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South China University of Technology

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中小城市社区型商业街区空间优化策略研究
——以常德老西门街区为例

作 者 姓 名	莫欣嘉
学 位 类 别	建筑学硕士
指 导 教 师	导师组
所 在 学 院	建筑学院
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Study on Spatial Optimization Strategies for Community Commercial Street Districts in Small and Medium-sized Cities — A Case Study of the Laoximen District in Changde

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Candidate：MO Xinjia

Supervisor：Supervisor Group

South China University of Technology

Guangzhou, China

分类号：TU98 **学校代号：10561**

学　号：202321006334

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作者姓名：莫欣嘉　　指导教师姓名、职称：导师组

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答辩委员会成员：

主席：庄少庞副教授

委员：苏平教授、李敏稚副教授、孙永生教授级高工、A. Prof. Mauro Berta

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作者签名：莫欣嘉　　日期：2026.5.25

指导教师签名：　　日期：2026.5.25

作者联系电话：15506904131　　电子邮箱：1290020370@qq.com

联系地址(含邮编)：广州市天河区五山路 381 号建筑学院（510640）

摘 要

随着城市更新由增量扩张逐步转向存量更新，中小城市部分特色街区在发展过程中逐渐面临外来活力不足、空间使用效率下降等问题。相较于大城市更多依赖消费与旅游带动的外来人流，中小城市街区的活力往往更多建立在周边居民日常使用的基础之上。一些街区在更新过程中仍以商业导入和形象塑造为主导，对居民在通行、停留、休憩与交往等方面的实际需求回应不足，导致空间功能定位与实际使用之间出现偏差，街区整体活力难以持续提升。常德老西门街区呈现出居民日常使用较为稳定但商业吸引力和公共空间承载力不足的特征，具有一定典型性。研究其公共空间活力的形成机制与优化路径，对于中小城市社区型商业街区更新具有一定的理论意义和实践价值。

本文以中小城市社区型商业街区公共空间为研究对象，以常德老西门街区为案例，从日常使用视角出发，围绕街区公共空间活力的形成机制与优化路径展开研究。研究结合环境行为学、日常性理论与公共空间设计理论，构建了面向社区型商业街区的分析框架，并从空间结构、功能供给、环境条件与停留设施四个维度建立建成环境指标体系。通过行为观察、实地调研与建成环境量化分析等方法，对街区公共空间活力分布特征及其影响机制进行系统分析。

研究表明，老西门街区当前活力总体上以居民日常使用为主导，活力空间呈现沿滨水空间展开、节点集聚的分布特征，步行、坐憩、交谈与跳舞等活动构成街区活力的主要来源；局部整合度、座椅密度、日照时长与遮阴面积率是影响街区公共空间活力的关键因素。整合度决定了人流集聚的基本结构，座椅密度直接影响停留与交往行为的发生，日照与遮阴条件体现出微气候环境对不同时段使用行为的显著影响。结合定量分析与现场观察，街区仍存在高可达性空间缺乏停留支撑、微气候资源利用不足、设施配置与使用需求错位、商业业态与界面组织不协调、景观资源未能有效转化为实际使用等问题。

针对上述问题，本文提出以小尺度、渐进式更新为基本路径的空间优化策略，从更新原则、空间组织与节点设计三个层面形成面向街区公共空间的应对思路。研究认为，中小城市社区型商业街区的活力提升不应单纯依赖商业导入，而应立足居民日常使用需求，通过公共空间环境的精细化优化提升街区的使用效率、活力稳定性与综合吸引力。本文可为中小城市社区型商业街区在存量更新背景下实现渐进式空间优化与活力提升提供参考。

关键词：社区型商业街区；建成环境；公共空间活力；中小城市；常德老西门街区

Abstract

As urban regeneration shifts from incremental expansion to renewal within the existing urban stock, some characteristic districts in Small and Medium-sized Cities are increasingly facing insufficient external vitality and declining spatial use efficiency. Unlike large cities, where vitality is more often supported by consumption and tourism, the vitality of districts in Small and Medium-sized Cities relies more on the everyday use of surrounding residents. In some renewal projects, commercial introduction and image-making are still prioritized, while residents' actual needs for movement, staying, resting, and social interaction are insufficiently addressed. This creates a mismatch between spatial functions and actual use and makes it difficult to sustain district vitality. The Laoximen District in Changde, which shows stable everyday use but insufficient commercial attractiveness and public space capacity, is a representative case.

This study takes the public space of Community Commercial Street Districts in Small and Medium-sized Cities as the research object, using the Laoximen District in Changde as a case study. From the perspective of everyday use, it examines the formation mechanism and optimization path of public space vitality. Based on environmental behavior theory, everydayness theory, and public space design theory, the study constructs an analytical framework and establishes a built environment indicator system from four dimensions: spatial structure, functional supply, environmental conditions, and staying facilities. Behavioral observation, field investigation, and quantitative analysis of the built environment are used to examine the spatial distribution of public space vitality and its influencing mechanisms.

The results show that the vitality of the Laoximen District is mainly dominated by residents' everyday use. Vitality spaces are distributed along the waterfront and characterized by node-based concentration. Walking, sitting, talking, and dancing constitute the main sources of vitality. Local integration, seating density, sunshine duration, and shade coverage ratio are the key factors affecting public space vitality. Local integration determines the basic structure of pedestrian concentration. Seating density directly affects staying and social interaction. Sunshine and shade conditions reflect the significant influence of microclimatic

conditions on spatial use at different times of day. Quantitative analysis and field observation further show that the district still faces problems such as the lack of staying support in highly accessible spaces, insufficient use of microclimatic resources, mismatch between facility provision and actual needs, conflict between commercial formats and interface organization, and the limited transformation of landscape resources into actual use.

In response, this study proposes a spatial optimization strategy based on small-scale and incremental renewal. It develops a framework for public space improvement from the three levels of renewal principles, spatial organization, and node design. The study argues that vitality enhancement in Community Commercial Street Districts in Small and Medium-sized Cities should not rely solely on commercial introduction. It should instead respond to residents' everyday use needs and improve spatial use efficiency, vitality stability, and overall attractiveness through the refined optimization of public space.

Keywords: Community Commercial Street District; built environment; public space vitality; Small and Medium-sized Cities; Laoximen District in Changde

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Chapter 1 Introduction

1.1 Research Background

1.1.1 The problem of insufficient external vitality in the renewal of urban characteristic districts

In recent years, as population growth has slowed and some cities have experienced population loss, the development momentum of certain cities has gradually weakened, and the attractiveness of district spaces has correspondingly declined. Some urban districts that once supported public activities and commercial consumption have gradually shown a lack of popularity and a decline in frequency of use. Compared with large cities, which rely on external flows generated by consumption and tourism, some Small and Medium-sized Cities, constrained by weaker industrial foundations and the outflow of young people, find it difficult to generate stable external consumption demand. As a result, the vitality of their districts depends more on the everyday use of surrounding residents to maintain basic operation.

Against this background, some cities have continued to adopt renewal models led by concentrated commercial introduction and spatial image improvement in district regeneration. However, due to relatively low local population mobility and limited consumption capacity, such renewal paths often fail to generate sustained and stable pedestrian support, and a clear gap frequently emerges between the actual use of commercial space and the intended goals. At the same time, many cities have tended to adopt similar spatial forms and commercial formats in renewal practice, leading to a lack of distinctive character among districts and further weakening their ability to attract external users. Under conditions of limited population and consumption bases, how to improve the efficiency and vitality of district spaces through spatial optimization and functional adjustment has become an important issue in the renewal of commercial districts in Small and Medium-sized Cities.



Figure1-1 A declining commercial district
(Source: photographed by the author)

1.1.2 The phenomenon of resident-dominated use in urban characteristic districts

Against the background of urban quality improvement and renewal, the supply of public space in some urban districts remains relatively insufficient, while residents continue to have ongoing needs for outdoor socializing, leisure, and exercise. As a result, these districts have gradually come to be used mainly by surrounding residents in practice, and to some extent have shown the use characteristics of a Community Commercial Street District. Such districts are usually defined in planning as characteristic districts or commercial districts, yet in actual operation, passing through, staying, and simple social interaction gradually become the most stable types of activity, and the center of public space use correspondingly shifts toward everyday activities.



a) Residents exercising in district space



b) Residents socializing in district space

Figure1-2 Everyday use in district spaces
(Source: photographed by the author)

The gap between planning positioning and actual use has created new coordination problems for the spatial organization of districts. Although spatial configurations dominated by commercial functions provide a certain amount of public activity space, they still respond inadequately to residents' needs for staying, interaction, and rest. Everyday activities form a stable base of pedestrian flow, yet in the absence of effective guidance and zoned organization, they may also interfere with commercial interfaces and, in turn, affect the overall order of use and vitality performance of the district.

Compared with some characteristic commercial districts in large cities, which are able to maintain vitality through tourism consumption, city-level commercial resources, and external visitor flows, similar districts in Small and Medium-sized Cities usually have more limited support from external consumption. Their daily operation is therefore more likely to rely on the high-frequency use of local residents. Accordingly, the renewal of Community Commercial Street Districts in Small and Medium-sized Cities should not simply follow a renewal logic centered on the attraction of external consumption and image-making. Greater attention should instead be paid to the everyday needs of surrounding residents in terms of passing through, staying, resting, social interaction, and basic consumption. On this basis, the role and boundaries of public space in meeting everyday activity needs while accommodating commercial functions also need to be further clarified. How to coordinate the relationship between residents' everyday activities and commercial functions under diverse use demands, and how to guide this relationship through spatial organization, is a key issue to be explored in this study.

1.1.3 Opportunities for public space optimization under an everyday use-oriented approach

In recent years, everyday life has increasingly been regarded as an important carrier of urban locality and authentic characteristics. Some spaces shaped by local ways of life and real use scenarios, such as the Jianguomen Old Vegetable Market Cultural and Creative District in Xi'an and the Shuangta Market in Suzhou, have created public spaces with regional character through the retention and transformation of everyday activities, and have gradually become

important symbols of urban culture. This indicates that spatial organization grounded in residents' actual use can provide a new path for vitality shaping in characteristic districts.

From the perspective of use characteristics, everyday activities such as passing through, staying, resting, and simple social interaction are frequent and continuous, and constitute an important basis for maintaining stable pedestrian flow in districts. Compared with short-term activities driven by external consumption, this type of everyday use has an accumulative effect over time and is more conducive to the formation of sustained district vitality.

In terms of spatial conditions, public spaces with good openness and continuous interfaces, such as pedestrian spaces and some waterfront spaces, are more likely to support everyday activities. Such spaces usually have better environmental quality and accessibility, providing basic conditions for staying and interaction. In addition, some districts are more closely connected with surrounding communities and are therefore more easily integrated into residents' daily activity systems, giving them certain advantages in accommodating public activities.

In the renewal of characteristic districts in Small and Medium-sized Cities, public space is the key carrier linking everyday use and district vitality. The stable pedestrian flow formed by residents' daily activities constitutes an important foundation of district vitality, while the organizational form and conditions of use of public space directly affect whether this everyday vitality can be sufficiently supported and effectively released. Under the condition of limited external consumption vitality, an everyday use-oriented approach that takes public space optimization as the entry point can tap into the district's existing vitality potential by improving conditions for staying, accessibility, and comfort of use, thus providing a gradual path for the renewal of characteristic districts in Small and Medium-sized Cities that differs from a consumption-oriented approach.

1.2 Research Objectives and Significance

1.2.1 Research objectives

This study takes the Community Commercial Street District in Small and Medium-sized Cities as its research object and selects the Laoximen District in Changde as a typical case. In

the current context of urban renewal, some characteristic districts face insufficient vitality generated by external consumption during development, and spatial use has gradually shifted toward daily activities led by surrounding residents. However, the existing spatial organization and functional configuration remain mainly commercial-oriented, resulting in a certain mismatch between public space use and functional positioning and making it difficult for overall district vitality to improve continuously.

From the perspective of everyday use, this study focuses on public space within the district. Through behavioral observation and quantitative analysis of the built environment, it identifies the use characteristics of district public space and the patterns of vitality distribution, and explores the mechanisms through which built environment factors affect public space vitality. On this basis, it summarizes the key spatial factors and existing problems that influence the formation of district vitality, and further proposes public space optimization strategies oriented toward everyday use in order to improve the efficiency of space use and the overall vitality level of the district.

This study aims to clarify the basis and pathways through which public space vitality is formed in Community Commercial Street Districts in Small and Medium-sized Cities, and to reveal their operational mechanisms under the intertwined context of consumption activities and public life. It seeks to provide both theoretical reference and practical support for similar districts in achieving gradual vitality enhancement based on everyday use under the conditions of incremental urban renewal.

1.2.2 Research significance

(1) Theoretical significance

This study takes public space in Community Commercial Street Districts in Small and Medium-sized Cities as its research object and explores, from the perspective of everyday use, the mechanisms through which spatial structure and built environment factors affect district vitality. Compared with existing studies, which mostly discuss district renewal from the perspectives of macro planning strategies or spatial form renewal, this study focuses on the real process of use in micro-scale spaces within the district. By combining behavioral observation with quantitative analysis of the built environment, it constructs an empirical

research path oriented toward public space vitality. Starting from micro-scale space use, it integrates behavioral characteristics with spatial environmental factors, thereby further enriching the analytical perspective of vitality research on districts in Small and Medium-sized Cities and providing new empirical evidence for understanding the formation mechanism of public space vitality. In terms of research methods, this study integrates multiple built environment indicators, quantitatively measures district public space vitality, and identifies key influencing factors through regression analysis. On this basis, it interprets their mechanisms from the perspective of everyday use and thus reveals the formation logic of district public space vitality as supported by daily activities.

(2) Practical significance

At the practical level, this study takes the Laoximen District in Changde as a typical case. Through field-based behavioral observation and quantitative analysis of the built environment, it systematically identifies the key built environment factors affecting the vitality of district public space and their spatial distribution patterns, and on this basis proposes targeted public space optimization strategies. The study shows that in Community Commercial Street Districts in Small and Medium-sized Cities, residents' everyday use is an important basis for maintaining district vitality. Through small-scale interventions such as improving the configuration of staying facilities, optimizing spatial interface relationships, and enhancing microclimatic adaptability, it is possible to effectively improve spatial use efficiency and vitality stability without relying on large-scale commercial introduction. The findings provide empirical support for exploring a gradual path of spatial optimization oriented toward everyday use under the background of renewal of existing urban stock in Community Commercial Street Districts in Small and Medium-sized Cities, and offer a referential methodological framework and strategic basis for the renewal practice of similar districts.

1.3 Research Content and Methods

1.3.1 Research object

The research object of this study is the Community Commercial Street District in Small and Medium-sized Cities. This type of district takes streets and open public spaces as its main

spatial form, possesses a certain level of commercial service function, and in actual use is often used frequently by surrounding residents. Its major activity types include everyday interaction, rest, and basic consumption, showing a spatial use characteristic dominated by everyday life.

The Laoximen District in Changde is located within the traditional urban area of Changde and is an important spatial node formed in the city's historical development. As the site of the ancient city wall remains, this area carries a certain historical identity within the urban structure while also preserving spatial memory and structural features from the city's development process. In recent years, under the impetus of urban renewal, the district has been comprehensively transformed with a positioning centered on commercial and cultural vitality nodes, forming an open district pattern dominated by commercial and leisure functions. However, constrained by factors such as limited consumption capacity and insufficient external pedestrian flow in Small and Medium-sized Cities, the commercial vitality of the district has not developed as expected, and phenomena such as declining pedestrian flow and store vacancy have gradually emerged. Against this background, spatial use has gradually shifted toward daily activities led by surrounding residents, and the actual function of the district has transformed from a commercial consumption space into a community public activity space, making it a typical case of a Community Commercial Street District under the background of renewal of existing urban stock in Small and Medium-sized Cities. Taking this district as a typical case, this study starts from the public space of the Community Commercial Street District, explores the relationships among its spatial characteristics, use behaviors, and built environment factors, analyzes the mechanisms through which it supports daily activities and promotes district vitality, and on this basis proposes targeted optimization strategies.

The "Community Commercial Street Districts in Small and Medium-sized Cities" discussed in this study do not mean that Community Commercial Street Districts exist only in Small and Medium-sized Cities. Rather, the term emphasizes that, under the conditions of relatively limited external consumption and insufficient conversion of commercial vitality in Small and Medium-sized Cities, such districts need to rely more on the everyday use of local residents as an important basis for vitality enhancement.

1.3.2 Research content

This study focuses on the formation mechanism and optimization path of public space vitality in Community Commercial Street Districts in Small and Medium-sized Cities. Through literature review, field investigation, and behavioral observation, it identifies the key built environment factors affecting district vitality, and conducts a systematic study of their influence mechanisms in combination with quantitative statistical analysis. On this basis, it summarizes the main problems in the current public space of the district and proposes targeted spatial optimization principles, strategies, and node design schemes.

Chapter 1 starts from the practical issues of insufficient external vitality and resident-dominated everyday use in the renewal of characteristic districts in Small and Medium-sized Cities. It clarifies the research background and problem awareness, establishes the Laoximen District in Changde as the case study, defines the research objectives, content, and methods, and constructs the overall research framework.

Chapter 2 focuses on the related concepts and theoretical foundations of the study. It defines key concepts such as Small and Medium-sized Cities, spatial vitality, Community Commercial Street District, and Small-scale Waterfront Space; systematically reviews environmental behavior theory, everydayness theory, and public space design theory; and on this basis analyzes the development process, spatial characteristics, and methodological suitability of the Community Commercial Street District, thus providing theoretical support for the subsequent study.

Chapter 3 constructs the analytical framework of this study. It first establishes the measurement method for district vitality from the perspective of vitality components and formation mechanisms. It then draws on the literature on public space vitality, street vitality, and waterfront space vitality, and, following the principles of relevance, scale suitability, and operability, builds a built environment indicator system covering four dimensions: spatial structure, functional supply, environmental conditions, and staying facilities. Finally, it explains the division of research units, data sources, and analytical methods, forming the overall path for the subsequent empirical study.

Chapter 4 takes the Laoximen District in Changde as the research object. Through field investigation and behavioral observation, it systematically reviews the historical background, spatial structure, and functional characteristics of the district, identifies the spatial-temporal distribution patterns of district vitality, the main activity types, and the characteristics of user groups, and conducts descriptive analysis of the spatial distribution of various built environment indicators, thereby portraying the basic characteristics of district vitality and the built environment at the overall level.

Chapter 5, on the basis of the previous investigation and indicator quantification, uses descriptive statistical analysis and multiple linear regression to identify the key built environment factors that significantly affect the vitality of district public space, and compares the spatial morphological characteristics of high-, medium-, and low-vitality areas. On this basis, it summarizes the main problems of the district in terms of accessibility, microclimate use, facility configuration, commercial interfaces, and landscape transformation, providing empirical support for the subsequent optimization strategies.

Chapter 6, based on the previous research, proposes renewal principles and optimization strategies for Community Commercial Street Districts in Small and Medium-sized Cities. It establishes design principles from five dimensions: coordination of everyday use, conditions for staying and interface optimization, user adaptation, climatic suitability, and activation of landscape resources. It then proposes specific strategies from four aspects: optimization of spatial interface and scale, space release and path optimization, insertion of facilities and improvement of the staying environment, and flexible use and temporary activation. Finally, five types of typical node designs are used to demonstrate the spatial translation and operability of the strategies.

1.3.3 Research methods

(1) Literature review

Through a systematic review of the literature on district public space vitality, the renewal of Community Commercial Street Districts, and related studies, this study summarizes the perspectives and methodological paths of existing research on the relationship between built

environment factors and spatial vitality, thereby providing a theoretical basis for the construction of the indicator system and the analytical framework of this study.

(2) Case study method

This study selects typical domestic cases of spatial renewal in Community Commercial Street Districts for analysis, focusing on their practical strategies in public space organization, the configuration of staying facilities, interface treatment, and the use of landscape resources. It extracts design experience with broad reference value and provides practical support for the proposal of spatial optimization strategies in this study.

(3) Behavioral observation method

By conducting multiple rounds of on-site observation in the study area, covering weekdays and rest days as well as morning, noon, and evening periods, this study continuously records and organizes users' activity types, staying behavior, and ways of using space. At the same time, it compares crowd aggregation, combinations of activities, and intensity of stay at different spatial nodes, and analyzes their correspondence with factors such as spatial scale, interface conditions, facility configuration, and microclimatic environment. In this way, it identifies the characteristics of everyday use, activity hotspots, and the distribution patterns of vitality in district public space, and provides behavioral-level interpretive support for the subsequent quantification of the built environment and regression analysis.

(4) Field investigation method

Combining on-site survey, image recording, and data collection, this study systematically reviews the spatial structure, functional distribution, spatial interfaces, facility configuration, and environmental characteristics of the study area, forming a basic database of the built environment and an inventory of spatial elements for the research area and providing field-based support for subsequent indicator extraction, zonal comparison, and strategy implementation.

(5) Quantitative analysis of the built environment

Based on field investigation, spatial data, and image materials, this study quantitatively characterizes and standardizes built environment factors such as spatial structure, environmental conditions, and facility configuration in the district, and constructs a micro-scale built environment indicator system. Specifically, it measures features such as street network structure, conditions for staying, and spatial interfaces, thereby providing a unified data basis for the subsequent regression analysis.

(6) Quantitative statistical analysis

Based on the behavioral observation data and the quantification results of the built environment, this study identifies key factors and their relative strengths through descriptive statistics and multiple regression analysis. Considering that district vitality is jointly shaped by multiple factors and that interactions and cumulative effects may exist among variables, this study adopts multiple regression as the main statistical method in order to evaluate the independent contribution of a single built environment factor while controlling for other variables. It also improves the stability and reliability of model interpretation through procedures such as collinearity diagnostics, thereby providing quantitative support for subsequent mechanism interpretation and spatial optimization strategies.

1.4 Review of Domestic and International Research

1.4.1 Review of research on urban spatial vitality

Urban vitality is essentially reflected in the state of human activities in urban space. Its core source lies in interpersonal interaction and daily activities, and it has gradually become an important topic of interdisciplinary concern in urban design, sociology, geographical economics, and other fields. Overall, scholars at home and abroad have conducted extensive research on urban vitality from different theoretical perspectives. Foreign research started relatively early, mainly exploring the relationship between public space and social life from the perspectives of urban sociology and urban design theory, and gradually developed empirical methods based on behavioral observation and multi-source data. Domestic research, on the basis of drawing on relevant theories and in combination with urban renewal practice and the needs of spatial governance, has carried out multi-level discussions on district vitality

from such aspects as the renewal of historic districts, spatial environmental factors, and quantitative analysis.

(1) Domestic research related to urban spatial vitality

Domestic research on district vitality making can generally be discussed from three aspects: theoretical guidance, the perspective of environmental behavior, and research on specific spatial elements.

Some studies start from urban design theory and renewal concepts and provide principled guidance for district vitality making. Under the guidance of theories such as organic renewal and new urbanism, Wu Lian and Shen Dan proposed basic principles for the revitalization of historic district vitality and applied them in the conservation planning practice of the Democratic Upper Street Historic District in Tongren, Qinghai[1]. Based on theories of organic renewal, neo-humanism, and new urbanism, Zhong Xingming studied the renewal practice of the Furong Street Historic and Cultural District in Jinan and proposed renewal strategies oriented toward vitality revitalization[2]. Jiang Difei and Li Jingxi further divided urban vitality making into three dimensions—economic vitality, cultural vitality, and social vitality — and proposed eight principles, including the all-time city and urban intermediary space, to guide the making of vitality in contemporary urban public space[3].

In addition, some studies approach the topic from the perspective of environmental behavior, focusing on the relationship between urban space and human behavior and reflecting on large-scale urban design that lacks humanization. These studies emphasize a people-centered concept of spatial design, although they differ in specific classification and research emphasis. Based on the characteristics of people’s daily behavior, Li Hao studied methods for making vitality in urban squares, urban streets, and urban parks, and proposed design principles such as multiple mixing, public life, and participatory landscape[4]. Starting from the two dimensions of people and place, Zang Hui analyzed the relationship between behavioral needs and the physical environment of places, and, in combination with different cultural backgrounds, proposed renewal strategies such as incorporating public participation mechanisms and meeting diverse needs[5].

Early research was mainly qualitative, while later studies gradually turned toward quantitative research based on multi-source data. Through indicators such as spatial scale and accessibility, Xu Yuhui and Zhuo Weide conducted a comparative study of the central area of Jiefangbei in Chongqing and Xintiandi Plaza in Shanghai, explored the influence of different spatial elements on public space vitality, and pointed out that the degree of influence of these elements varies across spaces of different scales[6]. Through analyses of the cases of Kuanzhai Alley and the Ciqikou district in Chengdu, Li Jingxiao pointed out that, in addition to the physical spatial environment, sociocultural factors and development models also have an important impact on district vitality[7]. From the perspective of urban texture, Tong Ming argued that urban texture influences the formation of urban vitality through connected paths, behavioral links, network relationships, and fractal characteristics[8]. Ye Yu, Zhuang Yu, and others adopted a hypothetical-deductive approach, quantified morphological indicators such as street accessibility, development intensity, and functional mix, and verified the influence of urban form on spatial vitality through empirical tests of the intensity of residents' optional activities[9].

With the development of urban big data, related studies have gradually introduced multi-source data and quantitative methods in order to more objectively reveal the relationship between built environment factors and urban vitality. Based on POI data and mobile signaling data, Long Ying and Zhou Yin used multiple linear regression analysis and found that factors such as distance to the city center, functional density, and functional mix have significant effects on the vitality of different types of streets. They further classified street types into public service, residential, and commercial service categories and explored the differentiated influence mechanisms of vitality in different types of districts[10]. Scholars such as Fan Lai and Zhang Dayu further used methods including correlation analysis and spatial autocorrelation analysis to study the spatial differentiation of district vitality and its influencing factors, revealing the spatial dependence of district vitality and its mechanisms[11]. Taking boundary permeability as the analytical perspective, Li Renfeng and Zhang Ling comprehensively employed PSPL behavioral observation, space syntax analysis, and POI functional evaluation to conduct quantitative research on the boundary spaces of urban villages from the three dimensions of crowd behavior, spatial structure, and functional

configuration, identified areas of high and low permeability, and accordingly proposed graded strategies for spatial activation[12].

(2) International research related to urban spatial vitality

Research on the vitality of public space abroad started relatively early and can be traced back to the mid-twentieth century. Early studies mainly explored the relationship between urban public space and social life from the perspectives of urban sociology and urban design theory, and on this basis gradually developed more systematic empirical research methods.

In The Death and Life of Great American Cities, Jane Jacobs argued that cities should maintain vitality through diversity, emphasized the importance of small-scale mixed functions to urban vitality, and, from a sociological perspective, revealed the relationship between everyday life and spatial form in urban districts, laying an important theoretical foundation for urban vitality research[13]. Subsequently, new urbanism further elaborated urban vitality systematically from the perspectives of community and public life. In The New Urbanism: Toward an Architecture of Community, Peter Katz proposed a community design concept characterized by walkability, compact development, and appropriate density, emphasizing the core role of public space and public life in urban communities[14]. In his research, John Montgomery argued that successful cities are products of structured complexity and require a balance between ordered urban form and diverse activities. He proposed that the formation of urban vitality depends on the combined effect of activity, image, and form, and put forward principles for urban vitality making that include human-scale dimensions, street connections, the public realm, green space, and waterscapes[15].

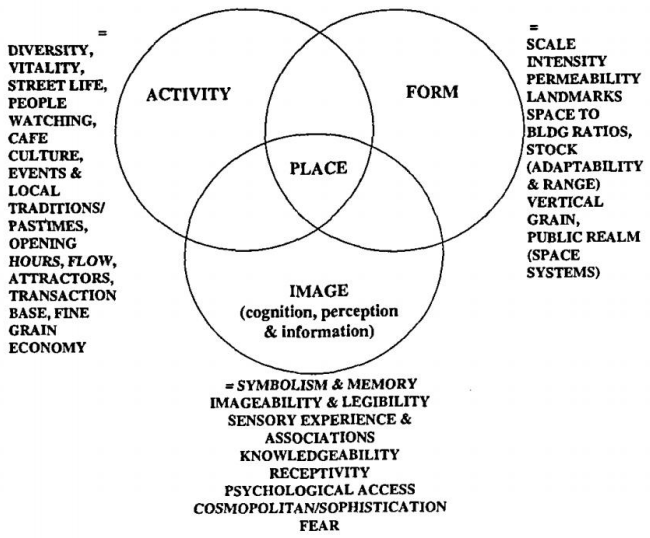


Figure1-3 Diagram of the mechanism of place identity formation in cities
(Source: Reference[15])

In research on specific public spaces and human behavior, Jan Gehl, from the perspective of sharedness, proposed the concept of integration and classified activities in public space into necessary activities, spontaneous activities, and social activities. He pointed out that district vitality can be continuously stimulated only when different functions and groups overlap in the same setting[16]. A group of architects within CIAM, namely Team 10, emphasized that urban structure should be understood from human behavior and everyday life, proposed that architecture and transport networks should form an organic whole, and stressed the relationship between mobility and human activities in urban space.

In theories of urban design practice, some studies further proposed specific methods for activating space. For example, the urban catalyst theory proposed by Wayne Otto and Don Logan holds that introducing specific catalyst elements into urban space, such as fountains, buildings, and stages, can stimulate the renewal of surrounding spaces and the growth of vitality. In Finding Lost Space, Roger Trancik proposed urban design ideas such as figure-ground theory, place theory, and linkage theory, emphasizing the restoration of vitality in urban public space through spatial structure and place making[17].

With the development of research, foreign scholars gradually shifted from theoretical discussion to empirical research and began to construct indicator systems for urban vitality. For example, some studies have shown, through analysis of the influence of small businesses on the urban environment, that their uniqueness, participation, and friendliness can

significantly enhance urban spatial vitality[18],Other empirical findings suggest, through systematic observation, that community vitality is significantly enhanced in spaces with visual permeability and places for everyday communication[19].

1.4.2 Review of research on the Community Commercial Street District

(1) Domestic research on the Community Commercial Street District

Early domestic research on community commerce mainly focused on hierarchy and type classification, functional layout, and the composition of commercial formats. It emphasized the basic type definition and spatial organization of community commercial spaces and highlighted their role as important transitional carriers linking residential areas and urban space. With the deepening of research, related studies gradually turned toward the service hierarchy of community commercial space and the perspective of user behavior, beginning to explore configuration models at different service scales and spatially adaptive forms based on users' actual activity characteristics.

As the problem of residential enclosure emerged during urban development and multicenter structures gradually formed, community commerce was progressively embedded within residential spaces and became an important medium connecting the city and the community. From a theoretical perspective, related studies have reflected on the development logic of community commerce from multiple dimensions and emphasized its important value in strengthening urban spatial connections, serving residents' daily life, and promoting public interaction. Duan Xiang pointed out that community commerce, as a transitional spatial form, helps shape a diverse spatial structure and strengthen the organic connections of urban space[20]. Liu Jin argued that under the drive of consumerism, commercial space has tended toward symbolization and scale expansion, gradually weakening its function of serving daily life, and should instead turn toward a spatial organization based on real use in order to strengthen everydayness and publicity[21]. Ma Qiguo held that community commerce provides an important carrier for informal interaction in space, transforming it from a single consumption place into a public space with social attributes[22].

At the level of spatial structure, related studies have examined the influence of street networks and spatial form on the layout of community commerce. Based on space syntax,

Huang Yuanyuan analyzed the effects of different district structures, such as grid, strip, and tree structures, on commercial distribution and pedestrian organization, and pointed out that spatial structures with lower topological depth and stronger external connections are more conducive to commercial development[23]. Starting from the distinction between street and road, Liu Zi'an proposed that the street network of residential areas influences the layout and form of commercial space through dimensions such as road hierarchy, accessibility, and street quality, further emphasizing the coordinated function of traffic attributes and place attributes[24]. Through empirical research on several community commercial cases in Shanghai, Lu Wenjun analyzed their organizational characteristics from both functional and spatial levels, argued that functional mix is an important factor affecting the vitality of community commerce, and pointed out that external space design should be combined with user needs and locational conditions, and that irregular interfaces can provide more staying space and thus promote activity diversity[25]. Jiang Yubo proposed a gradual renewal strategy implemented in stages and also pointed out that in old communities with tight land conditions, functional replacement can be used to shape business formats and, by making use of the time-difference characteristics of public space use, sites can be flexibly used during specific periods to achieve efficient use of space[26].

Research on service scales and business format configuration in community commerce has also gradually become richer. Liu Yiwen divided community commercial formats into essential and selective types, of which the former mainly satisfy daily life needs and the latter enhance spatial attractiveness through cultural entertainment and leisure experience[27] . Starting from the perspective of the life circle, Zhang Xiyu, Mao Mingrui, and others divided community commerce into baseline support and quality improvement types and, according to accessibility needs, proposed two layout modes: dispersed and centralized[28]. Through comparison of domestic and international cases, Lei Cheng and Liu Yuan sorted out multiple models of centralized community service facilities, pointed out differences in their spatial organization and supply mechanisms, and proposed a centralized service system centered on the community complex in order to achieve efficient integration of service resources[29].

(2) International research on the Community Commercial Street District

Research abroad on the Community Commercial Street District started relatively early and mainly developed across multiple dimensions such as spatial structure, consumer behavior, and community unit organization. Against the background of rapid industrialization and urbanization in the West, the central place theory proposed by the German geographer Walter Christaller was intended to explain the hierarchical distribution and service range of commercial and service facilities in space. The theory holds that central places of different levels form a hierarchical system through mechanisms such as threshold population and service range, thus providing an important theoretical basis for the hierarchical configuration and spatial layout of community commercial facilities[30].

At the level of consumer behavior, scholars such as Brian J. L. Berry and William L. Garrison proposed theories related to the spatiality of consumer behavior and constructed a three-level activity theory framework, incorporating consumption behavior into the system of spatial analysis[31]. This theory emphasizes starting from consumer demand and comprehensively considering the influence of individual factors on spatial choice. It points out that consumption activities are multipurpose and hierarchical, and that there is a dynamic interactive relationship between the structure of commercial space and consumer behavior, which in turn affects the hierarchy and service range of commercial centers.

At the level of community spatial organization, the Neighborhood Unit theory proposed by Clarence Perry organizes residential units on the basis of walkable scale and configures facilities such as schools, commerce, and public space. It emphasizes nearby provision of daily life services and functional integration within the community, and has provided an important reference for embedding community commerce into residential environments and forming a district spatial model oriented toward everyday life.

1.4.3 Review of research on street vitality

Since the 1960s, with the rise of urban renewal and public space research, scholars have gradually studied district space from the perspective of the relationship between social life and the spatial environment. In The Death and Life of Great American Cities, Jacobs pointed out that the street is the most important public space in the city, and that street safety and vitality derive from diverse crowd activities and mixed functional structure[13]. Since the

Community Commercial Street District takes street space as its main carrier, its spatial organization and use patterns are closely related to street characteristics. Therefore, introducing research related to street vitality into the literature review helps supplement the understanding of public space vitality in the Community Commercial Street District from the perspective of street space.

(1) Domestic research related to street vitality

From the perspective of research development, studies on urban street vitality have roughly gone through three stages. From the 1960s to the 1980s, related research mainly focused on the relationship between street public space and urban life and paid attention to the relationship between street spatial form and public activities. From the 1990s to the early twenty-first century, with the development of urban renewal practice, the research focus gradually turned to the conservation of historic districts, the transformation of commercial districts, and the shaping of district cultural characteristics. In recent years, with the development of spatial analysis technologies and multi-source data, related studies have gradually begun to conduct comprehensive analysis and evaluation of district spatial characteristics from multiple dimensions such as spatial structure, environmental quality, and crowd behavior.

In research on district spatial structure, Sheng Qiang, through a study of the clustering of small-scale commerce in districts within Beijing's Third Ring Road, revealed the spatial logic of the distribution of community-level commercial space, specifically manifested as an interface effect, in which the superposition of internal and external traffic flows jointly acts on the agglomeration of community functions[32]. Long Ying and Shen Yaoshuai proposed the concept of street urbanism and reexamined urban space from the street scale by constructing a street research framework through spatial analysis, statistics, and simulation methods[33]. Starting from the perspective of social actors, Lu Ming and Cai Zihan regarded original residents as an important driving force of vitality in historic and cultural districts and proposed improving district spatial quality by promoting the spatial integration of original residents[34].

In quantitative research, some scholars have studied district spatial environments through behavioral observation, questionnaire surveys, and spatial analysis methods. Gou Aiping and Wang Jiangbo used the semantic differential method to evaluate the spatial environment of multiple streets in Nanjing and analyzed, through questionnaire surveys, the influence of different environmental factors on spatial perception, pointing out the effects of commerce, squares, public transport, and human activities on street vitality[35]. From the pedestrian perspective, Chen Yong and Zhao Xinghua studied the influence of ground-floor street interfaces on walking behavior and pointed out that the width of building street-facing interfaces is an important factor affecting pedestrian staying activities[36]. Scholars such as Ou Yingying and Lin Lin used space syntax to analyze the structural characteristics of public space in Dayan Ancient Town, Lijiang, explored the relationship between spatial structure and the distribution of district activities, and pointed out the influence of spatial environmental quality and transport accessibility on pedestrian flow[37]. Ye Yu and Zhang Zhaoxi used street-view data and machine learning methods to evaluate street spatial quality and, in combination with road network accessibility, carried out a comprehensive analysis of district spatial environment to assess street spatial quality and micro-renewal potential, thus providing a more refined analytical basis for urban micro-renewal[38].

(2) International research related to street vitality

Research abroad on urban districts and pedestrian space started relatively early, and its focus has mainly been on street spatial quality, public space behavior, and the making of district vitality.

In The Aesthetics of the Street, Ashihara Yoshinobu studied street interfaces from the perspective of spatial form and argued that street spatial quality is closely related to building interfaces. He also explained the scale perception of street space through the ratio of street width to building height (D/H). At the same time, he proposed concepts such as the shadow corner space and pointed out that spatial forms with a sense of enclosure are more conducive to creating pleasant public space experiences[39].

Through comparative studies of many urban street cases, Allan B. Jacobs summarized that great streets should possess good accessibility, mobility, publicity, and a comfortable

pedestrian environment, and emphasized the important influence of the coordination of building interfaces on both sides of the street on street spatial quality[40].

In its report Streets as Public Spaces and Drivers of Urban Prosperity, UN-Habitat pointed out that streets do not only undertake transport functions, but also play an important role in social interaction, economic activity, and the dissemination of urban culture, and are important spatial carriers for promoting urban prosperity.

1.4.4 Review of research on urban waterfront space

As an important carrier of urban public activities, waterfront space has gradually shifted in the process of urban renewal from an industrially oriented function toward one oriented to public activities and the improvement of spatial quality. Waterfront space not only has ecological and landscape value, but also plays an important role in promoting public activities and enhancing spatial vitality.

Regarding the relationship between waterfront space and public activities, Yang Chunxia and Shao Bin (2018), through field observation, studied the relationship between elements of waterfront public space and people's staying activities, and pointed out that factors such as ground conditions, shoreline form, functional configuration, and public facilities have an important influence on people's staying behavior[41]. Through a multi-source data analysis method, Liu Song and Lai Siqi (2021) identified factors such as green space ratio, density of public service facilities, accessibility of the slow-traffic system, and density of commercial facilities as having important influences on the environmental quality of waterfront public space[42]. From the perspective of environmental behavior, Wang Shifu, Qin Xiaoling, and others, by studying the relationship between environmental space and human activities, pointed out that diverse functional configuration, continuous landscape interfaces, and life-oriented roads are important factors in improving waterfront space quality[43]. Fang Qing and Bu Jinghua (2003) summarized activity types in waterfront recreational space and concluded which recreational activities are suitable for different types of waterfront spaces[44].

Although existing studies have systematically discussed urban vitality from multiple levels, including theoretical principles, environmental behavior, and spatial elements, and have accumulated rich achievements in fields such as urban characteristic districts, waterfront

space, and community commerce, urban vitality, as a complex socio-spatial phenomenon, has a formation mechanism with clear contextuality and locality. Different cities and different types of districts vary significantly in resource conditions, spatial structure, and population composition.

However, existing research mainly focuses on the conservation of historic and cultural districts or the renewal of large commercial districts. Research attention is mostly placed on commercial format configuration, spatial form shaping, and landscape design, while relatively insufficient attention has been paid to small-scale Community Commercial Street Districts dominated by residents' everyday use. In particular, in characteristic districts with waterfront elements, the interactive relationship between water space and district spatial structure lacks systematic analysis. At the same time, most related quantitative studies take large cities as the research background, and discussion remains insufficient on how micro-scale built environment factors in the context of Small and Medium-sized Cities affect residents' actual spatial use behavior and the vitality of public space. The mechanism of spatial vitality formed through the intertwining of commercial functions and everyday life has therefore not yet been fully revealed.

Based on this, this paper takes the Community Commercial Street District in Small and Medium-sized Cities as the research object and the Laoximen District in Changde as the typical case. From the perspective of everyday use, it constructs a micro-scale built environment indicator system and, combined with quantitative regression analysis, systematically identifies the key factors affecting the vitality of public space. It aims to reveal the formation mechanism of spatial vitality under the symbiotic context of commerce and everyday life, and to provide empirical support for the renewal of existing urban stock and spatial optimization in such districts.

