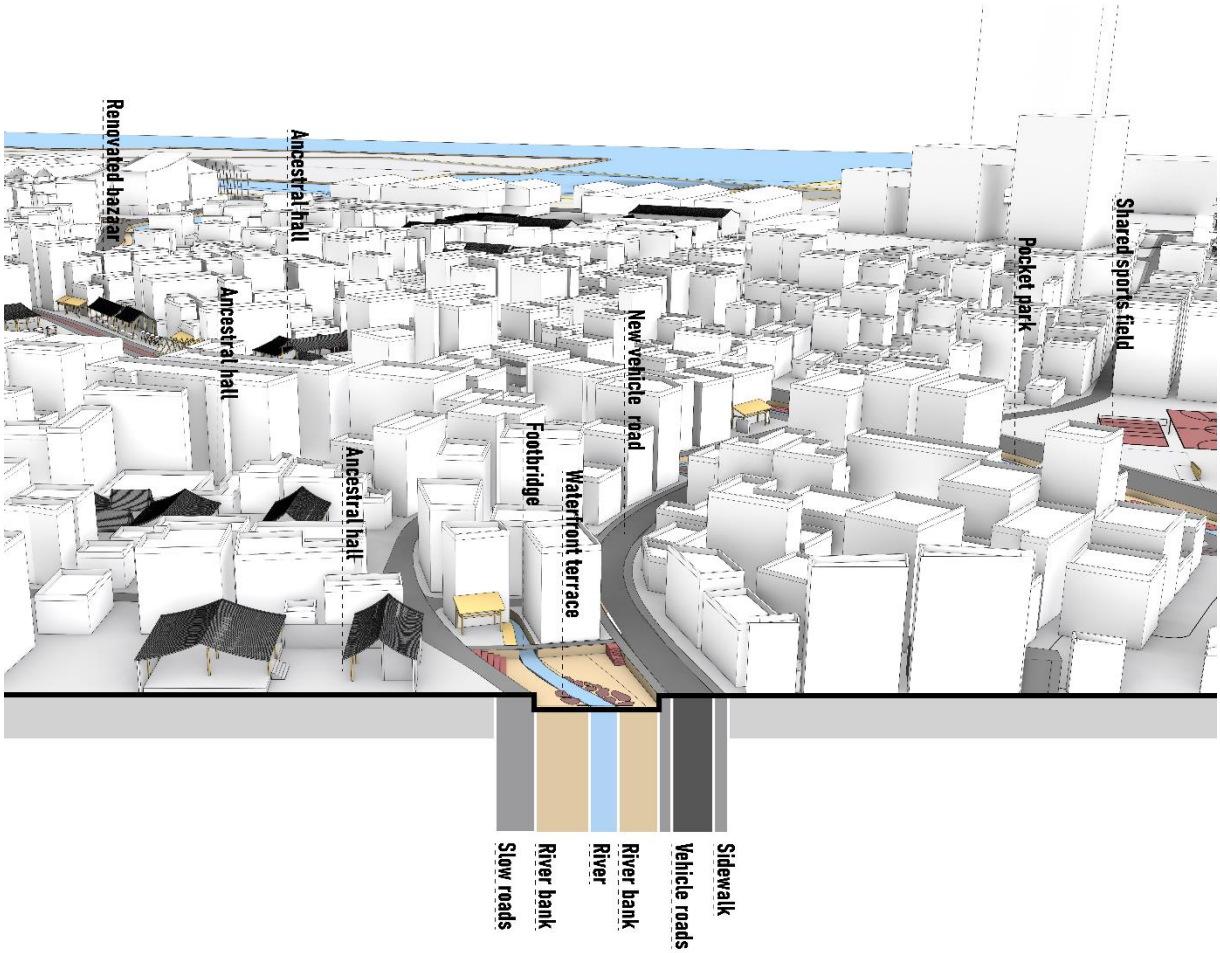


Figure 5-27 Lijiao West Street sectional perspective view (source: made by author)

Lijiao West Street is unique in that the eastern side of the street is an existing road that serves as a slow-moving path, while the western side of the street is a newly created motorway. The middle section is made up of two sections, the southern section separated by existing buildings and the middle section to the north separated by a gradual narrowing of the river and its banks. The overall trend from south to north is to form two parallel roads from diverging to merging. The main consideration of this road alignment is that the original narrower Lijiao West Street is no longer suitable for motorised traffic, and the creation of an additional motorised lane parallel to it will save space on the street while optimising the road alignment, giving a good pedestrian experience on the other side of the slow-moving street, and better integrating the ancestral halls with the river, for a more immersive experience of the ancestral halls and water village character of Lijiao Village. (Figure 5-45, 5-46, 5-47)

5.4.5 Overall Function Programming

The three streets within the core design area are positioned differently and differ in their function programming.

Figure 5-28 Situation of shared bicycle in Lijiao Village (source: photo by author)

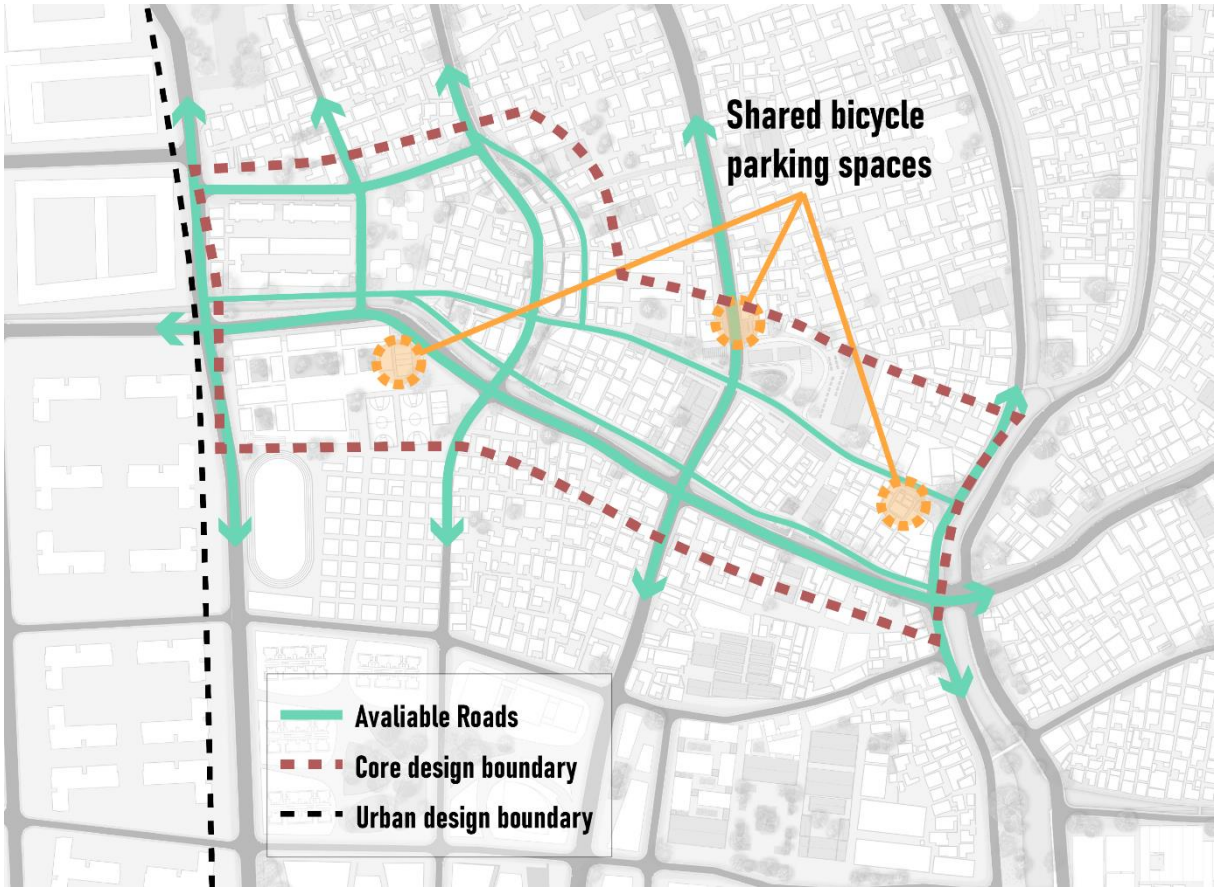


Figure 5-29 Parking area of shared bicycle (source: made by author)