1.5 Research Framework

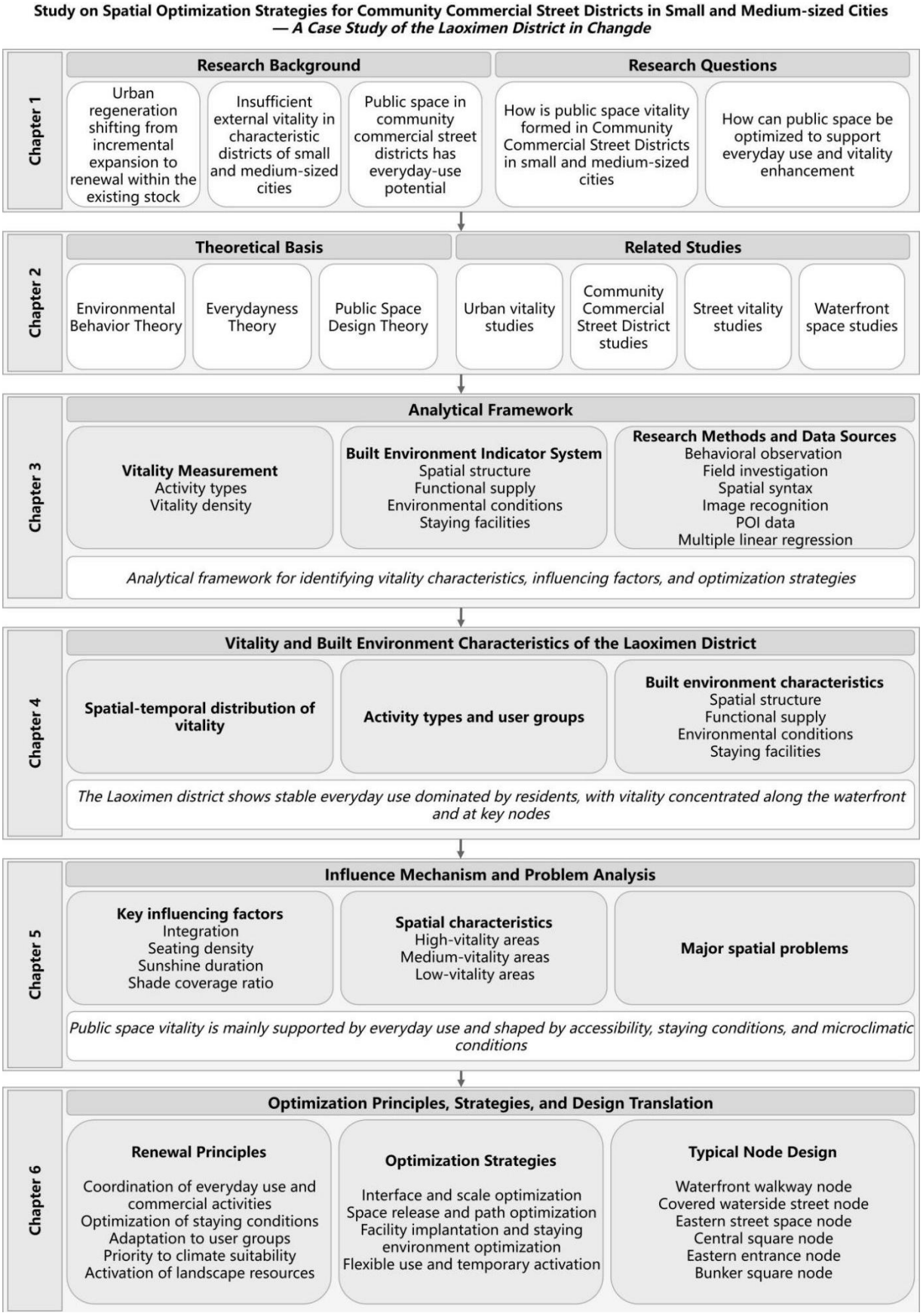


Figure1-4 Research framework
(Source: drawn by the author)

Chapter 2 Fundamental Research

2.1 Definition of Concepts

2.1.1 Small and Medium-sized Cities

Small and Medium-sized Cities cover a wide range of areas and populations, including most administrative regions and residents in China, and constitute an important foundation of the national urban system. They generally refer to cities with an urban permanent population between 100,000 and 1 million, with population size serving as the main criterion for classification. In terms of urban form, Small and Medium-sized Cities are diverse, including not only the main urban areas of prefecture-level cities, but also relatively independent municipal districts and county-level city centers, showing clear diversity.

In this study, the definition of Small and Medium-sized Cities follows the relevant criteria in the China Small and Medium-sized Cities Development Report (Green Book), using the size of the urban permanent population as the main basis for classification. Cities with an urban permanent population of less than 1 million are classified as Small and Medium-sized Cities. Among them, those with fewer than 500,000 residents are small cities, and small cities with fewer than 500,000 residents can be further divided into Type I and Type II, while those with 500,000 to 1 million residents are medium-sized cities.

The overall development of Small and Medium-sized Cities shows clear differences. A small number of cities have achieved relatively rapid growth on the basis of industrial support, while most still have relatively limited development levels. In terms of industrial structure, their development relies heavily on industry and manufacturing, and commercial diversity is relatively weak. These cities play an important nodal role in urban-rural connections, and their infrastructure and living environments have continued to improve. However, they still face insufficient attractiveness in the flow of population and factors, which constrains consumption vitality and the intensity of spatial use to some extent.

2.1.2 Spatial Vitality

The term "vitality" originally came from biology and ecology, where it was used to describe the capacity of living organisms to sustain survival and continue developing. With the development of related studies, the concept was gradually introduced into urban research to describe the level of human activity in urban space and the state of social life it reflects.

Kevin Lynch regarded vitality as one of the important performance dimensions of urban form, arguing that it reflects the degree to which urban space supports life activities, ecological balance, and human survival needs[45]. Jan Gehl, starting from public space use behavior, argued that vitality is mainly determined by both the number of people in a space and the amount of time they spend staying there, with its core lying in human activities and interactions[16]. John Montgomery further expanded the concept from the perspective of urban design, arguing that urban vitality is reflected not only in pedestrian flows on streets and surrounding areas, but also in temporal changes in pedestrian volume, the frequency of facility use, the number of cultural events and festivals, and the overall liveliness of street life. He also pointed out that successful urban spaces often possess a distinctive rhythm and sense of life[15].

In Chinese studies, Hao Xinhua, Long Ying, and others define street vitality as the social vitality of streets, whose core expression lies in the scale and intensity of activities carried out by people in street spaces[46]. On this basis, Chen Zhe and Ma Shuijing further extended the concept from the perspective of spatial structure, proposing notions such as "vitality source points," "vitality destination points," "vitality transfer points," and "vitality attraction points" to describe the roles of different spatial nodes in the formation of urban vitality[47].

Overall, existing studies generally agree that the core expression of urban vitality lies in human activities and interactions in urban space, and that it is a comprehensive manifestation of the scale of human activity, staying behavior, and the intensity of spatial use.

2.1.3 Community Commercial Street District

As an important unit of social organization, a community generally refers to a group of people and their living environment that form stable interactive relations within a certain spatial range. The German sociologist Ferdinand Tönnies was the first to introduce the concept of community into sociological research, linking it to traditional societies represented

by villages and small towns and emphasizing close social relations formed on the basis of locality and emotional ties. Later, the Chicago School, represented by Robert E. Park, further developed the concept in urban studies and argued that the community is a basic unit within the city, with its core characteristics lying in the aggregation of people on a territorial basis and the interdependent relations thereby produced[48]. Chinese sociology defines community from the perspective of social activities and cultural connections, holding that it is not only a spatial carrier of population concentration, but also a network of relations and a structure of shared life formed through continuous interaction. At the spatial level, a community is also manifested as a living unit with certain boundaries. Li Dingzhen proposed that a community can be understood as a residential space enclosed by roads or natural boundaries and equipped with various service facilities to meet residents' daily needs[30].

Community commerce is usually defined as a localized form of commerce that takes residential neighborhoods as its carrier, serves residents within a certain area, and aims to provide convenience and benefit to local people[49], Its core characteristics are strong locality, a clear service target, and business types mainly oriented toward daily necessities and convenience services. In terms of specific types, Fan Shenglan divides it into three categories: neighborhood-center community commerce, street-based community commerce, and residential project-supporting community commerce, and summarizes three property forms: ground-floor neighborhood shops, community commercial streets, and community commercial centers[50].

The Community Commercial Street District discussed in this study refers to an open spatial type that takes street space as its main carrier, commercial service as its basic function, and mainly serves the everyday life of surrounding residents. This type of district combines commercial interfaces with attributes of public interaction, and its spatial use is mainly characterized by high-frequency activities such as passing through, staying, resting, and everyday social interaction. Taking the Laoximen District as an example, although it was planned as an open commercial district or a characteristic district, in actual use it has gradually come to be dominated by the everyday activities of surrounding residents. Its spatial vitality mainly comes from frequent local use behavior, showing typical characteristics of a Community Commercial Street District.

2.1.4 Small-scale Waterfront Space

Waterfront space generally refers to waterside areas formed by rivers, lakes, and other water bodies together with the adjacent land[51], and it usually consists of three parts: water area, shoreline, and land area[52]. According to factors such as the visual relationship between the two banks, waterfront space can be divided into large-scale waterfront space, medium-scale waterfront space, and small-scale waterfront space[53].According to the visual effects and perceptual experiences of water bodies at different scales, waterfront spaces can be classified by section scale into three types fine scale (within 100 meters), hierarchical scale (100–120 meters), and outline scale (more than 1,200 meters)[54].The moat section of Laoximen involved in this study belongs to small-scale waterfront space, with a river width within 30 meters and a high degree of visual accessibility and potential spatial interaction between the two banks.

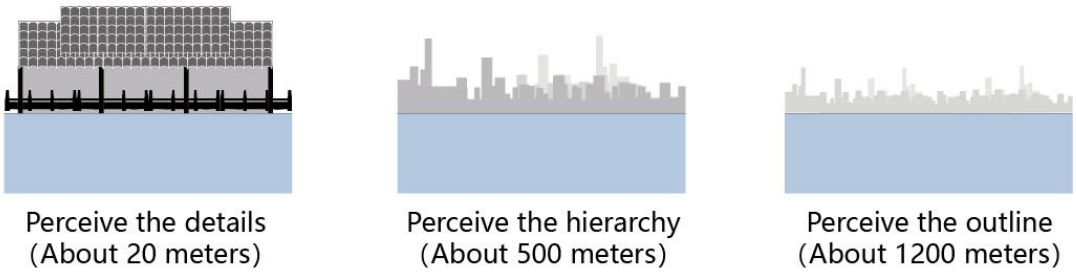


Figure2-1 Real Riverfront Scenes at Different Scales
(Source: drawn by the author based on the referenced literature[54])

Compared with large-scale waterfront space, small-scale waterfront space has distinctive characteristics in spatial perception and use behavior. Its human-scale proportion brings users closer to the water, giving it stronger waterfront accessibility and a stronger sense of enclosure, which more easily supports staying and social interaction. At the same time, small-scale waterfront space is often embedded within urban districts and closely connected with the everyday life of surrounding residents, giving it the spatial basis to support everyday rest and social activities. This spatial characteristic means that its vitality depends more on built environment factors such as walkability, the provision of staying facilities, and microclimatic conditions, rather than on the experience logic of large-scale waterfront areas dominated by scenic views.

2.2 Theoretical Research

2.2.1 Environment–Behavior theory

Environment–behavior theory is the study of the relationship between people and the physical environment at different scales[55], emphasizing the dynamic connection among "human–environment–behavior." This theory holds that the environment influences human behavior, while human behavior and needs in turn shape the environment. It not only focuses on the design of physical space, but also pays attention to users' actual experiences and feedback. Starting from place scale, user characteristics, and social behavioral phenomena, and incorporating the time dimension, it constructs a multi-scalar analytical framework for the relationship between people and environment[56].

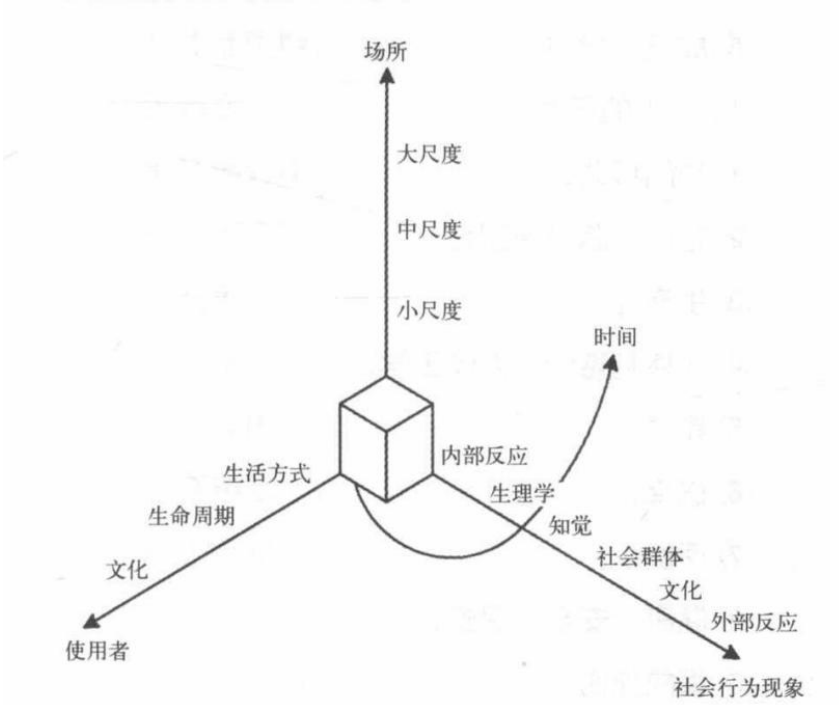


Figure2-2 Main Analytical Scales in Environment–Behavior Theory
(Source: Reference[56])

From the perspective of theoretical development, environment–behavior theory originated in psychological research. In the second half of the nineteenth century, the German psychologist Wilhelm Wundt proposed the concept of "consciousness" and emphasized the subjectivity of sensation. Kurt Lewin proposed the functional relationship of behavior, indicating that human behavior is not determined by a single factor but is formed through the

interaction between individual characteristics and environmental conditions. In the early twentieth century, the American psychologist John B. Watson first advanced behaviorist psychology. By the late twentieth century, Gary T. Moore further constructed the theoretical framework of environment–behavior studies.

At the individual level, Abraham Maslow's hierarchy of needs divides human needs into physiological needs, safety needs, belonging and love needs, esteem needs, and self-actualization needs, revealing how different levels of needs drive individual behavioral choices. At the environmental level, environment is further divided into phenomenal environment, personal environment, and socio-cultural environment. Personal environment, as the level directly perceived and understood by individuals, is an important intermediary connecting objective physical space and behavioral response. Its formation depends not only on the physical characteristics of space itself, but also on differences in individual experience and cognition[4]； Professor Li Daozeng defined contextual environment as one of the important dimensions of environment, namely the socio-cultural environment, mainly including the life cycle, living standards, and lifestyle[57]. Based on the relationship between people and environment, environment–behavior theory divides this relationship into three models: environmental determinism, interactionism, and mutual penetration. Mainstream studies today tend to favor the perspectives of interaction and mutual penetration, namely that people and environment continuously shape each other through sustained interaction.

In terms of environmental perception, environmental cognition is realized through the coordinated action of multiple senses, including vision, hearing, smell, touch, and taste, and on this basis affects individuals' understanding of space and their behavioral responses. In The Image of the City, Kevin Lynch proposed urban image elements such as paths, edges, nodes, districts, and landmarks, emphasizing that people construct an overall understanding of urban space through perception and cognition.

In terms of spatial behavior, Robert Sommer's Personal Space explored interpersonal distance and its influence on social behavior from behavioral and psychological perspectives, revealing the internal relationship between spatial scale and behavioral patterns. Jan Gehl proposed spatial behavioral mechanisms such as the "edge effect" and the "niche effect," revealing the correspondence between people's choice of where to stay in space and

conditions such as spatial boundaries and seating arrangement[58]. Through extensive behavioral observation of urban squares, parks, and street spaces, William H. Whyte systematically analyzed the mechanisms through which social activities form in public space. He pointed out that people tend to gather at the edges of squares or near street-corner shop windows, and that urban public space is essentially "a place where people gather." Its vitality depends on whether the space can meet people's social needs. The study further shows that seating, sunlight, trees, water features, and food facilities are all basic conditions that can attract people to stay[59].

At the methodological level, environment–behavior research has gradually formed a diversified empirical research system. It includes approaches based on subjective perception, such as post-occupancy evaluation (POE), questionnaires and interviews, and the semantic differential (SD) method, as well as methods such as behavioral observation that record actual activities in order to reveal the interaction between people and space. With the development of spatial data analysis, quantitative methods have also been used to examine the relationship between built environment factors and behavior. As a result, environment–behavior research has gradually formed an integrated path from perceptual cognition to behavioral expression and then to quantitative spatial analysis.

2.2.2 Everydayness theory

"Everyday life" is not the same as "daily life"; it is not a simple record of individual daily experience, but an analytical perspective constructed on the basis of real experience. Scholars generally believe that everyday life is the sum of a series of activities through which individuals maintain their own survival and social connections in everyday practice, including work, residence, consumption, interaction, and leisure. In Critique of Everyday Life, Lefebvre pointed out that everyday life is composed of multiple elements such as food, clothing, housing, transportation, family relations, and the social environment, and constitutes the most basic level of social operation.

For a long time, everyday life was often regarded as an ordinary, trivial, and theoretically insignificant field and was usually marginalized in traditional social research. Since the twentieth century, with the development of phenomenology and sociology, an "everyday turn"

has gradually emerged in academia, and everyday life has come to be regarded as an important entry point for understanding social structure and individual experience. Edmund Husserl proposed the concept of the "lifeworld" in phenomenology, emphasizing that before scientific abstraction, human beings always exist in a concrete and real world of experience. Later, Martin Heidegger's theory of "Dasein" and Maurice Merleau-Ponty's phenomenology of perception, among others, emphasized from different angles the foundational role of lived experience in understanding the world. Alfred Schutz further introduced this line of thought into sociology and founded phenomenological sociology, making everyday life an important object of sociological analysis.

With the development of everyday life research, urban studies gradually began to focus on the relationship between space and everyday life. Theories such as Situationism and Everyday Urbanism both emphasize that urban space should be understood from the perspective of users' experience. In Situationist theory, Guy Debord argued that urban space is not only the physical form produced by planning and design, but also a social space constantly reproduced through everyday use and perception. When urban space becomes excessively dominated by spectacles of consumption, real everyday life is obscured and the city easily falls into homogenization[60]. Ma Rongjun pointed out that everyday life space is not only a familiar place of activity for individuals, but also an important spatial carrier of multiple individuals and emotional meanings[61]. Li Chenghua summarized everyday life space into such types as work-unit space, places of consumption, spaces of interaction and leisure, and residential space[62].

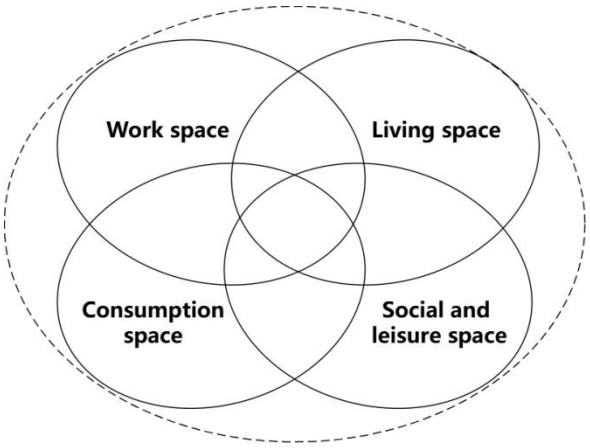


Figure2-3 Types of Everyday Space
(Source: Reference[62])

Through observing everyday life in New York districts, Jane Jacobs proposed that urban vitality comes from diversified everyday activities and emphasized the important roles of streets, shops, and neighborhood interaction in shaping urban public life[13]. Later, Margaret Crawford and others proposed Everyday Urbanism, advocating that residents' everyday experience should be brought into the core of urban planning and design[63]. Chinese scholars such as Wang Xingzhong and Li Xiangning have also conducted research from the perspectives of the spatial structure of urban life and everyday urban landscapes, emphasizing the foundational role of everyday life in the formation of urban space.

Table2-1 Development of Everydayness Research in the Field of Urban Space
(Source: drawn by the author)

Year	Scholar	Representative Theory or Work	Main Content
1957	Guy Debord	Situationist International, The Society of the Spectacle	Urban space is continuously practiced and reproduced in everyday use and perception
1961	Jane Jacobs	The Death and Life of Great American Cities	Urban vitality comes from diversified everyday activities and neighborhood interaction
1999	Margaret Crawford et al.	Everyday Urbanism	Everyday spaces such as supermarkets and food markets sustain urban life connections and cultural identity
2001	Momoyo Kaijima et al.	Made in Tokyo	Reveals the creativity and hybridity of everyday space through "no-good architecture"
2004	Wang Xingzhong	Research on the Structure of Urban Living Space in China	Analyzes forms of everyday urban life from the perspective of the structure of urban living space
2014	Li Xiangning et al.	Made in Shanghai	Extracts urban cultural genes through the everyday spatial imagery of Shanghai

In terms of research methods, everyday life research has gradually formed a variety of approaches centered on micro-level observation. As early as the nineteenth century, Walter Benjamin observed urban life from the perspective of the flâneur in the "Arcades Project" in order to reveal the social structure of the modern metropolis. In the twentieth century, the

Japanese scholar Kon Wajirō proposed "modernology," advocating the use of sketches, image records, and other methods to capture objects and behaviors in everyday urban life[64].

Everydayness research re-emphasizes the subject position of individuals in space and holds that the meaning of urban space is gradually generated through continuous use, interaction, and emotional connection. Haimel pointed out that human emotion and individuality depend on the continuous change of external stimuli and internal perception, and that this composite quality of everyday stimulation constitutes the real psychological basis of urban life[65]. By focusing on everyday activities and social interaction, urban space is no longer regarded as a static physical environment, but as a processual place constantly constructed in everyday practice. This perspective provides an important theoretical basis for understanding district vitality and its renewal strategies.

2.2.3 Public space design theory

Public space design theory starts from human behavior and discusses how the physical spatial environment influences users' activity choices and willingness to stay, providing an important theoretical framework for understanding the relationship between built environment factors and the vitality of public space. Jan Gehl proposed the planning logic of "life–space–buildings," emphasizing that design must first understand people's everyday life, activity trajectories, and psychological needs, then determine spatial nodes on that basis, and only afterward carry out building layout and design[66].

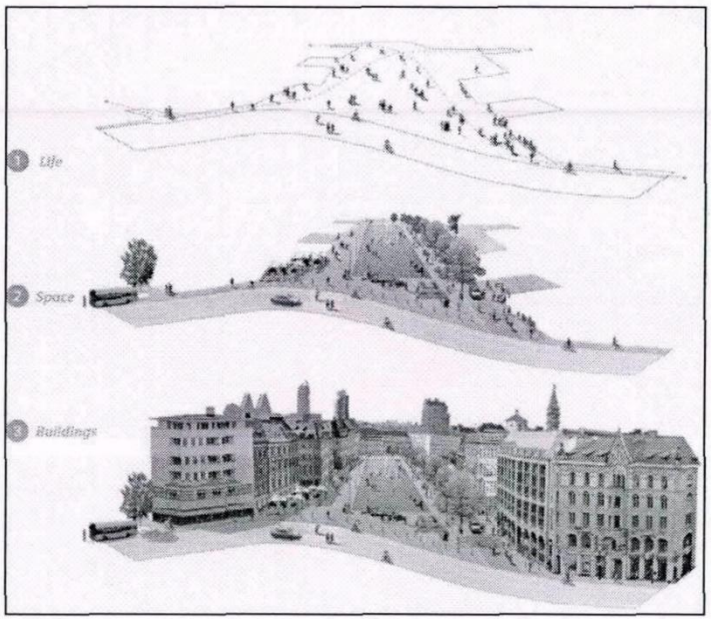


Figure2-4 Life, Space, and Buildings
(Source: Reference[66])

At the methodological level, the PSPL survey method uses field observation and behavioral counting to systematically record pedestrian flows, staying time, and activity types in public space, providing empirical support for analyzing spatial use characteristics and their relationship with environmental factors. Starting from spatial hierarchy, Liao Fang divided public space into macro, meso, and micro levels, arguing that spatial factors at different scales jointly influence the occurrence of public activities. The meso level mainly involves structural factors such as spatial layout and building setbacks, while the micro level includes more specific factors such as spatial form, scale, and environmental texture[67], thus providing a basis for the multi-scalar identification of built environment factors.

In terms of specific design strategies, the renewal of public space has gradually shifted from large-scale transformation to an approach centered on micro-renewal and public participation. Micro-renewal emphasizes achieving incremental improvement through localized transformation and functional optimization while the overall spatial structure remains basically stable, and is mainly used to improve problem spaces in built-up areas that suffer from functional imbalance, low use efficiency, and insufficient environmental quality[68]. Urban catalyst has been widely applied as an important strategy. Its core idea is to trigger broader spatial change through small-scale intervention and to produce a chain reaction from point to surface. The effectiveness of catalyst strategies depends to a large

extent on site selection and the mode of intervention. Reasonable catalyst points are usually located at key nodes in the spatial structure and possess strong relational and diffusive capacity, thereby magnifying the effects of local intervention.

Public participation is not only an important implementation method of micro-renewal, but also points toward the goal of community building. Through the process of participation, it promotes the formation of community identity and the reconstruction of social relations, thereby realizing the continuous generation of spatial vitality. Its modes include multi-actor collaborative participation, designer-led participation, resident-led participation, and government-guided or directly promoted participation[69]. In addition, public space design should also respond to the needs of different groups. Inclusive design theory emphasizes improving accessibility, safety, and diversity to build a use environment for all age groups. Through the reasonable allocation of spatial resources, the improvement of pedestrian systems, and the provision of diversified activity spaces, it enhances fairness in use and spatial adaptability for different groups[70].

2.3 Research Basis of the Community Commercial Street District

2.3.1 Formation and development of the Community Commercial Street District

Community commerce first emerged in the United States in the 1950s along with the suburbanization of residential areas, and was later gradually introduced to countries such as the United Kingdom and Japan. Community commerce has developed differently across countries. In the United States, it is characterized by open and themed consumption spaces; in Japan, commercial streets mainly integrate alley-based commerce with everyday functions; and in Singapore, the neighborhood-center system builds community service systems at different levels through graded allocation and centralized management[71].

Since its emergence in China in the twentieth century, community commerce can be roughly divided into three stages of development. In the early stage, it was oriented toward basic daily needs. Community commerce mainly took the form of neighborhood ground-floor shops and street-facing shops, with a service range limited to residential clusters. Business types were mainly vegetable markets, convenience stores, and daily life service shops, and its

core goal was to meet the basic consumption needs of surrounding residents, with relatively weak public activity attributes. With urban development and the implementation of the strategy to expand domestic demand, community commerce gradually broke through the limits of a single residential compound and expanded to areas based on a fifteen-minute walking distance, forming community commercial circles serving a wider range and beginning to undertake the compound functions of connecting urban life and promoting consumption[72]. In the era of new consumption, residents' demands have gradually shifted from simple material consumption to experiential and quality-oriented consumption. Creating distinctive scenes, introducing diversified business types, and improving the quality of public space have become important means of attracting people to stay and consume[73]. Community Commercial Street Districts are gradually shifting from single commercial consumption spaces to compound spatial forms with shared attributes. Public space and external open space together form important transitional interfaces connecting commercial space and residential space. On this basis, representative cases are further selected for analysis to explore the spatial organization characteristics and renewal practices of Community Commercial Street Districts.

(1) Chengdu Mengzhui Bay

Chengdu Mengzhui Bay is located along the Jinjiang River in Chengdu and was originally an industrial area formed in the 1950s and 1960s. The renewal area centers on the riverside section, with a total length of about 1 km, and extends to surrounding alley spaces and Wangpingfang courtyard on the south side. Taking spatial reorganization as its point of entry, the project narrowed the vehicular roadway, widened the slow-traffic riverside space, and introduced experiential business types such as cafés and small bars, gradually transforming the waterfront promenade from a passage-oriented route into a compound public space that combines staying, social interaction, and light consumption.

In the specific transformation, the original two-way motor-vehicle road of about 7 m in width was compressed into a bicycle lane of about 4 m, and several leisure platforms with different functions were integrated along a waterfront interface of about 500 m. By removing enclosed elements such as shrubs and railings, the originally negative green belt was activated, turning the waterfront from a single passage space into a public activity place that can be

entered and used for staying, thereby constructing an everyday activity framework connecting the district.



Figure2-5 General Plan of Mengzhui Bay
(Source: Reference[74])

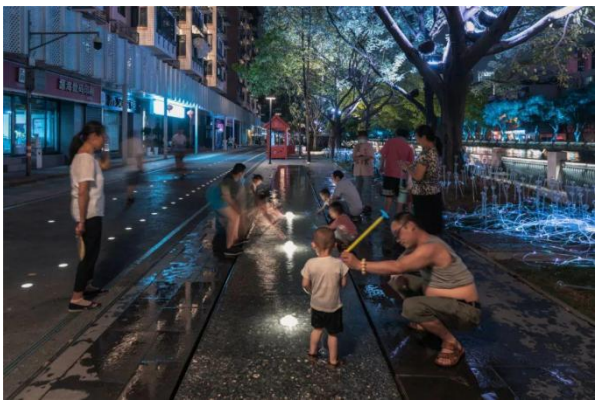
Unlike renewal oriented solely toward commerce, Mengzhui Bay introduced new business types while retaining its original teahouses and vernacular alleys, allowing the everyday use of local residents and experiential consumption by outside visitors to coexist in the same space and forming a mixed vitality condition based on everyday life with experiential consumption superimposed upon it. The renewal of Wangpingfang courtyard follows the same idea. By opening the building interface and strengthening the image of the entrance, the originally inward-looking courtyard space was connected to the city, and through functional replacement it was transformed into a public place with exhibition and communication attributes.



Figure2-6 Entrance Space Transformation
(Source: Reference[74])

It further embedded historical narratives into everyday use. Through landscape installations such as photographic projection and prism devices, combined with pedestrian systems and staying spaces, the district's industrial memory was transformed into a

perceptible everyday experience. At the same time, in response to residents' habits of night walking and leisure, the lighting system was optimized so that the district remained active at night, forming spatial vitality with temporal continuity.



a) Nighttime activity scene



b) Daytime activity scene

Figure2-7 Integration of landscape nodes and everyday activities
(Source: Reference[74])

(2) Chengdu Yulin Alley

Chengdu Yulin Alley is located on Yulin Third Alley in Chengdu. The district overlays architectural textures formed in different periods and presents a strong atmosphere of everyday urban life. The renewal aimed to create a more pleasant community environment and public interaction space. On the basis of retaining its original living atmosphere, it sought to gradually form an open and continuously vital community space through the optimization of spatial organization and the improvement of supporting services.

Through sorting out the existing space, the renewal transformed some areas into core nodes with clear functions, such as a community stage, square, longevity canteen, community support space, and accessible-friendly space. These nodes are embedded in residents' everyday life and become relatively stable places where activities occur, while the remaining space stays open and flexible, allowing different groups to use district space in multiple ways at different times.

In terms of spatial use, the project did not adopt rigid functional zoning, but instead realized the overlay and coexistence of multiple functions through relatively flexible spatial division. In this process, it introduced creative business types while retaining original everyday functions such as barbershops, and also attracted social organizations and some commercial uses, thereby strengthening the compound use characteristics of the space.

Spaces that had previously served mainly as interfaces or transitional areas were reactivated as public places for staying. In front of the community service center, a resting platform turned the building interface into a space with social attributes. The accessible-friendly space, through the continuous organization of outdoor space, semi-enclosed space, and indoor space, realized transition and connection among different spatial levels. At the same time, through the overall transformation of existing building interfaces and the use of large openings, the transparency and flow of space were strengthened. Through local convex-concave variation and the insertion of resting facilities, the pedestrian interface acquired a staying attribute rather than functioning only as a passage, further enhancing the use intensity and vitality of the street space.



a) Before the renewal of the building interface b) After interface renewal and transformation

Figure2-8 Renewal of building interfaces in Yulin Alley

(Source: Reference[75])



Figure2-9 Renewal of street interfaces in Yulin Alley

(Source: Reference[75])

The semi-open space formed by pergolas and shading facilities not only provides basic conditions for staying, but can also be temporarily activated as a small activity or performance space under certain circumstances, demonstrating the elastic transformation capacity of space under different use conditions.



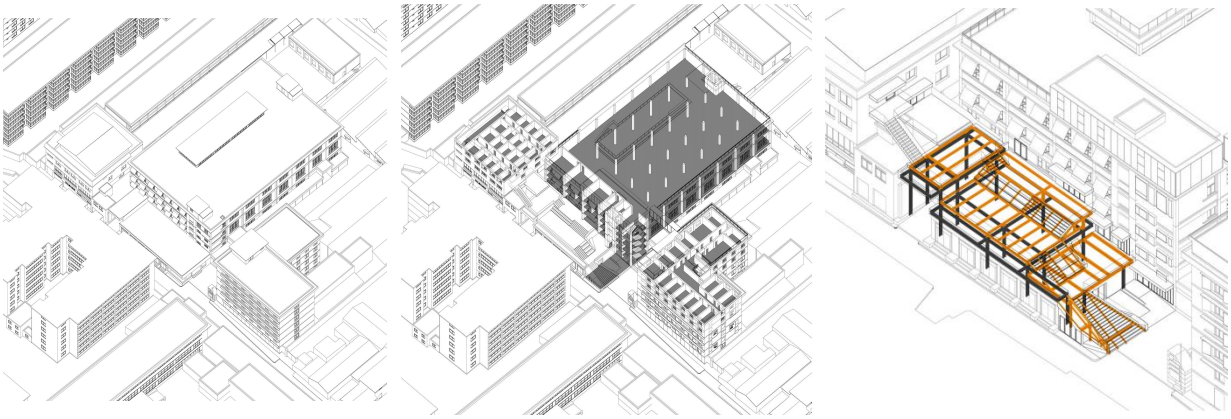

Figure2-10 Shaping of transitional space in Yulin Alley
(Source: Reference[75])

(3) Xi'an Laocaichang Market District

The Xi'an Laocaichang market district is located on the southeastern side inside the Xi'an city wall. It was transformed on the basis of a former velveteen factory and the comprehensive market that developed later, and is a representative case of micro-renewal implemented on the basis of an existing everyday urban space. Unlike overall reconstruction, this project preserved the original life scenes and gradually activated the space through small-scale intervention, forming a compound district that combines everyday life with creative experience. During the renewal, the vegetable market, as the core function of the district, was fully retained to continue serving the everyday needs of surrounding residents, while new functions were mainly inserted into upper or edge areas of the original space, such as idle floors, rooftops, and corner spaces. This additive renewal approach introduced catering, cultural-creative, exhibition, and other diversified business types without disrupting the original order of life, allowing different kinds of use behavior to coexist within the same space and forming a compound vitality structure based on everyday use with experiential consumption as a supplement.

By sorting out and connecting the original fragmented spaces, the project integrated dispersed buildings and sites into a public system that can be used continuously. Through the

demolition of local structures, it created an open entrance and stepped space, turning the originally negative building interface into a public place combining gathering and staying. It also formed a connecting space centered on broad steps between two buildings, thereby strengthening the connection among spaces at different elevations, releasing and activating the upper building interface, and expanding the dimensions of district use. While carrying traffic and connection functions, these spaces gradually became activity nodes for staying, viewing performances, and socializing. In this process, the material and structural characteristics of the original buildings were retained, allowing historical traces and new interventions to coexist.



a) Original spatial form　　b) Spatial integration and structural adjustment　　c) Interface opening and insertion of activity space

Figure2-11 Spatial integration and interface opening in the Laocaichang district
(Source: Reference[76])



Figure2-12 Axonometric View of the Public Activity Space after the Renewal of the Laocaichang District
(Source: Reference[76])

In terms of interface treatment, spaces that had originally been enclosed were reopened and endowed with public attributes. By setting signs and interface elements, the visual expression and accessibility of the spatial interface were strengthened, thereby improving its attractiveness to users.

2.3.2 Typical characteristics of Community Commercial Street Districts

Compared with large cities, the core urban areas of Small and Medium-sized Cities are smaller in scale. The service range of Community Commercial Street Districts therefore often extends beyond a single residential cluster and forms mixed-use characteristics oriented toward a broader range of people, while the boundary between commercial service and public activity is also more blurred. In terms of spatial form, interface relationship, functional configuration, and user groups, this type of district shows the following typical characteristics.

(1) Open public space as the core framework

At the level of spatial organization, the Community Commercial Street District takes streets and open public space as its basic structure. Unlike enclosed shopping centers, its activities mainly take place in outdoor and semi-outdoor space. By combining commercial space with open spaces such as nodal squares and pocket parks, the district usually acquires the capacity to support everyday passing through, staying, and activities, and thus becomes an important place for residents' daily walking, resting, and social interaction.

(2) High integration of commercial interfaces and public activity interfaces

In terms of interface characteristics, commercial interfaces and public activity space show a high degree of integration. Through the provision of transitional spaces such as outdoor seating areas, semi-enclosed space, pilotis, arcades, and corridors, commercial activities extend outward and the boundary between interior and exterior space becomes more continuous. Such transitional spaces not only provide residents with sheltered places for staying, but also make the commercial atmosphere highly intertwined with residents' spontaneous activities, forming a compound interface that combines passing through, staying, and consumption.

(3) Functional mixture and rich facility support

In terms of functional composition, the Community Commercial Street District combines basic daily services with leisure-oriented consumption. Its business structure is often continuously adjusted through long-term use and gradually forms a stable pattern mainly serving surrounding residents, such as convenience retail, dining, beauty and hairdressing. The introduction of public or semi-public service facilities such as education and training and healthcare further strengthens the district's role as a community life service center. In districts with relatively good spatial quality, experiential business types such as cafés and cultural-creative shops may also be introduced, expanding the range of users and forming a compound business structure in which convenience services and experiential consumption coexist, so that the district can maintain a certain level of pedestrian support at different times of day.

At the facility level, the provision of elements such as seating and children's play facilities enables the district to effectively support staying behavior, while pedestrian-vehicle separation and a continuous pedestrian system improve safety and comfort. Facility provision usually takes into account the needs of different age groups so as to meet diversified everyday activities.

(4) Mixed use by different user groups

The users of a Community Commercial Street District are not limited to surrounding residents, and their composition is jointly influenced by business types and spatial quality. In districts dominated by everyday convenience services, users are highly concentrated among residents of nearby residential areas, the spatial layout is compact, and passing through and shopping behaviors dominate. By contrast, districts with a certain degree of spatial quality and experiential business types can attract users from a wider range, forming a mixed-use condition in which destination-oriented consumption and everyday leisure activities coexist.

In the context of Small and Medium-sized Cities, because the overall scale of urban areas is relatively small and public service resources are relatively limited, the boundary of the service range of Community Commercial Street Districts is often relatively blurred, and user groups show more diversified characteristics. Different groups vary in activity types, periods of use, and spatial needs. On the one hand, this provides the district with a multi-level base of

pedestrian flows; on the other hand, it also places higher demands on the differentiated capacity of space in terms of functional organization and environmental adaptation.

2.3.3 Theoretical and methodological support for vitality research on the Community Commercial Street District

This study focuses on the formation mechanism and optimization path of spatial vitality in Community Commercial Street Districts of Small and Medium-sized Cities. The core issues mainly include two aspects: identifying the key built environment factors that affect spatial vitality in Community Commercial Street Districts, and proposing targeted spatial optimization strategies on the basis of the mechanism of influence. Around these issues, this study constructs a research framework centered on quantitative built environment analysis and the spatial overlay of behavioral data, in order to reveal the relationship between physical spatial conditions and the distribution of public activities and thus support the analysis and optimization of spatial vitality in Community Commercial Street Districts.

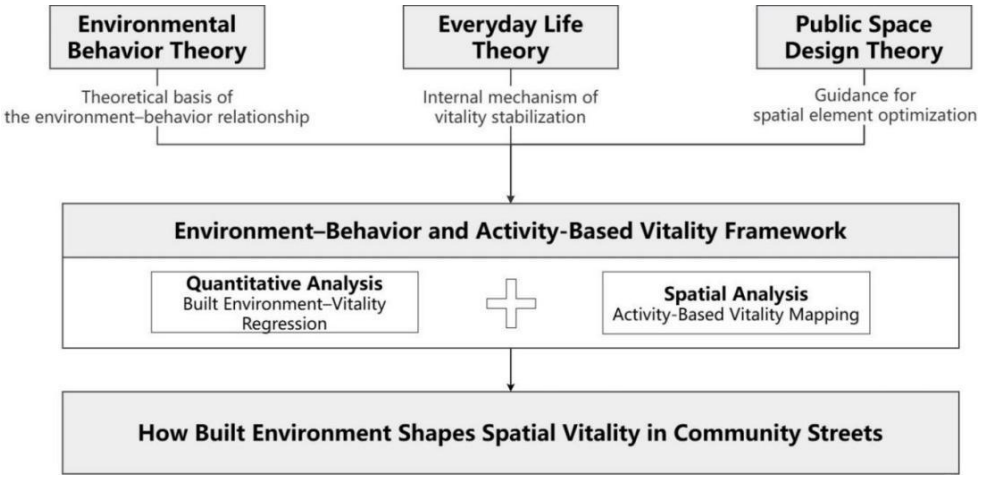


Figure2-13 Theoretical Basis and Construction of the Research Framework
(Source: drawn by the author)

At the theoretical level, the "human–environment–behavior" logic of environment behavior theory provides the basis for explaining how built environment factors influence user behavior. Everydayness theory explains the sustained formation mechanism of district vitality from the perspective of the high frequency and repetitiveness of residents' activities(Figure2-13). At the same time, existing vitality studies, through their definition of

activity types and vitality representation, provide the basis for vitality measurement and indicator selection in this study.

On this basis, the study obtains the spatial distribution characteristics of public space activities through behavioral observation and combines them with quantitative analysis of built environment indicators. It then identifies the direction and degree of influence of each factor in a multiple linear regression model, thereby achieving a systematic analysis of the relationship between environment and behavior. This framework can identify the independent effects of built environment factors under the control of multiple variables, and is suitable for the study of spatial vitality in Community Commercial Street Districts.

2.4 Summary of This Chapter

This chapter focuses on the research basis of public space vitality in Community Commercial Street Districts of Small and Medium-sized Cities, and provides support for the subsequent empirical analysis from three levels: concept definition, theoretical construction, and type-based research.

At the conceptual level, core concepts such as Small and Medium-sized Cities, spatial vitality, Community Commercial Street Districts, and small-scale waterfront space are defined, clarifying the spatial type and problem orientation of the research object and specifying the basic scope of this study in terms of city size, district type, and spatial scale.

At the theoretical level, the chapter constructs a theoretical support system for the study from three dimensions: environment–behavior theory, everydayness theory, and public space design theory. Environment–behavior theory, starting from the relationship of "human–environment–behavior," provides the basic framework for explaining how built environment factors influence users' spatial choices and activity behavior. Everydayness theory emphasizes the foundational role of residents' high-frequency and repetitive everyday activities in the formation of spatial vitality, and thus provides the theoretical basis for taking everyday use as the core perspective of this study. Public space design theory, from the perspectives of spatial organization and facility provision, offers design-level support for the subsequent proposal of optimization strategies. Together, the three form a theoretical framework that moves from mechanism explanation to strategy transformation.

At the level of type-based research, by reviewing the formation and development of community commercial street districts and combining representative cases such as Chengdu Mengzhui Bay, Yulin Alley, and Xi'an Laocaichang, this chapter summarizes the common characteristics of such districts in terms of spatial framework, interface form, functional configuration, and user groups. It reveals the basic pattern that the formation of vitality in community commercial street districts depends on the coordinated action of everyday use behavior and spatial environmental conditions, and clarifies the methodological path of combining behavioral observation with multiple linear regression to identify the mechanisms through which built environment factors influence spatial vitality, thus laying the foundation for the construction of the indicator system and the empirical analysis in Chapter 3.

Chapter 3 Research on Factors Influencing Vitality in Community Commercial Street Districts

3.1 Measurement of Vitality in Community Commercial Street Districts

3.1.1 Constituent elements of vitality in Community Commercial Street Districts

A review of the literature shows that the vitality of public space in a district originates from human use and is mainly composed of three types of activities: necessary activities, spontaneous activities, and social activities. Necessary activities refer to indispensable behaviors in everyday life that occur under almost all conditions, such as commuting, going to school, and handling basic daily affairs. Spontaneous activities refer to non-compulsory behaviors supported by certain environmental conditions, such as walking, pausing, and taking photos. Social activities depend on interpersonal interaction, such as conversation, children's play, and collective activities[16].

For public space, spontaneous activities and social activities better reflect the quality of space use and the level of vitality, and they are the main sources of sustained vitality in public space. As the material carrier of activities, public space in characteristic districts is shaped by both environmental conditions and the capacity to attract people. Space provides the setting, people generate attraction, and activities are continuously produced and superimposed through the interaction between the two. Together, these three dimensions constitute the basic structure of vitality in district public space.

3.1.2 Formation mechanism of vitality in Community Commercial Street Districts

Existing studies often characterize urban spatial vitality from three dimensions—economic, social, and cultural[77]. At the district scale, however, vitality is more directly reflected in the combined outcome of human activities and space use. In Community Commercial Street Districts, vitality is not driven by a single source, but results from the joint action of residents' everyday life, commercial activities, and the spatial environment.

Accordingly, its formation mechanism can be understood from three aspects: the community, commerce, and the landscape environment.

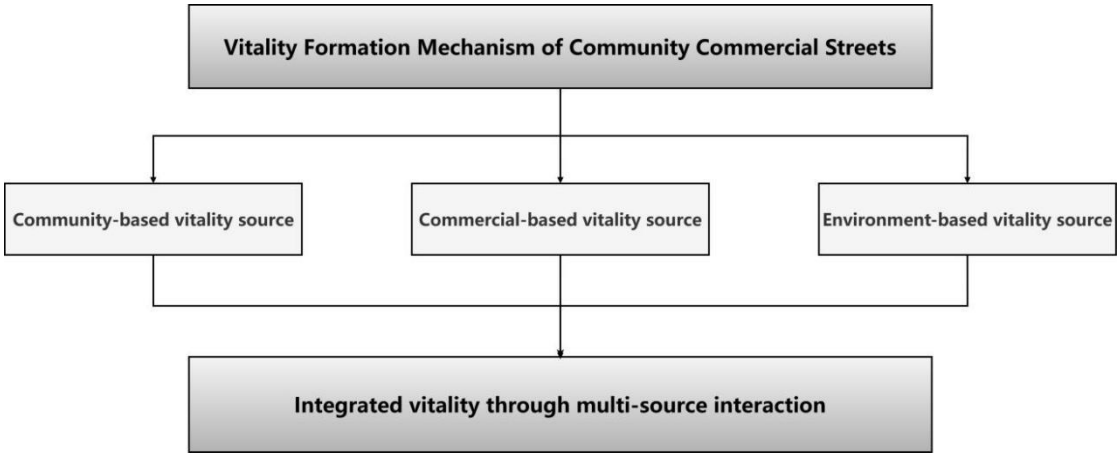


Figure3-1 Formation mechanism of spatial vitality in Community Commercial Street Districts
(Source: drawn by the author)

(1) Community-based source of vitality

The vitality of a Community Commercial Street District first comes from the everyday use behaviors of surrounding residents. Unlike commercial districts dominated by tourists, this type of district relies more on the continuous use of local residents, forming a stable pedestrian base through everyday activities such as passing through, staying, and social interaction. This mode of use, centered on neighborhood relations and daily needs, gives the district strong continuity and stability and constitutes the fundamental source of its vitality.

(2) Commerce-based source of vitality

Commercial functions are an important supplementary source of district vitality. Business types such as dining, retail, and daily life services can attract people and, to a certain extent, prolong staying time, thereby promoting interaction and consumption in space. However, in Community Commercial Street Districts, commercial activities mainly serve the daily needs of surrounding residents. Their vitality therefore tends to be relatively stable and, compared with large-scale consumption-oriented commercial districts, places greater emphasis on integration with community life.

(3) Landscape and environmental source of vitality

The landscape environment and spatial conditions provide material support for district vitality. A good walking environment, appropriate staying spaces, and a comfortable

microclimate can increase people's willingness to use the space and promote staying and social behavior. At the same time, elements such as waterfront spaces, greenery, and open nodes can enhance spatial attractiveness, enabling the space not only to meet passing-through needs but also to support rest and interaction, thereby further stimulating district vitality.

3.1.3 Measurement of vitality in Community Commercial Street Districts

To portray the spatial distribution of district vitality, this study uses vitality density as the core indicator to measure the vitality of district public space. Vitality density reflects the distribution of activity intensity per unit area and can reveal the degree of concentration of human activities in different spatial units. On this basis, the spatial manifestation of district vitality is further interpreted in combination with activity types and user characteristics. In this study, the number of activity points observed or counted on site is used as the basic data and divided by the area of the corresponding spatial unit to obtain the vitality intensity per unit area. The formula is as follows:

$$D_i = \frac{N_i}{A_i} \tag{3-1}$$

Where D_i is the vitality density of the i-th spatial unit; N_i is the total number of activities recorded in that unit during the observation period; and A_i is the area of that spatial unit.

3.2 Construction of the Built Environment Indicator System

3.2.1 Principles for indicator selection

Research on factors influencing urban vitality has developed a relatively rich body of theories and methods. At the macro scale, relevant studies often start from the relationship between the built environment and human activities and construct relatively mature frameworks for vitality evaluation. A typical example is the 5D model, which explains the formation mechanism of urban vitality from the perspectives of density, design, diversity, transit accessibility, and destination accessibility[78]. Studies on district vitality also often adopt indicators such as functional mix, transport accessibility, and facility density for analysis[79].

However, these indicator systems mostly serve vitality research at the city or area scale and place greater emphasis on the agglomeration and flow characteristics of population, functions, and transport over larger areas. At the micro scale of a Community Commercial Street District, vitality differs both from tourism- and consumption-oriented commercial districts and from street spaces that mainly serve passing-through functions. Instead, it is grounded in the everyday use of surrounding residents and is more often reflected in the superimposed result of daily passing through, staying, interaction, and small-scale consumption. Differences in vitality often depend on differences among specific spatial units in accessibility, staying conditions, functional supply, and environmental comfort, and are jointly shaped by community life services, commercial support, and spatial environmental quality. Some macro indicators show limited variation within the district and therefore cannot effectively explain vitality differences among nodes and spatial units.

Therefore, drawing on studies related to street space, public space, and waterfront space, and taking into account the dual characteristics of the Laoximen District as both a setting for residents' everyday use and a space with commercial service functions, this study screens and integrates the influencing factors of the built environment. In studies of street vitality, micro-scale indicators such as integration, seating density, sidewalk width, and interface form have been incorporated into the analytical framework of the built environment[35,79–81]. In studies of waterfront space vitality, factors such as waterfront accessibility, shoreline form, landscape node density, and shading conditions have commonly been examined as candidate indicators affecting people's staying behavior [41,42]. On this basis, and in combination with the characteristics of the study area, this study conducts a targeted selection of indicators and constructs an indicator system suitable for micro-scale analysis of Community Commercial Street Districts. The final system is organized around four dimensions, namely spatial structure, functional supply, environmental conditions, and staying facilities (Figure3-2).

Three principles are mainly followed in the indicator screening process. First is the relevance principle, which prioritizes indicators that have broad consensus in existing studies and are closely related to spatial vitality. Second is the scale-adaptation principle, which retains micro- and meso-scale indicators that show spatial variation within the district. Third

is the operability principle, which prioritizes indicators for which data are obtainable and suitable for quantitative analysis.

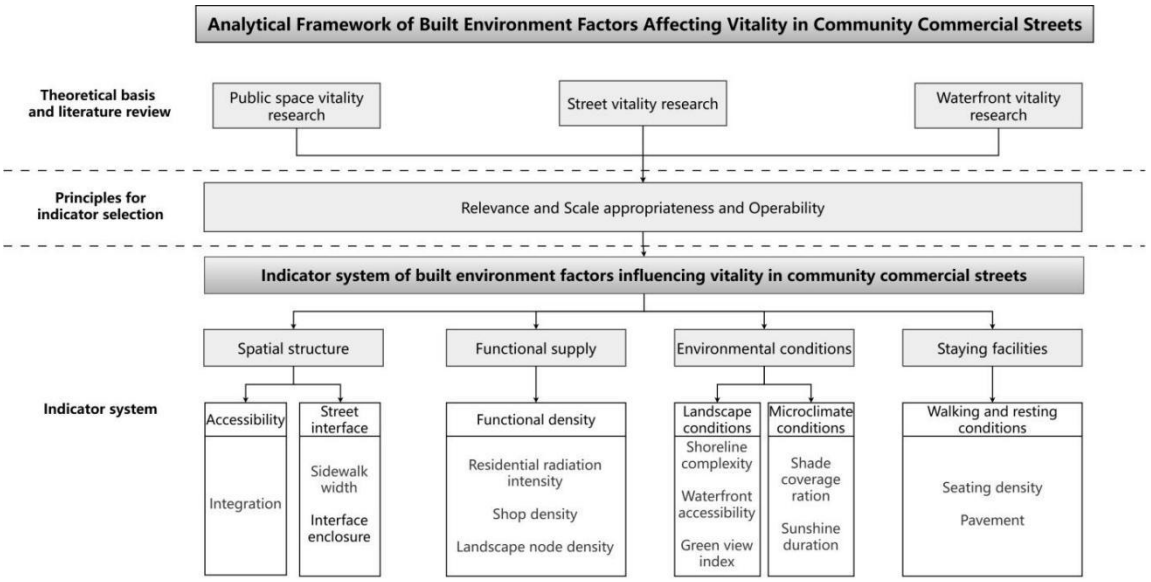


Figure3-2 Construction of the indicator system for factors influencing spatial vitality in Community Commercial Street Districts (Source: drawn by the author)

3.2.2 Construction of the indicator system

On the basis of the above principles, and in combination with the literature review results and the characteristics of the research object, this study screens and integrates built environment elements and constructs an indicator system from four aspects: spatial structure, functional supply, environmental conditions, and staying facilities.

Table3-1 Representation system of vitality in the built environment
(Source: drawn by the author)

Category	Primary indicator of vitality representation	Secondary indicator of vitality representation
Spatial structure	Accessibility	Local integration
	Street interface	Street width
		Interface enclosure degree
Functional supply	Functional density	Residential radiation intensity
		Shop density
		Density of landscape attractions
Environmental conditions	Landscape conditions	Shoreline complexity
		Waterfront accessibility
		Green view index
	Climatic conditions	Shade coverage ratio

Table3-1 Representation system of vitality in the built environment (Continued)

Category	Primary indicator of vitality representation	Secondary indicator of vitality representation
Staying facilities	Walking and resting conditions	Sunshine duration Seating density Pavement type

3.2.3 Indicator descriptions and quantification methods

(1) Local integration

Accessibility is represented by the integration indicator in space syntax. By building a segment model of the road network, local integration is calculated. Integration reflects the centrality of a street segment within the overall road network and the probability of being passed through, and it is an important meso-scale factor affecting the distribution of pedestrian flow and the concentration of activities. The higher the integration value, the more likely the space is to become a gathering node for everyday activities. This indicator has been widely used in studies of street vitality and walking behavior to represent spatial accessibility and the potential distribution of pedestrian flow.

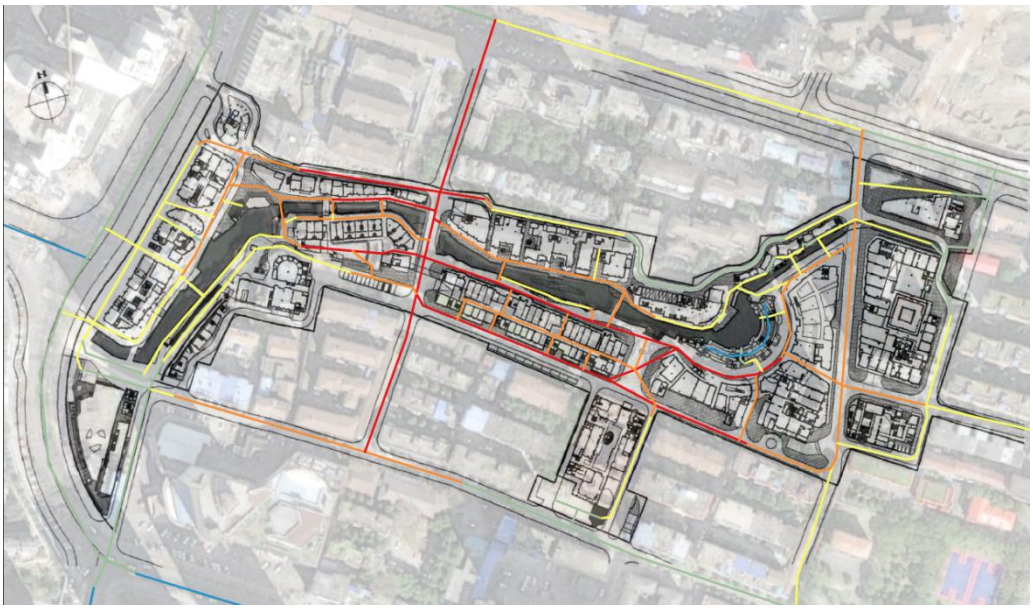


Figure3-3 District integration
(Source: drawn by the author)

In Community Commercial Street Districts, both the everyday trips of surrounding residents and the consumption and strolling behaviors of outside users tend to prioritize paths with higher integration. Integration reflects not only the convenience of movement in space,

but also, to a certain extent, the intensity of pedestrian concentration and the accessibility of commercial services.

(2) Street width

Street width is used to reflect the spatial scale of the street and the degree of openness of the walking environment. A reasonable street scale affects not only traffic efficiency but also the likelihood of staying and social activities. In studies of Community Commercial Street Districts, street width can be regarded as an important physical indicator of spatial carrying capacity and comfort. Streets not only undertake everyday passing-through functions, but also support staying, interaction, and temporary consumption. Appropriate street width helps ensure movement efficiency while also providing spatial conditions for staying and activities, thereby promoting people's use of street space.

This study calculates the equivalent average width using the ratio of road area to total road centerline length. The formula is as follows:

$$W_{\mathrm{i}} = \frac{A_{\mathrm{road,i}}}{L_{\mathrm{line,i}}} \tag{3-2}$$

Where $A_{\mathrm{road,i}}$ is the total road area within the unit, $L_{\mathrm{line,i}}$ is the total road centerline length within the unit.

(3) Interface enclosure degree

Interface enclosure degree is used to measure the extent to which various street-side interfaces on both sides of a street—including building facades, walls, and similar elements—enclose the street space and define the completeness of its boundary. A higher interface enclosure degree means that the street space has clearer boundary definition, which helps create a stable spatial perception and increases users' sense of security and willingness to stay while walking. In Community Commercial Street Districts, spaces with a strong sense of enclosure are not created only by commercial interfaces. Non-commercial interfaces such as walls and gable walls can also define spatial boundaries and strengthen territoriality, thereby providing relatively stable spatial support for residents' staying and social activities. The formula is as follows:

$$C_{\mathrm{i}} = \frac{L_{\mathrm{facade,i}}}{L_{\mathrm{street,i}}} \tag{3-3}$$

Where $L_{facade,i}$ is the total length of various street-side interfaces, including building facades and walls, and $L_{street,i}$ is the total street length.

(4) Residential radiation intensity

Given that there are relatively few residential buildings within the district and that internal density cannot adequately reflect residential support, this indicator is characterized using kernel density analysis of surrounding residential uses. By calculating the kernel density of residential functions around the district and taking the mean value for each spatial unit, the potential supporting effect of the external residential population on district activities is reflected.

In Community Commercial Street Districts, district vitality depends to a large extent on the everyday use and repeated activities of surrounding residents. Although internal residential functions are limited, the external residential population still exerts a continuous influence on the district through passing through, consumption, and daily activities.

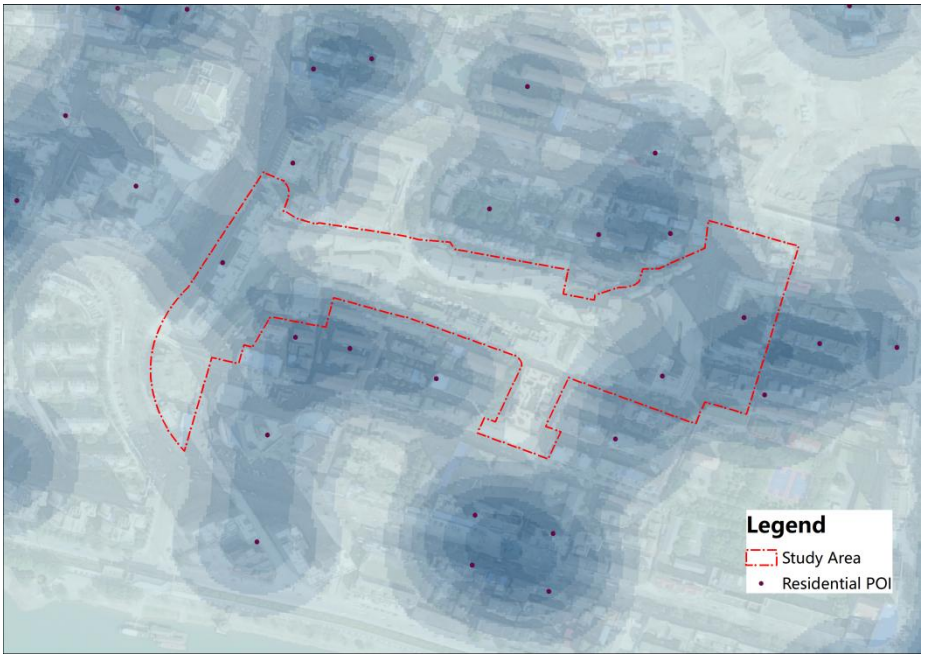


Figure3-4 Residential radiation intensity
(Source: drawn by the author)

(5) Shop density

Shop density reflects the concentration of street commercial functions and the capacity of consumption supply. A high density of shops usually means a stronger commercial

atmosphere and greater consumer attraction, and it is an important factor influencing staying and the occurrence of activities.

In Community Commercial Street Districts, commercial functions both serve the daily needs of surrounding residents and, to a certain extent, attract outside users for consumption and staying. Appropriate shop density helps form a continuous life-service interface, improves convenience and continuity of spatial use, and enriches users' experience in the district through diversified commercial supply. This can prolong staying time and promote the occurrence of multiple behaviors, including staying and light consumption. The formula is as follows:

$$D_{\text{shop,i}}=\frac{N_{\text{shop,i}}}{A_{\text{i}}} \tag{3-4}$$

Where $N_{\text{shop,i}}$ is the number of shops within the unit, and A_{i} is the area of the corresponding research unit.

(6) Density of landscape attractions

Density of landscape attractions is used to measure the distribution of spatial nodes with visual appeal, cultural symbolism, or recreational value, including landscape installations, historical remains, and waterfront nodes, thereby reflecting the supply level of cultural and landscape resources in space.

In Community Commercial Street Districts, landscape nodes become prominent points of recognition through their visual image and spatial characteristics and often have strong aesthetic attraction and check-in appeal. Such nodes can attract outside users into the district in a short time and become high-frequency spaces for photography, staying, and short pauses. A higher density of landscape nodes helps improve the overall recognizability and spatial memorability of the district, guides people's strolling routes to a certain extent, and promotes pedestrian concentration and activity occurrence in local spaces. The formula is as follows:

$$D_{\text{landmark,i}}=\frac{N_{\text{landmark,i}}}{A_{\text{i}}} \tag{3-5}$$

Where $N_{\text{landmark,i}}$ is the number of landscape nodes or attractions, and A_{i} is the area of the corresponding research unit.

(7) Shoreline complexity

As the spatial interface between land and water, the shoreline constitutes an important open public-space boundary within the district, and its morphological characteristics directly affect use behavior. Shoreline complexity is used to represent the degree of variation of this interface in the horizontal dimension. A certain degree of curvature can form locally protruding or recessed spatial units, thereby providing conditions for spontaneous activities such as staying, viewing, and lingering. In Community Commercial Street Districts, the shoreline is not only an important landscape carrier but also a key spatial interface for organizing public activities. By affecting opportunities for staying, its morphological variation further influences the intensity of waterfront space use. The formula is as follows:

$$S_{\mathrm{in,i}} = \frac{L_{\mathrm{real,i}}}{L_{\mathrm{straight,i}}} \tag{3-6}$$

Where $L_{\mathrm{real,i}}$ is the actual length of the waterfront shoreline, and $L_{\mathrm{straight,i}}$ is the straight-line distance between the two endpoints of the shoreline.

(8) Waterfront accessibility

Waterfront accessibility refers to the degree of convenience and interactive depth with which the edge space of the waterfront establishes connections with the waterbody at both physical and perceptual levels. This indicator reflects not only horizontal accessibility between people and the waterbody, but also vertical and perceptual dimensions such as visual connectivity and the possibility of touching the water. Higher waterfront accessibility can weaken or even eliminate physical barriers between people and water, thereby enhancing spatial attraction and participation.

This study classifies waterfront accessibility by grades. According to the degree of accessibility and perceptibility between people and the waterbody, it is divided into five levels: completely away from the waterbody, adjacent to the waterbody but invisible, visible waterbody with relatively strong visual obstruction, visible waterbody with limited obstruction, and direct contact with the waterbody.

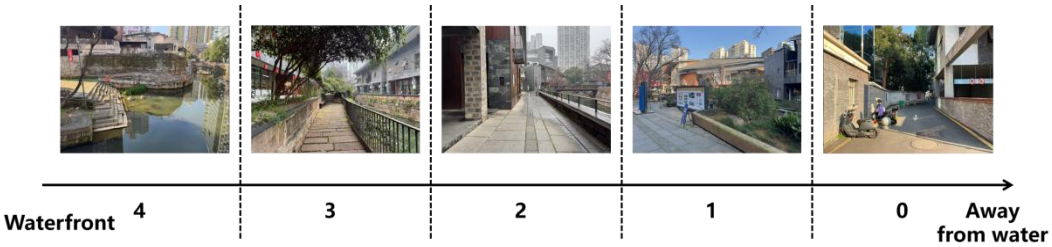


Figure3-5 Classification of waterfront accessibility levels in the district
(Source: drawn by the author)

In Community Commercial Street Districts, waterfront accessibility enhances nature-related experience by strengthening perceptual connections between people and water. Compared with waterfront spaces that are only for viewing, shorelines with higher waterfront accessibility enable more direct visual and tactile interaction with the waterbody, thereby increasing spatial attractiveness and emotional experience. Such experiential characteristics are more likely to attract outside users into the district and generate staying and gathering behavior in waterfront areas, thus promoting the intensity of space use to a certain extent.

(9) Green view index

Based on street-view photographs taken on site in the district, this study uses ImageJ for image recognition and pixel statistics. By calculating the proportion of green pixels in the total number of pixels, the green view index value for each zone is obtained. Starting from visual perception, this method transforms two-dimensional image information into a quantifiable indicator to represent the proportion of visible vegetation elements in street space.

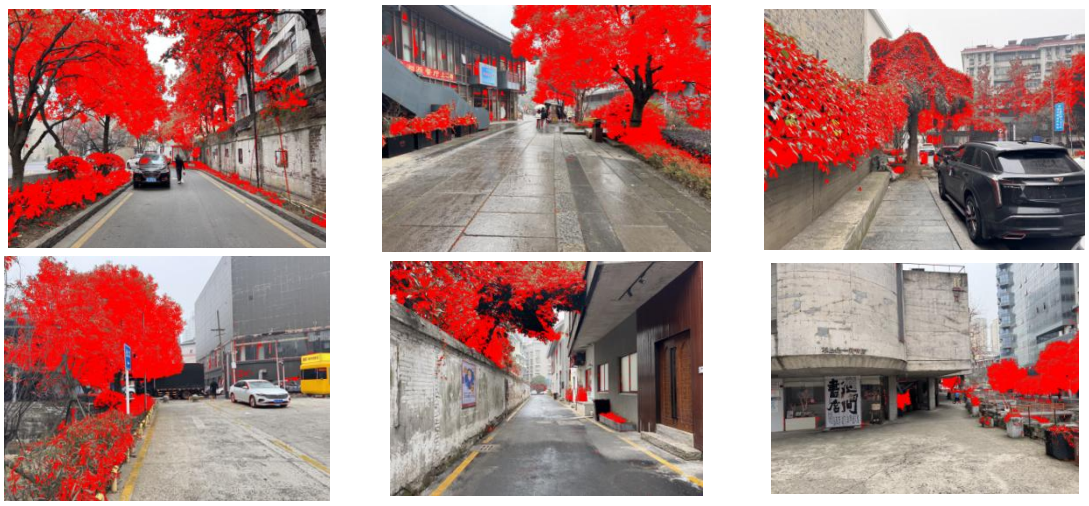


Figure3-6 Recognition of green elements
(Source: drawn by the author)

In Community Commercial Street Districts, a higher green view index helps improve spatial comfort and environmental quality, alleviates visual fatigue during walking, and thereby enhances people's willingness to stay and their experience of space use.

Given that image-recognition methods based on color-threshold ranges may in some cases misidentify light-colored paving, reflections from green glass, or shadowed areas as green pixels, this study manually reviews samples with large reflective surfaces or glass facades during the recognition process and adjusts thresholds where necessary in order to reduce the impact of such errors on the results.

(10) Shade coverage ratio

Shaded space is composed of semi-outdoor elements such as pergolas, pilotis, and building overhangs. As a transitional interface between indoor and outdoor space, it enhances adaptability to climate change through shading and rain protection. At the same time, its functional ambiguity and flexibility of use provide conditions for informal interaction and incidental activities, which helps maintain the continuity of spatial vitality over time. The formula for shade coverage ratio is as follows:

$$R_{e,i} = \frac{A_{shading,i}}{A_i} \tag{3-7}$$

Where $R_{e,i}$ denotes shade coverage ratio, $A_{shading,i}$ is the total area of semi-outdoor gray spaces such as arcades, canopies, and setback eaves, and A_i is the area of the corresponding research unit.

(11) Sunshine duration

Effective sunshine duration is a key indicator for the common sun-basking activities observed in the district. Using the Sun Hours plug-in, the study simulates sunlight conditions in the three-dimensional building model of the district, analyzes the cumulative hours of sunshine received by ground-level pedestrian activity areas between 8:00 and 18:00 on Major Cold Day, and quantifies the result through grid-based average values (Figure3-7).

Existing studies show that sunlight conditions have a significant impact on the use of public space. Appropriate sunshine not only improves thermal comfort but also increases people's preference for outdoor environments. In Community Commercial Street Districts, spaces with better winter sunshine conditions are more likely to become places where people

stay, as seen in activities such as sunbathing, sitting idly, or accompanying children. Longer sunshine duration helps enhance the attractiveness of spatial use and thus increases staying intensity and the level of everyday activities within the district.

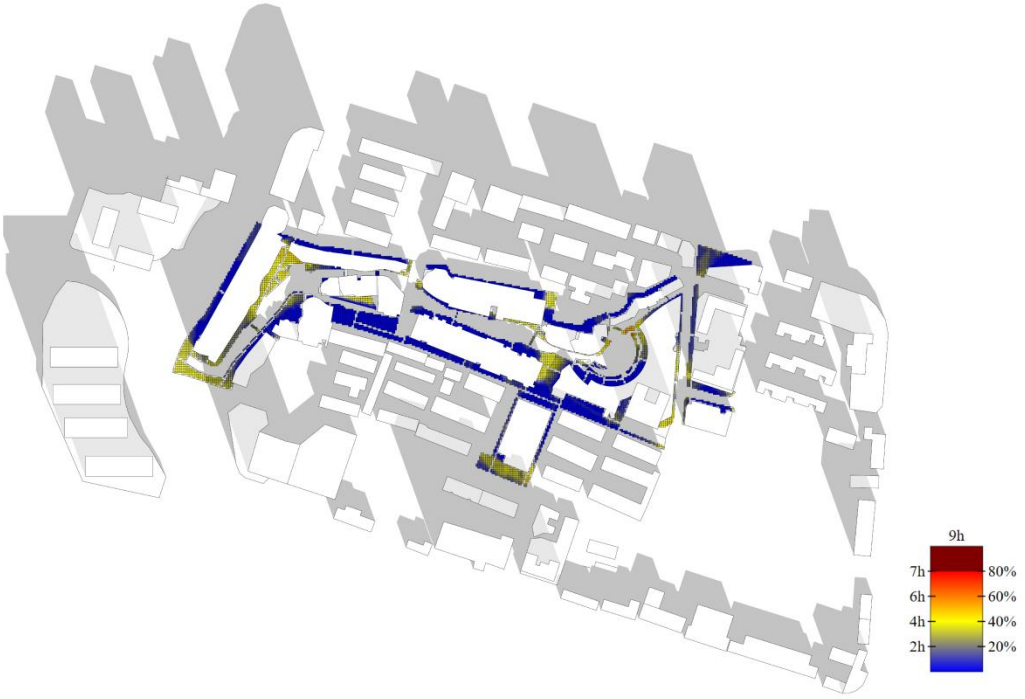


Figure3-7 Sunshine-duration simulation
(Source: drawn by the author)

(12) Seating density

As a typical staying facility, seating lowers the threshold for rest and interaction and promotes the transformation of street and alley space from a passage space oriented mainly toward movement into a living space that supports lingering and interaction. In the measurement process, to unify the statistical standard for different forms of seating, this study converts non-standardized staying facilities into equivalent seating quantities based on effective sittable length.

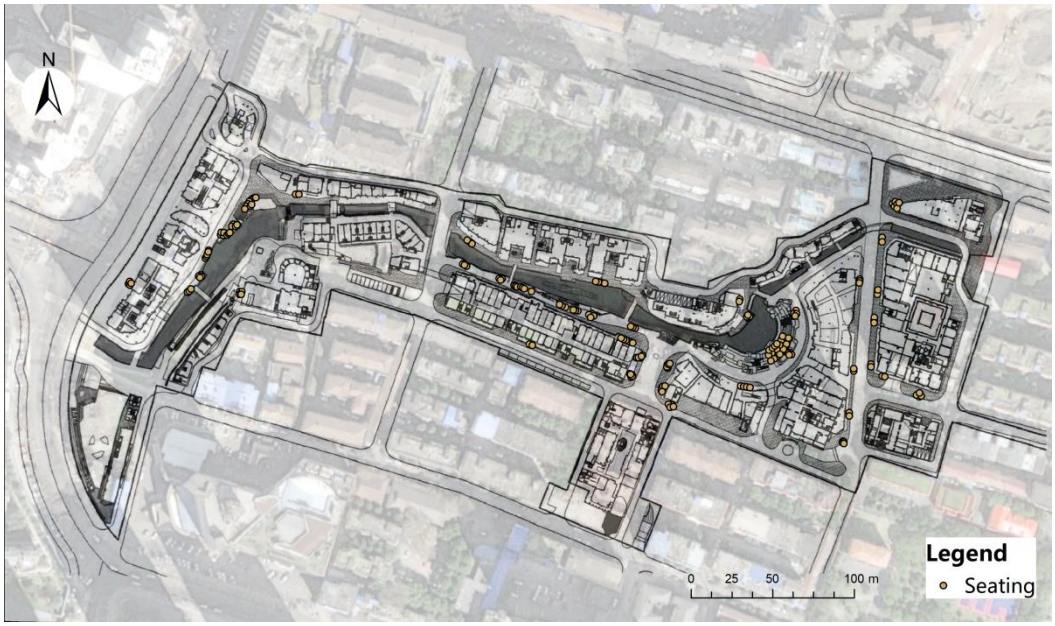


Figure3-8 Seating distribution
(Source: drawn by the author)

The formula for seating density is as follows:

$$D_{\text{seat,i}} = \frac{N_{\text{seat,i}}}{A_{\text{i}}} \tag{3-8}$$

Where $D_{\text{seat,i}}$ denotes seating density, $N_{\text{seat,i}}$ is the total number of public seats and other stay-supporting facilities within the research unit, and A_{i} is the area of the corresponding research unit.

(13) Pavement type

Ground pavement type affects comfort and safety during walking and is closely related to the adaptability of different user groups. Smooth and continuous paving is more favorable for older people, children, and strollers, whereas surfaces with wide gaps or uneven finishes may reduce walking comfort and increase safety risks such as tripping.

In Community Commercial Street Districts, pavement conditions directly affect people's walking experience in space. Good pavement can support slow-moving activities such as walking and accompanying children, allowing street space not only to undertake movement functions but also to possess certain everyday leisure attributes.

Based on pavement smoothness and suitability for use, this study classifies district pavement into five categories and scores them by grade: fine soft paving (such as wooden paving), fine hard paving (such as concrete and tiles), large bricks with wide joints, small bricks with wide joints, and rough pavement.

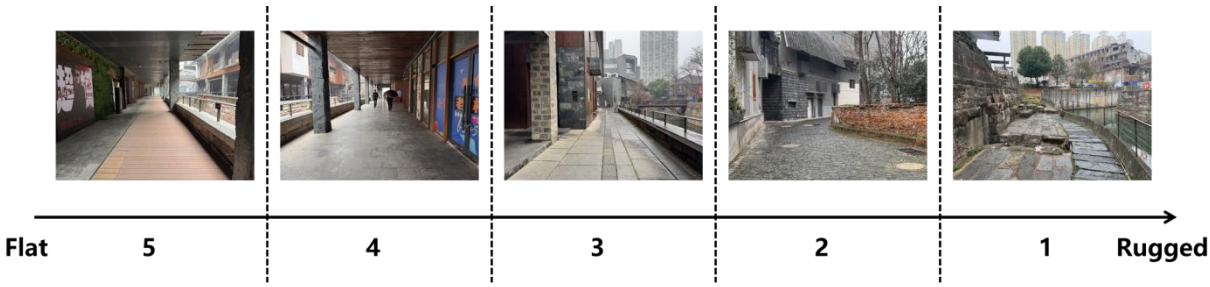


Figure3-9 Classification of pavement quality levels in the district
(Source: drawn by the author)

3.3 Research Spatial Units and Data Sources

3.3.1 Research units

The division of research scale directly affects the accuracy of spatial analysis results. This study takes internal district space as the main research object, focusing on spatial differences and vitality performance at the micro and meso scales. Compared with the macro urban scale, internal district space more directly accommodates specific use behaviors and situational activities, and the relationship between spatial structure, facility supply, environmental conditions, and the distribution of vitality is more direct. The locational setting of the district and the surrounding residential structure are used only as background information to understand the sources of district users and the support of their living networks, and are not included in the specific quantitative analysis.

In the division of research units, considering the heterogeneity of internal spatial structure, the distribution characteristics of facilities, and actual usage conditions, the research area is divided into 65 spatial units, with an average area of about 400 square meters. This scale can both reflect spatial differences within the district and ensure that the sample size meets the needs of quantitative analysis, thereby providing a foundation for subsequent regression analysis.

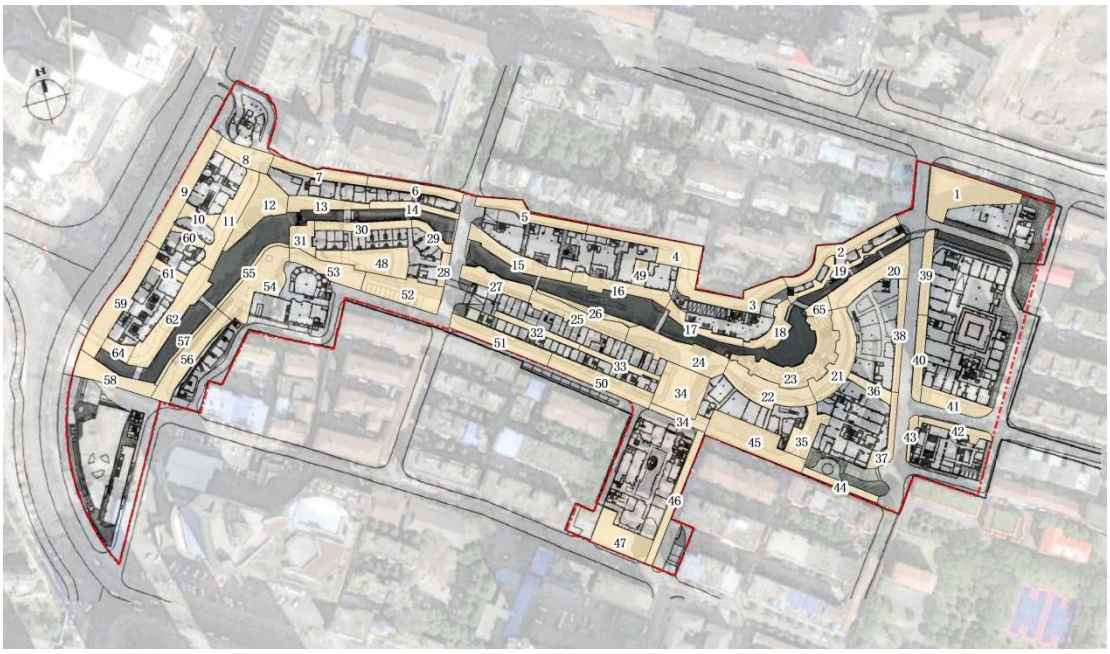


Figure3-10 District zoning
(Source: drawn by the author)

3.3.2 Data sources

The data used in this study mainly come from basic spatial and built environment data, big data on functions and accessibility, and behavioral observation data. The integration of multiple data sources improves the comprehensiveness and precision of the analysis.

(1) Basic spatial and built environment data

Basic spatial and built environment data mainly include information on road networks, water systems, and green space obtained from map databases, as well as on-site survey data, and are used to support the analysis of indicators such as road-network accessibility.

This study obtains basic data on road networks, water systems, and green space through the Shui Jing Zhu platform, and compares and corrects them with OpenStreetMap (OSM) and the National Basic Geographic Information Database in order to improve data accuracy and completeness.

At the same time, field survey data constitute an important data source for this study and are mainly used to supplement the deficiencies of online data at the micro level of urban space. Through a combination of online information collection and field investigation, and by using on-site observation, measurement, and image recording, the study systematically obtains key

built environment indicators at the district scale, such as seating density and waterfront accessibility, thereby providing the necessary data support for subsequent evaluation of spatial characteristics and analysis of use behavior. In addition, the quantification of some built environment indicators relies on ground-floor plans and satellite imagery. The study collects ground-floor building plans for the research area through online platforms, imports them into ArcGIS for georeferencing and scale correction, and then carries out vector extraction and spatial calculation of morphological indicators such as interface enclosure degree and street width. These methods make it possible to effectively quantify micro-scale built environment indicators in the absence of a detailed building database and compensate for the lack of morphological information in publicly available data at the district scale.

(2) Big data on functions and accessibility

Big data on functions and accessibility mainly consist of POI (Point of Interest) data. POI data are used to extract spatial distribution characteristics such as shop density and residential density. With advantages such as strong timeliness and fine-grained classification, POI data can reflect the dynamic changes of urban functions. This study obtains POI data from the Amap data platform. The dataset contains 23 first-level categories, such as catering, shopping, and tourist attractions. After cleaning and classification, the data are analyzed according to research needs and imported into ArcGIS for visualization and spatial calculation.

(3) Behavioral observation data

To more accurately reveal the interaction between user behavior and urban space, this study introduces behavior mapping and the PSPL (Public Space Public Life) observation method to systematically record district vitality. Through continuous observation across different time periods and spatial locations, user behaviors are classified, counted, and mapped, providing empirical support for analyzing the relationship between users and the environment. The survey periods covered typical weekdays and rest days and selected sunny days with good visibility in order to exclude incidental disturbances to everyday behavior caused by extreme weather.