The first point worth noting is that shared bicycles are an important form of transport in Lijiao Village. As the main public transport stops are on the periphery of Lijiao Village and

car parking is not easily accessible within the village, access to the interior of Lijiao Village is mainly by foot and bicycle. However, as walking is not as efficient as cycling in the village, shared bicycles, which offer a high degree of freedom, have become the main means of transport within the village. However, bicycle sharing services often have irregular starting and ending points, and the lack of parking areas for bicycles within Lijiao Village not only makes indiscriminate parking the norm, but also lacks the conditions for large numbers of shared bicycles to be placed. In front of some residences, you can find shared bicycles that have been privately locked by residents and turned into exclusive shared bicycles. (Figure 5 20) Therefore, the design provides shared bicycle parking spots in various important high-traffic areas, with an interval of approximately 150m, to meet the needs of residents for short daily trips. (Figure 5 21)

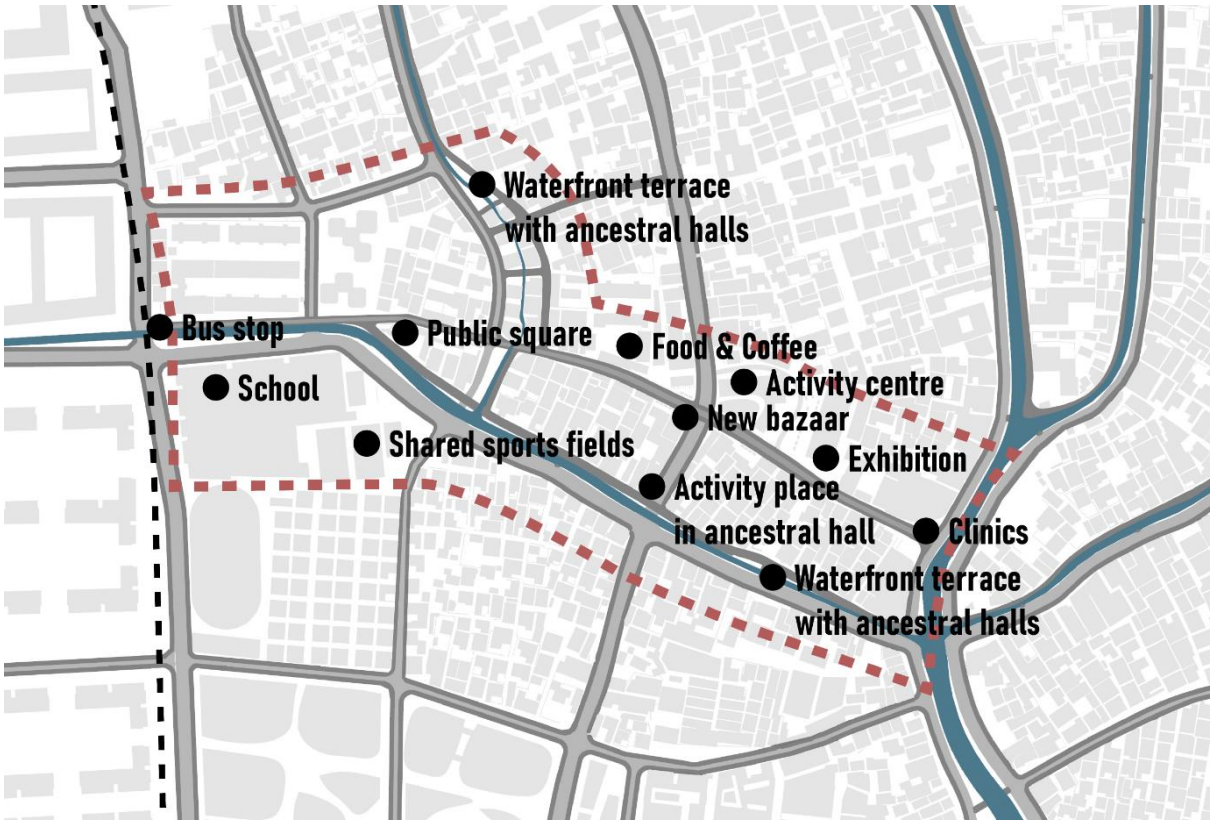


Figure 5-30 Functions in core design area (source: made by author)

Within the core design area, the functional nodes on the streets are planned according to the three main planning axes and functions. Firstly, important functional points that have existed for a long time within the village of Lijiao will be retained. Examples include the

clinic, traditional businesses and some places for daily activities under the trees. Such functional spaces will be renovated and upgraded or maintained as they are, depending on their use. Secondly, functions that are currently decaying or unable to meet daily needs will be re-established or upgraded from their original state, such as schools, ancestral halls and bus stops, to meet basic needs while designing for the future and providing higher quality services. Finally, special features are added to the streets to improve the quality of life and attractiveness of the urban village, such as public spaces, new businesses, cultural exhibitions and bazaars. By satisfying basic needs, enhancing daily needs and adding special features to improve the attractiveness of the street to different groups of people, it promotes the vitality of the street. (Figure 5 22)

5.4.6 Function & Nodes: Lijiao West Street

In Lijiao West Street, the main functions are based on leisure and sports. (Figure 5 21) The core nodes in Lijiao West Street are, from north to south, waterfront terrace, ancestral halls, public square and shared sports fields, and the street will be dominated by lifestyle services, restaurants, entertainment and leisure. Related cultural and ceremonial shops will be located around the ancestral hall to cater for ancestral hall activities. The separation of the motorway and the slow-moving street in Lijiao West Street not only provides a place for residents to live and relax, but also retains its original role as an important thoroughfare within Lijiao Village. At the same time, the parallel fast-track roads allow for the efficient introduction and decongestion of people, providing the street with an active pedestrian flow. The flow of pedestrians entering from the north of Lijiao Village will be guided by the river, with the most important node of the ancestral halls separating the slow-moving street from the vehicular road and creating a larger open space with a good natural environment. This series of spatial sequences gradually culminates in a spatial experience that reinforces the importance of the nodes and the variety of pedestrian spatial experiences, relieving the feeling of congestion and oppression within Lijiao Village and thus enhancing the vitality of the street. (Figure 5-23, 5-24, 5-25, 5-26, 5-27)

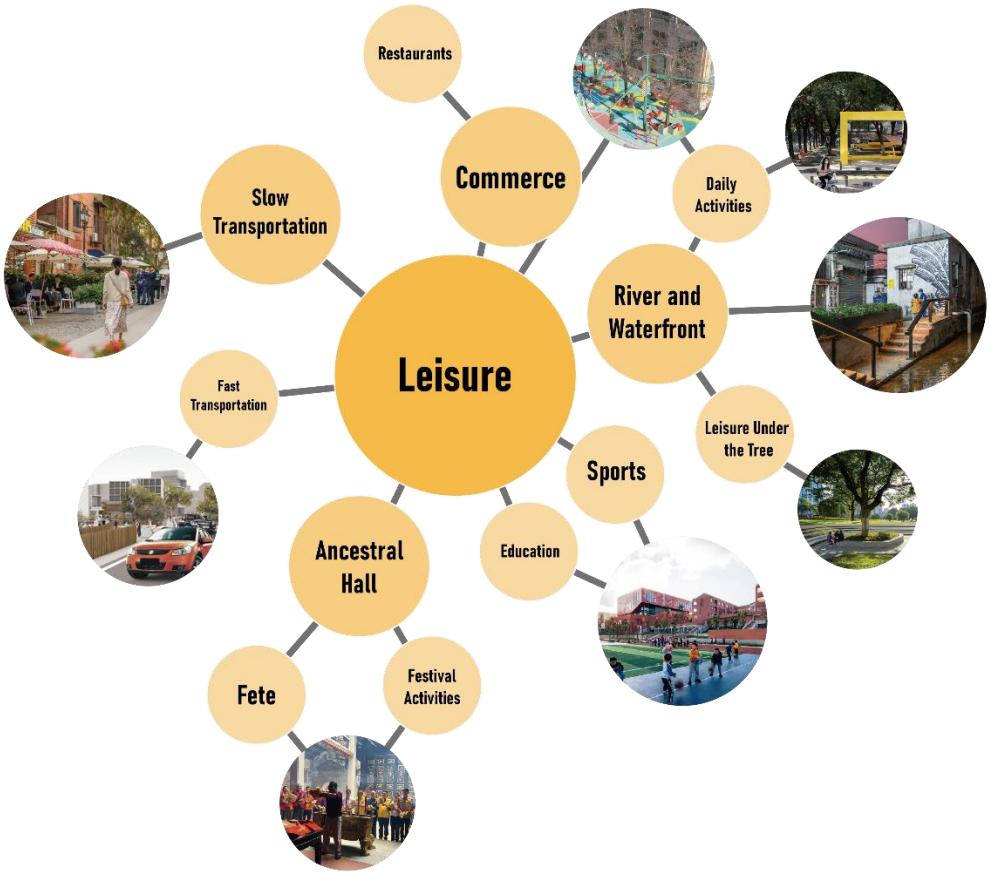


Figure 5-31 Function Programming of Lijiao West Street (source: made by author)

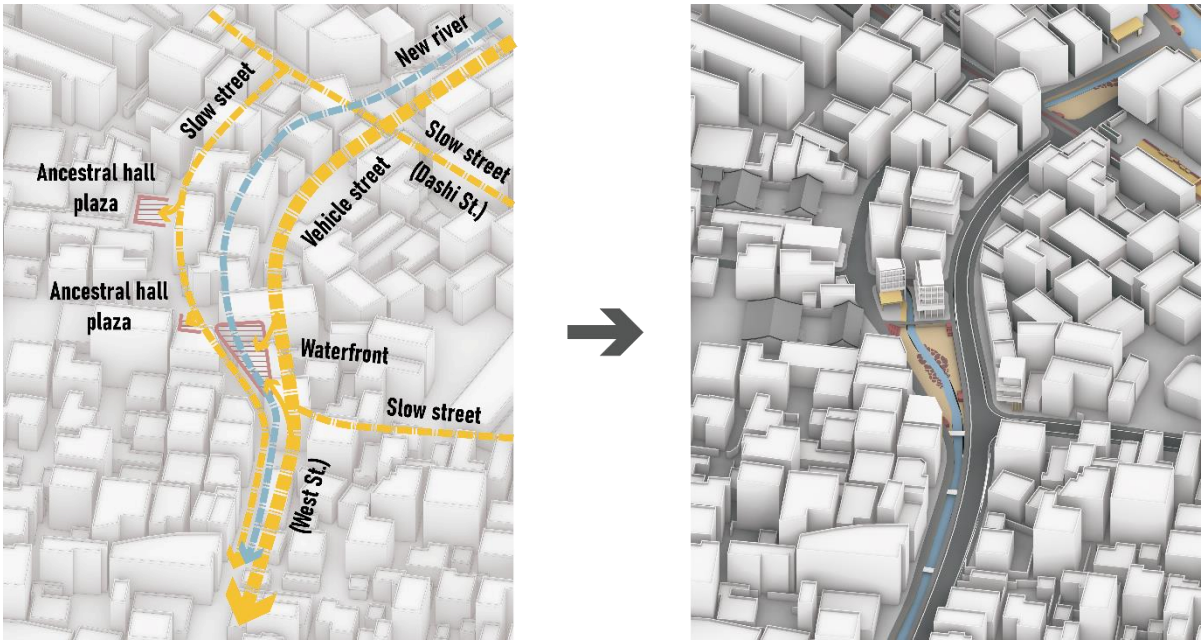


Figure 5-32 Generation of Lijiao West Street (source: made by author)

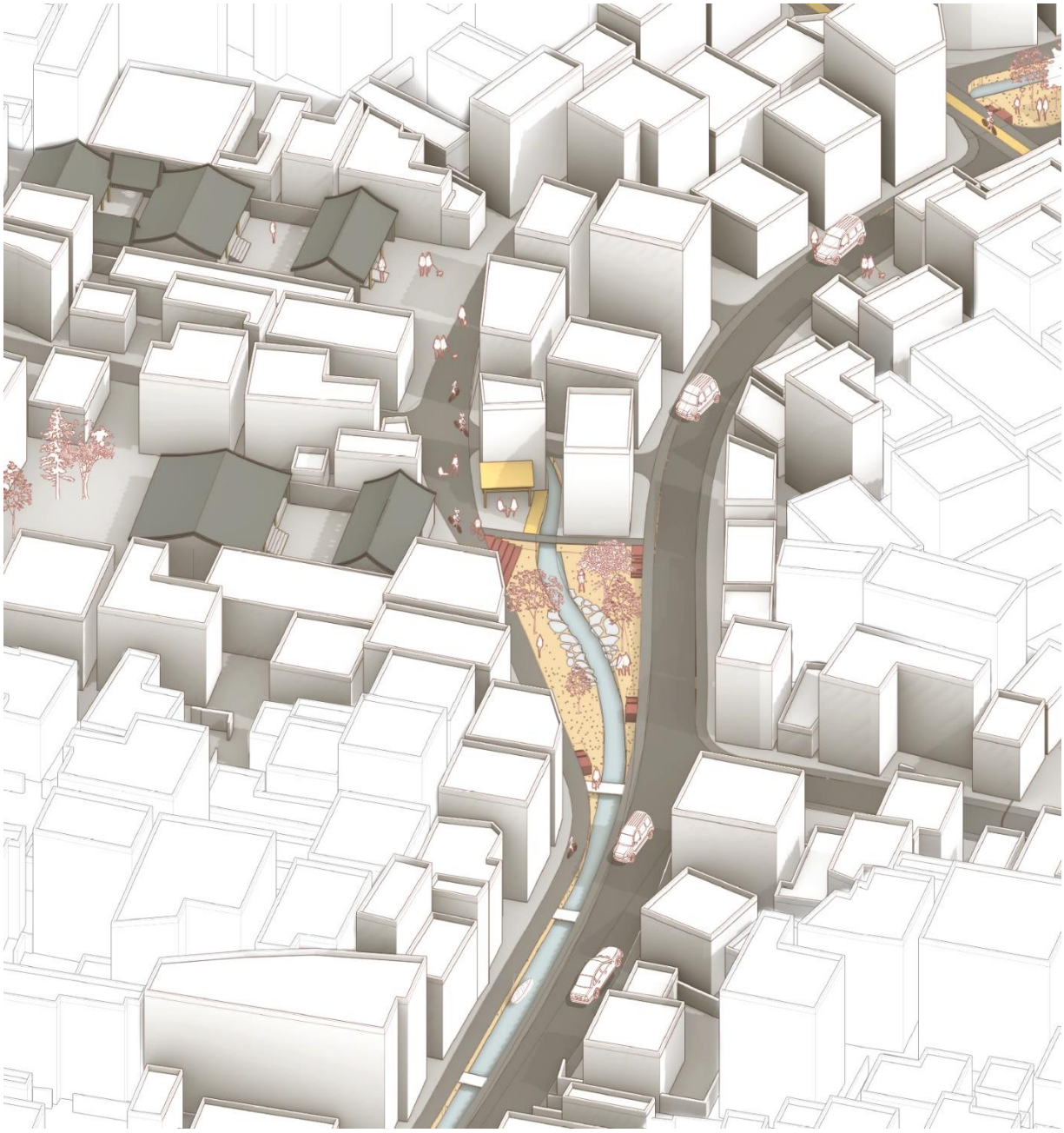


Figure 5-33 Ancestral hall plaza on Lijiao West Street (source: made by author)

Figure 5-34 Original street view of Lijiao West Street (source: Baidu Street Map)

Figure 5-35 New street view of Lijiao West Street (source: made by author)

5.4.7 Function & Nodes: Lijiao Dashi Street

In Lijiao Dashi Street, street traffic is predominantly slow, but with the same fast traffic input of incoming visitors, traffic is not blocked. Considering the large number of young

people living in Lijiao Village and the lack of places to serve them, Lijiao Dashi Street has been positioned as a new commercial and cultural street in Lijiao Village.(Figure 5 26) The core nodes of Lijiao Dashi Street consist of a sunken square, daily activities, a creative market, a cinema under the trees and cultural exhibitions, which are relatively easy to be preferred by the younger generation, providing them with a low threshold and a free space for their activities. The overall mix of businesses in Lijiao Dashi Street is lively and youthful, providing a mix of snacks and light meals, creative shops, cultural exhibitions, social institutions and public facilities serving the ancestral hall for the young residents of Lijiao Village and visitors drawn from outside the village. The business format is flexible and allows for the operation of outside shops, market salons and free-standing stalls. In order to ensure efficient movement, a relatively fast cycle lane is provided in the middle of the road to enable residents to cross quickly. These flexible commercial and cultural facilities can also be adapted to the flow of traffic due to the relatively good condition of the street and the fact that it runs parallel to Lijiao Huanxiufang Street, an important road in Lijiao Village. When traffic volumes are too high for Lijiao Huanxiufang Street to carry, Lijiao Daichi Street will serve as a route to relieve traffic congestion and play a flexible and versatile role. (Figure 5-28, 5-29, 5-30,5-31, 5-32)

Figure 5-36 Function Programming of Lijiao Dashi Street (source: made by author)