Field behavioral observation was carried out six times. The selected dates and weather conditions were as follows:

December 14, 2025 (Sunday, sunny, temperature 4°C–14°C);

December 15, 2025 (Monday, cloudy, temperature 6°C–12°C);

December 18, 2025 (Thursday, sunny, temperature 4°C–16°C);

January 8, 2026 (Thursday, sunny, temperature 2°C–15°C);

January 9, 2026 (Friday, sunny, temperature 4°C–17°C);

January 11, 2026 (Sunday, sunny, temperature 1°C–14°C).

3.3.3 Analytical methods

(1) Regression analysis

Stepwise regression is a common variable-selection method in multiple linear regression analysis. Under conditions with multiple independent variables, it can gradually introduce or remove variables to build a regression model with relatively strong explanatory power and a relatively stable structure. Considering that district vitality is jointly affected by multiple built environment factors, single-indicator analysis cannot reveal the independent role of different factors when other variables are controlled. Therefore, a multiple regression model is adopted for comprehensive testing. At the same time, because some correlations may exist among built environment indicators, the stepwise selection mechanism helps improve structural stability while maintaining the explanatory power of the model.

In the specific analysis process, 13 built environment factors are taken as independent variables and population density in each zone is taken as the dependent variable to quantitatively analyze vitality differences among spatial units in the district. Population density can reflect the concentration of people during the actual use of the district and, to a certain extent, the activity level of different zones, so it is selected as the indicator for measuring district vitality. Through regression analysis, the direction and degree of influence of each built environment factor on district vitality can be identified, providing data support for subsequent interpretation of spatial characteristics and the proposal of spatial optimization suggestions.

(2) Interpretive induction

On the basis of quantitative regression analysis, this study adopts interpretive qualitative analysis to attribute mechanisms and summarize spatial characteristics. Based on the key influencing factors identified through regression analysis, and combined with field behavioral observation records, the built environment conditions of spaces with different vitality levels are compared and analyzed. The differential characteristics of high-vitality, medium-vitality, and low-vitality areas are then summarized in terms of spatial structure, interface conditions, facility configuration, and microclimatic elements. On this basis, by comparing quantitative results with spatial morphological characteristics, the core problems constraining district vitality are summarized and interpreted, thereby forming an integrated understanding of the mechanism through which built environment factors operate and providing a basis for subsequent spatial optimization strategies.

3.4 Summary of This Chapter

This chapter systematically examines the factors influencing vitality in Community Commercial Street Districts. From three aspects—vitality measurement, indicator construction, and analytical methods—it establishes the basic framework for analyzing vitality in Community Commercial Street Districts and provides theoretical and data support for subsequent analysis of spatial characteristics and research on optimization strategies.

First, starting from activity types, district vitality is divided into necessary activities, spontaneous activities, and social activities, and its formation mechanism is clarified from the three aspects of community, commerce, and landscape environment, thereby identifying the multidimensional structure of district vitality sources. Second, with vitality density as the core indicator, a quantitative measurement method for the vitality of district public space is constructed. Combined with activity types, age structure, and heat-distribution characteristics, this provides a basis for identifying and interpreting the spatial manifestation of vitality. On the basis of existing research results and district spatial characteristics, a built environment indicator system oriented to Community Commercial Street Districts is constructed. Specific indicators are selected from four aspects—spatial structure, functional supply, environmental conditions, and staying facilities—and quantitatively defined in combination with

district-scale characteristics. Through the division of spatial units and the acquisition of multi-source data, a data foundation is formed for subsequent analysis.

In terms of analytical methods, this study uses a multiple linear regression model to identify the direction and degree of influence of built environment factors on district vitality, and combines it with interpretive qualitative analysis to summarize and compare the built environment characteristics of spaces with different vitality levels, thereby revealing the relationship between the built environment and human activities as well as its underlying mechanism.

Chapter 4 Vitality and Environmental Characteristics of the Laoximen District

4.1 Overview of the Study Area

4.1.1 Historical evolution and renewal background

According to local historical records such as the *Wuling County Gazetteer*, the ancient city of Changde had already been enclosed by city walls during the Qing dynasty. The area between the Great West Gate and the Small West Gate of the prefectural city was known as “Ximen,” which is today’s Laoximen. Owing to its proximity to the moat, official and educational institutions such as the county yamen, academies, and the Confucian temple were concentrated here during the Ming and Qing dynasties, making the area a continuing political, economic, and cultural core of the ancient city. Remains such as the princely residence of the Rong Prince in the Ming dynasty and the memorial archway of the Yang Sichang family further reinforced the historical significance of the area.

After the Battle of Changde, the ancient city was almost completely razed to the ground. Postwar reconstruction gradually turned Laoximen into a shantytown characterized by both disorder and everyday vitality. Before redevelopment, living conditions in the district were poor, with per capita residential space of less than 13 m^2 . Houses were densely stacked along both sides of the moat, the water surface was covered with concrete and turned into a sewage channel, and on the eastern side there were sunken houses and brick-and-timber dwellings with grey-tiled roofs, resulting in high building density and a disorderly spatial environment.



Figure4-1 On-site view before redevelopment
(Source: Reference[82])

Although its form did not conform to modern standards of urban road networks, Laoximen still retained vivid scenes of everyday life, such as farmers' markets and traditional alleyways. At the same time, the area preserved important historical and cultural relics, including the Changde Sixian Troupe, wooden sunken houses, old medicinal warehouses, low city-wall bunkers, and the ancient city wall from the Ming and Qing dynasties, making it an important area for carrying urban memory in Changde.



Figure4-2 Aerial view of the Laoximen District before redevelopment
(Source: Reference[83])

The redevelopment project of Laoximen started in 2011 and was completed in 2017. It covers about 86,000 square meters, with a total floor area of approximately 200,000 square meters, including 75,000 square meters of housing, 65,000 square meters of commercial space, and 10,000 square meters of cultural facilities. Nearly all of the original buildings were demolished during the redevelopment process, but about 1,600 households were resettled on site. Based on shantytown redevelopment and urban renewal, the project was positioned as a mixed commercial and cultural district.

Although the district was positioned in the planning stage as a characteristic district and an urban landmark, in actual use its function has gradually shifted toward a public activity space for the everyday use of surrounding residents. This reveals a discrepancy between planned positioning and actual use, and reflects how residents' use behaviors have reshaped the spatial environment.

4.1.2 Surrounding environment of the district

In terms of overall location, the study refers to the Baima Lake main urban center, the Yangming Lake sub-center, and the High-speed Railway New Town sub-center proposed in the Changde Territorial Spatial Master Plan (2021–2035). The shortest straight-line distances from the study site to these three urban centers were measured using the distance tool on Amap. Within the polycentric spatial structure of central Changde, the study area occupies a relatively central position. It lies within the overlapping sphere of influence of the Baima Lake main urban center, the Yangming Lake sub-center, and the High-speed Railway New Town sub-center, and its straight-line distances to the three centers are relatively similar.

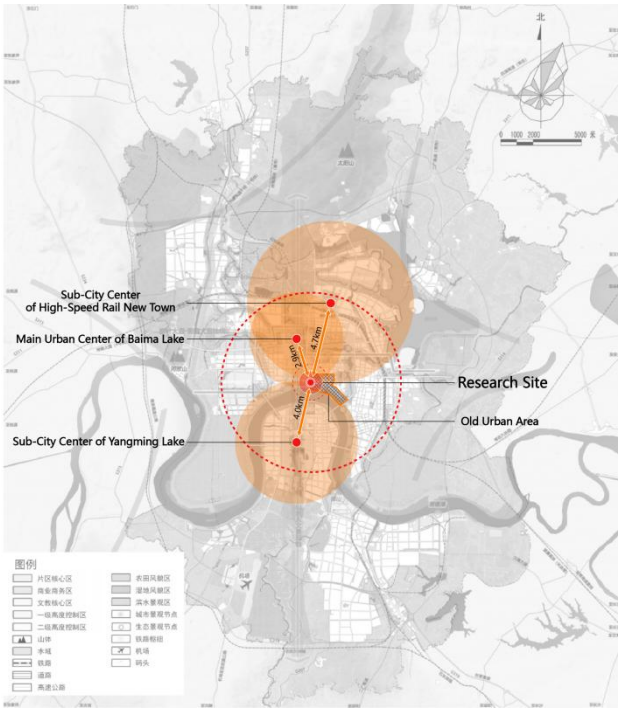


Figure4-3 Location of the district
(Source: Drawn by the author)

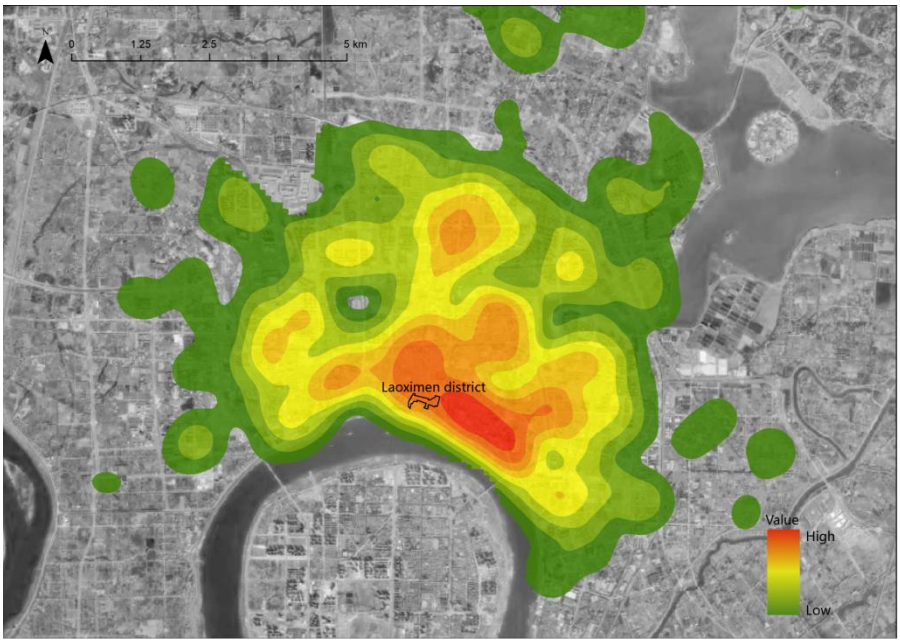


Figure4-4 Distribution of residential POI density
(Source: Drawn by the author)

In terms of urban residential density, high-density residential areas are mainly concentrated to the south of the study area and its adjacent zones, forming a relatively clear functional concentration area with strong population presence and high demand for activities (Figure4-4). The outer area surrounding the study site is dominated by residential functions overall. The western side of the district adjoins a major urban arterial road and serves as an

external traffic corridor; the southern, northern, and eastern interfaces are all connected to surrounding residential communities, reflecting a strong community service orientation.

In terms of surrounding functional distribution, the outer area of the study site is mainly residential, with a small number of office buildings in some local areas. A pedestrian street with a cluster of commercial functions is located on the right side, while a large indoor shopping mall is located on the left. Educational and medical facilities are also distributed nearby, together forming a relatively complete community service system. Considering both the distribution of urban residential areas and the surrounding functional structure of the Laoximen District, the district is located within a predominantly residential area with a certain degree of residential concentration, which provides a continuous and stable user base for the vitality of its public spaces.

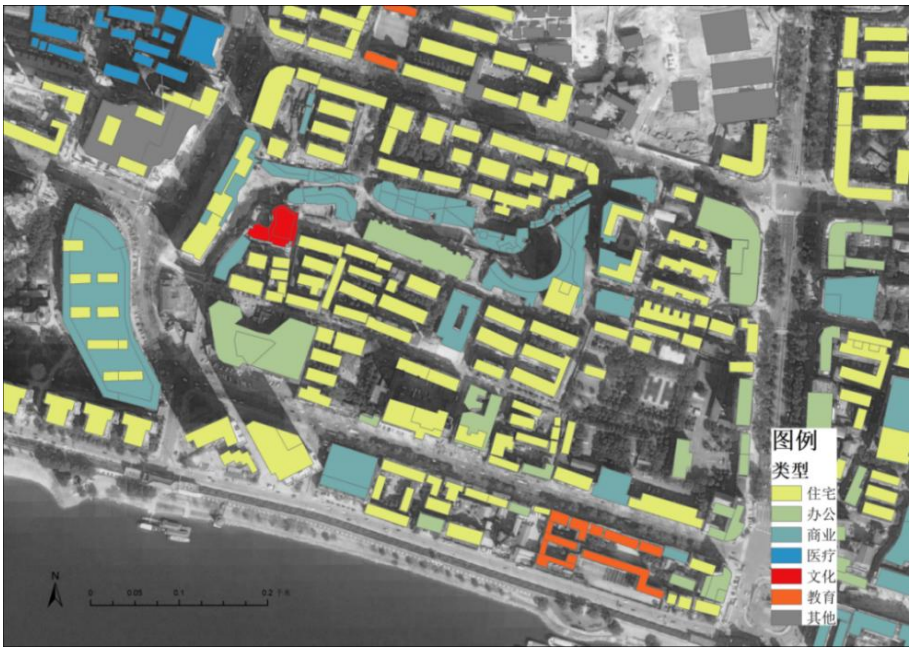


Figure4-5 Distribution of surrounding functions of the district
(Source: Drawn by the author)

In terms of transport conditions, the road network surrounding the study area is relatively well developed and well connected with major urban roads, resulting in strong overall connectivity. Bus stops are distributed densely, and the area enjoys a relatively high level of public transport coverage. This gives the district a certain degree of external accessibility and provides a basic condition for the aggregation of pedestrian flows.

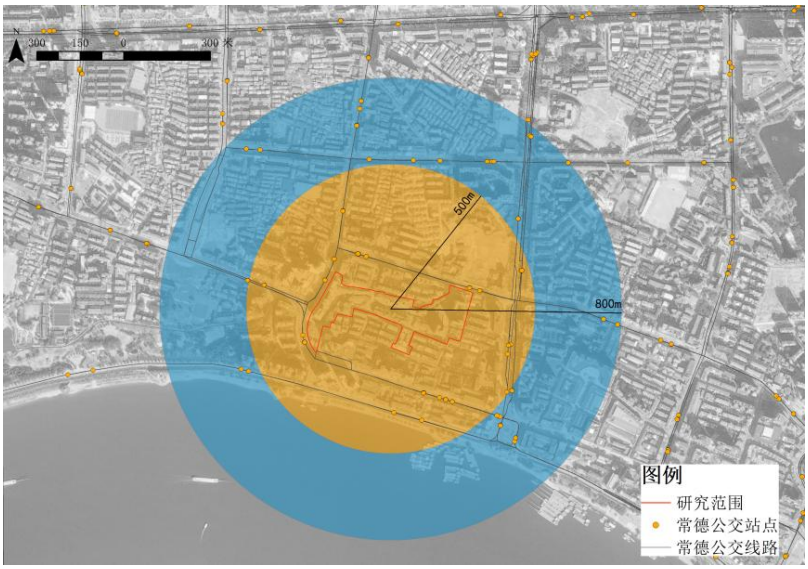


Figure4-6 Distribution of surrounding bus stops
(Source: Drawn by the author)

4.1.3 Spatial structure and functional characteristics of the district

In terms of overall spatial structure, the Laoximen District restored the formerly covered moat, preserving and strengthening the original landscape pattern of the water system. With the moat as its core axis, the district formed an overall building layout adapted to this water structure. Spatially, it presents an east–west pattern extending along the moat, with four major parallel pedestrian routes running east–west and several local north–south passages connecting residential areas on both sides of the river. Among them, the two central routes develop around the moat water system and form a characteristic water street space, linking a series of important nodes from east to west, including Xiaoximen Square, Hulukou Square, Huoshen Temple Square, and Yangjia Memorial Archway Square. The southern side of the district adjoins residential buildings, forming a mixed commercial–residential interface, while the northern side is mainly enclosed by the walls of gated communities, making the space relatively closed.

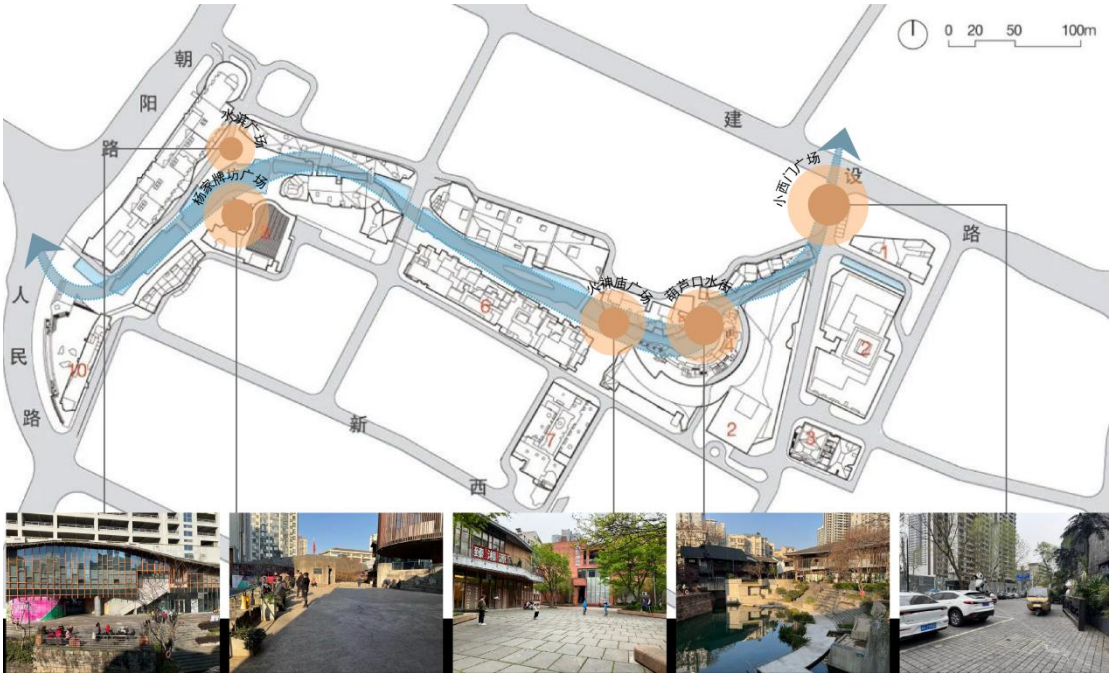
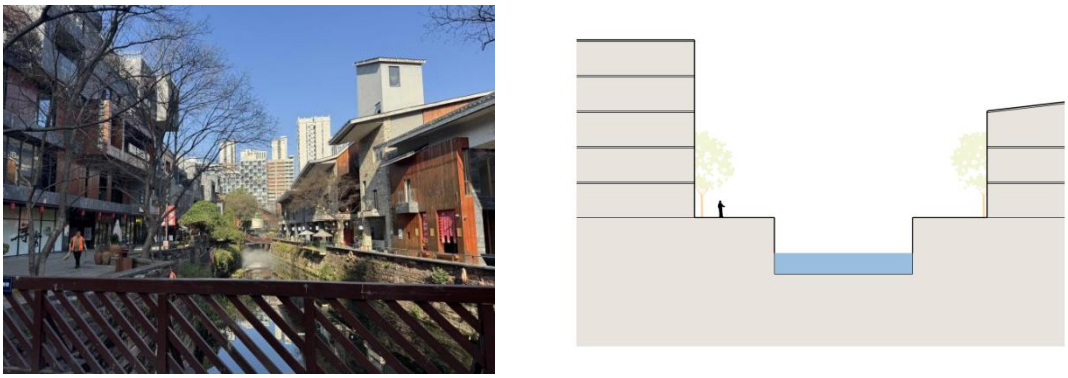
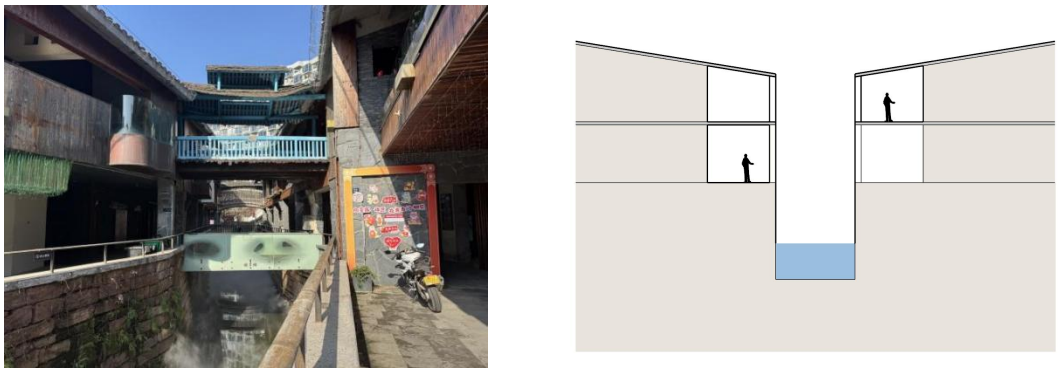


Figure4-7 On-site views of district nodes after redevelopment
(Source: Drawn by the author)

In terms of street scale and spatial form, the district is overall relatively spacious. According to relevant studies in *A Pattern Language*, the suitable spatial scale of a pedestrian street should generally not exceed the height of the surrounding buildings. Ashihara Yoshinobu also pointed out that when the height-to-width ratio of a street is less than 1 or greater than 2, the space can easily appear either too narrow or too open[84]. Four typical cross-sections were selected for analysis. In the central section of the main street, influenced by the river space, the district forms a relatively open street scale; taking the middle section as an example, the height-to-width ratio is about 1:2. In the western water-street section, corridor spaces are formed on both sides, and the pedestrian space is relatively narrow, with a height-to-width ratio of about 3:5. On the outer side of the district near the urban arterial road, a spatial condition is formed with carriageways and sidewalks placed side by side and commercial interfaces on both sides; one side consists of a podium-and-tower form and the other of a commercial interface, with a height-to-width ratio of about 2.5:1. On the southern side, where commercial interfaces meet the residential area, the height-to-width ratio is about 1.4:1.



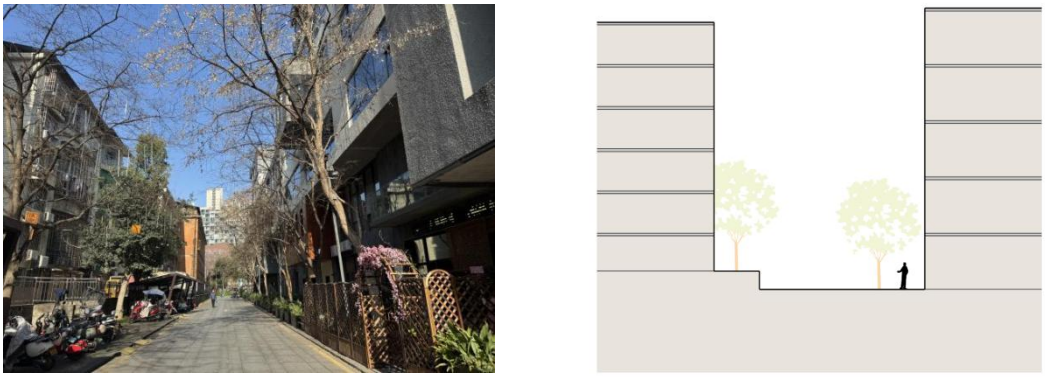
a) Central Part of the Block



b) Water Street on the West Side of the Block



c) East Side of the Block



d) South side of the block

Figure4-8 Analysis of spatial cross-sections and interface characteristics of the district
(Source: Drawn by the author)

In terms of overall architectural style, the district adopts a design language of grey bricks and grey tiles, with a highly unified visual character. Grey tones form the dominant color palette of the district, while grey stone facades combined with local timber details and sloping roofs create a modern expression of traditional elements. Some buildings have prominent volumes, and the use of cantilevers and stepped terraces creates rich and distinctive architectural imagery. In addition, the design of some irregularly shaped buildings further strengthens the stylistic character of the district.

In terms of functional composition, the Laoximen District presents a mixed structure integrating commerce, office, residence, leisure, and culture. The district contains libraries, cafés, studios, exhibition halls, theaters, and other functional spaces, creating a relatively diverse range of usage scenarios. Field investigation of commercial service facilities shows that the district has gradually formed a commercial structure centered on cafés and bars, while restaurants, retail stores, and convenience stores also account for a relatively high proportion, together constituting the main business types in the district. Among them, the catering sector includes restaurants, teahouses, and cafés; the leisure and entertainment sector is mainly composed of bars; the retail sector includes clothing stores and creative retail stores; and the life-service sector covers education and training, beauty and hairdressing, and convenience supermarkets.

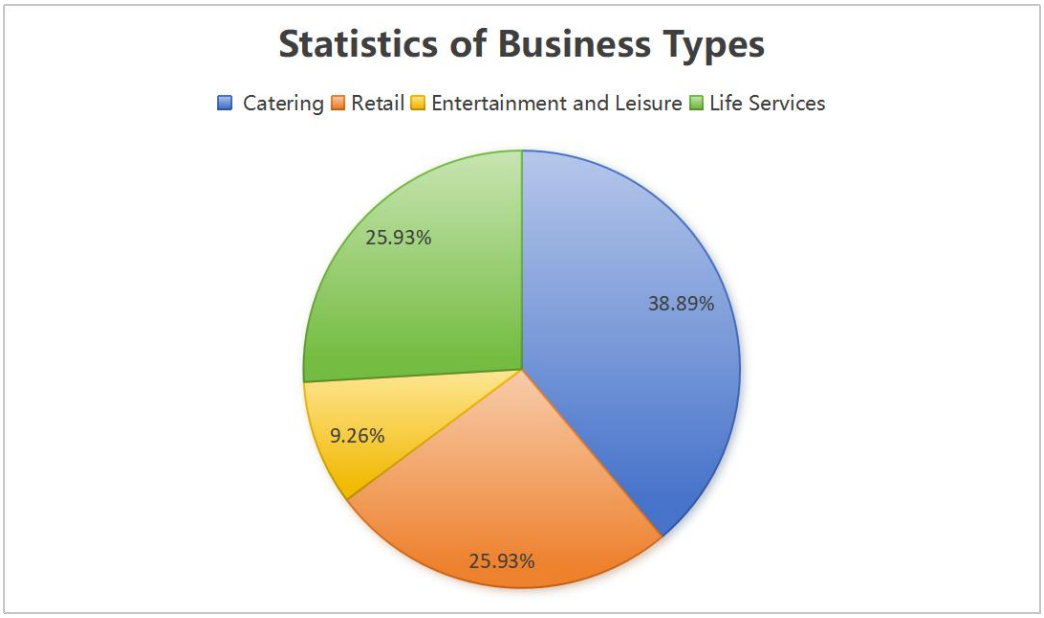


Figure4-9 Statistics of business types in the district
(Source: Drawn by the author)

4.2 Vitality Characteristics of the District

4.2.1 Spatiotemporal evolution of vitality

Behavioral observations were conducted during three representative periods—morning, afternoon, and evening—to reflect patterns of use under different rhythms of everyday activities. Based on continuous field observation over several days, a total of 16 observation periods were completed, covering different temporal types (weekdays and weekends) and different periods of the day. Video recording, combined with GIS-based spatial positioning and statistical analysis, was used to extract the spatial distribution characteristics and hotspots of pedestrian activities in the district; areas with denser red clusters indicate higher vitality density. The results show clear spatial differentiation in user activities, with pedestrian flows unevenly distributed within the district.

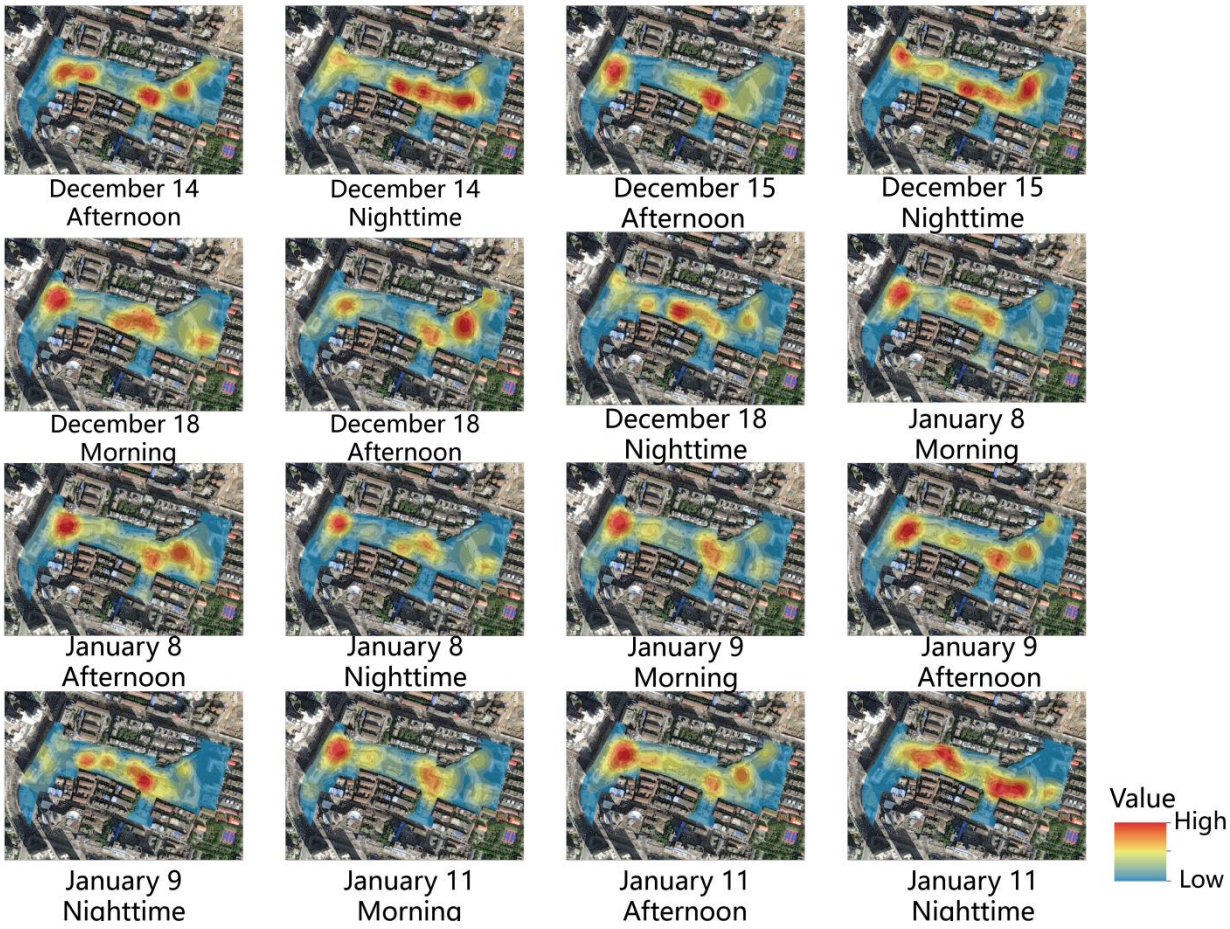


Figure4-10 Vitality heat map

(Source: Drawn by the author)

Overall, the district exhibits a hotspot structure centered on the western square and the central-eastern street sections. Among them, the western area has the highest pedestrian density and maintains strong stability across multiple time periods, forming a core vitality area that persists over a long duration. By contrast, pedestrian flow in the central-western part of the district is relatively sparse, which may be related to the lack of staying spaces and supporting environmental elements in that area.

Vitality in the eastern part of the district is characterized by the linkage of multiple nodes. Hotspots are concentrated around the central square, open waterside nodes, and locally widened spaces. Some of these hotspots are interrelated, forming a continuous vitality surface.

In addition, vitality levels in the back streets and alleys on the north and south sides of the district are generally low, which may be related to enclosed boundaries and insufficient spatial permeability. Overall, the distribution of district vitality is closely coupled with enlarged nodal spaces, and node spaces play a significant structural supporting role in the aggregation of vitality.

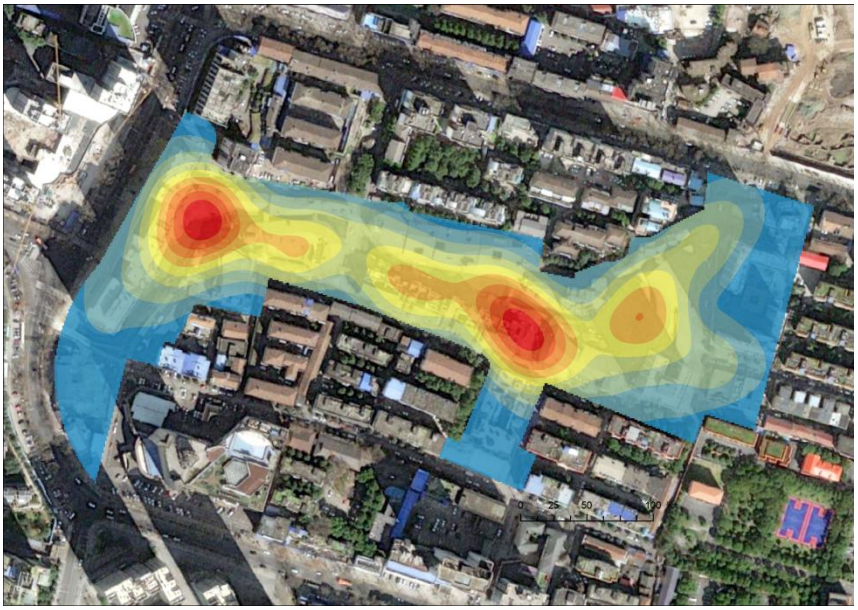
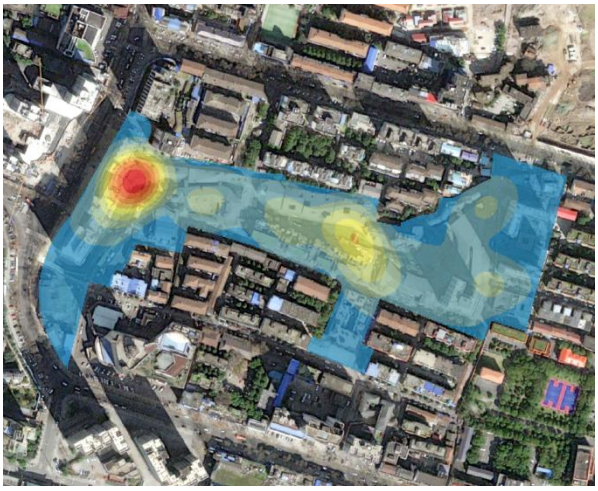


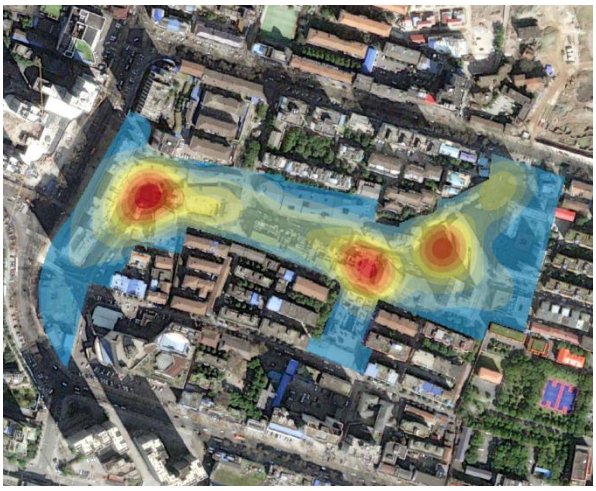
Figure4-11 Overall kernel density distribution of pedestrian activities in the district
(Source: Drawn by the author)

In the morning, pedestrian flows are mainly concentrated in the western part of the district, while only weak local hotspots appear in the central area. In the afternoon, in addition to the western square, pedestrian activities in the central and eastern parts of the district increase significantly, forming multiple core hotspots. By the evening, pedestrian activities

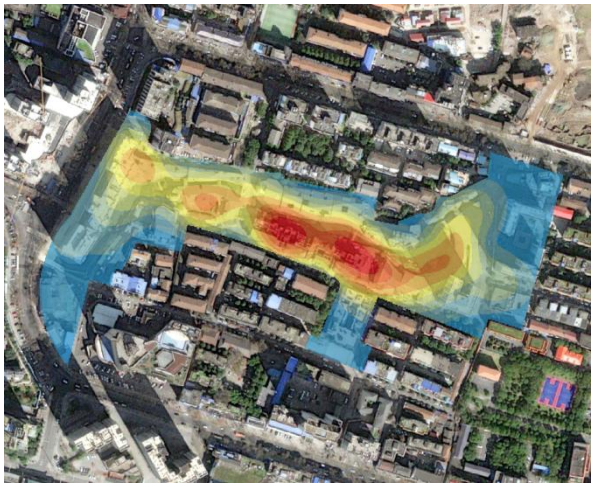
become connected between the eastern area and the middle section of the district, showing a spatial pattern that develops from isolated points to a continuous band.



a) Morning Period



b) Afternoon Period



c) Evening Period

Figure4-12 Kernel density distribution of pedestrian activities at different times
(Source: Drawn by the author)

4.2.2 Characteristics of activity types in the district

Observation of activity types in the district shows that activities in the Laoximen historic district can be divided into two broad categories: everyday leisure activities and sightseeing activities. Everyday leisure activities dominate and occur more frequently, while sightseeing activities are relatively limited.

Everyday leisure activities include walking, sitting, chatting, and square dancing. People mainly use under-eave spaces and relatively wide pedestrian spaces for collective activities such as square dancing, while sitting spaces are used for rest and social interaction.

Time-based observation shows that child-accompanying activities are relatively concentrated in the morning; at midday, many people gather in the square areas for exercise; and during weekend evenings, activity clusters dominated by children appear around play facilities. At the same time, other everyday behaviors, such as dog walking, can also be observed in the district, reflecting its strong living-oriented character.

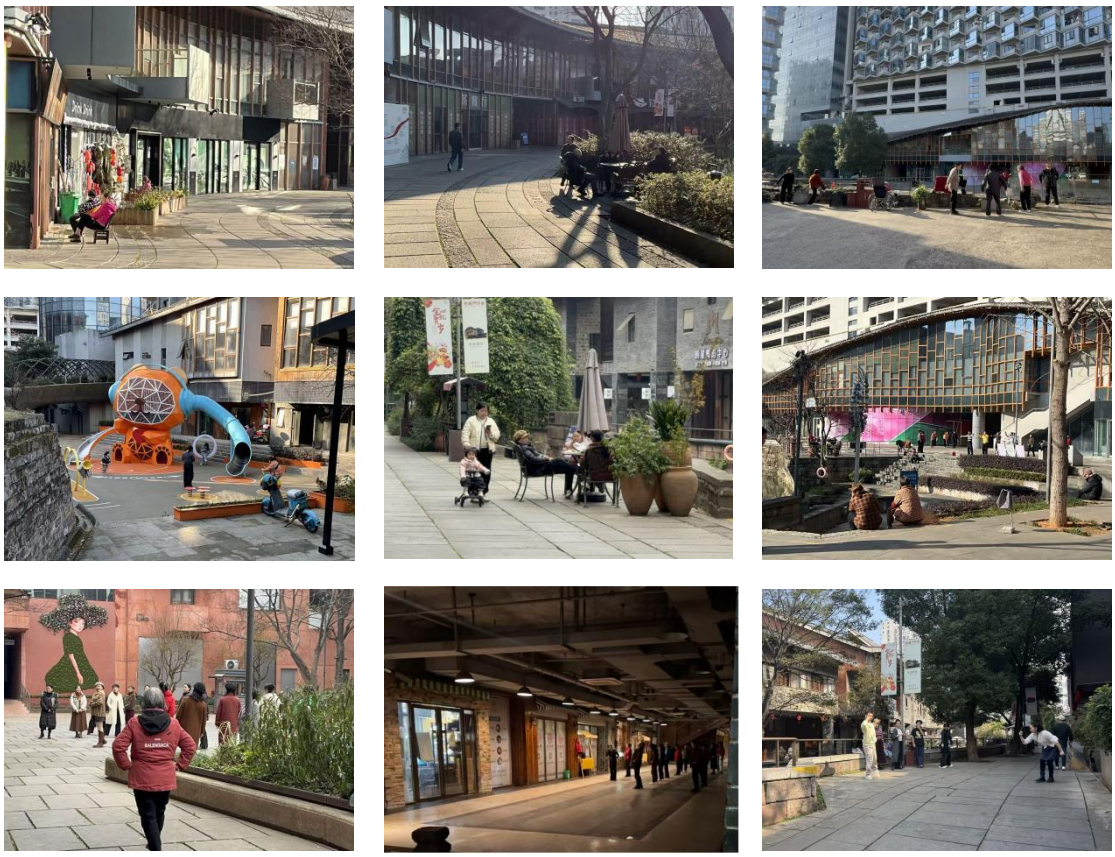


Figure4-13 Photographs of crowd activities
(Source: Photographed by the author)

By contrast, sightseeing activities occur less frequently and are mainly concentrated at landscape nodes such as waterside steps, decorative murals, and stone bridges, typically taking the form of photo-taking and short stays by visitors. In areas such as the historic wall and cultural display wall, viewing-oriented activities characterized by brief stopping can also be observed.

This study selected weekdays as the representative observation period in order to reflect the everyday use characteristics of the district, which is mainly used by surrounding residents. Based on earlier multi-period site visits, relatively active periods of pedestrian flow were selected for on-site behavioral recording, and behavior maps were drawn to analyze activity

types and their spatial distribution. A total of about 388 activity observations were recorded in this round of observation, covering about 12 activity types. The statistical results show that walking, sitting, chatting, and dancing constitute the main sources of district vitality and are the most frequent behavior types. In addition, play and stopping to watch also account for a certain proportion.

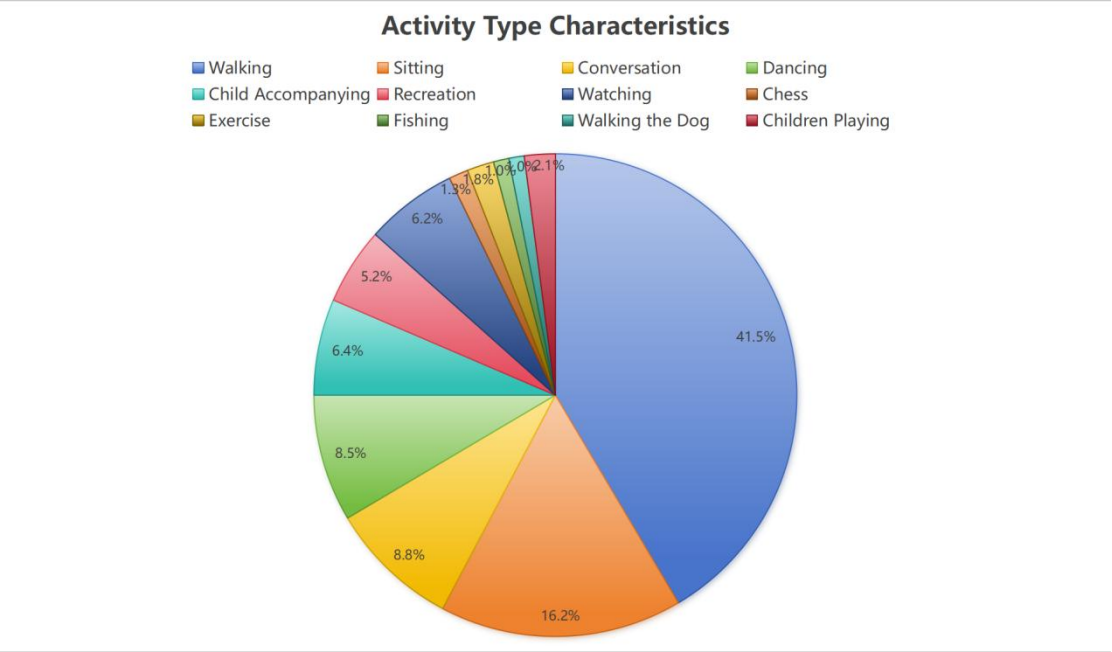
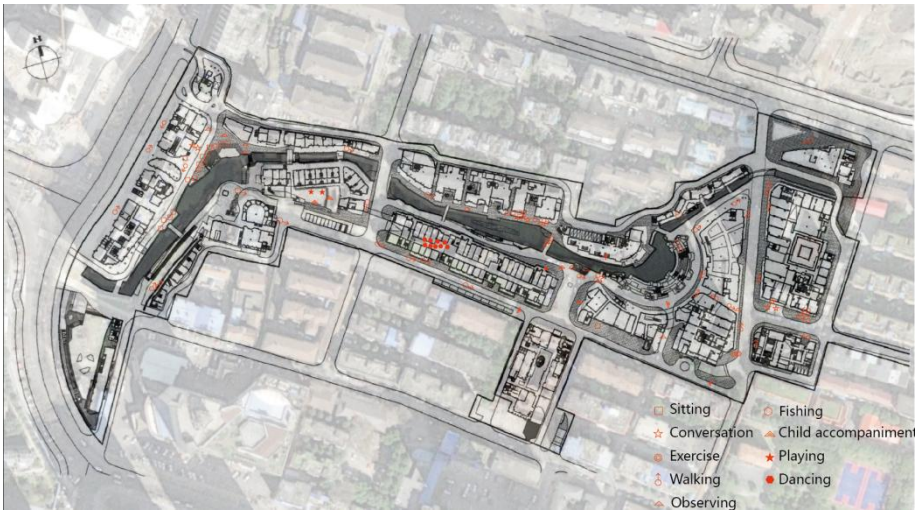
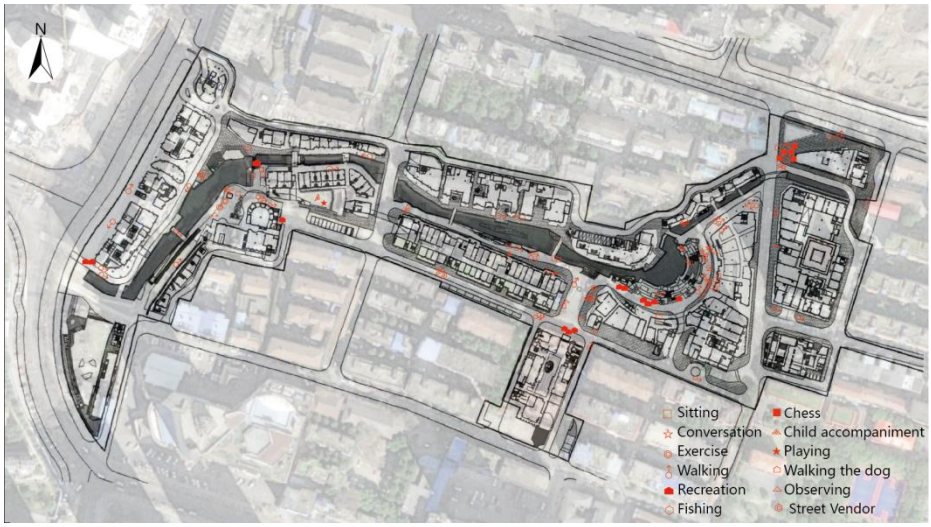


Figure4-14 Statistics of activity types
(Source: Drawn by the author)

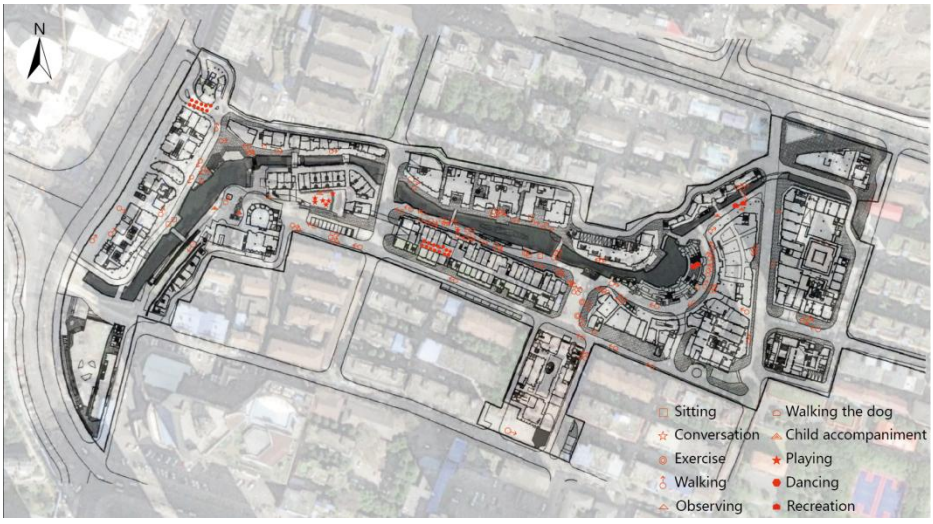
Based on the overall statistics, a behavior map was drawn according to the locations where activities occurred, and three typical time periods—10:00, 15:00, and 19:00—were selected for marking and comparative analysis. The results show clear spatial differences in the distribution of different activity types. Walking mainly occurs in linear circulation spaces such as both sides of the water street and the southern part of the district; chatting and sitting are mostly distributed along both sides of the waterfront and mainly rely on spatial nodes equipped with seating; dancing mainly occurs in the evening and is concentrated in the semi-enclosed space at the western entrance and in the central square area. Overall, activities in the district are dominated by everyday behaviors, and different activity types show certain spatial dependencies, reflecting the direct influence of spatial conditions on behavioral occurrence.



a) Morning Period



b) Afternoon Period



c) Evening Period

Figure4-15 Behavior map
(Source: Drawn by the author)

4.2.3 Characteristics of user groups in the district

Further descriptive analysis of user-group characteristics shows that the age structure of users in the Laoximen District is relatively broad, but overall it is characterized by a relatively high proportion of middle-aged and older adults and a relatively low proportion of young people. Among them, people aged 60 and above account for a large share, while the number of those under 18 is relatively small. The 40 – 59 and 60+ age groups constitute the main users of the district. Overall, the vitality of the district is dominated by the everyday use of middle-aged and older adults.

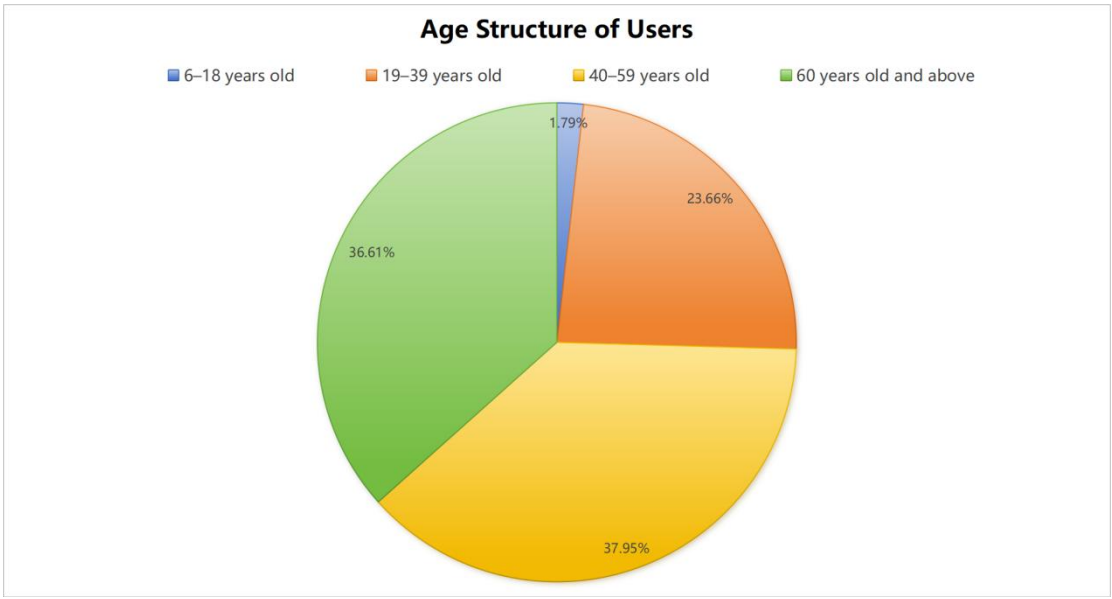


Figure4-16 Statistics of age structure of user groups
(Source: Drawn by the author)

Different user groups show certain differences in spatial use. Middle-aged and older residents are more often associated with activities such as walking, sitting, talking, and square dancing, while children and caregivers are more frequently found near play facilities and open nodes. The optimization of district public space should therefore respond primarily to the everyday use of middle-aged and older residents, while also taking into account the differentiated needs of other groups, including children and short-stay visitors.

4.3 Characteristics of the Built Environment in the District

4.3.1 Spatial structure

(1) Accessibility

According to the results of spatial syntax analysis, the roads in the central part of the district and along the north and south sides show relatively high values of local integration, indicating strong spatial centrality and accessibility. These roads have a relatively high degree of accessibility within the overall road network structure, making them more likely to attract pedestrian flows and activity aggregation, and thus forming an important spatial foundation for potential vitality in the district. To further identify differences in spatial structure, this study classifies roads based on their local integration values. Areas with values above 66.56 are defined as high-integration streets, with a total of 22 units, accounting for 33.85% of all units; those with values between 38.63 and 66.55 are medium-integration units, accounting for 60%; and those with values below 38.62 are low-integration streets, accounting for 6.15%.

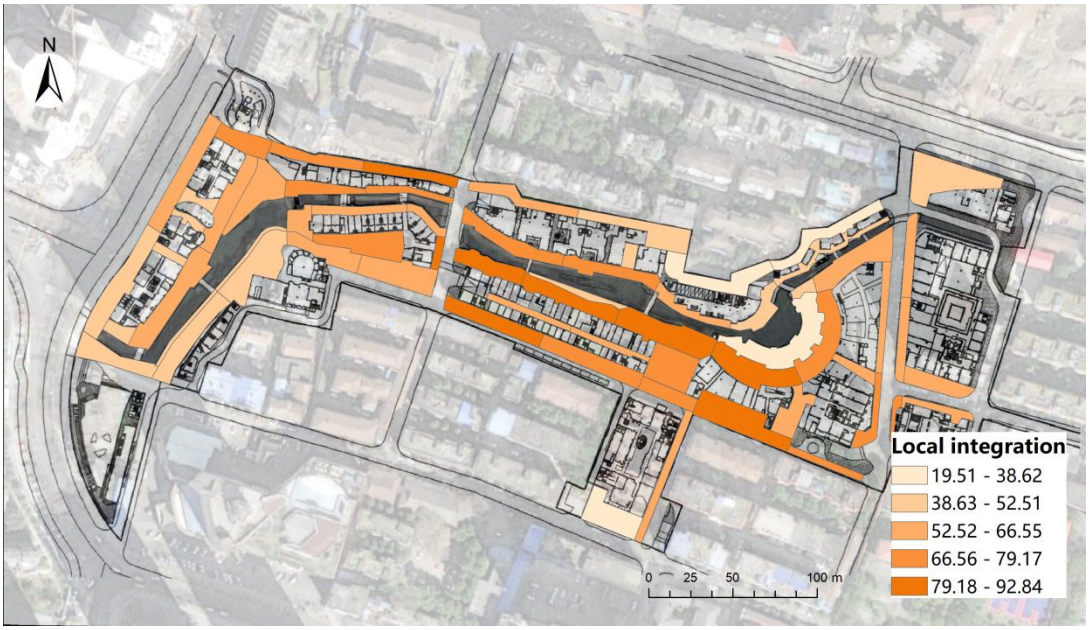


Figure4-17 Distribution of local integration
(Source: Drawn by the author)

(2) Street interface

In terms of street width, the district as a whole tends to have relatively large street widths. The central part of the district and some roads on the western side form relatively wide street spaces. Statistical calculation of the average widths of 65 streets shows that the overall average width of the district is 7.22 meters. Based on street-width values, streets are classified into three levels: areas with widths above 10.32 meters are classified as relatively wide pedestrian streets, accounting for 15.38% of all units; those between 4.92 and 10.31 meters

are classified as moderately suitable pedestrian streets, accounting for 49.23%; and those below 4.91 meters are classified as relatively narrow pedestrian streets, accounting for 35.38%.

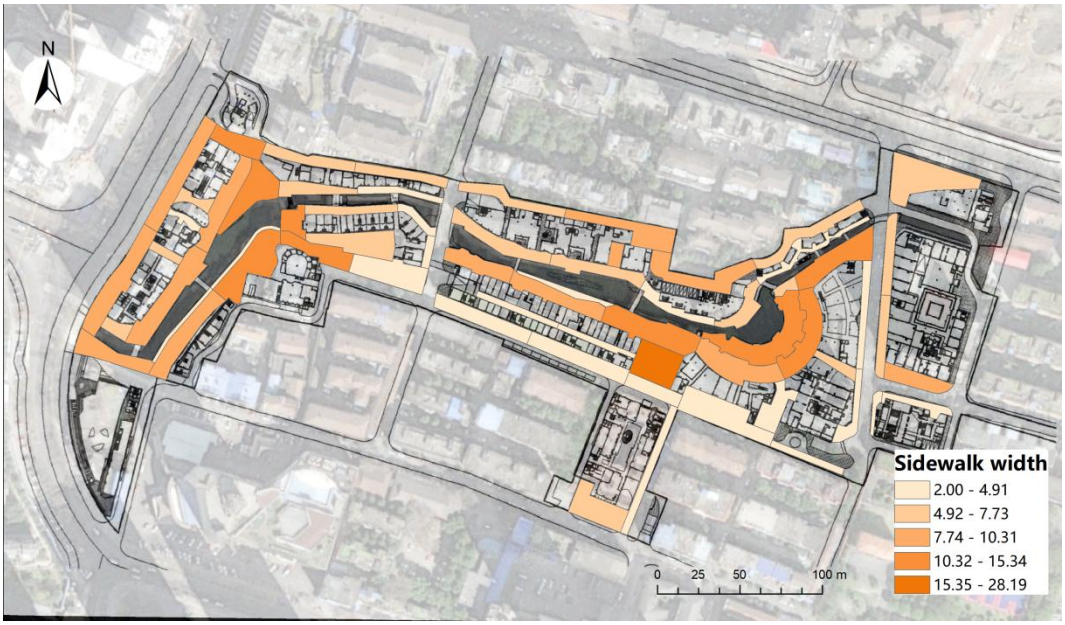


Figure4-18 Distribution of street widths
(Source: Drawn by the author)

(3) Interface enclosure degree

In terms of interface enclosure degree, areas with high values usually have building interfaces on both sides of the street, creating a strong sense of enclosure, and are mainly distributed along the north and south sides of the district. Because a water system runs through the central part of the district, the spaces on both sides are relatively open and often take the form of one-sided building interfaces. However, because the overall interface lines remain relatively complete, these areas still form relatively continuous interface characteristics. Areas with low interface continuity are mostly plazas or locations with concentrated entrances and exits, where the interface is more frequently interrupted. Although the eastern side is separated by carriageways and thus forms a one-sided interface, it still shows strong enclosure because the interface line is relatively complete and subject to limited disturbance. In terms of numerical distribution, units with interface enclosure degree higher than 1.03 account for 61.54%; those between 0.39 and 1.02 account for 30.77%; and those lower than 0.38 account for 7.69%. Overall, the district has a relatively high level of interface enclosure.

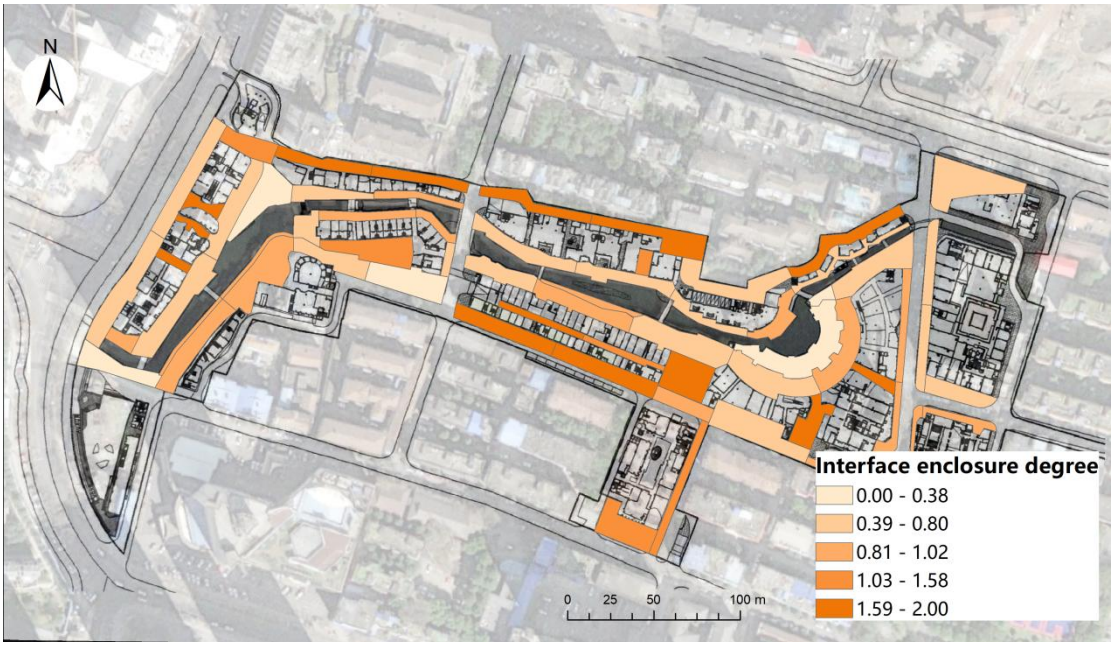


Figure4-19 Distribution of interface enclosure degree
(Source: Drawn by the author)

4.3.2 Functional supply

(1) Residential radiation intensity

In terms of residential radiation intensity, the district itself is dominated by commercial and office functions and contains relatively few residential buildings, but the surrounding area has a relatively concentrated residential distribution that exerts a certain influence on the use of district space. Therefore, this study establishes a kernel density model of surrounding residential areas to measure the residential radiation intensity received by different spatial units. The results show that the eastern and western parts of the district receive relatively high residential radiation intensity, as residential land is distributed in multiple directions around these two areas, whereas the central area is mainly influenced by residential radiation from one side and thus has relatively weaker overall radiation intensity. According to the radiation index values, areas above 64.89 are classified as high residential radiation areas, accounting for 27.69% of all units; those between 17.96 and 39.74 are medium residential radiation areas, accounting for 33.85%; and those below 17.95 are low residential radiation areas, accounting for 38.46%.

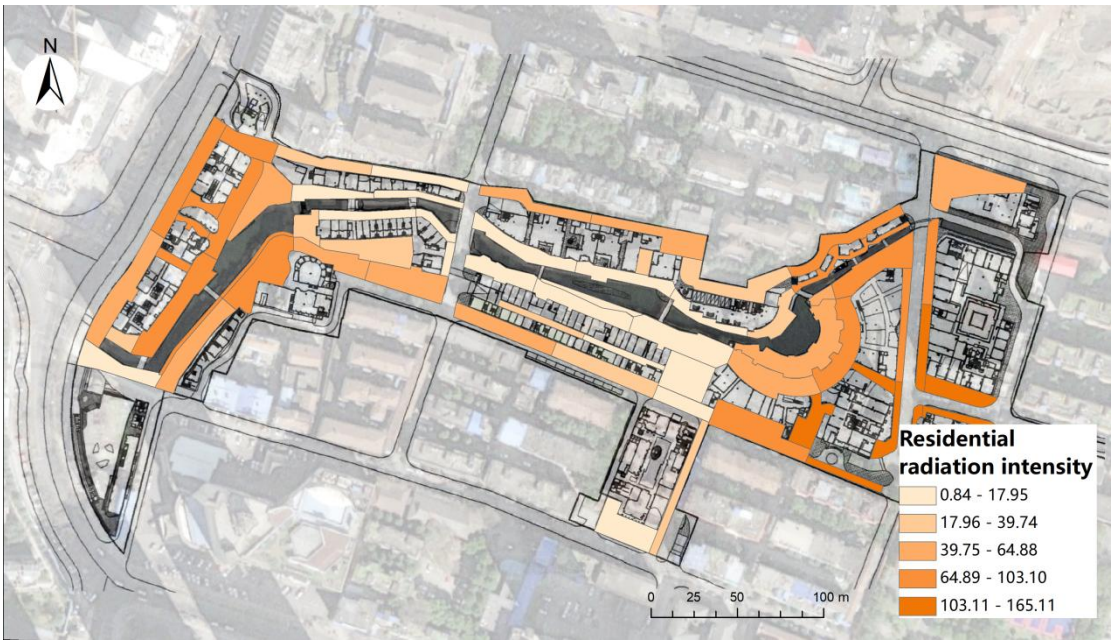


Figure4-20 Distribution of residential radiation intensity
(Source: Drawn by the author)

(2) Shop density

In terms of shop density, the overall distribution of shops in the district is relatively sparse. Shops are mainly concentrated along both sides of the narrow water street and in areas close to urban roads, while the remaining spaces have not formed continuous commercial interfaces. The unit with the highest number of shops contains only three stores, mainly located in street sections close to the urban edge. In terms of numerical distribution, there are 40 units with shop density below 0.0013, accounting for 61.54%; 21 units with values between 0.0014 and 0.0081, accounting for 32.31%; and only 4 units with values above 0.0082, accounting for 6.15%. Overall, commercial vitality in the district is low, and commercial spaces show a point-like distribution pattern.

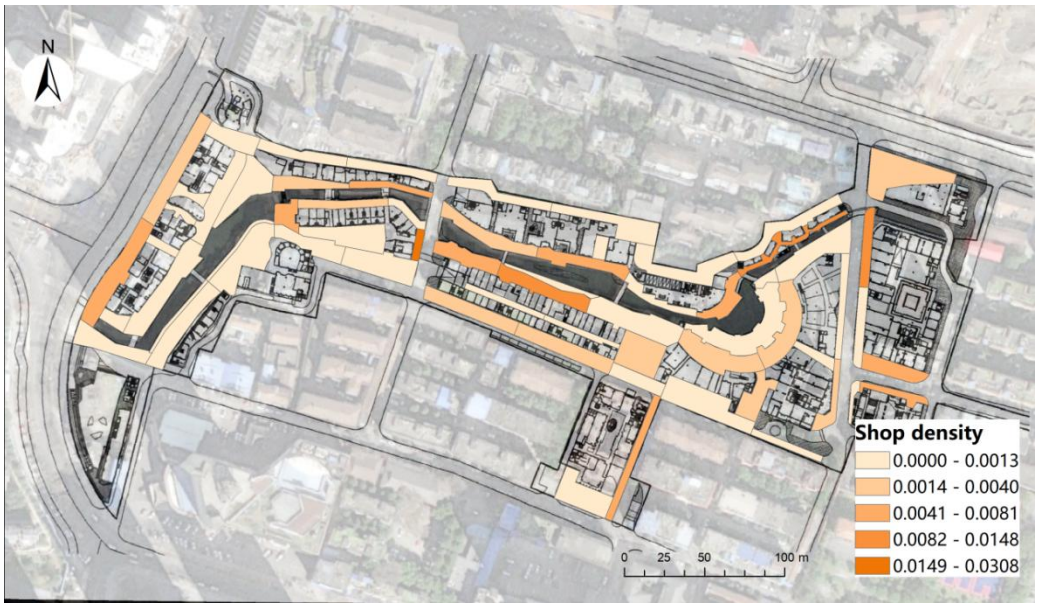


Figure4-21 Distribution of shop density
(Source: Drawn by the author)

(3) Density of landscape attractions

In terms of the density of landscape attractions, the district as a whole has a relatively low density level. Most units have no landscape facilities, accounting for 63.08% of all units. Units configured with one to two landscape facilities have density values between 0.0001 and 0.0039, accounting for 24.62% of all units. Only a small number of units have relatively concentrated landscape facilities, accounting for 12.31% of all units, and these are mainly concentrated in the eastern plaza node area of the district.

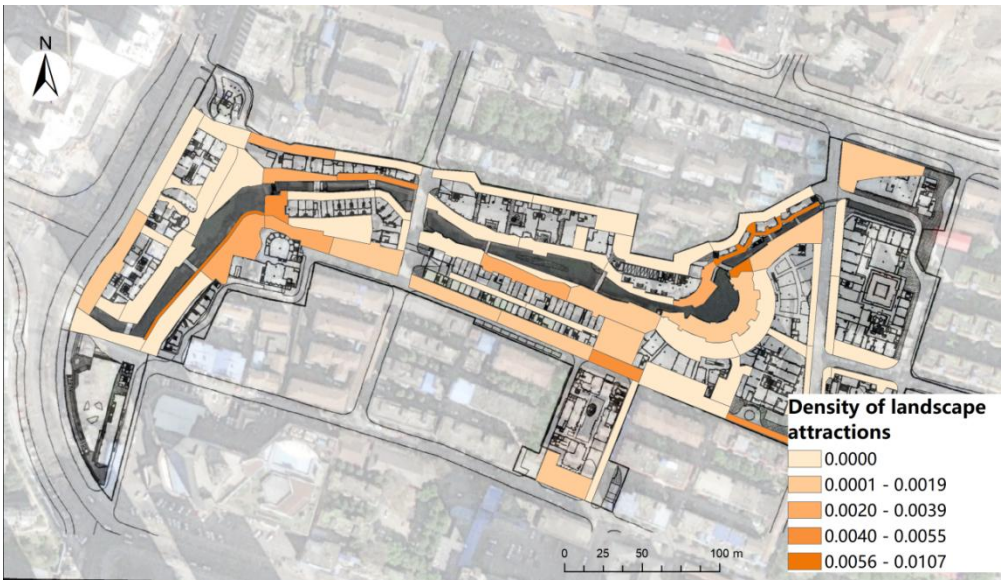


Figure4-22 Distribution of the density of landscape attractions
(Source: Drawn by the author)

4.3.3 Environmental conditions

(1) Shoreline complexity

In terms of shoreline complexity, this study identifies 22 waterfront shoreline units. Overall, the shoreline form of the district is relatively straight, with some local variations in curvature. At curved segments and corner locations, shoreline complexity values are relatively high, and such locations often form more open views and landscape nodes. In terms of numerical distribution, shoreline segments with complexity above 1.171 account for 31.82%; those between 1.023 and 1.170 account for 54.55%; and those below 1.022 account for 13.64%. Overall, the district is dominated by relatively straight shorelines, while some local nodes show higher complexity.

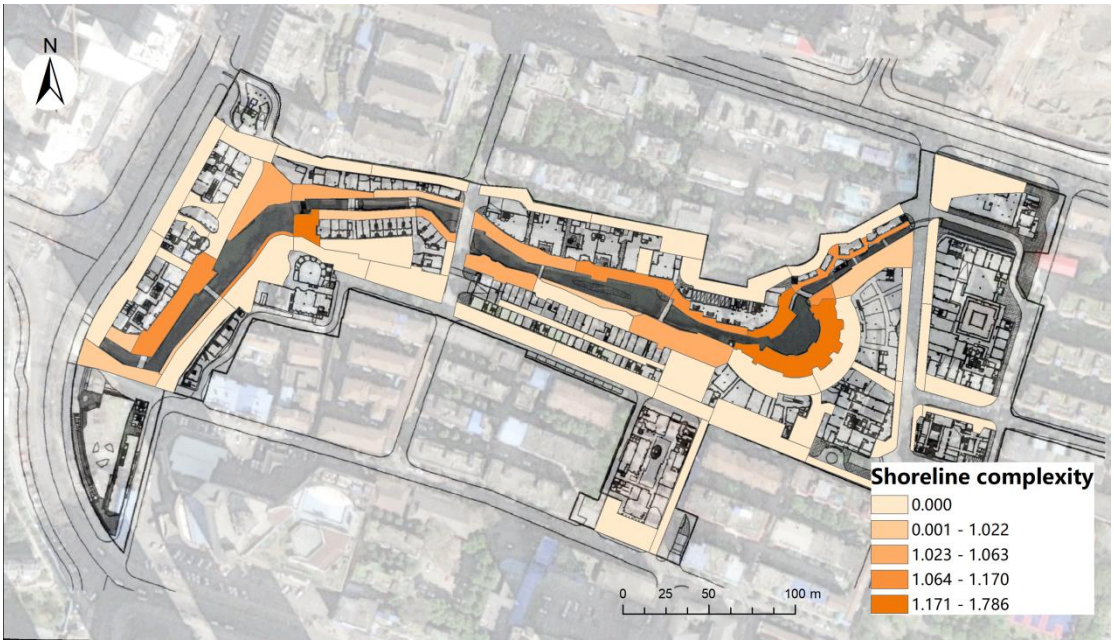


Figure4-23 Distribution of shoreline complexity
(Source: Drawn by the author)

(2) Waterfront accessibility

In terms of waterfront accessibility, the proportion of areas in the district that directly adjoin the waterfront and have strong waterside accessibility is relatively low. Areas with higher accessibility levels are mainly concentrated at waterfront nodes in the central part of the district and at some local turning points, while lower-level areas are mostly distributed along shoreline sections with enclosed interfaces or without direct access to the water. According to the statistical results, a total of 29 units are adjacent to the water street and can

directly view the water landscape. Units with waterfront accessibility levels of 3 – 4 account for 13.85% of all units; those with levels of 1 – 2 account for 30.77%; and those with level 0 (not directly adjacent to the waterfront) account for 55.38%.

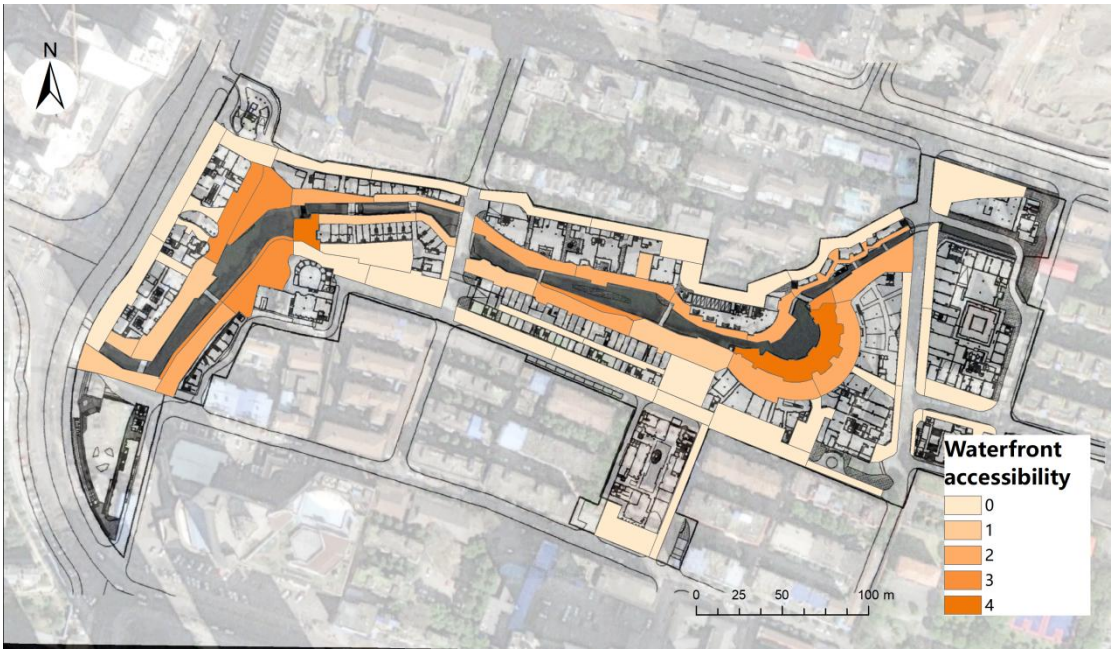


Figure4-24 Distribution of waterfront accessibility
(Source: Drawn by the author)

(3) Green view index

In terms of the green view index, the district shows certain spatial differences overall. Areas with relatively high green view index values are mainly concentrated along both sides of the water, around some spatial nodes, and along street sections where roadside trees are relatively dense near residential areas on both sides. Other street sections have relatively limited greenery. According to the classification results, areas with green view index values above 10.47% are classified as high-green-view-index areas, accounting for 16.92% of all units; those between 2.00% and 10.46% are medium-green-view-index areas, accounting for 52.31%; and those below 1.99% are low-green-view-index areas, accounting for 30.77%.

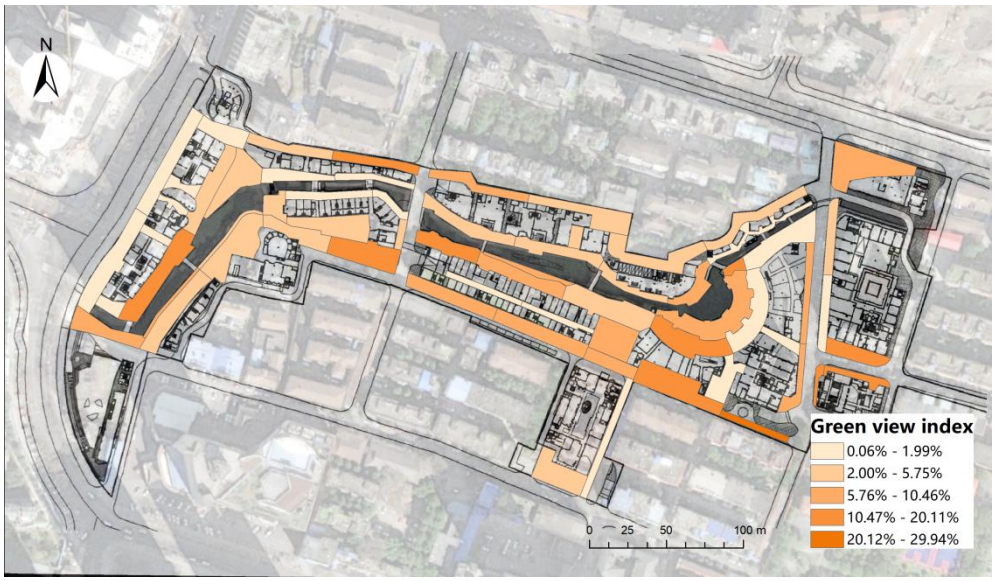


Figure4-25 Distribution of green view index
(Source: Drawn by the author)

(4) Shade coverage ratio

In terms of the shade coverage ratio, areas along both sides of the water tend to have relatively high values because they contain more overhanging eaves, corridors, and architectural grey spaces. According to the classification results, areas with shade coverage ratio above 45.88% are high-shade areas, accounting for 29.23% of all units; those between 9.61% and 45.87% are medium-shade areas, accounting for 32.31%; and those below 9.60% are low-shade areas, accounting for 38.46%.

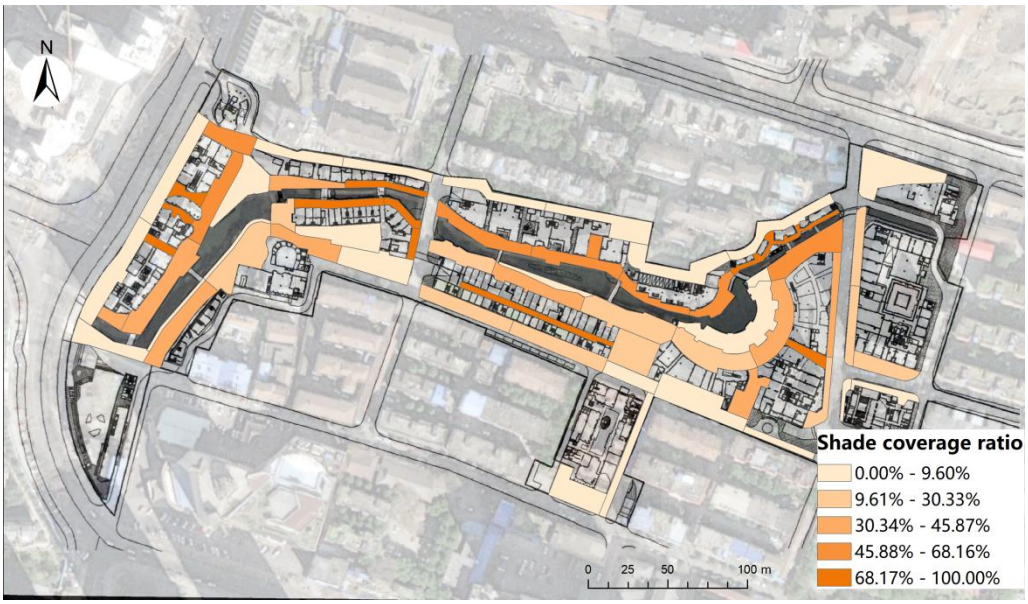


Figure4-26 Distribution of shade coverage ratio
(Source: Drawn by the author)

(5) Sunshine duration

In terms of sunshine duration, according to the software simulation results (8:00 – 18:00), the maximum sunshine duration of a single unit in the district is 4.39 hours. Areas with longer sunshine duration are mostly distributed in open plazas and around the water surface. Because these spaces are relatively wide and subject to less obstruction, they receive relatively sufficient sunshine. According to the classification results, 14 units have sunshine duration longer than 1.53 hours, accounting for 21.54% of all units; 29 units have sunshine duration between 0.26 and 1.52 hours, accounting for 44.62%; and 22 units have sunshine duration below 0.24 hours, accounting for 33.85%.

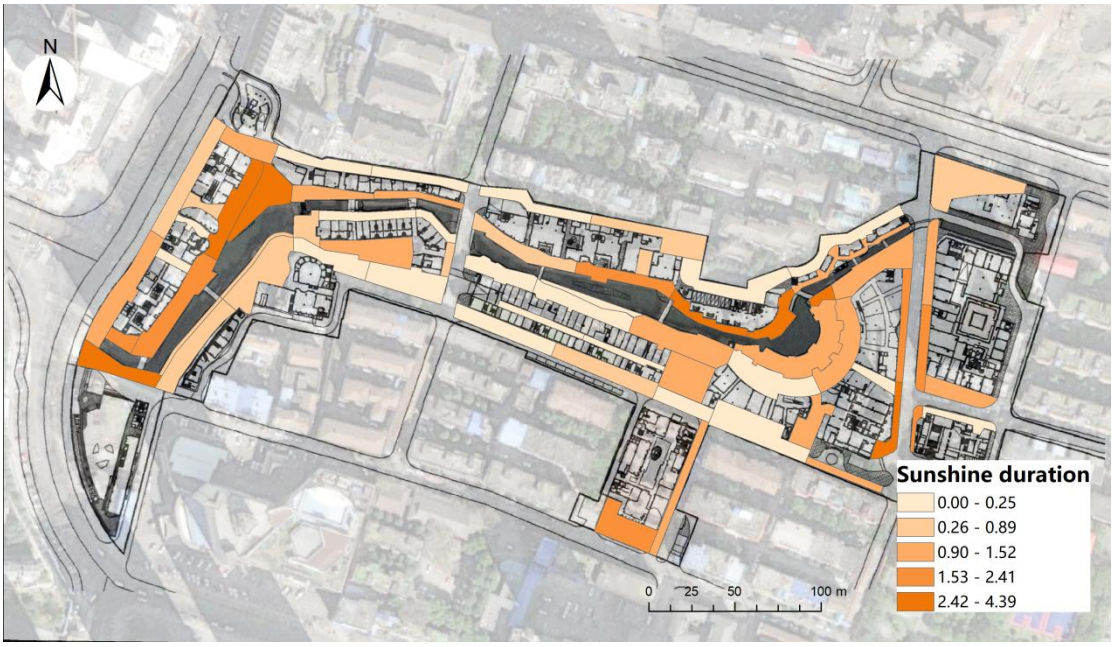


Figure4-27 Distribution of sunshine duration
(Source: Drawn by the author)

4.3.4 Staying facilities

(1) Seating density

In terms of seating density, the district is dominated by areas with low seating density, and the supply of facilities supporting staying behaviors is relatively limited. Seating types include fixed seats and some informal seats, and their overall distribution is clearly uneven: in some areas seats are relatively concentrated, while many other units have no seating facilities. High-density areas are mainly concentrated along both sides of the waterfront and at some spatial nodes. According to the quantitative classification results, areas with seating density

above 0.1639 are high-density areas, accounting for 10.77% of all units; those between 0.0173 and 0.1638 are medium-density areas, accounting for 23.08%; and those below 0.0172 are low-density areas, accounting for 66.15%.