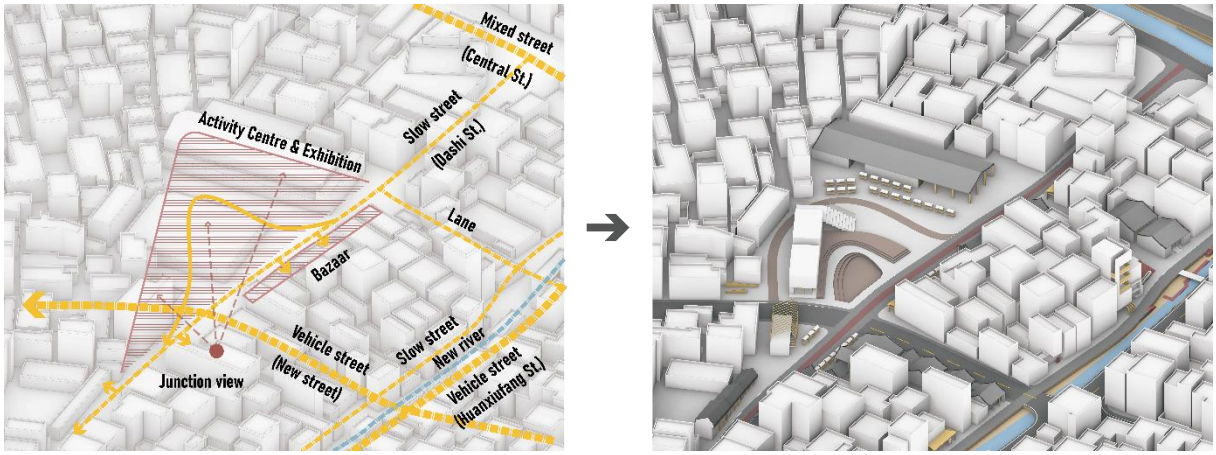


Figure 5-37 Generation of Lijiao Dashi Street (source: made by author)

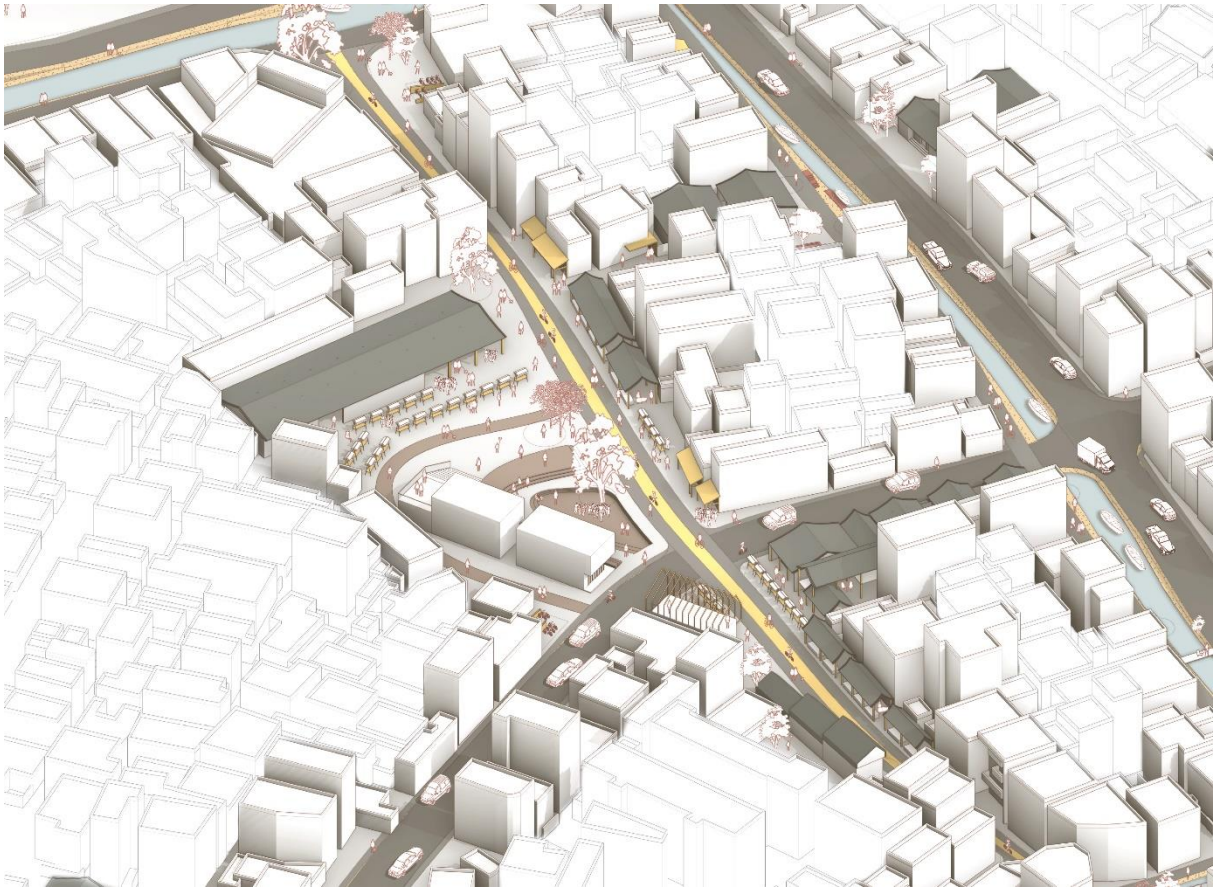


Figure 5-38 Bazaar, exhibition & activity centre on Lijiao Dashi Street (source: made by author)

Figure 5-39 Original street view of Lijiao Dashi Street (source: Baidu Street Map)

Figure 5-40 New street view of Lijiao Dashi Street (source: made by author)

5.4.8 Function & Nodes: Lijiao Huanxiufang Street

Lijiao Huanxiufang Street is an important traditional commercial street in Lijiao Village, and in its renovation, it is more oriented towards restoring its historical and traditional appearance. (Figure 5 31) The restoration of the collective historical memory is therefore a good starting point. In most sections of Lijiao Huanxiufang Street, the businesses are mainly serving the most everyday needs of the villagers of Lijiao Village, such as services, shopping, restaurants and schools. Transport facilities also need to be taken into account in the high-traffic areas. A number of ancestral halls exist on this street, which could be expanded to form landscape nodes in combination with the river and pocket park, providing more elements of ancestral and water village culture to the street. At the junction with Lijiao West Street and Lijiao Dashi Street, very close to the outside of the village, a triangular public square is formed as a transitional space between the village and the outside, reducing the impression of congestion when entering Lijiao Village from the outside. On the other side of the street is the school with shared playing fields facing the village. A primary school previously existed nearby and has been relocated, and the new primary school here fills the gap in educational

resources. At the same time, the side of the primary school near the entrance is used as a time-shared sports field, allowing the sports field to be used as a public resource and providing a place for residents to play. These fields also provide easy access for students to and from school, being able to act as a buffer zone for parental drop-offs and pick-ups, and are quickly relieved by two motorways within the village. (Figure 5-33, 5-34, 5-35, 5-36, 5-37, 5-38, 5-39)

Figure 5-41 Function Programming of Lijiao Huanxiufang Street (source: made by author)

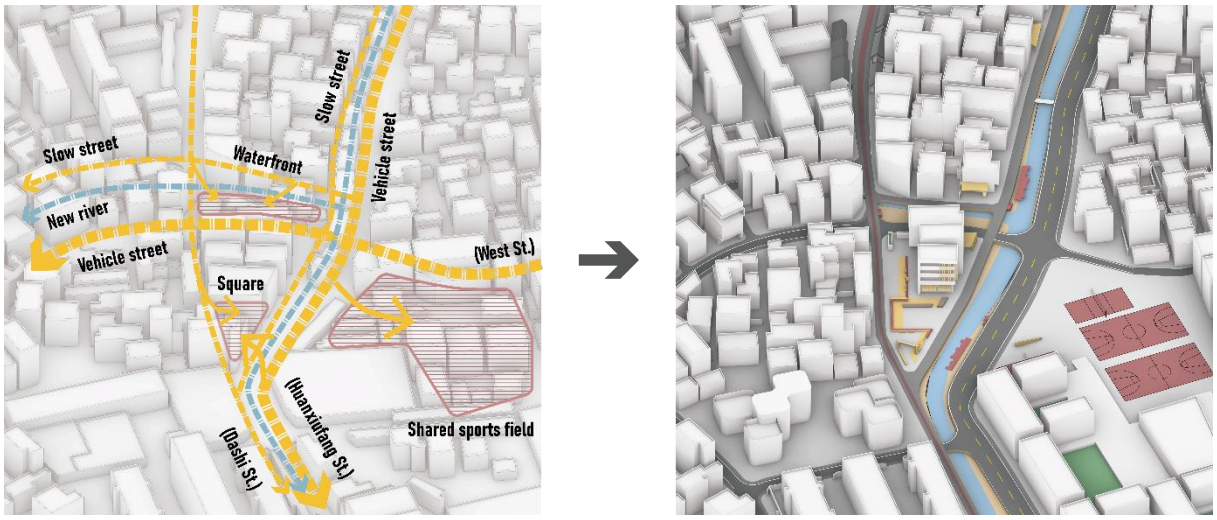


Figure 5-42 Generation of Lijiao Huanxiufang Street (source: made by author)