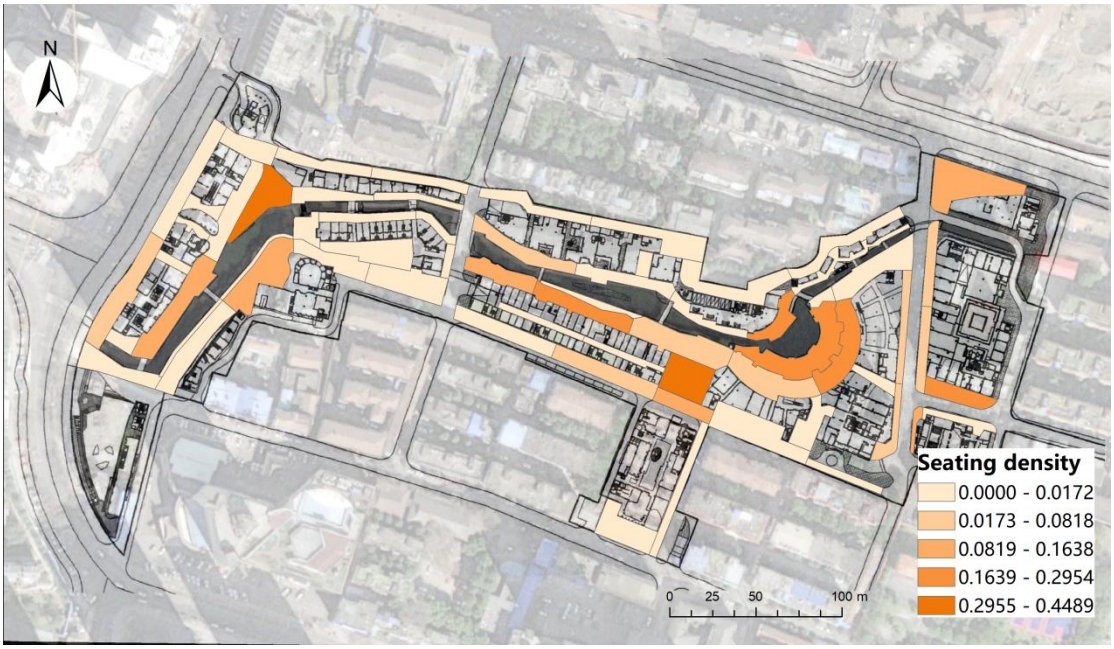


Figure4-28 Distribution of seating density
(Source: Drawn by the author)

(2) Pavement type

In terms of pavement type, this study adopts a graded scoring method and classifies pavement quality into five levels from 1 to 5. Overall, pavement quality in the district is at a medium level, and some local areas have constrained pedestrian conditions. Most pavements in the district are concentrated within the score range of 1.5 – 3 and are mainly stone paving, but some areas have relatively large joints, which affects walking comfort and continuity. Pavements with scores above 3 usually have better slip resistance and walking continuity, mainly including concrete paving and stone paving with smaller joints, accounting for 32.31% of all units; medium-level pavements account for 58.46%; and pavements with a score of 1 are mostly uneven surfaces or roads with obvious level differences, accounting for 9.23%.

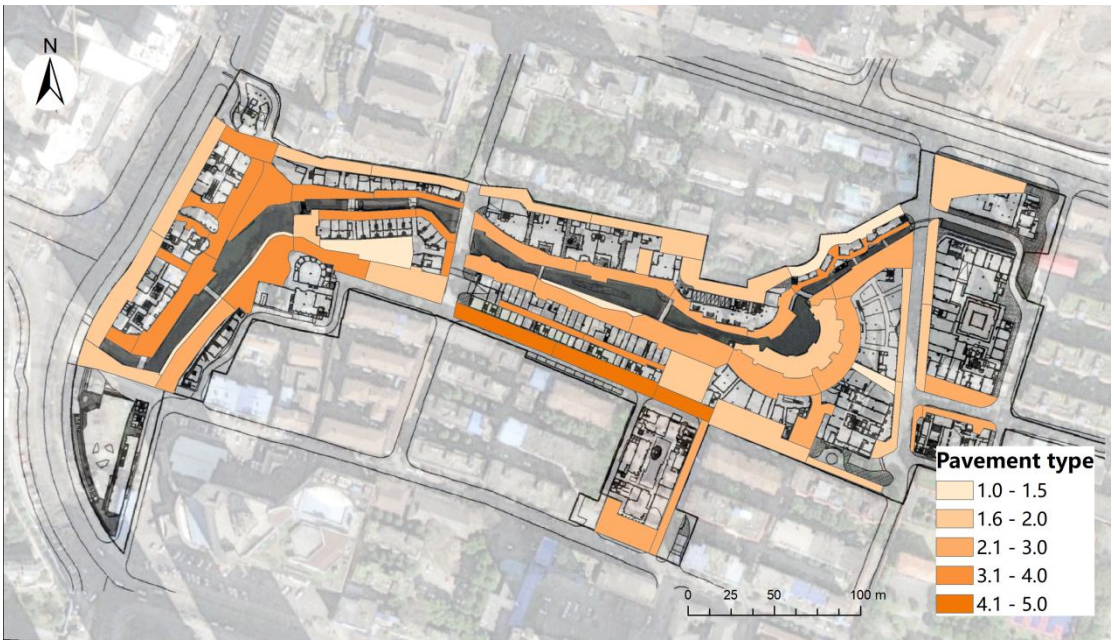


Figure4-29 Distribution of pavement types
(Source: Drawn by the author)

4.4 Summary of This Chapter

This chapter analyzes the actual performance of public space vitality and the spatial environmental conditions of the Laoximen District. It first reviews the district's evolution from a traditional urban core to a shantytown and then to a redeveloped area by examining its historical development and renewal background. Combined with its location, surrounding business types, and transport conditions, the chapter provides an overall understanding of the urban environmental context in which the district is situated. On this basis, it further analyzes the internal spatial characteristics of the district from the perspectives of spatial structure, scale and form, and functional composition, and clarifies its overall spatial pattern, with waterfront space as the core and pedestrian flow organization as the structural framework.

In terms of vitality characteristics, through multi-period behavioral observation and kernel density analysis, the chapter identifies the spatiotemporal distribution patterns of pedestrian activities in the district. It finds that district vitality shows an agglomeration pattern centered on the western square and the central-eastern street sections, and that it develops from isolated points to linear bands at different times of day. Through analysis of activity types and user-group attributes, the chapter further reveals a vitality structure dominated by everyday use, in which different types of activities show clear spatial dependencies.

In terms of built environment characteristics, this chapter conducts systematic quantification and distribution analysis of spatial elements in the district from multiple dimensions, including spatial structure, functional supply, environmental conditions, and staying facilities, and identifies the spatial differences and potential directions of influence of different elements. Overall, the district has a certain foundation in accessibility, interface enclosure, and spatial scale, but still shows deficiencies in commercial continuity, landscape provision, and staying facilities.

Chapter 5 Analysis of the Influence Mechanism of the Built Environment on Street District Vitality

5.1 Influence Mechanism between the Built Environment and Vitality

5.1.1 Descriptive statistical analysis

Overall, the built environment indicators show clear variation and imbalance across the study area.

In the dimension of spatial structure, the mean value of local integration is 61.46, with a standard deviation of 14.97. This indicates that the district has a certain foundation of spatial accessibility, while differences among spatial units remain evident and reflect a relatively clear spatial hierarchy. The mean street width is 7.22 m, ranging from 2.00 m to 28.19 m, with a standard deviation of 4.07, suggesting substantial variation in street scale and uneven continuity and walking experience. The mean interface enclosure degree is 1.03, which is at a medium to relatively high level overall, but the minimum value is 0, indicating that some areas have open or missing interfaces and a weak sense of enclosure.

In the dimension of functional provision, the mean residential radiation intensity is 55.78, with a standard deviation of 43.07, indicating significant spatial differences in the supporting effect of residents' activities on spatial vitality. Commercial density and landscape node density are both low overall, with mean values of 0.002 and 0.001 respectively, and both show relatively small standard deviations. This suggests that commercial and landscape resources are sparsely and unevenly distributed and have not yet formed a systematic support network.

In the dimension of landscape and environmental conditions, the mean shoreline complexity is 0.38, with a standard deviation of 0.54, indicating relatively rich variation in the waterfront interface form but also substantial differences among areas. The mean waterfront accessibility is 0.92 out of 4, which is generally low and suggests that the accessibility and usability of the waterfront space still have room for improvement. The mean green view index is 5.92%, with a standard deviation of 5.55%, showing that the overall visual perception of

greenery is relatively weak and unevenly distributed. The mean shade coverage ratio is 33.38%, but its standard deviation is high, indicating obvious differences in the distribution of shaded space and a lack of effective shade in some areas.

In the dimension of microclimate and staying conditions, the mean sunshine duration is 1.07, with a maximum of 4.39 and a standard deviation of 1.10, indicating significant differences in sunshine conditions across spaces. The mean seating density is 0.05, which is low overall, while the maximum reaches 0.45, suggesting that staying facilities are insufficient and unevenly distributed. The mean pavement type score is 2.85, with a standard deviation of 1.02, reflecting certain differences in materials and environmental quality across the district.

The study area has a certain structural foundation, but clear imbalance remains in functional provision, landscape attractiveness, and staying conditions, especially in the low density of commercial and landscape resources and the lack of waterfront accessibility and staying facilities.

Table5-1 Descriptive statistics of the indicators

(Source: Drawn by the author)

	Accessibility	Street interface			Functional density	
	Local integration	Street width (m)	Interface enclosure degree	Residential radiation intensity	Shop density	Landscape node density
Mean	61.46	7.22	1.03	55.78	0.002	0.001
Minimum	19.51	2.00	0.00	0.84	0.000	0.000
Maximum	92.84	28.19	2.00	165.11	0.031	0.011
Standard deviation	14.97	4.07	0.52	43.07	0.005	0.002

	Landscape conditions		Climatic conditions			Walking and resting conditions	
	Shoreline complexity	Waterfront accessibility (ordinal variable)	Green view index	Shade coverage ratio	Sunshine duration (h)	Seating density	Pavement type (ordinal variable)
Mean	0.38	0.92	5.92%	33.38%	1.07	0.05	2.85
Minimum	0.00	0.00	0.06%	0.00%	0.00	0.00	1.00
Maximum	1.79	4.00	29.94%	100.00%	4.39	0.45	5.00
Standard deviation	0.54	1.20	5.55%	34.99%	1.10	0.10	1.02

5.1.2 Linear regression results

In studies on the factors influencing street district vitality, multiple linear regression has been widely used to identify key built environment variables[79]. Since street district vitality is

shaped by the combined influence of multiple built environment factors, single-variable correlation analysis alone is insufficient to identify the independent effect of each factor while controlling for the others. Therefore, this study adopts a multiple linear regression model. After normalizing the variables, the backward stepwise selection method is used to identify the key influencing factors and reveal the explanatory power of the variables under combined effects.

First, the 13 independent variables were normalized to a range of 0 to 1 in order to eliminate the scale effect caused by different units. The normalization formula is as follows

$$X' = \frac{X - \min(X)}{\max(X) - \min(X)} \tag{5-1}$$

where X' is the normalized value, X is the original variable, and $\min(X)$ and $\max(X)$ are the minimum and maximum values of that variable, respectively.

After variable normalization, the backward stepwise selection method was used to remove variables that did not pass the significance test. After screening, variables such as walking width, interface enclosure degree, and waterfront accessibility were gradually excluded. The final retained variables were sunshine duration, seating density, green view index, shade coverage ratio, and integration, with a total of five variables.

Table5-2 Linear regression results

(Source: Drawn by the author)

Stepwise regression results (n=65)							
	Unstandardized coefficients		Standardized coefficient	t	p	Collinearity diagnostics	
	B	Standard error	Beta			VIF	Tolerance
Constant	-0.042	0.016	-	-2.543	0.014*	-	-
Integration	0.172	0.025	0.615	6.912	0.000**	1.193	0.838
Seating density	0.09	0.022	0.354	4.15	0.000**	1.099	0.91
Shade coverage ratio	0.036	0.016	0.218	2.244	0.029*	1.427	0.701
Sunshine duration	0.061	0.019	0.267	3.14	0.003**	1.09	0.918
Green view index	-0.055	0.031	-0.18	-1.785	0.079	1.533	0.652

Table5-2 Linear regression results (Continued)

Stepwise regression results (n=65)	
R^2	0.609
Adjusted R^2	0.576
F	F (5,59)=18.357,p=0.000
D-W value	2.137

Note: Dependent Variable = Pedestrian Flow Density

* p<0.05 ** p<0.01

The retained variables were then tested for collinearity. The results show that the VIF values of all independent variables are below 5, indicating no significant multicollinearity. The Durbin–Watson value is close to 2, suggesting that the model does not show obvious autocorrelation.

The final model has an R^2 of 60.9%, indicating that the selected variables can explain the spatial differences in street district vitality relatively well and that the model fit is satisfactory.

5.1.3 Identification of key influencing factors

Based on the regression results and behavioral observation data, the formation of street district vitality is jointly influenced by spatial structure, facility provision, and microclimatic conditions. Among these, integration, seating density, sunshine duration, and shade coverage ratio are key variables with significant effects.

(1) Integration

Integration reflects the centrality of a street segment within the overall road network and the probability of being passed through. It is an important structural factor at the meso scale that affects the distribution of pedestrian flow and the concentration of activities. The higher the integration value, the more likely a space is to become a gathering node for everyday activities.

The regression results show that the p-value of integration is 0.000, with $p < 0.01$, indicating a high level of significance. It is one of the core variables affecting the distribution of street district vitality. Behavioral observation shows that walking accounts for the highest proportion of activities in the district, and most activities are attached to the main circulation paths. These include not only everyday strolling but also a certain proportion of sightseeing

activities. Spaces with high integration often take on the main circulation function and form the basic framework for the concentration of pedestrian flow.

From the perspective of spatial mechanism, integration constitutes the most fundamental structural support of the district. For first-time visitors, routes that are easy to reach and move through are usually the first spaces to be perceived and used. For surrounding residents, convenient routes support daily travel and social activities. Therefore, integration not only affects the distribution pattern of pedestrian flow, but also strengthens the district's role as an interface connecting the community with the wider city.

(2) Seating density

The regression results show that the p-value of seating density is 0.000, with $p < 0.01$, indicating a high level of significance. As a typical staying facility, seating is the direct material support that enables staying behavior to occur.

From the perspective of behavioral mechanism, seating lowers the threshold for resting and social interaction, thereby transforming public space from a pass-through space dominated by movement into a staying space that supports lingering and interaction. Behavioral observation shows that conversations and sitting activities are mostly concentrated in areas with seating and are often accompanied by relatively long stays. The presence of seating not only provides conditions for physical rest, but also offers a basis for informal interaction and occasional activities in space.

(3) Sunshine duration

The regression results show that the p-value of sunshine duration is 0.003, with $p < 0.01$, indicating that it has a significant effect on pedestrian density and is one of the important environmental factors affecting street district vitality.

The observation was conducted in winter, when sunshine became an important attractive resource for outdoor activities. Longer sunshine duration improves comfort and the possibility of staying, encouraging activities such as sunbathing, resting, and social interaction to occur in concentrated areas. Behavioral observation also shows that sitting and conversation are mostly distributed in areas with abundant sunshine, reflecting users' active preference for sunlight resources. In addition, the waterfront space itself has strong outdoor leisure attributes.

Compared with ordinary commercial streets or enclosed park spaces, it relies more heavily on the support of natural environmental conditions. As a key microclimatic factor, sunshine strengthens the openness and leisure character of the waterfront space and provides important support for the formation of district vitality.

This result also reflects the sensitivity of district vitality to microclimatic conditions. In addition to sunshine duration, factors such as temperature, shade conditions, and overall thermal comfort may also jointly affect the frequency and duration of outdoor activities. This study uses sunshine as a quantifiable indicator, but its mechanism of influence essentially reflects the dependence of open waterfront space on climatic suitability.

(4) Shade coverage ratio

The regression results show that the p-value of shade coverage ratio is 0.029, which is below 0.05. This indicates that it has a significant effect on pedestrian density, although its explanatory power is relatively weaker than that of the variables discussed above.

From the perspective of spatial mechanism, shaded conditions correspond to the everyday activity needs of community residents to a certain extent. The sheltered spaces formed by wider streets and building eaves provide relatively stable venues for group activities such as square dancing. At the same time, the relatively bright lighting environment within shaded spaces also improves comfort during evening use, producing a synergistic effect.

In addition, shaded spaces are often attached to building eaves or rear interfaces and usually have a certain sense of enclosure and boundary support. At the psychological level, such spaces enhance the sense of safety and stability and help promote staying and group activities. Therefore, the shade coverage ratio strengthens the characteristics of nighttime use and community-based activities in district vitality to some extent.

Beyond the significant variables identified above, environmental and landscape indicators such as the green view index and waterfront accessibility did not show significant independent effects in the model. Among them, although the green view index entered the final model, it did not reach the significance threshold, while indicators such as waterfront accessibility were excluded during the stepwise regression process. This result does not mean

that such indicators lack spatial value. Rather, it suggests that their influence on district vitality is more often indirect. Field observation shows that greenery and waterfront interfaces can affect users' spatial choices by improving spatial perception, enhancing landscape attractiveness, and increasing the comfort of staying. However, in the Laoximen District, if landscape resources are not supported by continuous paths, seating facilities, and spaces for staying, they are still difficult to transform into stable public activities. Indicators such as the green view index and waterfront accessibility need to work together with factors such as path organization, staying facilities, and interface openness in order to more effectively promote the formation of district vitality.

5.2 Spatial Characteristics of Vitality Hotspot Areas

Pedestrian density was classified into five levels in GIS using the natural breaks method. According to the classification results, the top two levels are defined as high-vitality areas, which show a relatively obvious concentration of pedestrian flow. The middle level is defined as a medium-vitality area. The lowest two levels are defined as low-vitality areas, where pedestrian density is relatively low. This classification method moderately merges high- and low-value areas while retaining spatial differentiation, so as to highlight the clustering and divergence characteristics of pedestrian distribution and improve both readability and analytical focus.

5.2.1 Spatial characteristics of high-vitality areas

In terms of overall spatial structure, high-vitality spaces are mainly distributed in the middle of the district and extend continuously along the waterfront space, forming a linear vitality belt dominated by the waterfront interface. Several local vitality cores are formed at the eastern and western ends of the district and at central nodes. Overall, the spatial structure is characterized by linear linkage and nodal concentration. These spaces usually have good accessibility, appropriate spatial scale, and clear supports for staying and activity. The superposition of these conditions jointly promotes the concentration and sustained use of people.

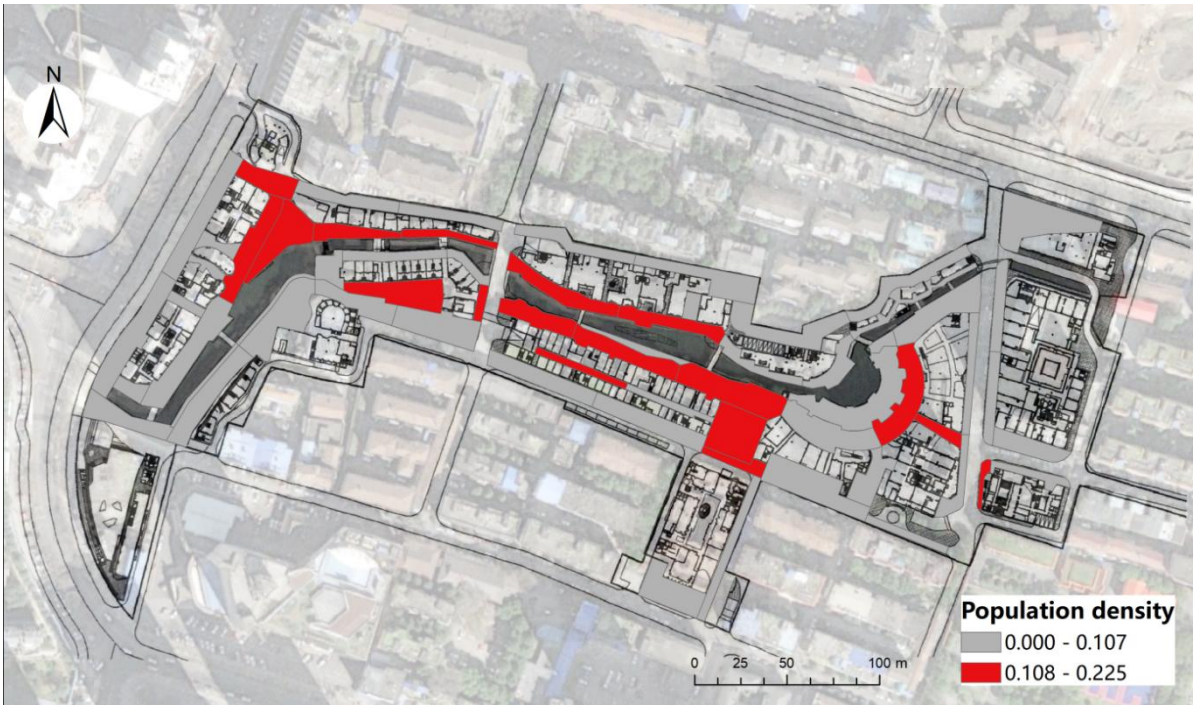
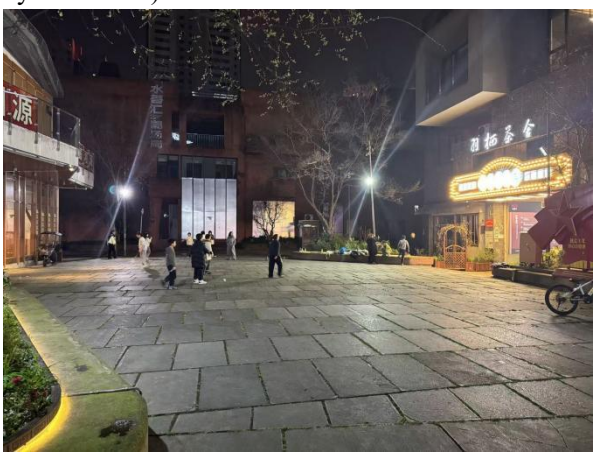


Figure5-1 Distribution of high-vitality areas

(Source: Drawn by the author)



a) Western node space



b) Central plaza space



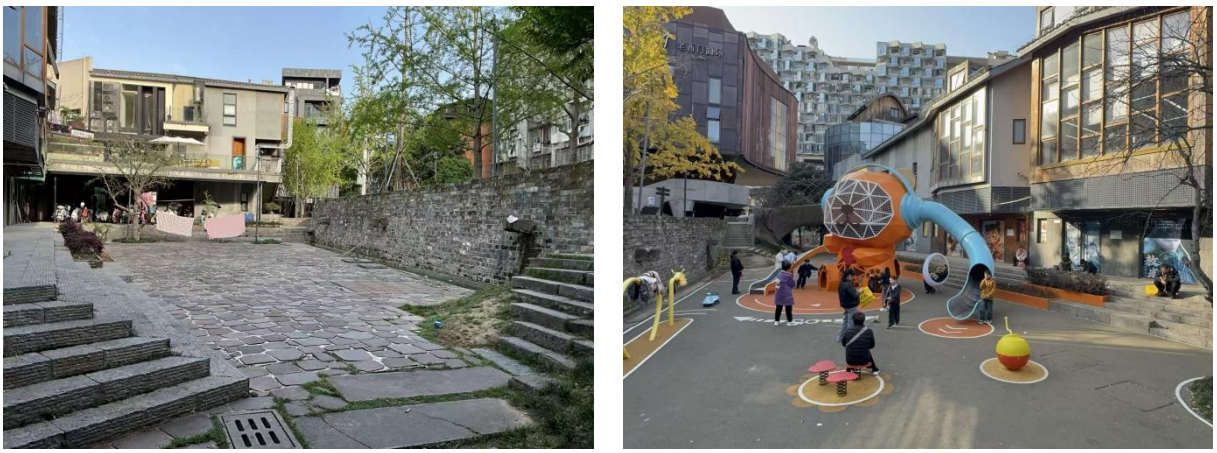
c) Eastern street space

Figure5-2 Field views of high-vitality spaces

(Source: Photographed by the author)

Field observation shows that these spaces meet users' needs for staying and activity to different degrees, thereby encouraging crowd concentration. Although the commercial interface of the western node space has not been fully activated, the street scale is appropriate and can satisfy circulation needs, while the small plaza on the waterfront side provides certain staying conditions. This forms a composite spatial structure in which the street serves as the activity carrier and the small plaza acts as the staying node. The relatively wide street provides the basic capacity for spatial activities, and the locally expanded plaza supports behaviors such as resting and conversation, attracting residents to engage in everyday activities such as sunbathing, dancing, and chatting (Figure5-2a). The central plaza is relatively large in scale and can accommodate group activities, while informal seating facilities create staying areas where sitting and square dancing are common (Figure5-2b). Relying on an open spatial form, good accessibility, and relatively favorable environmental quality and sunshine conditions, the eastern node forms a spatial structure in which street space serves as the main carrier of activities. The relatively wide street provides sufficient space for residents' activities, and residents spontaneously bring chairs to stay and communicate there, gradually forming a stable concentration of pedestrian flow and a clear atmosphere of neighborhood interaction (Figure5-2c).

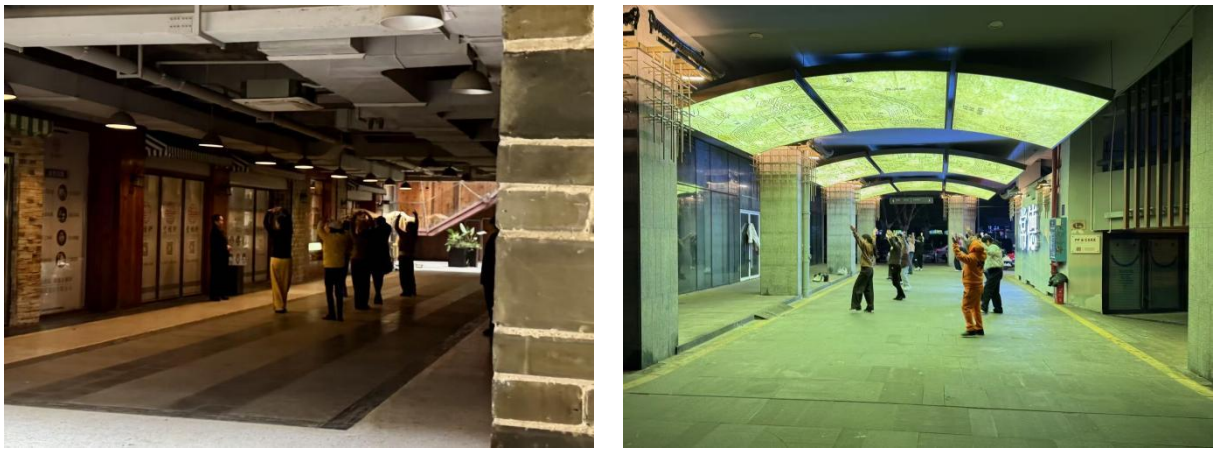
There are also several point-like high-vitality spaces within the district, where vitality is mainly triggered by specific facilities or activities. For example, the small plaza at the northwest corner originally lacked vitality, but after children's play facilities were introduced, it began to attract children's activities (Figure5-3). The commercial interior corridor in the middle of the district and the semi-enclosed entrance space at the northwest corner were transformed into venues for collective activities such as dancing when their commercial functions were underused (Figure5-4). Although these spaces are relatively small in scale, they can still form local vitality hotspots because they have clear activity triggers. However, such activities often show a certain degree of temporal intermittence, and the continuity of vitality remains relatively weak. Further exploration is therefore needed on the spatial conditions and organizational methods that can support more stable use.



a) The small plaza at the northwest corner originally lacked vitality

b) After children's play facilities were introduced

Figure5-3 Comparison before and after the introduction of children's play facilities
(Source: Photographed by the author)



a) Interior corridor space of the commercial building in the middle of the district

b) Semi-enclosed entrance space at the northwest corner

Figure5-4 Everyday use of shaded spaces
(Source: Photographed by the author)

5.2.2 Spatial characteristics of medium-vitality areas

Medium-vitality areas are mainly distributed at locally expanded spatial nodes and spatial locations with relatively high integration, such as district entrances, corners, and central nodes, or in spaces closely connected with surrounding residential areas, such as the residential entrance at the southeast corner and the areas around the ground-floor shops of the resettlement housing on the eastern side. Because these spaces receive a certain amount of everyday pedestrian flow, they can maintain a basic level of activity intensity.

From the perspective of spatial form, these areas are mostly linear spaces. Although they have a certain pedestrian base, their staying conditions are relatively limited, and activities are mainly pass-through behaviors. Their overall vitality level therefore lies between that of high-vitality and low-vitality areas.

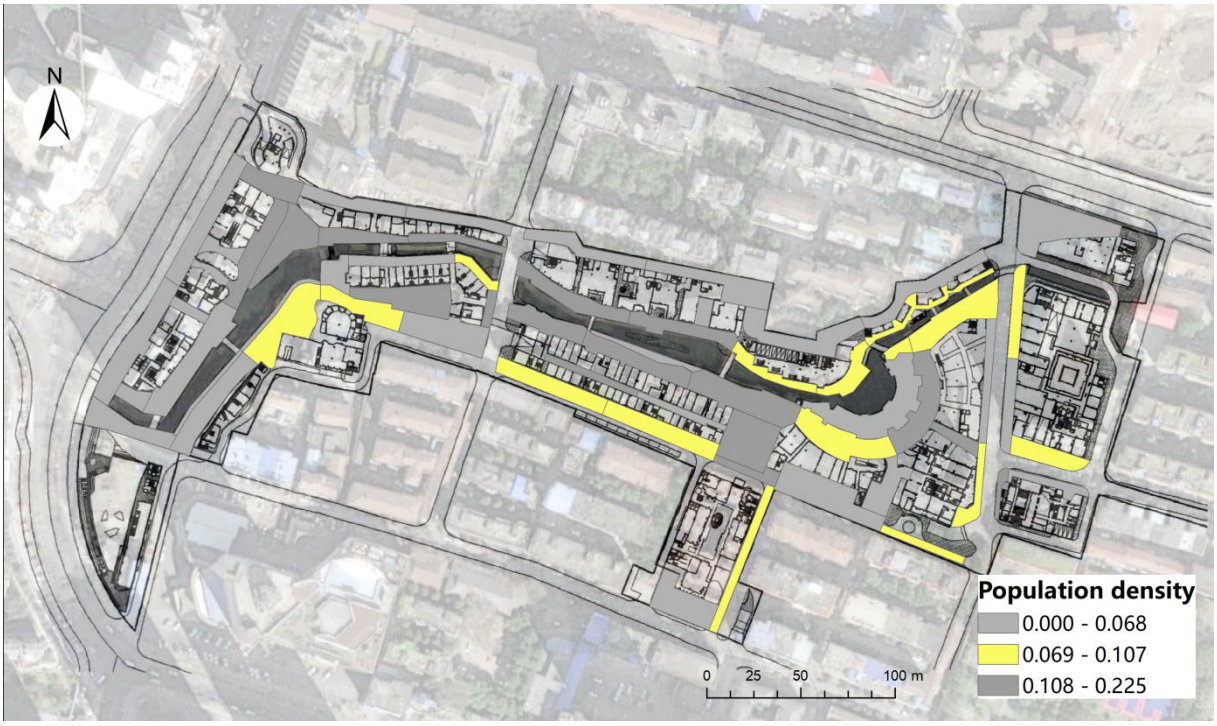


Figure5-5 Distribution of medium-vitality areas
(Source: Drawn by the author)

5.2.3 Spatial characteristics of low-vitality areas

Low-vitality spaces are mainly distributed in the peripheral areas outside the core waterfront zone and generally show insufficient accessibility and weak interface conditions. In terms of spatial structure, these areas have relatively low integration and weak connections with the main activity paths of the district, making it difficult to form a sustained concentration of pedestrian flow. At the same time, their spatial interfaces are often adjacent to urban arterial roads or the edges of residential compounds. Vehicle-oriented road interfaces and highly enclosed wall interfaces weaken spatial openness and the staying character of the space, thus negatively affecting vitality formation. In addition, some spaces are relatively large in scale but are occupied by parking and similar functions, which reduces the usability of public space and its capacity to support activities. Overall, low-vitality spaces often result

from the combined effects of weak accessibility, negative interfaces, and the occupation of public space.

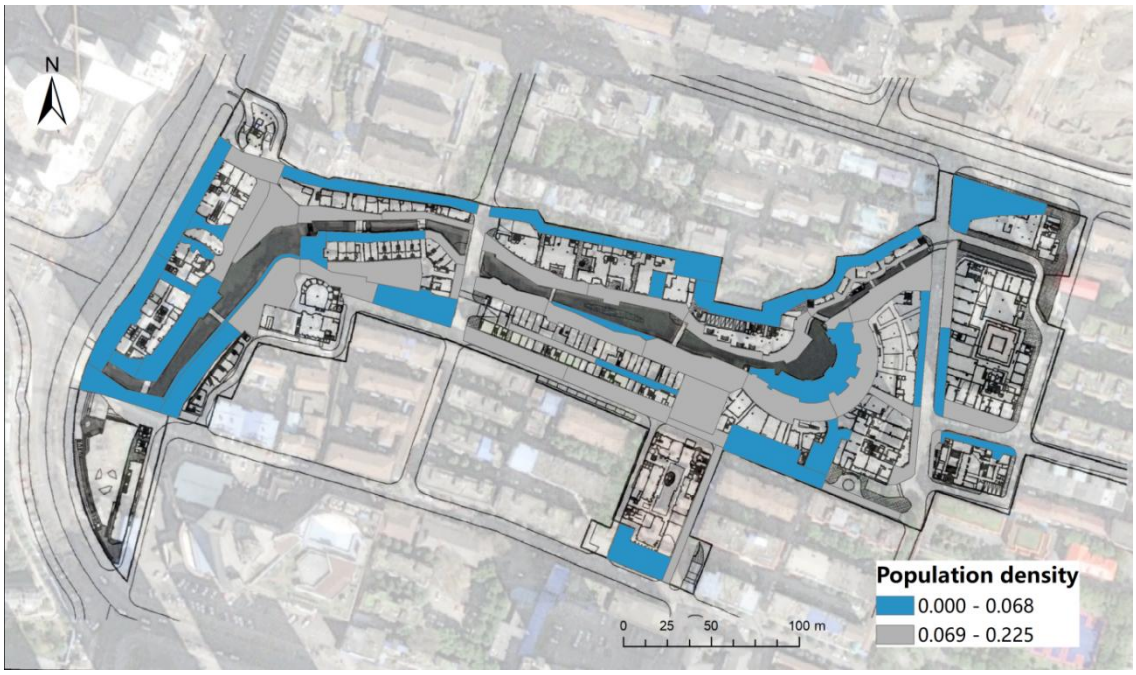


Figure5-6 Distribution of low-vitality areas
(Source: Drawn by the author)

Some spaces, such as the southern plaza of the district, have good sunshine conditions and an appropriate spatial scale. However, because of low integration, insufficient connection with the main activity paths, and the lack of effective path guidance, and because the space is also used as a parking lot, its spatial vitality has not been fully expressed. Nevertheless, some residents can still be observed sunbathing there, indicating that the space has potential use demand and a latent vitality foundation.



Figure5-7 Plaza space occupied by parking and its current use under sunny conditions
(Source: Photographed by the author)

Although the western waterside street has relatively high integration, its scale is rather narrow, and some interfaces are occupied by restaurant back-of-house spaces. These interfaces are closed or semi-closed and fail to respond to public space, forming a continuous negative interface that weakens the attractiveness and active use of the waterfront space. Without staying space and interface support, the area mainly serves a circulation function and has not formed a concentration of vitality. The southeast corner of the district is dominated by residential entrances and wall interfaces, which are highly enclosed and therefore difficult to interact effectively with users.



a) Interface of the western waterside street



b) Interface at the southeast corner of the district

Figure5-8 Field views of negative interfaces

(Source: Photographed by the author)

Some eastern spaces have relatively favorable integration and facility conditions. However, because they are adjacent to urban roads, with a vehicular roadway on one side and a continuous commercial interface on the other, and because the environment is dominated by hard paving and lacks landscape and leisure elements, the spatial experience is oriented toward movement and cannot support continuous staying behavior.



Figure5-9 Field view of the eastern street space of the district
(Source: Photographed by the author)

In addition, the unreasonable arrangement of facilities in some areas fails to support actual use effectively and thereby affects vitality formation. For example, the curved stepped seating area in the middle of the district has a relatively favorable interface environment, but because of level changes and the single form of the seating, the stepped seats are not conducive in either scale or comfort to social activities such as conversation. The stone material also reduces use comfort, which limits the formation of staying behavior. The interior corridor space in the middle of the district is constrained by lighting conditions, so its use period is relatively limited. Collective activities only appear during part of the afternoon, and the space is used less at other times.



Figure5-10 Seating facilities that are not fully used
(Source: Photographed by the author)

5.3 Summary of District Problems

5.3.1 Highly accessible spaces lack conditions to support vitality

The regression analysis clearly shows that integration is the most significant variable affecting pedestrian density in the district, indicating that high accessibility is the core basis for attracting pedestrian concentration. However, spaces with high integration do not necessarily become highly vital. Field observation shows that the western waterside street, despite its relatively high integration, is constrained by narrow street scale and the lack of adequate staying interfaces and resting support conditions. Although this interface is located at the main commercial entrance, some shops are still vacant, so the interface remains insufficiently active and the overall space appears relatively negative. Pedestrian flow is dominated by rapid passage, and effective staying and gathering behaviors are lacking. As a result, the advantage of high accessibility has not been transformed into actual spatial vitality.

By overlaying highly integrated areas with interface conditions in GIS, integration was divided into five levels, and the top three levels were defined as high-integration areas in order to identify interface types within highly integrated spaces. The analysis shows that landscape interfaces and the interfaces at major commercial entrances generally function as relatively positive interface types and can interact effectively with public space. In contrast, interfaces lacking architectural functions, vehicular road interfaces, wall interfaces, and other highly enclosed non-public interfaces such as hotels and residences constitute the major negative interfaces and restrict spatial openness and frequency of use to a certain extent.

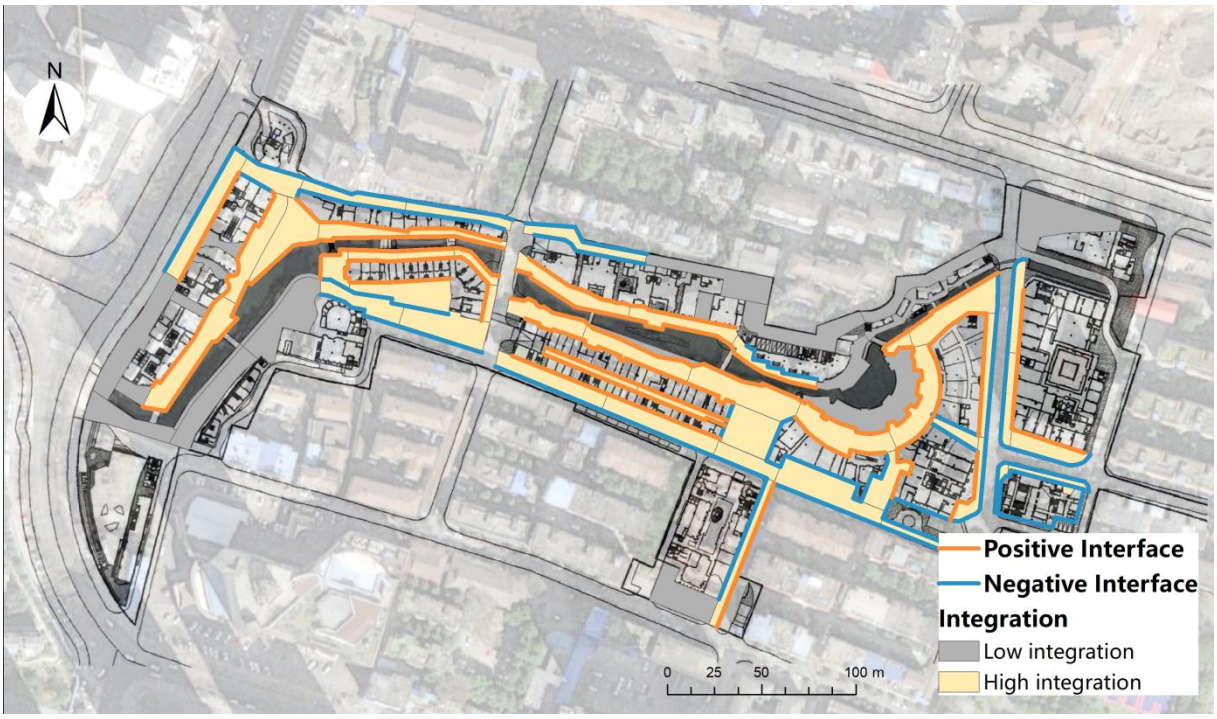


Figure5-11 Overlay analysis of interface attributes and integration
(Source: Drawn by the author)

5.3.2 Insufficient use of microclimatic resources

Both sunshine duration and shade coverage ratio have significant effects on district vitality, reflecting users' active selection of microclimatic conditions at different times of day. This observation was conducted in winter, when sunshine was an important attractive resource for outdoor activities, and sitting and conversation were concentrated in sunny areas. Shaded spaces mainly supported collective activities such as square dancing at night and worked together with lighting conditions. However, spaces with favorable sunshine conditions often lack corresponding staying facilities, while semi-enclosed spaces with shade have limited capacity and are unable to accommodate collective activities.

By classifying sunshine conditions in GIS and comparing them with vitality density levels, the study identified spatial units with differences greater than two levels. The results show that these spaces are mostly located at the ends of the district or in relatively small areas, where spatial position and structural conditions limit vitality formation to some extent. Overall, there is a mismatch between the spatial distribution of microclimatic resources and the organization of circulation and functional layout in the district, and the response to use

needs at different times remains insufficient. As a result, the potential positive effect of climatic conditions on spatial vitality has not been fully realized.

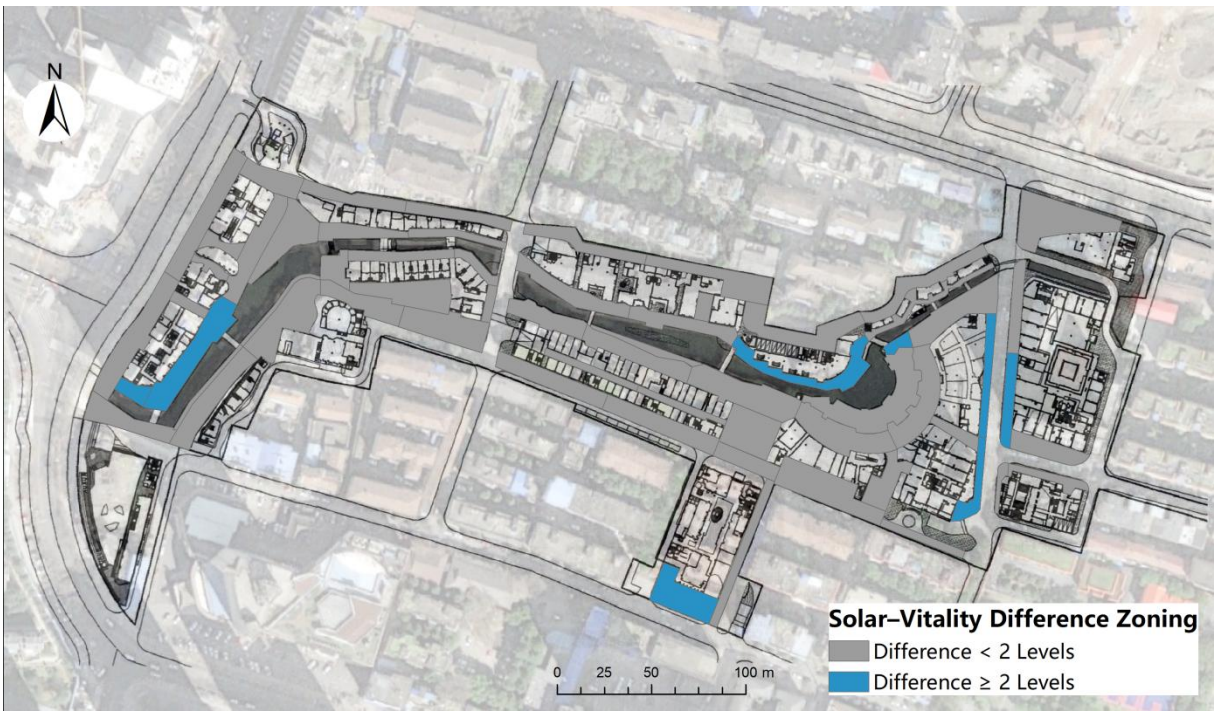


Figure5-12 Distribution of differences between sunshine conditions and spatial vitality
(Source: Drawn by the author)

5.3.3 Mismatch between facility provision and use demand

Seating density has a significant positive effect on district vitality, but field observation shows that some facilities are mismatched with actual use demand, which constrains the occurrence of staying behavior. There are three main problems in the provision of staying facilities within the district. First, facility forms do not match behavioral needs, and some seats cannot support social behaviors such as conversation and resting. Second, materials do not adapt well to climatic conditions, which reduces comfort in different seasons. Third, facility layouts are not coordinated with spatial organization and fail to form staying units with clear boundaries and a sense of territory.

5.3.4 Single commercial mix and conflicts in interface relations

The current commercial functions in the district are mainly convenience-oriented service businesses, including education and training, beauty and hair services, and other everyday service functions. These businesses mainly serve surrounding residents, and their spatial use

is function-oriented, so their attractiveness to outside visitors is relatively limited and the overall consumption experience is relatively monotonous. Some retail businesses are scattered and lack spatial continuity, making it difficult to form an agglomeration effect and weakening the overall attractiveness and strolling experience of the district.

Formats such as restaurants often occupy large bays. Their interface forms are relatively monotonous and lack variation, which affects the rhythm and continuity of spatial experience. Education and training businesses also show low interface activity along the street during some periods, weakening the attractiveness of district space. For example, in the central area of the district, clustered formats such as restaurants and teahouses are continuously arranged along the street and extend across an interface of about 40 m. The interface form is relatively uniform and lacks variation in openings and functional permeability, resulting in insufficient interface richness and making it difficult to create a continuous rhythm of spatial experience.



Figure5-13 Field view of the commercial interface in the middle of the district
(Source: Photographed by the author)

5.3.5 Insufficient conversion of landscape resources into staying behavior

The district possesses waterfront space as an important landscape resource, but its role in attracting people and encouraging staying has not been fully realized. Overall, the space is mainly used for viewing, while staying behavior remains limited. Field observation shows that the water has a certain visual attraction, but activities are mostly short stays.

At the spatial level, the connection between the waterfront space and the pedestrian activity interface is insufficient. In some areas, waterfront accessibility is weak, and elevation

differences, railings, and green buffers create interface barriers that weaken accessibility between people and the water, making it difficult for the water to become part of everyday activity routes. At the level of spatial structure, the waterfront space is mainly a linear circulation space and lacks the necessary staying spaces and nodal organization. The layout of facilities such as seating fails to interact effectively with the landscape interface and cannot support staying and social behavior.

Although the green view index did not pass the significance test, field observation shows that greenery is widely present in the space but remains separated from areas that support staying. It mostly takes the form of street trees along roads and has not been transformed into effective spatial boundaries or attractions for staying. In general, although the district has a certain foundation of landscape resources, these resources have not been adequately transformed in spatial organization and use, and they have not effectively become usable spaces that support staying and activity.

5.4 Summary of This Chapter

Based on built environment analysis and behavioral observation, this chapter systematically analyzes the factors influencing district vitality and its spatial expression. The descriptive statistics show that the district has a certain structural foundation, but there are differences and imbalances in functional provision, landscape conditions, and staying facilities. The regression analysis further identifies integration, seating density, sunshine duration, and shade coverage ratio as the main variables affecting vitality distribution, indicating that spatial structure, staying facilities, and microclimatic conditions jointly shape the occurrence and concentration of human activities.

At the level of spatial distribution, district vitality shows characteristics of expansion along the waterfront space and concentration at nodes. High-vitality areas are mostly concentrated in spaces with high integration and adequate staying conditions. Medium-vitality areas are mainly distributed in nodal spaces and areas closely connected with residential zones. Low-vitality spaces result from the combined effects of insufficient accessibility, negative interfaces, or the occupation of public space. Differences in structural conditions and use patterns across these levels jointly shape the overall pattern of district vitality.

At the level of problem identification, the district shows several issues, including highly accessible spaces lacking staying support, insufficient use of microclimatic resources, mismatches between facility provision and use demand, lack of coordination between commercial formats and interface organization, and the failure to convert landscape resources into actual use. These problems reflect a mismatch between spatial conditions and use behavior, causing some spaces with potential to fail to form stable concentrations of activity and providing a basis for subsequent spatial optimization strategies.

Chapter 6 Renewal Principles and Strategies for Community Commercial Street Districts in Small and Medium-sized Cities

6.1 Design Objectives and Vision

The analysis in Chapter 5 shows that the Laoximen District already possesses a certain foundation of spatial resources and a stable group of everyday use users. However, multiple mismatches still exist between existing built environment conditions and actual user needs. On the one hand, some spaces enjoy favorable location and accessibility conditions but lack adequate staying conditions, making it difficult to support diverse public activities. On the other hand, some areas with landscape potential have not been effectively transformed into sustainable places of use, so their spatial vitality has not been fully activated.

In response to these issues, this renewal takes everyday use as its point of departure. It aims to improve the district's capacity to accommodate residents' daily activities through refined public space optimization, so that existing spatial resources can be used more fully and efficiently.The optimization of the Laoximen District should not take large-scale commercial introduction or tourism-oriented transformation as its main approach. Instead, it should be grounded in the actual conditions of limited external consumption support and the relatively high proportion of residents’ everyday use in Small and Medium-sized Cities. Through small-scale and incremental public space optimization, the district should improve its capacity to accommodate everyday activities such as passing through, staying, resting, social interaction, and basic consumption, and on this basis gradually promote the recovery of community commercial vitality.

In the short term, the focus is on improving accessibility, staying conditions, and user comfort, while strengthening the basic conditions for passing-through, resting, and social interaction, so as to enhance the stability and continuity of everyday vitality. In the long term, the goal is to gradually improve overall spatial quality and place attractiveness on the basis of meeting residents' daily needs, so that the district can retain its everyday character and local identity while developing a certain degree of external appeal, ultimately forming a composite

vitality structure grounded in everyday use and supplemented by experience and consumption.

In terms of design positioning, this study does not rely on large-scale spatial reconstruction or strong commercial importation. Instead, it adopts small-scale and incremental spatial optimization as its basic approach, giving priority to activating the potential of existing spaces and enhancing vitality while respecting the original spatial pattern. Public space optimization serves as the core entry point, with interventions carried out in four aspects, namely accessibility improvement, enhancement of staying conditions, optimization of interface relationships, and transformation of landscape resources. These correspond to the major spatial problems identified earlier. Through targeted adjustments to the relationships among spatial structure, environmental elements, and user behavior, the design seeks to guide passing-through behavior toward staying and activity behavior, thereby establishing a framework for the specific strategies that follow.

6.2 Optimization Principles

6.2.1 Principle of coordinating everyday use and commercial activities

In the context of Small and Medium-sized Cities, a Community Commercial Street District is not merely a space of consumption. Rather, it is a composite public space that combines commercial services with residents' everyday social interaction. Empirical analysis of the Laoximen District shows that although some commercial interfaces have not yet been fully activated, relatively stable clusters of spontaneous activities can still emerge within the district. This indicates that district vitality does not depend entirely on commercial drivers, and that residents' everyday use itself provides an independent and continuous source of vitality. Renewal of Community Commercial Street Districts should therefore follow a coordinated development approach that balances everyday use and commercial activities, rather than squeezing public activity spaces through a purely commercial orientation.

In terms of functional configuration, priority should be given to business types closely related to daily life, such as convenience services, light dining, and community retail, so as to meet residents' basic needs, address service shortages according to actual use, and improve

the overall functional system. At the same time, public service or commercial facilities with a broader service range may be introduced in moderation to enhance the district's overall attractiveness.

In terms of spatial organization, sufficient public activity space should be reserved and reinforced through staying facilities and social spaces. Behavioral observation shows that activities such as conversation occur frequently in the district. It is therefore necessary to create diversified social spaces to encourage everyday interaction among residents, so that place identity and community cohesion can gradually accumulate through daily use.

6.2.2 Principle of optimizing staying conditions

During district renewal, emphasis should be placed on creating spatial environments that support staying and social interaction. By optimizing spatial scale, interface relationships, and facility provision, the capacity of space to accommodate user behavior can be improved. Empirical analysis shows that seating density has a significant influence on district vitality, yet there remains a certain mismatch between facility forms, spatial organization, and actual user needs, which calls for targeted optimization.

In terms of facility provision for staying spaces, the material, scale, orientation, and arrangement of seating should be optimized from the perspective of actual behavior so as to meet diverse needs such as conversation, rest, and short-term staying. Priority should be given to materials with better thermal comfort, while the needs of different age groups should also be taken into account in order to improve the applicability and frequency of use of such facilities.

In terms of the spatial form of staying spaces, circulation spaces and staying spaces should be reasonably distinguished. Through grouped seating layouts, changes in pavement, and green enclosure, staying units with a certain sense of territoriality can be created, thereby enhancing recognizability and stability of use and promoting the transformation of the district from a passage-oriented environment into one that supports staying and social interaction.

In terms of interface organization for staying spaces, closed and monotonous building edges should be weakened, and small-scale activity spaces should be introduced by using corner spaces and interface setbacks. In areas where residents' activities are relatively

concentrated, the connection between public space and commercial interfaces should be strengthened in order to promote interaction between space use and commercial activity. In sections mainly used for passing through, pedestrian experience should be improved through control of interface bay width and interface continuity.

6.2.3 Principle of function adaptation based on user groups

During district renewal, the needs of different user groups should be fully addressed so as to improve the adaptability of space to diverse activities. The primary users of a Community Commercial Street District are surrounding residents. Although the user composition is relatively stable, differences in demand are significant. Targeted spatial provision is therefore an important basis for activating spontaneous activities and maintaining a stable flow of people.

Behavioral observation shows that the district is mainly used by surrounding middle-aged and elderly residents, while also accommodating children and caregivers, leisure walkers, and other groups. Different groups show clear differences in activity type, time of use, and spatial demand. Elderly users tend to stay in spaces with good sunshine conditions and resting facilities. Children's activities depend on sites with clear boundaries and facility guidance. Collective activities such as square dancing place higher demands on openness and shading conditions.

Spatial optimization should be based on actual behavioral characteristics and provide differentiated support for different user groups and their activities. In the design process, facility types, spatial scale, and modes of activity organization should be adapted to the characteristics of the dominant user groups so as to reduce mismatches between provision and actual demand. For example, resting facilities suitable for elderly users should be arranged first in sunny areas, children's activities should be supported in places with a certain sense of enclosure, and continuous paving and shading conditions should be reserved in open spaces for collective activities, so as to enhance the capacity and applicability of space for diverse everyday activities.

6.2.4 Principle of prioritizing climatic suitability

The behavioral observations in this study were conducted in winter, when climatic conditions exert a particularly strong constraint on outdoor activities. Quantitative analysis shows that both sunshine duration and shade coverage ratio significantly affect district vitality. Users display clear adaptation to thermal comfort in their spatial choices. In winter, resting and social activities are highly concentrated in sunny areas, while semi-enclosed shaded spaces are more suitable for collective activities at night. At present, however, a mismatch exists. Areas with favorable sunshine conditions lack resting facilities, whereas shaded spaces are limited in size and fragmented in organization, which prevents the potential positive effect of climatic conditions on outdoor activities from being fully transformed into actual use of space.

Climatic suitability should be treated as a priority dimension in spatial layout and facility provision. In winter, staying facilities should be arranged in areas with concentrated sunshine to encourage stable staying behavior. Continuous shelter systems should be created through pergolas, building eaves, and semi-enclosed spaces, so as to expand usable space for collective activities. At the overall level, connections between sunny areas and sheltered areas should be coordinated to form a temporally flexible spatial system, thereby reducing the limitations imposed by season and time on outdoor activities and improving the quality of use throughout the year and across different times of day.

6.2.5 Principle of activating landscape resources

During district renewal, landscape and cultural resources should be transformed from visual display into actual use so as to strengthen their support for spatial vitality.

The district has advantages in waterfront landscape and historical remains, yet the current spatial organization is still dominated by viewing functions. Landscape resources are weakly connected with residents' everyday use, and their conversion efficiency remains limited. Empirical analysis shows that landscape-related indicators such as Green View Index and waterfront accessibility do not have significant effects on vitality. Field observation further reveals that existing greenery is mainly ornamental and separated from staying spaces. Cultural nodes such as the bunker and historic buildings can attract photography and short stays, but they lack spatial organization linked to everyday activities and therefore fail to

generate continuous and stable vitality clusters. Landscape and cultural resources still remain largely at the visual level and have not been effectively transformed into actual use behavior.

Renewal design should promote the transformation of landscape and cultural resources into spatial carriers that can be participated in and stayed in from the perspective of actual use. In terms of landscape organization, greenery should be integrated with seating, shading facilities, and activity areas so that it becomes part of the staying space system. In terms of cultural use, historical remains should be embedded into everyday activity scenes through path guidance and node strengthening so as to enhance spatial recognizability. By turning landscape and cultural resources into spaces that can actually be used, they can truly become spatial carriers that activate daily activities and extend staying time, rather than remaining symbolic visual displays.

6.3 Optimization Strategies

6.3.1 Strategy of optimizing spatial interfaces and scale

Local integration is the most significant factor affecting pedestrian density in the district. At a fundamental level, the street network structure determines the distribution of pedestrian flows and the possibility of spatial use. The previous analysis shows that in areas with relatively high accessibility, negative interfaces and inappropriate spatial scale are important factors constraining vitality. Targeted optimization is therefore needed at both the interface level and the spatial scale level.

At the interface level, negative interfaces in the district are mainly concentrated in interface types with strong continuity but insufficient openness. These include long building interfaces formed by restaurants, hotels, and similar uses, traffic interfaces distributed along carriageways, and vacant commercial interfaces without tenants. Such interfaces lack effective interaction with public space and weaken the attractiveness of spatial use. In handling boundaries adjacent to carriageway interfaces, priority should be given to improving the transitional relationship between public space and the roadway. In areas close to urban arterial roads, green buffer belts, subtle topographic treatment, or built screening elements may be used to reduce traffic interference at both the visual and psychological levels, thereby

enhancing enclosure and safety. For commercial interfaces, business types may be divided according to functional attributes into daily convenience uses and experiential consumption uses. Daily convenience uses include dining, retail, and life services, which are closely related to residents' daily activities. Their interface design should be organized together with staying spaces, with seating and interface setbacks supporting associated behaviors such as waiting and short stays (Figure 6-1). Experiential consumption uses should focus more on atmosphere creation, and the overall recognizability of the interface should be strengthened through coordinated control of materials, colors, and shop sign scale, thereby enhancing the district's commercial image and spatial continuity (Figure6-2).

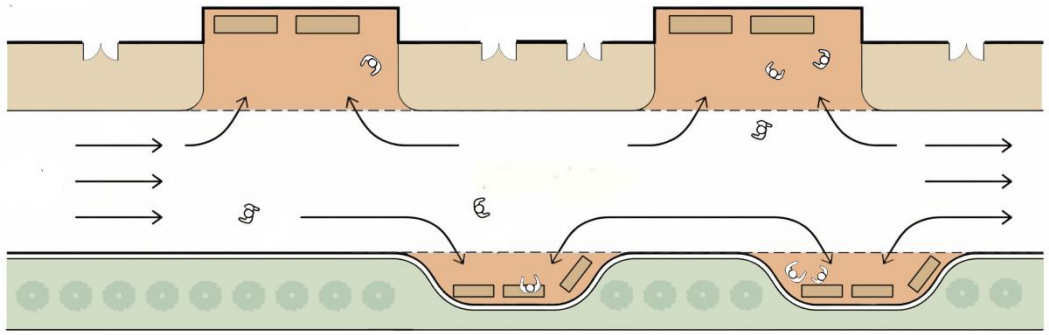


Figure 6-1 Interface permeability strategy
(Source: Drawn by the author)

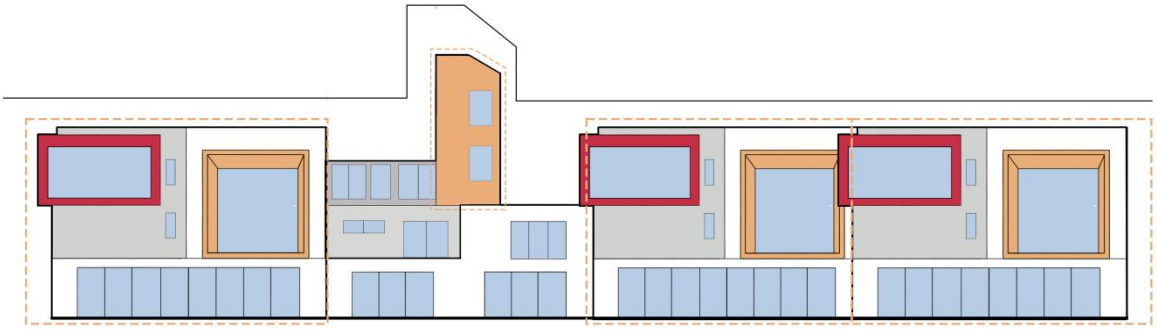


Figure6-2 Skyline Shaping and Facade Style Enhancement
(Source: Drawn by the author)

In terms of spatial scale, some areas are relatively constrained. Roads with low traffic volume may be moderately narrowed so that part of the roadway can be converted into pedestrian activity space and combined with resting facilities and bicycle passage space to improve the public use capacity of the street. Semi-enclosed spaces and corner spaces may also be introduced in moderation along street interfaces or in low-vitality areas. Through

interface setbacks and enclosure formation, smaller social places with stronger staying attributes can be created. In addition, local pedestrian path geometry may be adjusted, and curved or folded pedestrian routes may be introduced where conditions allow in order to form spatial nodes with staying attributes. Through local path adjustment and pavement guidance, the relationship between pedestrian space and plaza space can be strengthened so that pedestrian flow can naturally enter public nodes, thereby promoting staying behavior and improving space-use efficiency.

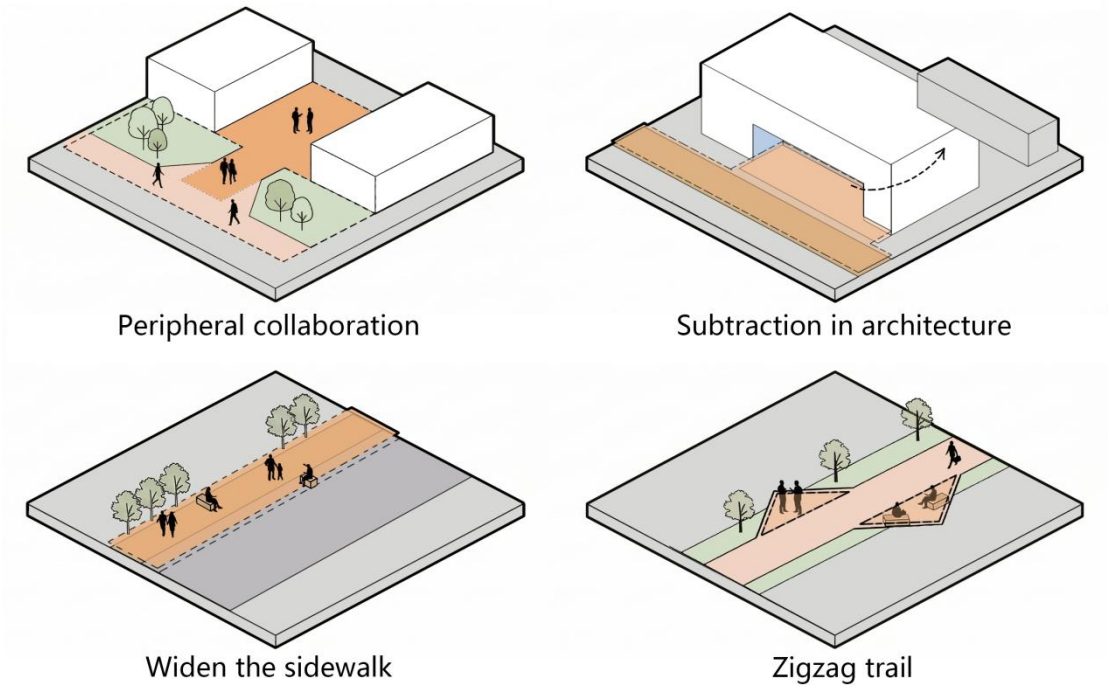


Figure6-3 Expanded activity space
(Source: Drawn by the author)

6.3.2 Strategy of space release and path optimization

The previous analysis shows that some spaces with favorable sunshine or shading conditions have not been fully used. This is mainly because they are located at the ends of circulation paths or are occupied by parking and other functions, and therefore have not been incorporated into the system of everyday activity routes. In response, this strategy intervenes from two aspects, namely path connections and functional replacement, in order to reintegrate marginalized spaces into the district's daily movement system.

Spaces with good sunshine or shading conditions but occupied by parking or temporary functions should be released first through functional replacement or time-based management so as to restore their public activity attributes. During peak daytime periods of public activity, residents' everyday use should be given priority. In areas where parking demand exists, staggered use mechanisms may be adopted so that parking functions can return during non-activity periods, thereby enabling flexible use of spatial resources. Once released, such spaces should be linked continuously to major movement lines through extended paving and path connections so that they do not become isolated again.

At the level of path connections, visual and pedestrian links between low-vitality areas and major circulation paths should be strengthened. Through node opening, path linkage, and pavement guidance, the recognizability and accessibility of marginal spaces can be improved so that they are reintegrated into everyday movement routes. Measures such as signage systems and landscape node arrangement may also be used to enhance path attraction, compensate for breaks in use caused by structural accessibility limitations, and guide pedestrian flow toward spaces with latent potential.

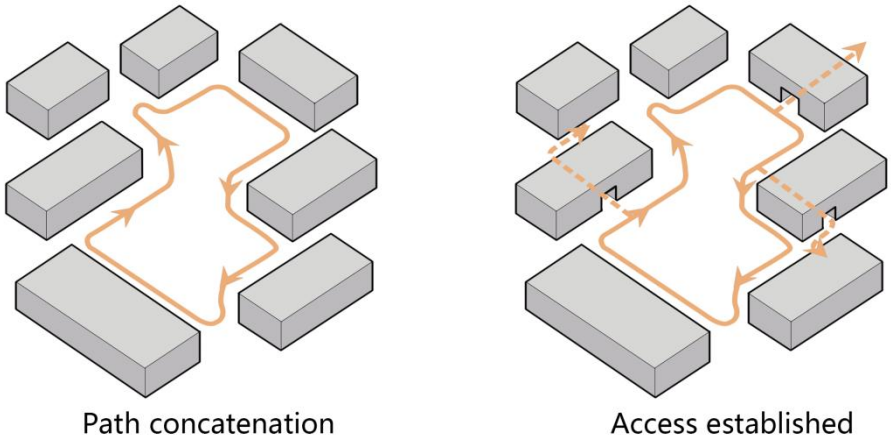


Figure6-4 Path linkage strategy
(Source: Drawn by the author)

6.3.3 Strategy of facility insertion and optimization of the staying environment

During district renewal, the capacity of spaces to support multiple types of staying behavior should be improved through coordinated optimization of facility provision and spatial organization.

In terms of facility provision, the form, scale, and combination of facilities should be carefully designed from the perspective of actual behavior so as to meet the needs of different age groups. Seating should mainly consist of multi-person seats, supplemented by linear benches. Multi-person seating supports face-to-face communication and is therefore conducive to conversation and leisure activities, whereas linear benches are more suitable for short stays along paths. Seating scale should respond to the district's user characteristics, which are dominated by middle-aged and elderly people. Appropriate seat height should be controlled, and materials such as wood or composite materials with better thermal comfort should be preferred. Stepped seating is often too narrow and too single in orientation to support social interaction such as conversation. It may therefore be partially widened to form stable staying nodes, with timber paving added to improve comfort.

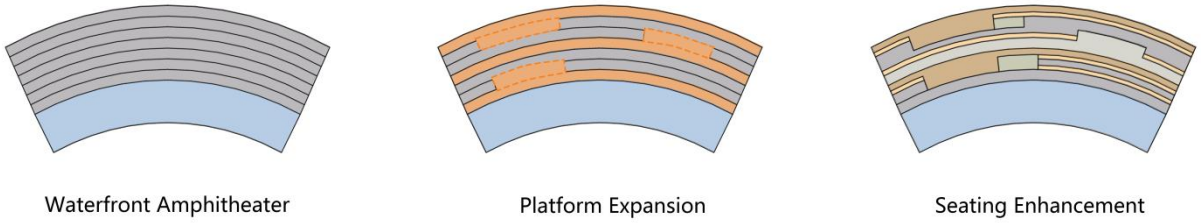


Figure6-5 Renewal strategy for stepped seating
(Source: Drawn by the author)

In terms of facility layout, integrated provision should respond to seasonal environmental conditions. Priority should be given to arranging seating in winter at locations with good sunshine, a supporting edge behind, and open views in front so as to improve users' sense of safety and environmental comfort. In summer and at night, pergolas, tree shade, and lighting facilities should be combined to extend the effective period of space use. At the same time, public service facilities and children's activity facilities should be supplemented according to the needs of different age and user groups in the district, thereby improving accessibility, usability, and the attractiveness of everyday staying. Improvement of staying behavior cannot rely on seating alone. Facility provision should be considered together with spatial organization. Through differentiated paving, green enclosure, or slight spatial setbacks, relatively independent staying units can be created without altering the overall pattern, thereby strengthening the sense of territoriality and the stability of use.

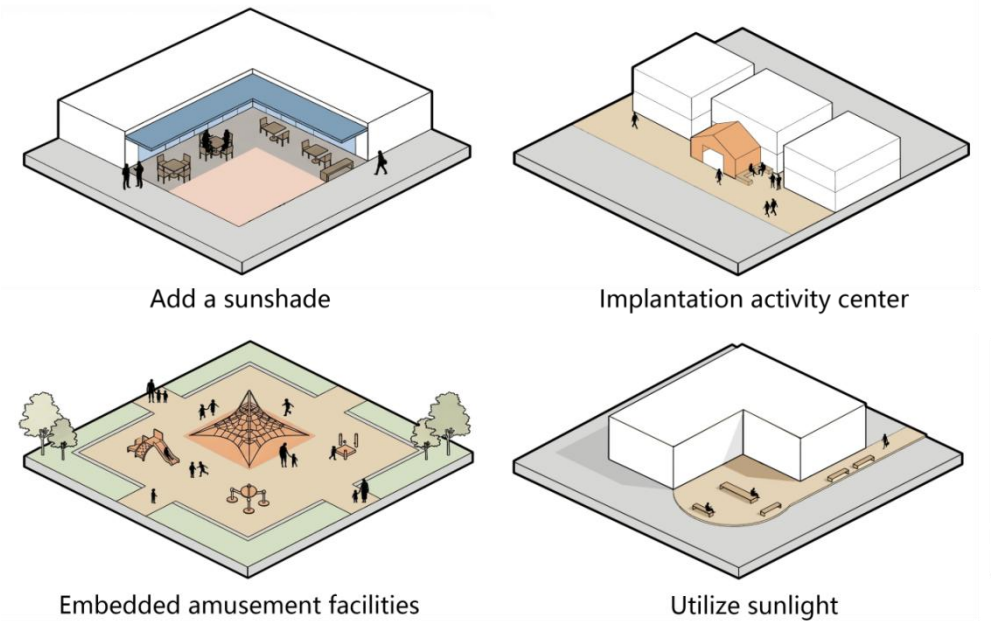


Figure6-6 Strategy of facility insertion
(Source: Drawn by the author)

In terms of landscape organization, the coordinated relationship between landscape elements and staying functions should be strengthened so that interfaces do not remain only at the level of visual appreciation. Through the composite arrangement of small-scale greenery, waterscape nodes, and resting elements, staying units can be embedded while spatial hierarchy is enriched. In this way, the landscape interface can be transformed from a visual display into a behavioral supporting boundary, thereby improving actual space-use efficiency.

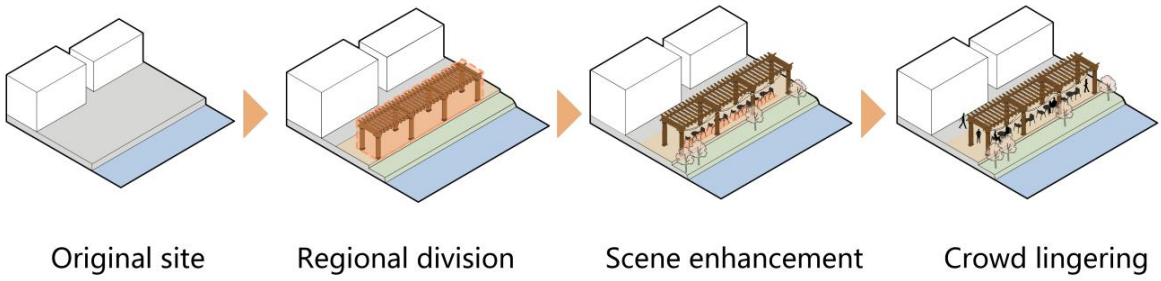


Figure6-7 Strategy for inserting scenic leisure nodes
(Source: Drawn by the author)

6.3.4 Strategy of flexible use and temporary activation

For long-vacant commercial spaces with closed interfaces, moderate interface opening may be carried out on the premise of ensuring structural safety and preserving flexibility for future use. By weakening the original closed boundary and converting it into a semi-open or

open interface, such spaces can acquire the potential to accommodate temporary staying and activities. Combined with temporary uses or basic staying facilities, the interface can respond more effectively to public space and transform from a negative interface into a participatory activity interface. In specific implementation, the degree of interface opening should be flexibly controlled in coordination with future business development. Through recoverable or adjustable design, a staged transition can be achieved from temporary use to stable commercial operation, thereby avoiding the loss of adaptability caused by rigid functional fixation.

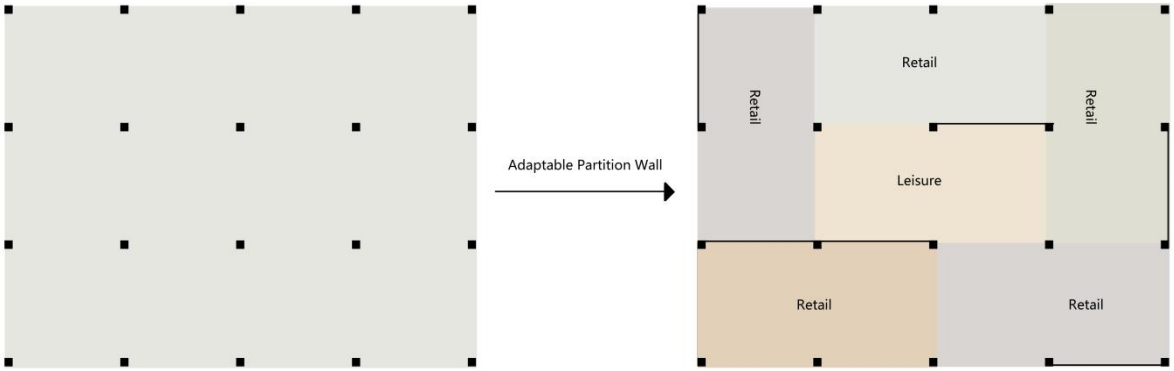


Figure 6-8 Flexible Space Strategy
(Source: Drawn by the author)

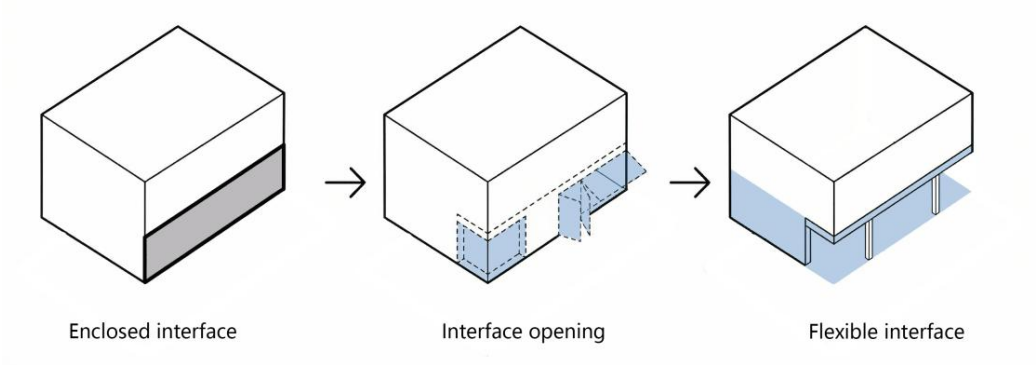
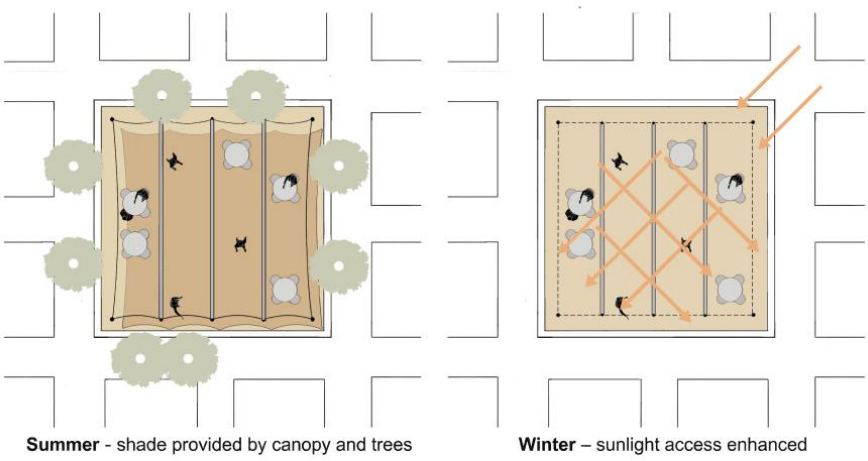


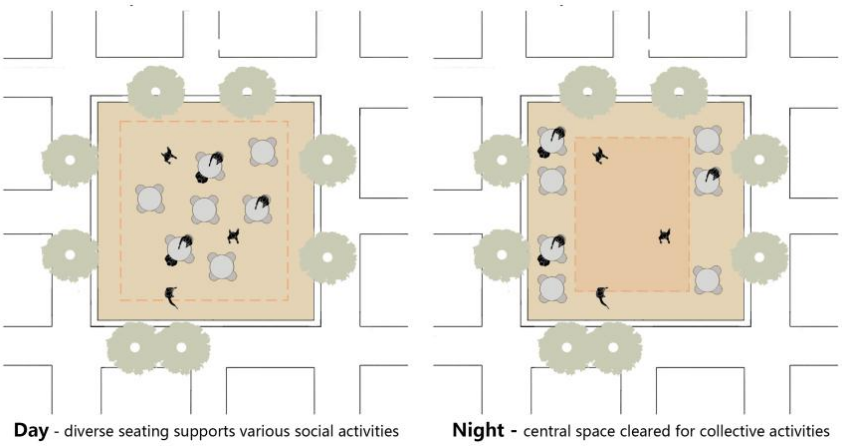
Figure6-9 Flexible interface strategy
(Source: Drawn by the author)

In addition, public spaces may realize multiple modes of use through time-based spatial organization. For example, spaces used mainly for seated staying and small-scale social interaction during the day may convert at night into spaces for small markets or collective activities by storing part of the facilities and releasing the central activity area. Under different

climatic conditions, temporary shading devices, movable structures, or modular facilities may also be used to adjust the spatial environment and improve comfort.



a) Seasonal flexible-use strategy



b) Day – night flexible-use strategy

Figure6-10 Flexible-use strategy

(Source: Drawn by the author)

6.4 Design of Typical Nodes

6.4.1 Overall strategy

The overall renewal strategy takes the improvement of district connectivity and the quality of public space use as its main line. In terms of overall spatial organization, a continuous waterfront slow-traffic path is constructed along the moat to connect the western entrance, the central square, and the eastern waterfront node, thereby forming the main public activity belt within the district. At the same time, in combination with the existing circulation

space and building interfaces on the southern side of the district, the southern pedestrian connection is reorganized and strengthened, so that together with the waterfront path it forms a pedestrian network linking the interior and exterior of the district. At local nodes, a number of staying spaces are created through path turning, local space expansion, and the insertion of greenery, enabling the originally passage-oriented linear spaces to acquire a certain spatial rhythm and conditions for staying.

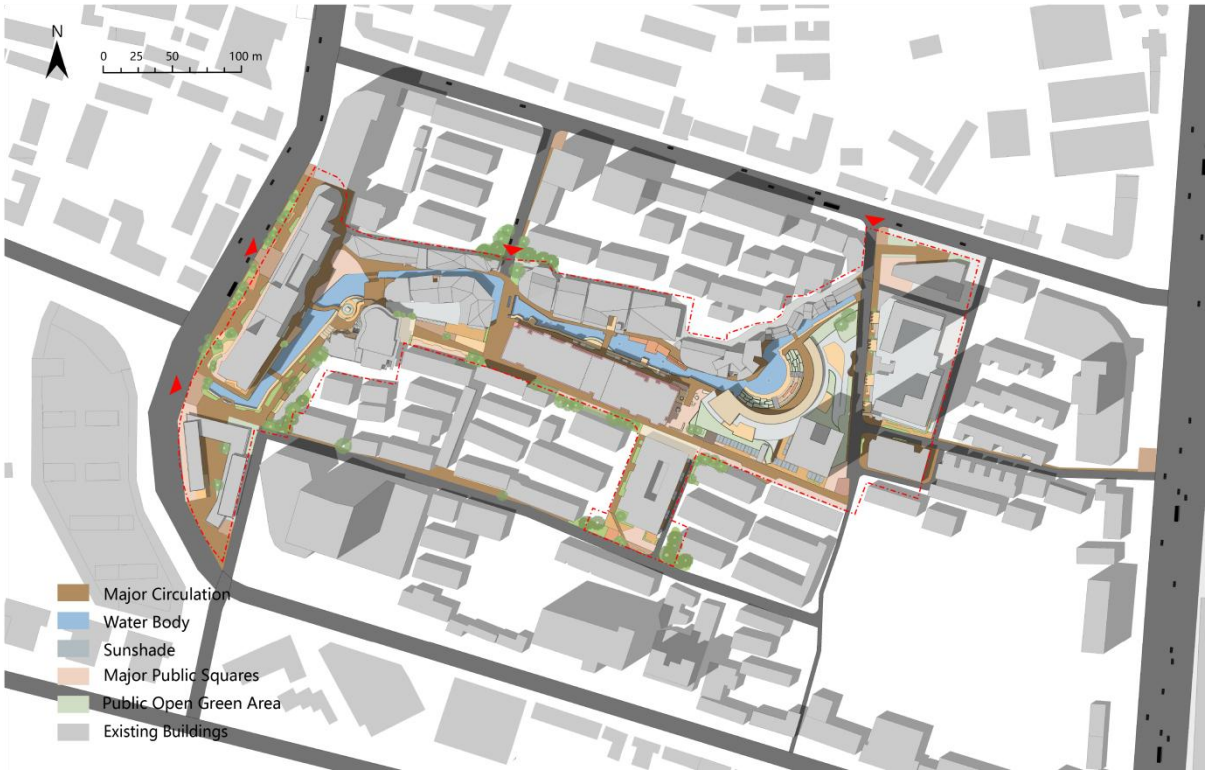


Figure6-11 Overall plan of spatial optimization in the Laoximen District
(Source: Drawn by the author)

In terms of accessibility optimization, the pedestrian connections and spatial guidance relationships between the interior of the district and the surrounding communities are strengthened. On the one hand, relying on the north-south passages in the central and eastern parts of the district, the connections between the waterfront spaces and the residential areas on the north and south sides are enhanced, so that the waterfront public space can be better integrated into the everyday travel routes of surrounding residents. The overall accessibility of the district is further improved through the local addition of new connections. On the other hand, interface-guiding nodes are arranged at the points where the district connects with urban roads. Through pavement continuation, entrance signage, and the reorganization of boundary spaces, the recognizability and permeability of the district toward surrounding roads are

improved. For some marginal spaces and street grey spaces around the district, where implementation conditions still require further coordination, gradual improvement may be carried out in the future through public participation and micro-renewal. In this way, small-scale places for staying and social interaction can be added, and the pedestrian connections between the district and the surrounding communities can be further improved, thereby forming a more stable foundation for everyday use.