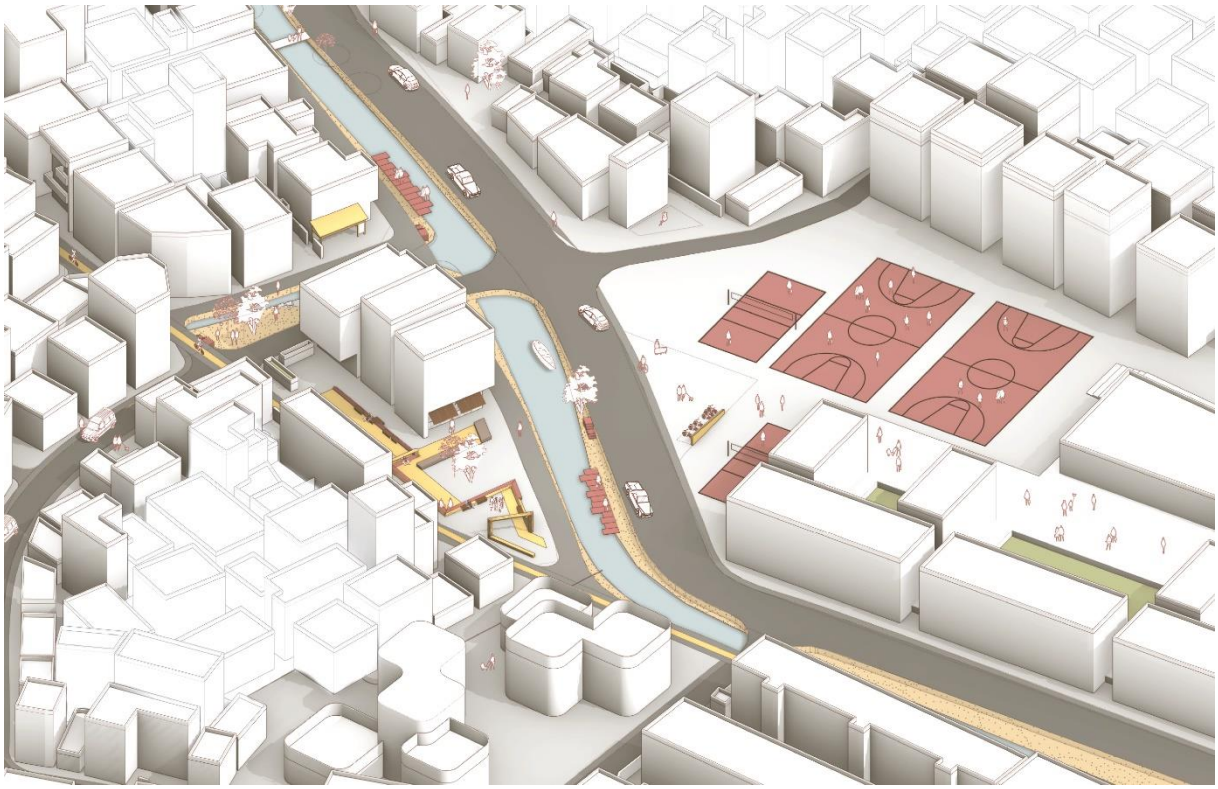


Figure 5-43 Shared sports field & public square on Lijiao Huanxiufang Street (source: made by author)

Figure 5-44 Original street view of Lijiao Huanxiufang Street (western part) (source: Baidu Street Map)

Figure 5-45 New street view of Lijiao Huanxiufang Street (western part) (source: made by author)

Figure 5-46 Original street view of Lijiao Huanxiufang Street (eastern part) (source: Baidu Street Map)

Figure 5-47 New street view of Lijiao Huanxiufang Street (eastern part) (source: made by author)

5.5 Renovation Samples

In the Core design area, there are two types of building renovation, ancestral halls and street buildings.

5.5.1 Ancestral Halls

There are three main types of transformation of the ancestral halls, which correspond to the relationship between the hall and the surrounding streets and environment.

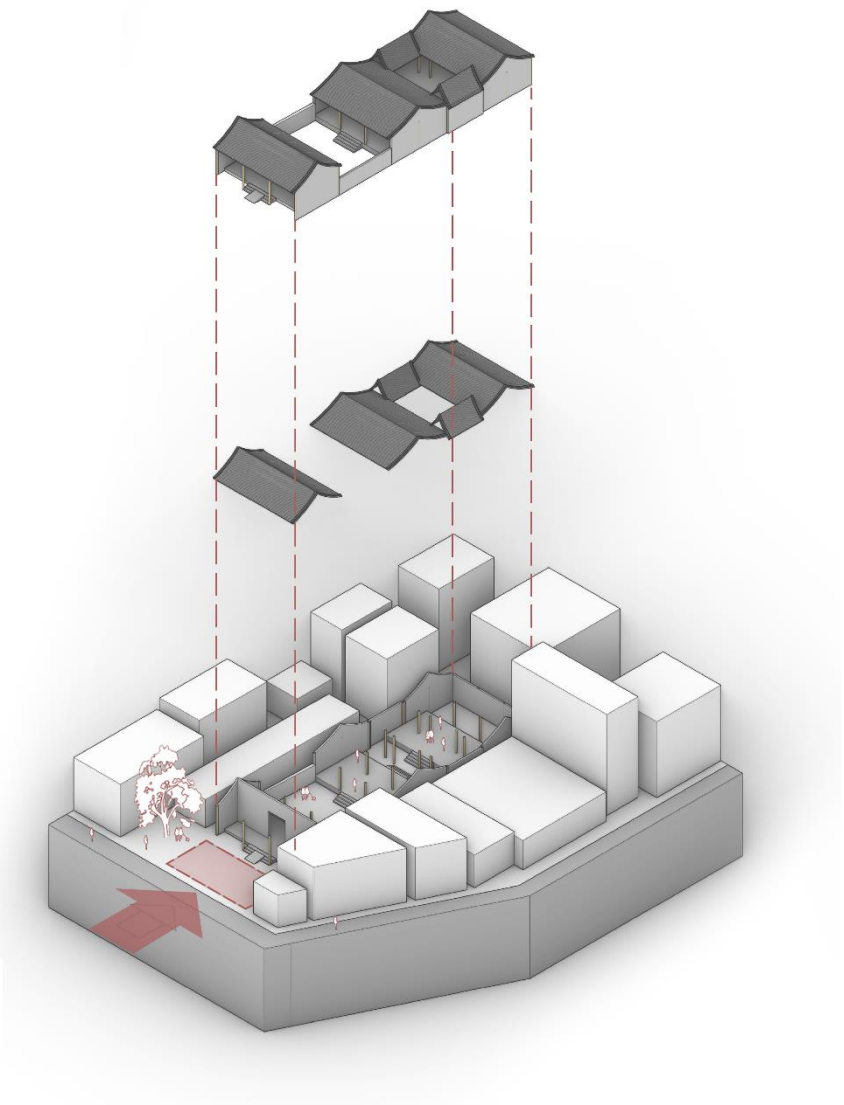
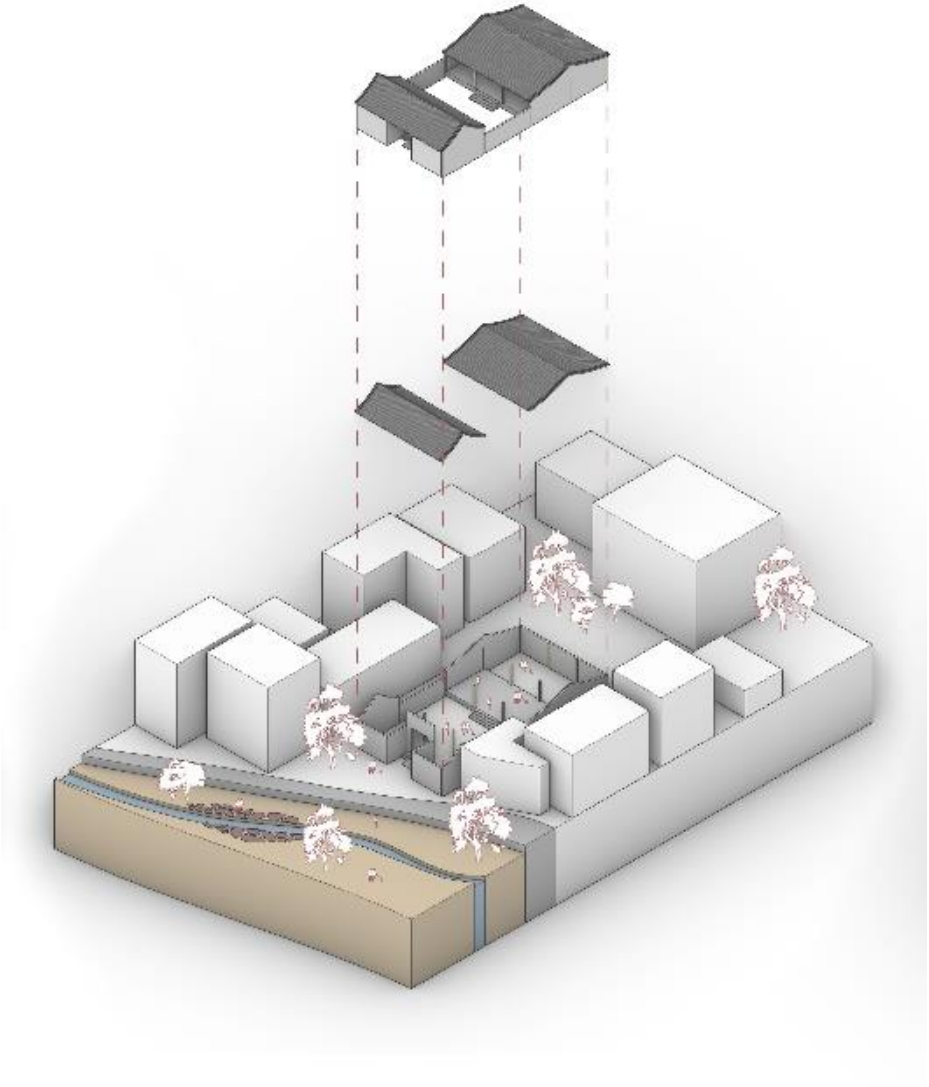


Figure 5-48 Renovation samples of ancestral halls Number 1 (source: made by author)

The first type is an ancestral hall which is located on one of the street sides. (Figure 5 48) This type of ancestral hall is usually largely surrounded by buildings on the other three sides,

with the main orientation facing the street; in a few cases the main orientation of the ancestral hall is completely surrounded by additional buildings, with no main street passing through. This type of ancestral hall requires an emphasis on the relationship between the front space and the surrounding buildings. In spaces where there is no main street passing through, new streets need to be created first so that the ancestral hall is exposed to the street. Where conditions permit, the ancestral hall gate forms a recessed square space with the surrounding buildings. This space not only emphasises the presence of the ancestral hall and its importance in Lijiao Village, but also provides a buffer space to enter the ancestral halls. This space can also host relatively casual daily activities and small-scale landscape elements, and can provide a pleasant space for short stays on the street, effectively enhancing its vitality.



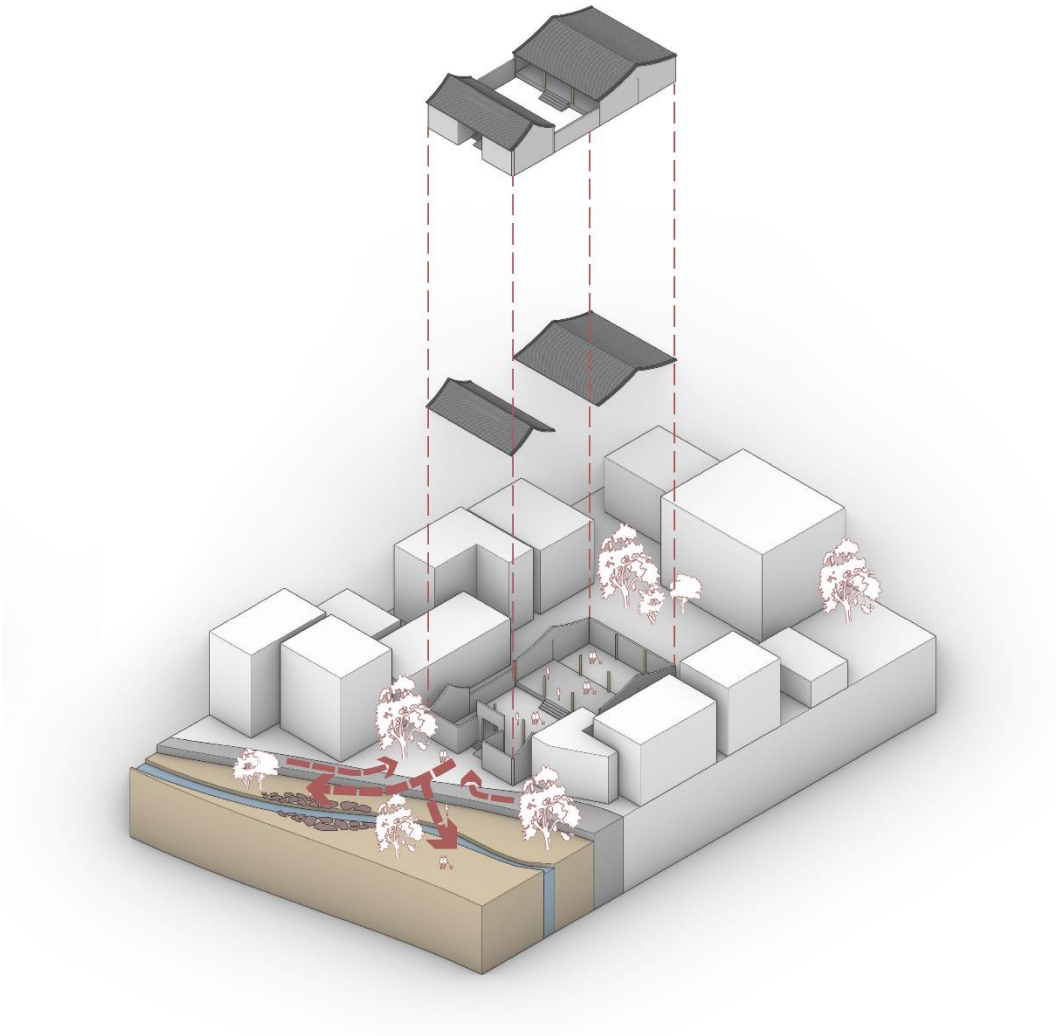


Figure 5-49 Renovation samples of ancestral halls Number 2 (source: made by author)

The second type is also an ancestral hall with a street frontage, but the ancestral hall faces directly onto the river. (Figure 5 49) This type of ancestral hall is similar to the first type of transformation, but needs to be transformed in a way that enhances the linkage with the riverbank. Visual and behavioural links with the ancestral hall can be formed in the planting and landscape design to extend the reach of both and gain greater appeal.

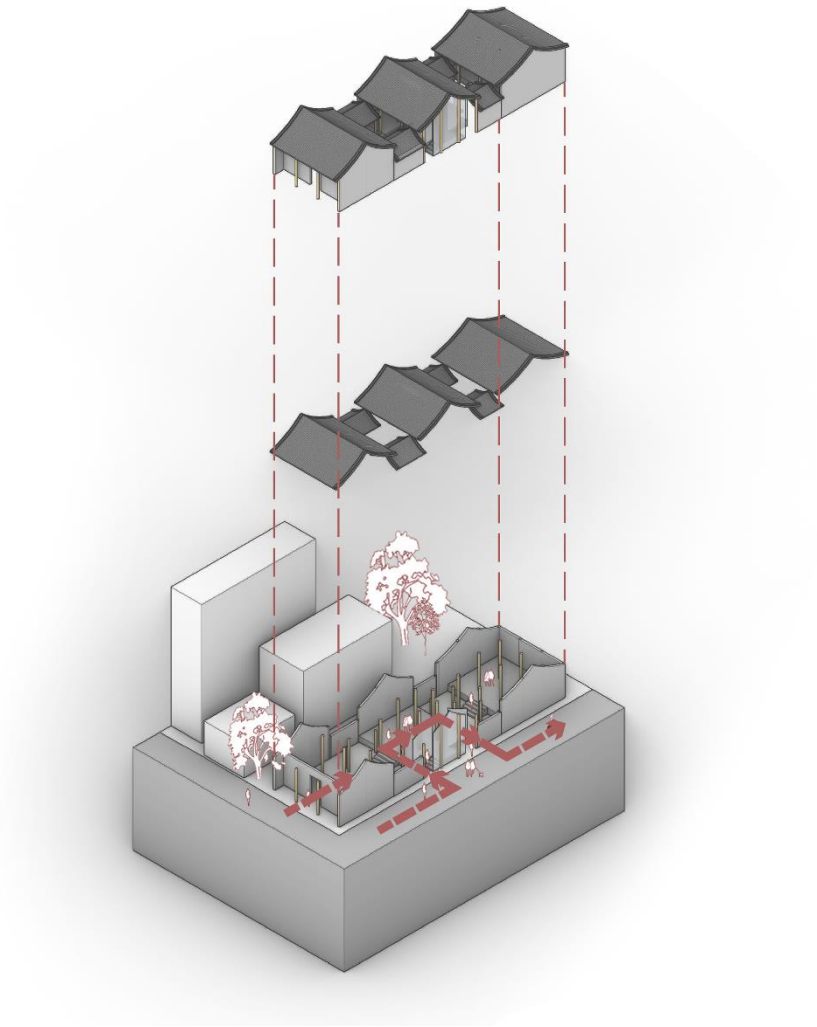


Figure 5-50 Renovation samples of ancestral halls Number 3 (source: made by author)

The third type of ancestral hall is the one with two street fronts, which is located on the corner of street. Usually, the walled side of the ancestral hall is not open and therefore creates a non-interactive wall-like interface on the street parallel to it. In order to obtain a more interactive interface, the side of the ancestral hall can be deflated by using a relatively permeable façade or by adding an entrance so that passers-by can observe the activities taking place inside and can easily join in. This semi-permeable space can be used to limit the activity to one place and reduce the impact on the surrounding area, but also to act as a stage in the street and increase the sense of participation of passers-by in the street. (Figure 5 50)

5.5.2 General Buildings

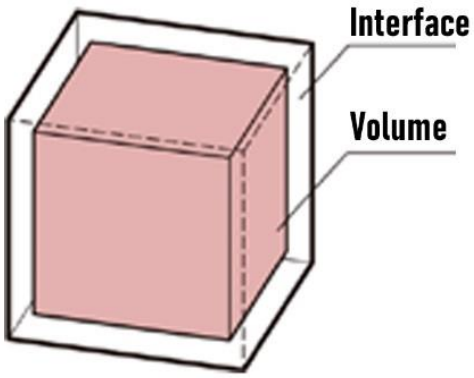


Figure 5-51 Relationship between interface and volume (source: Research of Urban Villages Renewal Based On "Flexible Interface": A Case Study of Xi'an City, Kong Zimeng and Li Yueyan)

In general, these approaches are designed to break the hard street interface that is common to Lijiao Village and most urban villages, which is one of the most important reasons for the lack of vitality. Streets with too hard an interface are often characterised by non-interactive buildings along the street, excessively straight and impenetrable building rows, long walls and a lack of public services and commercial functions. In a word, uninteresting streets with too rigid an interface restrict the range of human activity to the road surface, which is used for passage and difficult to stay on, and lack the elements or conditions that draw people into the space created by the buildings on either side of the street or between them. These elements and conditions are the key to solving this problem.

It should be noted that the concepts of "Interface" and "Volume" do not exactly coincide. Figure 5 51) The former is a description of the state of existence of things in their environment, the latter is an expression of the state of things themselves. Interface is usually larger than Volume. In urban space, Interface expresses the state of boundaries and the relationship to the city, the first point of contact between people and the city; Volume is the perception of the internal spatial organisation of the neighbourhood and represents the real state of the building in its physical environment.[22] The softening of the street interface is therefore not only a matter of manipulating the volume of the building, but also of taking

human behaviour and psychological perception as an important reference point.

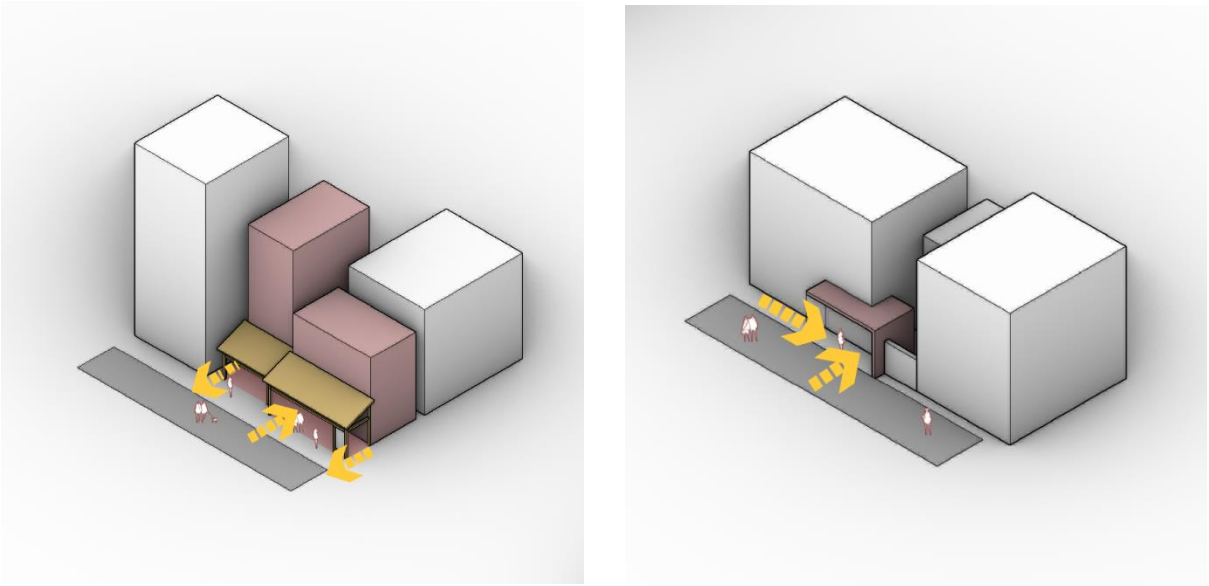


Figure 5-52 "Extend" (source: made by author)

The "Extend" approach is applied to large recessed spaces or straighter street interfaces that require attention, and uses mainly lighter signage, canopies and commercial outbuildings to mark entrances, extend building masses and increase business space. This approach places more emphasis on the building and is an extension of the building by attracting people to the interior of the building or the activities that occur in relation to its function. (Figure 5 52)

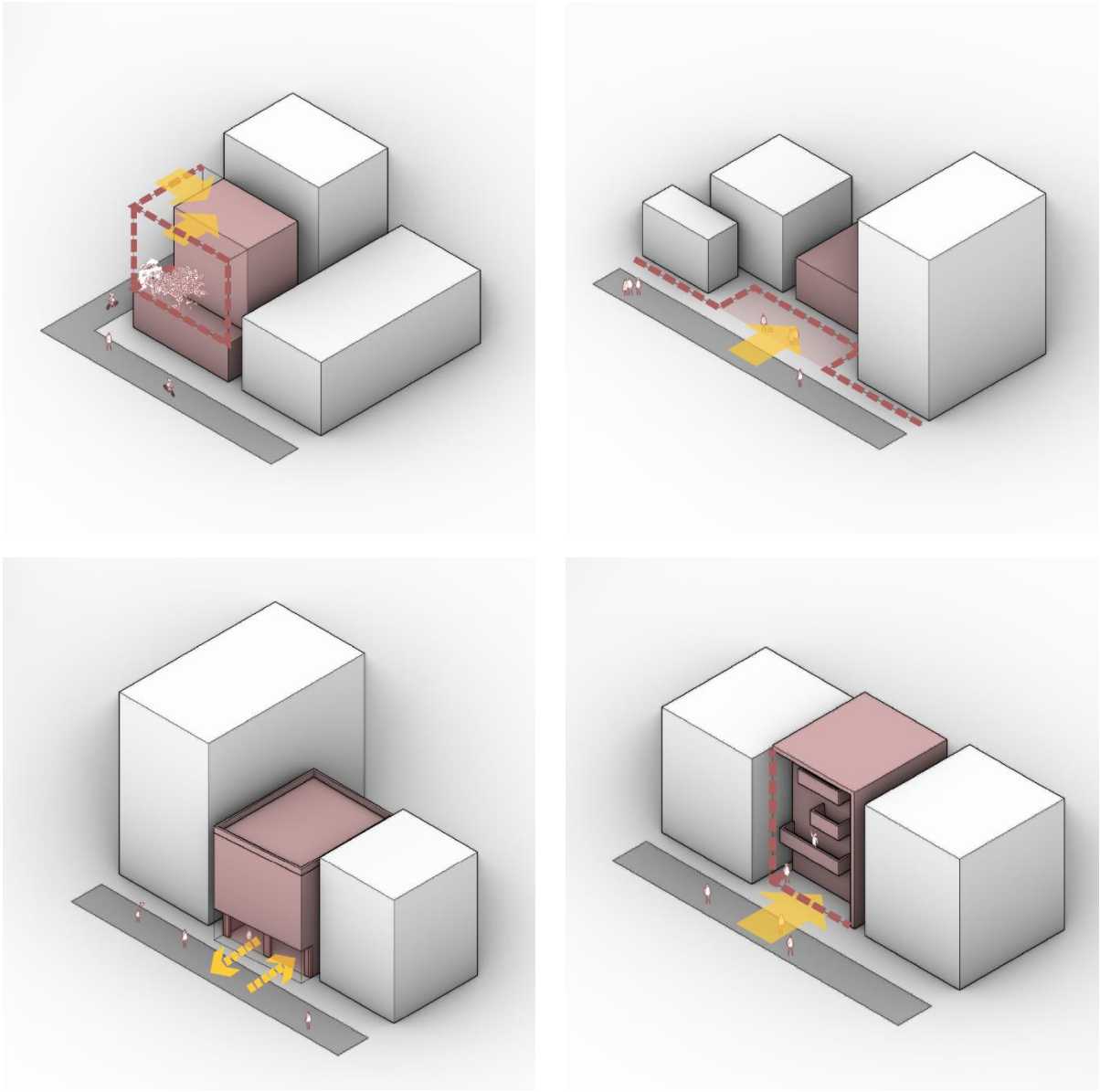


Figure 5-53 "Shrink" (source: made by author)

The "Shrink" approach in Lijiao Village is mostly used when the volume of buildings along the street takes up too much of the pedestrian view or creates a long, non-interactive street interface. In Lijiao Village, many of the narrow streets are flanked by taller buildings, which tend to make pedestrians feel cramped and oppressed. Reducing and compressing the massing of the higher floors of the buildings can effectively increase the area of sky in view and shift the eye to the ground floor along the street where it is closer to people. For longer continuous street interfaces, building setbacks as a whole, partial setbacks, first floor setbacks

or elevations can be used to make more space for the street. This type of design approach places more emphasis on the street, enables interactive recessed spaces to be embedded in the street and also solves the problem of people finding it difficult to stay in the street. (Figure 5 53)

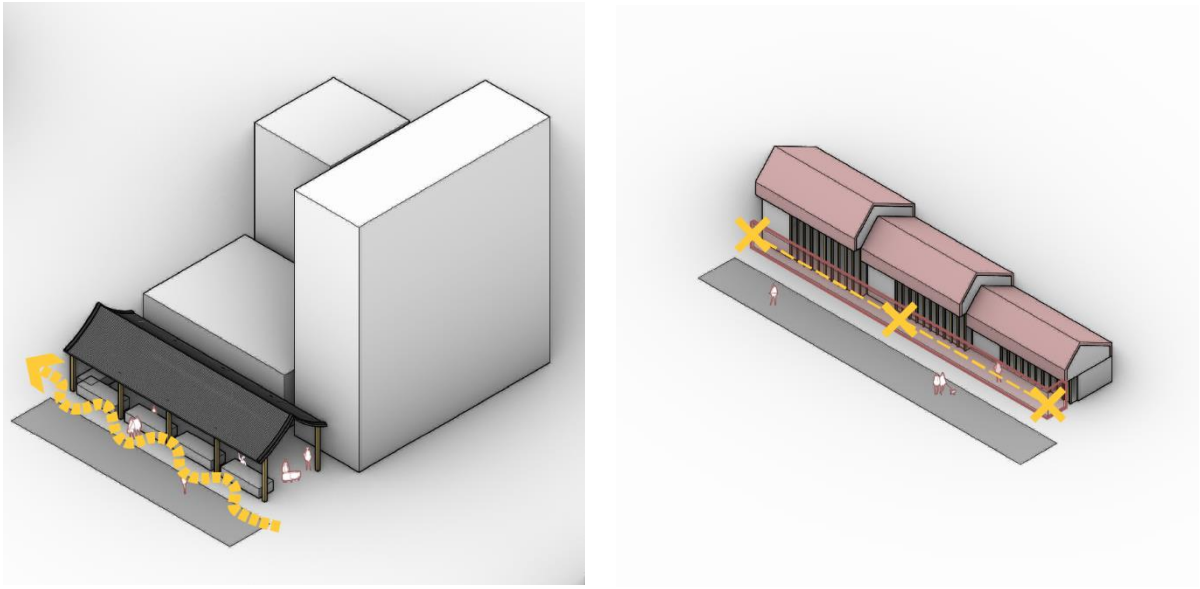


Figure 5-54 "Replace" (source: made by author)

The "Replace" take two main forms within the design: the conversion of temporary parking sheds and the replacement of walls. A common feature of both is the denial of human access and interaction. Lijiao Dashi Street, where the temporary parking shed is located, is designed to be an important slow and active street, the impact of which is entirely negative, and the function of parking has been shifted outwards. Within this long linear space, a marketplace with a high degree of flexibility and interest is the best option, which also complements the new businesses and public facilities in the vicinity. Walls are generally used to define an internal space, but buildings can also take on this function. The building can extend the wall into a space that interacts with the outside world, both in terms of efficiency of use and impact on the street. (Figure 5 54)

Conclusion and Discussion

Conclusion

In Lijiao Village, it is clear from the above analysis that the enhancement of street vitality has become a major issue that needs to be addressed within the village. With a large number of residents, the lack of street vitality has led to an inefficient use of space within the village. Streets that are not sufficiently vital are often lacking in a variety of businesses and good street conditions, causing residents to travel outside the village to meet their living and working needs. At the same time, this pattern of behaviour accelerates the decline in the vitality of the streets within the village, creating a vicious circle. The result is a spatial phenomenon in which commerce declines, culture is buried and daily activities are difficult to carry out. This lack of spatial belonging and comfort has led to a psychological shift in the villagers, who no longer have a high sense of responsibility for the environment they live in. This has resulted in a large number of building additions and destruction of natural resources. In the long term, this will cause irreversible damage to the daily life and character of the village.

In addition, the village of Lijiao suffers from street vitality problems as well as problems with its own village structure. The village of Lijiao is a long-established natural village with a village form and street system that is highly linked to the river network. For the earlier agricultural way of life, this natural form tied to water was conducive to traffic movement and productive life. In modern times, however, the river has been filled in, the ecology destroyed and the quality of the space degraded in the interests of efficiency of movement and access to space. The problem of the village of Lijiao not adapting to modern urban life needs to be targeted at its own village structure and the root cause of the problem needs to be unblocked.

In terms of design, the use of space syntax to integrate the urban road network from the perspective of the village as a whole and to improve the spatial experience in conjunction with the street section form can provide the basis for the street to become vital; on a micro level, the use of streetscape data and POI analysis to identify functional and spatial elements

and use them to develop new functional plans and spaces can lead to spaces and businesses that are more in tune with the current social context, creating new social energies and attractions. This combination of digital analysis and traditional design techniques can identify pain points more accurately and provide personalised design strategies, laying a good foundation for refined design.

Similarly, urban villages in Guangzhou, and indeed in other cities across China, also suffer from different types of vitality problems to a greater or lesser extent. This dilemma stems from the rapid urbanisation process, which is an inevitable part of urban development. Most of the current problems in urban villages need to be solved by means of planning and design, and residents should be guided to adapt their living environment in the right and benign direction. The urban village is also a special area for the city, and the city needs to face up to its existence and discover its significance to the city. Urban managers also need to devote more attention to urban villages to promote a mutually beneficial coexistence between cities and urban villages.

Discussion

As an emerging trend in analysis and design, digital analytics has increasingly become an integral part of design. Digital analytics can start from raw data and provide objective, accurate and sensitively processed and collated data to designers, ultimately yielding different perspectives on analysis and design strategies.

However, the technology is not currently considered to be a complete or mature design system and there is still much room for improvement and optimisation.

In terms of the technology itself, a significant proportion of it cannot be called mature. Some of it lies at the level of tools, some at the level of algorithms and some at the level of standards development. In addition, there is still considerable resistance to access to some of the information. The current level of informatisation in Chinese cities is not yet high enough, open-source resources are not sufficient and raw data is difficult to obtain, making this part of information resources monopolised at a high price or even not made public. This not only causes a lot of duplication of work, but also makes accurate analysis of cities more difficult,

reduces the enthusiasm of researchers and makes the construction of smart cities based on big data encounter obvious obstacles.

From the point of view of the user of the technology, the designer, the ability to extract the key elements from the mass of data varies, as does the level of knowledge and use of tools. As an important design direction for the future, designers need to be more sensitive to data. At the same time, more thinking at the abstract data and algorithmic level should be incorporated into design, and more mathematical logic should be incorporated into analysis and design. In short, there is still a long way to go in incorporating digital analytics in design.

In summary, not only in the shaping of street vitality, but in any aspect of design, digital analytics currently still requires a degree of assistance from traditional analytical methods. But this is not a bad thing. The city is not a precision-run machine, nor does it need to prioritise efficiency at all times. Algorithms are accurate, but they usually lack a human touch. A humane neighbourhood needs to evoke a passion for life in its inhabitants, and this requires a keen sense of smell and empathy on the part of the designer, as well as a collaborative effort between the designer and the inhabitants. This is something that designer cannot be completely replaced by machine. But by combining the two to form a cocktail of therapies for the city, progress can be made in both directions, contributing to a higher level of design and a better living environment.

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