Figure6-12 Strategy for accessibility optimization in the district
(Source: Drawn by the author)

In terms of interface optimization, the scheme focuses on renewing spaces that have high accessibility but negative interfaces. For boundary spaces strongly affected by urban roads, traffic disturbance is mitigated through green buffers, pavement continuation, and entrance reorganization. For areas where building interfaces are monotonous and insufficiently open, interface permeability, outdoor spill-out spaces, and the insertion of staying facilities are used to strengthen the interaction between commercial space and public space. In terms of waterfront-space renewal, the scheme organizes continuous waterfront walkways and platform spaces along both sides of the moat, and introduces facilities for viewing, staying, and resting at local nodes. In this way, the waterscape is transformed from a purely visual

resource into a public space that is accessible, usable for staying, and open to participation, thereby improving both the scenic quality and the everyday use value of the waterfront space.



a) Optimization of street-edge spaces b) Optimization of waterfront-edge spaces

Figure6-13 Interface optimization strategy

(Source: Drawn by the author)

In the treatment of important nodes, the eastern node is organized as an arc-shaped stepped stand to accommodate gathering and activities, thereby strengthening the crowd-carrying capacity of this area. It also forms a spatial response to the central waterside street section and helps extend overall vitality toward the middle section. In the central waterside street section, staying platforms and activity spaces are arranged in response to the shoreline form, so that both circulation and staying functions can be accommodated. In the western entrance area, local space expansion and path guidance are used to form a buffer entrance space facing the urban road, allowing external pedestrian flow to be incorporated more clearly into the internal circulation system of the district through a more legible opening and visual guidance. At the same time, in response to the plaza spaces identified earlier as having favorable sunshine conditions but insufficient use efficiency, the scheme seeks to activate them through measures such as space release and the supplementation of facilities.



Figure6-14 Plaza nodes in the district
(Source: Drawn by the author)

The district's public space can be divided into four main functional zones. The central water-street zone is mainly characterized by the combination of open commercial uses and community-based everyday activities. Its building masses are relatively regular and its street scale is appropriate, allowing it to accommodate staying, social interaction, and light consumption while ensuring circulation. Through the flexible arrangement of community activities and outdoor commercial extensions, this zone becomes the core area of the district's everyday use. The eastern zone organizes a multilayer public activity system by making use of rooftops and level differences. With its relatively large spatial scale and good accessibility, this area is suitable for pedestrian concentration and the superposition of multiple activities, including parent–child activities, leisure stays, small exhibitions, and festive uses, thereby achieving greater activity redundancy and adaptability across time periods. The western water-street zone relies on a continuous commercial interface to form a linear commercial street. By combining waterfront landscape with staying points, it enhances strolling continuity and spatial attraction, supporting mixed uses such as light dining, convenience retail, and everyday leisure. At the far western end, the bunker and the western plaza together form a cultural leisure zone. Centered on the combination of a historic node and an open plaza, this

area undertakes both cultural experience and public leisure. Through the overlap of open activity spaces and surrounding everyday use, historical visits and residents' daily life are integrated into the same public space, thereby creating a scene of public life with local memory.

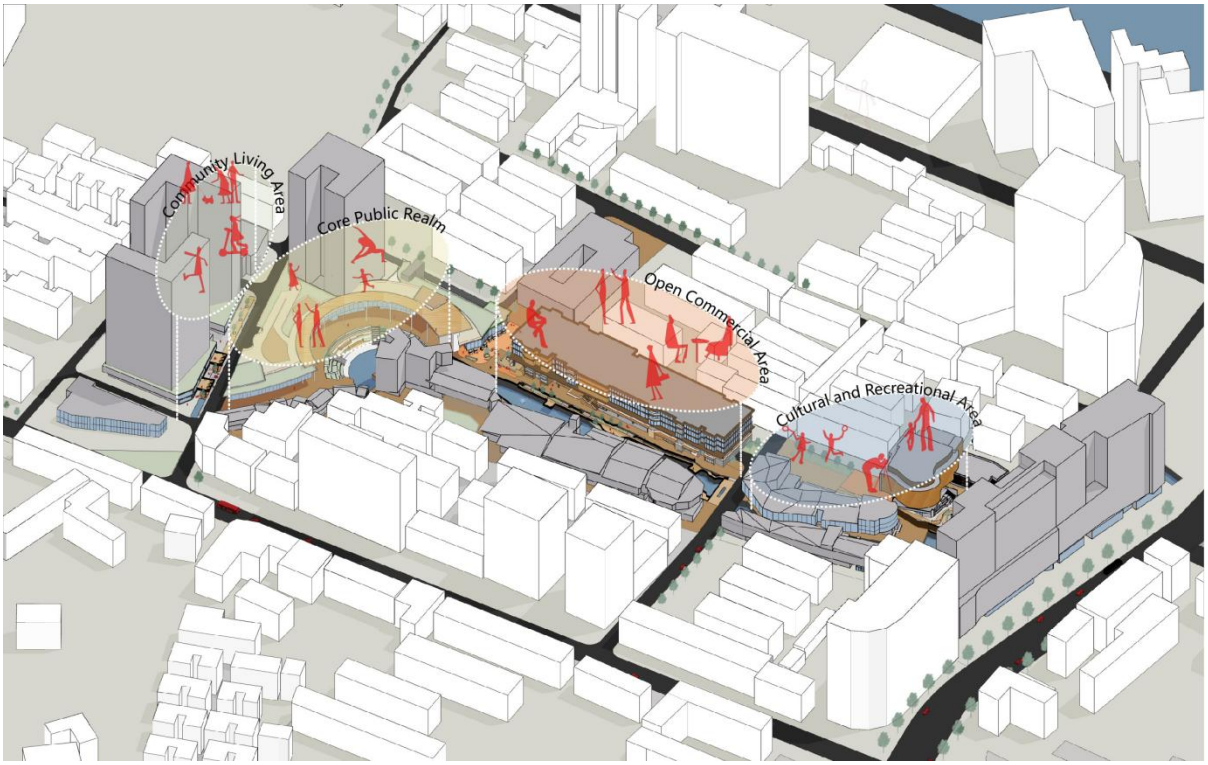


Figure6-15 Functional zoning of the district
(Source: Drawn by the author)

At the level of specific practice, this study selects six representative spatial nodes in the district as renewal examples. These address different types of problems, including improvement of waterfront interfaces, nodalization of linear water streets, expansion of activity spaces, integration of vehicular interfaces, and guidance by historical nodes. Through node-level spatial design and scene building, they demonstrate how the strategies can be implemented. Specifically, the examples include the central waterfront walkway node and the commercial interface node of the inner corridor on its south side, which aim to strengthen waterfront experience and improve coordination between the commercial interface and public space; the renovation of the scenic stair at a key node in the inner corridor, which expands the staying and activity attributes of vertical space; the western covered water-street node, which improves the compressed linear passage space through pocket-sized staying platforms and interface activation; the eastern street-space node and the central plaza node, which increase

overall vitality by improving staying facilities and enhancing flexibility between daytime and nighttime activities; and the western bunker plaza node, which overlaps historical visits with residents' everyday use through path guidance and cultural expression, thereby increasing the district's cultural attractiveness.

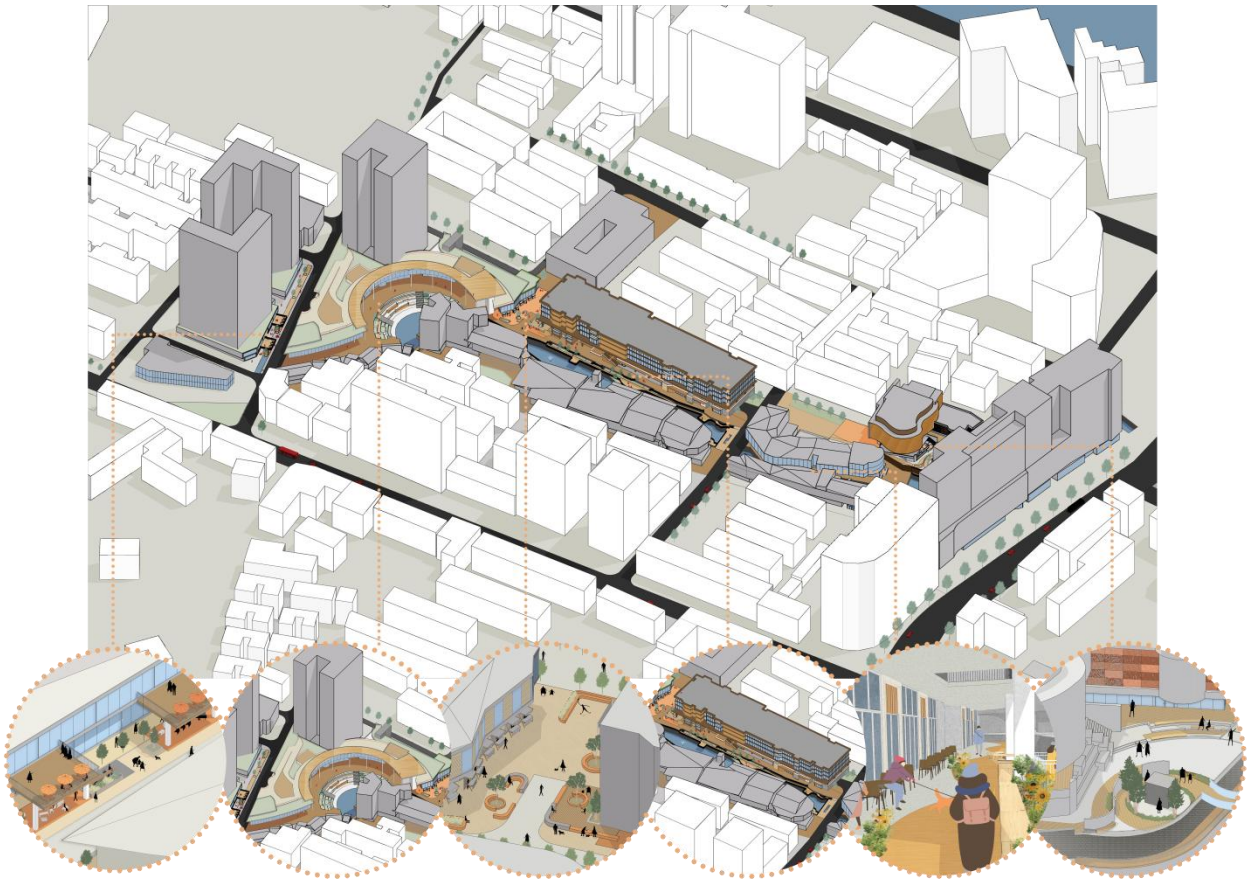


Figure6-16 Node distribution
(Source: Drawn by the author)

6.4.2 Activation of landscape conditions and use of commercial interfaces

The overall waterfront space of the district has relatively weak waterfront accessibility. On the one hand, the street is relatively wide, while the water surface is narrow and set at a lower elevation, which limits the visible range of the water body within the street space. On the other hand, the existing segments with relatively high waterfront accessibility do not have a continuous pedestrian system, making it difficult to form a sustained waterfront activity experience.

(1) Central waterfront walkway node

A node in the middle section of the district with relatively favorable waterfront conditions was selected as the design object. Originally, this area contained a short descending walkway, and it also formed a certain visual relationship with the elevated tower on the opposite bank, giving it a relatively good landscape basis. At the same time, the south side of the street consists of an inner-corridor commercial street with commercial uses arranged on both sides, and the overall pedestrian continuity is relatively good.



Figure6-17 Existing view of the waterfront node
(Source: Photographed by the author)

For the treatment of the waterfront interface, the original embankment is transformed into a stepped water-friendly revetment. While meeting safety requirements, this intervention strengthens interaction between people and water and improves the visual relationship between the pedestrian space and the water body, enabling the pedestrian route at the higher elevation to perceive the waterfront landscape more effectively. First, the water-friendly walkway is extended toward both the east and west sides to build a continuous waterfront slow-traffic system, thereby creating an organic connection between the waterfront space and the overall pedestrian network of the district and improving accessibility and continuity of use. Second, in selected parts of the waterfront space, green belts and small-scale public activity spaces are introduced to moderately enlarge the node and form waterfront staying platforms, allowing users to approach the water more closely and generate stable staying activities.

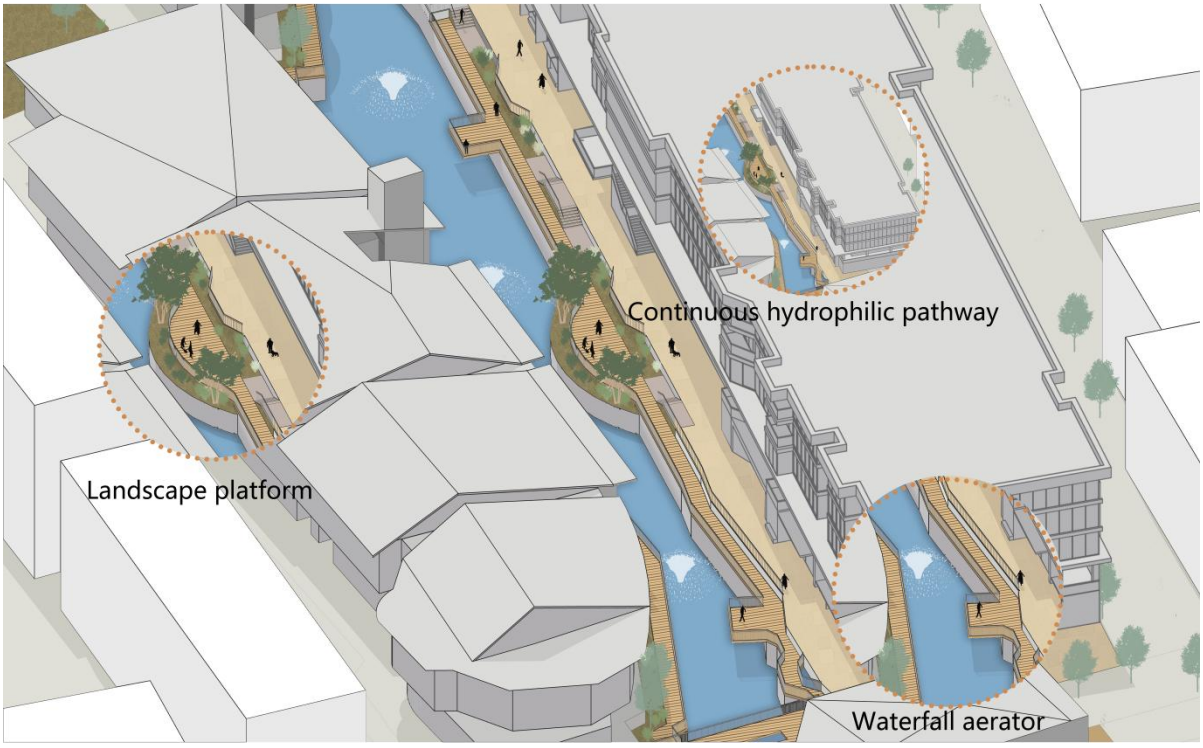


Figure6-18 Schematic transformation of the waterfront node
(Source: Drawn by the author)

For the commercial interface on the south side of the street, the column grid is moderately opened up at the level of spatial structure to form a more open interface pattern and improve accessibility and permeability. Through moderate concave–convex changes in plan and differentiation of entrance hierarchy, a transitional space from outdoor to indoor is created. While strengthening interface recognizability, this also provides a buffer interface for staying and activities, thereby enabling coordinated use between the commercial interface and public space. The plan layout adopts a flexible approach. Light intervention elements such as movable partition walls are introduced to enhance the flexibility of space use, allowing the area to function as community public activity space even before all commercial units are occupied.



Figure6-19 Elevation of the commercial interface on the south side of the node
(Source: Drawn by the author)

On this basis, key nodes within the inner-corridor space are further strengthened. The original scenic stair mainly served vertical circulation, and its mode of use was relatively single, making it difficult to form effective spaces for staying and activities. By enlarging the scale of the stair and reconstructing the interface, it is transformed into a stepped activity space that combines circulation and staying, thereby providing a continuous staying interface while still satisfying vertical movement needs.

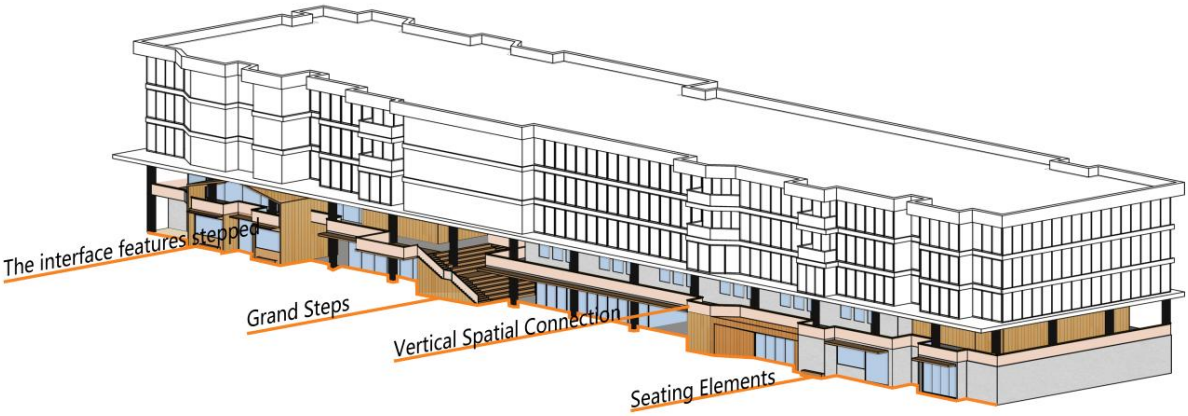


Figure6-20 Renovation of the commercial interface on the south side of the node
(Source: Drawn by the author)

(2) Western water-street space

Although the western water-street space has a sound structural basis, its latent vitality has not been effectively translated into actual use because of interface form and environmental constraints. This area is a linear space with a commercial interface on one side and a waterfront interface on the other, and the street width is about 4 m. Influenced by semi-enclosed spaces formed by building projections and the continuous colonnade structure, the space appears constrained in scale and closed in interface, with poor visual permeability and weak staying conditions. Its overall atmosphere is therefore relatively oppressive. As a result, it mainly serves circulation and lacks activity interfaces that support staying and communication, while the waterfront landscape resources have not been effectively utilized.



Figure6-21 Existing view of the covered western water-street node
(Source: Photographed by the author)

The renewal strategy takes nodalization of linear space as its core. By embedding pocket-sized staying nodes and waterfront activity interfaces into the continuous corridor, the original single circulation attribute is broken, allowing the space to maintain circulation continuity while also gaining the possibility of staying and use.

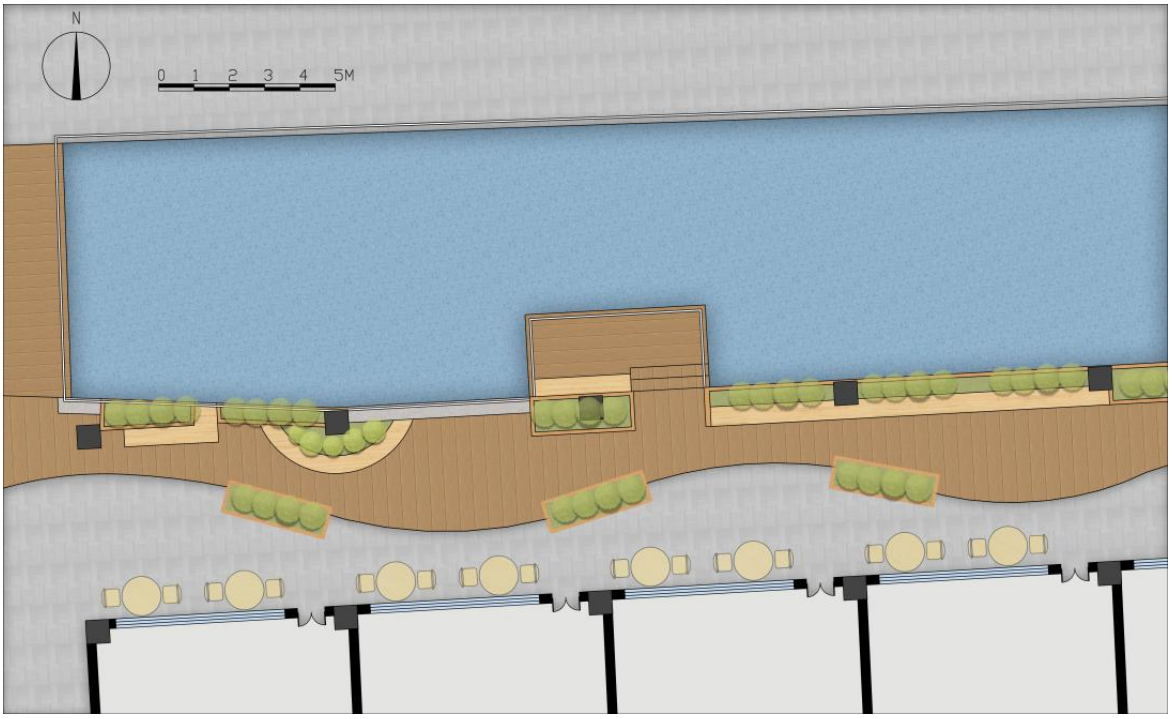


Figure6-22 Renovation plan of the covered western water-street node
(Source: Drawn by the author)

At the level of spatial organization, the interface on the waterfront side is partially expanded and equipped with continuous viewing seats and staying platforms, enabling users to approach the water naturally while walking and form staying behavior, thereby strengthening participation in the waterfront space and enhancing the landscape experience.

At the level of interface optimization, the openness and everyday atmosphere of the space are enhanced through activation of the commercial interface and colonnade space. On the one hand, outdoor extensions, display interfaces, and greenery are introduced along the commercial facade to improve permeability and interaction. On the other hand, seating, planters, and other small-scale facilities are rhythmically arranged in combination with the colonnade structure, thereby forming a continuous system of staying nodes and gradually transforming the originally closed and oppressive corridor of passage into a composite street space that combines movement, rest, and social interaction.



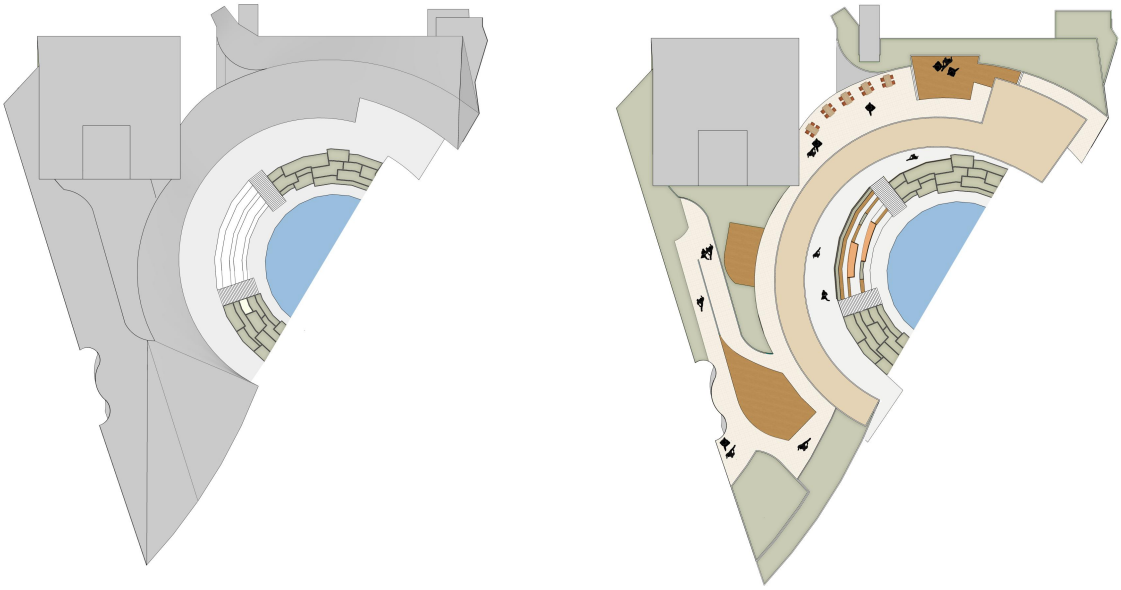
Figure6-23 Schematic transformation of the covered western water-street node
(Source: Drawn by the author)

6.4.3 Expansion of activity spaces and optimization of facilities

(1) Eastern street-space node

The eastern street space is composed of residential towers, commercial interfaces, and street space, and it is an important activity node of the district. This area has good local integration and sunshine conditions, and everyday staying activities such as sunbathing by

residents can already be observed there, indicating a certain basis for vitality. However, the current space still has deficiencies in staying facilities and spatial organization, which limit its further development into a stable activity space.



a) Plan before renovation

b) Plan after renovation

Figure6-24 Schematic plans before and after renovation
(Source: Drawn by the author)

On this basis, the strategy reuses the transitional space between the residential towers and the commercial podium, building a hierarchical transition from residential space to semi-public leisure space and then to open public space. In combination with the introduction of shading facilities, this improves the space's ability to respond to seasonal use needs and further strengthens the efficiency with which environmental resources are utilized.

To address the problems of large level differences and a single seating form in the waterfront stepped space, the original stepped form is retained while local widening is introduced to create staying nodes. The paving material is also optimized so that the space can accommodate social activities, thereby transforming it from a place of simple staying into one of communication and interaction.

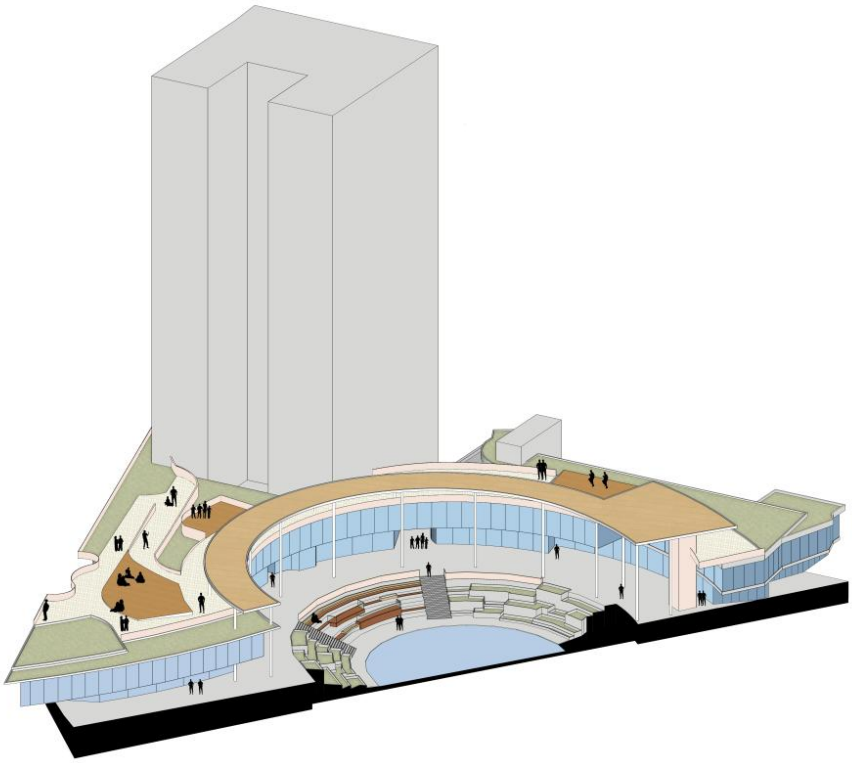


Figure6-25 Bird's-eye view of the renovation of the eastern street-space node
(Source: Drawn by the author)

(2) Central plaza node

The central plaza area also has relatively high local integration and is an important location where pedestrian flows converge in the district. At the same time, because of favorable sunshine conditions, spontaneous activities such as sunbathing and temporary staying often occur there. However, the spatial organization remains relatively loose, and vitality has not yet formed into a stable node.

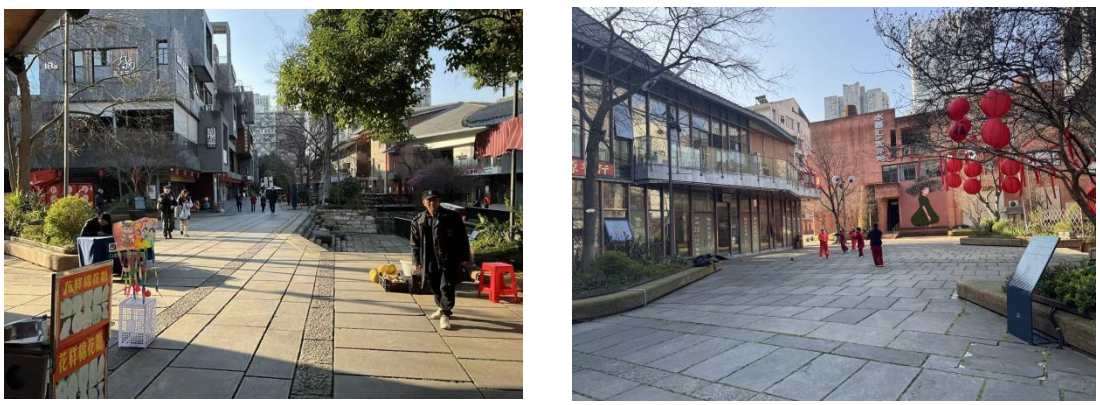


Figure6-26 Existing view of the central node
(Source: Photographed by the author)

The renewal integrates two originally independent spaces into one overall activity area by strengthening the spatial connection between this node and the plaza to the south. At present, the two spaces form a T-shaped relationship, but the junction lacks transition and guidance. The design therefore weakens the right-angled boundary and optimizes paving and spatial organization so that pedestrian flow can naturally move into the plaza, creating a more coherent spatial experience.

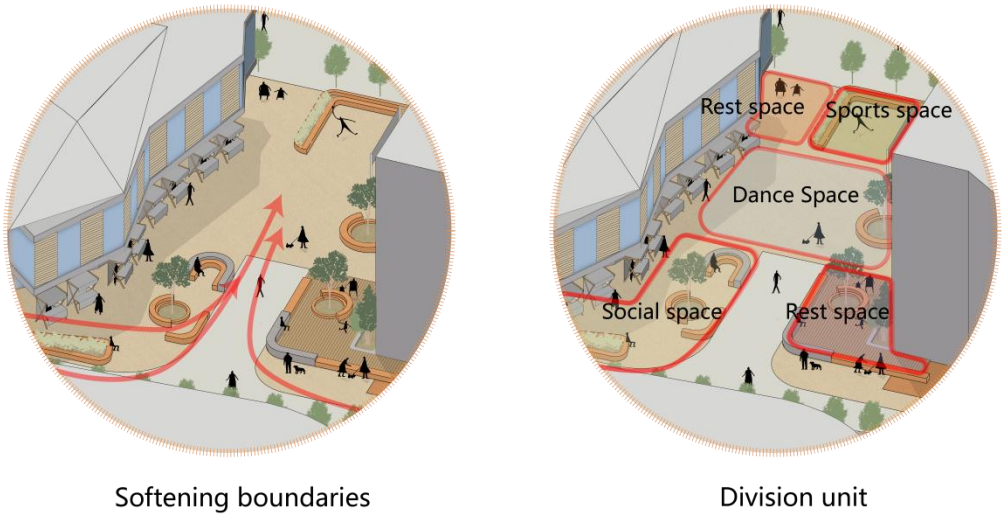


Figure6-27 Renovation strategy for the central node
(Source: Drawn by the author)

At the level of spatial organization, paving areas and building-edge spaces are redivided so that part of the edge area is transformed into staying space with a sense of enclosure. At the same time, the originally large plaza is subdivided into multiple smaller spatial units in order to accommodate different types of public activities.



Figure6-28 Schematic transformation of the central node
(Source: Drawn by the author)

At the functional level, this node can accommodate residents' communication and resting activities during the day, while at night it can be transformed into a space for small-scale sports or public activities, thereby forming a composite public space with temporal flexibility. At the same time, through moderate functional replacement of surrounding buildings and the introduction of convenience service facilities, its role as the district's core node can be further strengthened, helping to generate more stable activity paths within the district.

6.4.4 Integration and activation of vehicular interfaces

As an important entry space to the district, the eastern entrance carries relatively concentrated everyday passing-through flows. However, because pedestrian space is limited and staying facilities are insufficient, while the vehicular roadway and commercial interface on the right side have not yet been activated and landscape conditions are weak, people mainly pass through the space, with relatively little staying and activity.

In response, the renewal strategy takes overall optimization of the street space as its core. By moderately compressing the vehicular space and widening the pedestrian areas on both sides, public activity space can be released and the pedestrian environment improved. At the

same time, by constructing a composite section of bicycle lane, leisure space, and pedestrian space, a buffer is formed against vehicle movement, reducing the disturbance of traffic to pedestrian activity and thereby improving the capacity of the space to support staying.

At the level of spatial organization, the original linear walkway is segmented and functionally integrated. Through the insertion of resting facilities and landscape elements, multilayered spatial units for activity are created, enhancing both staying attributes and richness of use. At the same time, pedestrian routes are guided and defined through continuous green belts, paving changes, and low landscape elements, strengthening the recognizability of pedestrian movement lines at both the visual and spatial levels and weakening, to a certain extent, the interference of the carriageway with pedestrian activities.

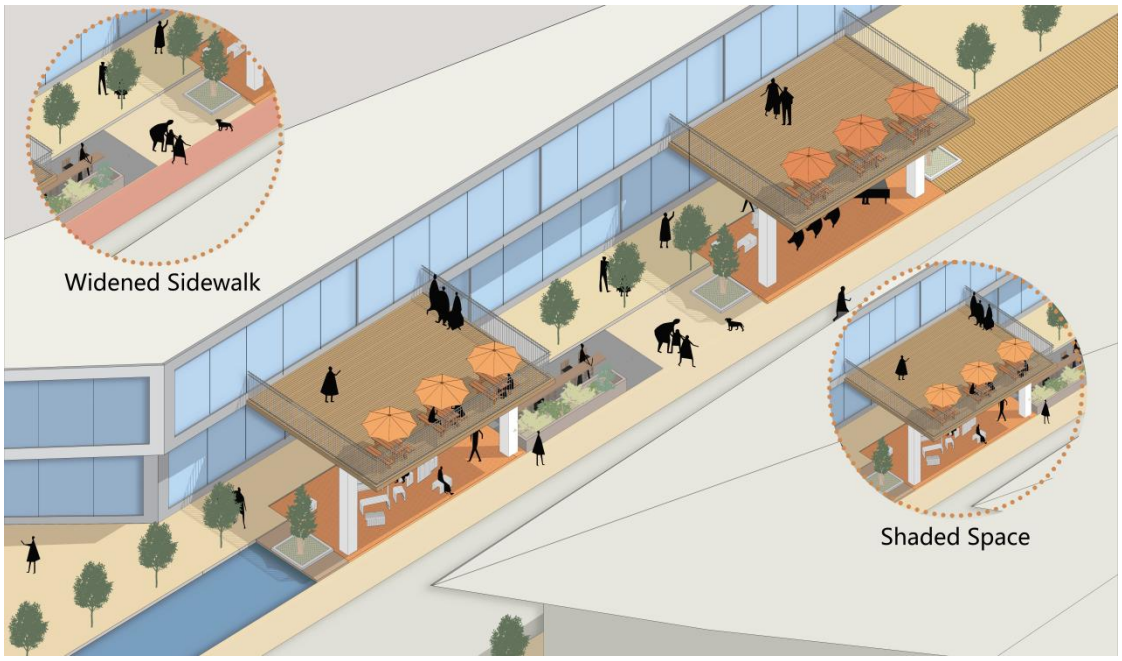


Figure6-29 Schematic renovation of the eastern entrance node
(Source: Drawn by the author)

6.4.5 Organization of everyday activity spaces guided by landscape nodes

The bunker plaza node is located on the west side of the district and occupies a relatively marginal position in the overall spatial structure. It is weakly connected to the main activity paths in the central part of the district, and its accessibility is relatively insufficient. Although cultural facilities such as the Sixian Theatre and the bookstore are distributed nearby, together with a plaza of a certain size that provides basic conditions for everyday communication and

activity, the area has not yet formed a stable node of pedestrian concentration and activities because path guidance is inadequate.



Figure6-30 Existing view of the bunker node
(Source: Photographed by the author)

The renewal aims to enhance the vitality potential of this node by strengthening spatial connections and everyday use through path organization and node optimization. First, a curved pedestrian path is introduced to link the spaces on the east and west sides of the bunker. While improving spatial connectivity, this guides pedestrian flow into the node area and addresses its lack of accessibility. The path creates a continuous walking experience in space, gradually transforming the bunker node from a marginal space into an activity node that can be perceived and participated in.

Within the node, paving changes and spatial definition are used to strengthen its staying attributes. In combination with resting facilities in the plaza, this provides conditions for residents' everyday communication and short stays, thereby transforming the area from a single scenic display space into a public activity space that also supports everyday use. In addition, the position of the bunker is emphasized through paving changes, and display facilities are arranged around the node to provide users with opportunities to stay and learn about historical information, thereby reinforcing both staying attributes and cultural perception.

At the level of landscape expression, historical traces such as the bunker bullet holes are abstractly translated and incorporated into the design of the architectural interface, allowing historical elements to participate in the everyday spatial experience in a more perceptible way. In this way, cultural expression and spatial recognizability can be strengthened without weakening everyday use.

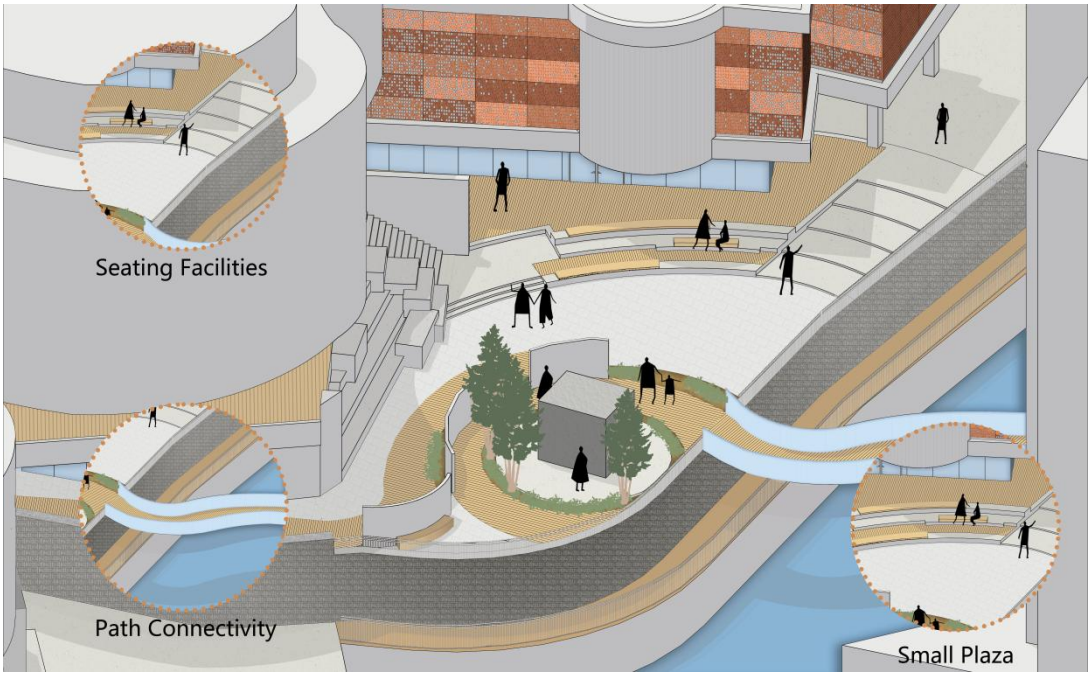


Figure6-31 Schematic transformation of the bunker plaza node
(Source: Drawn by the author)

6.5 Summary of This Chapter

Through the comprehensive analysis of the built environment and public activities in Chapter 5, the main problems of the Laoximen District were identified in terms of spatial structure, interface conditions, and the use environment. On this basis, the present chapter translates those analytical conclusions into spatial responses and constructs a renewal system that progresses from principles to strategies and then to node design, all centered on everyday use.

At the principle level, this chapter proposes renewal orientations in five aspects, namely coordination between everyday use and commerce, optimization of staying conditions, adaptation to user groups, prioritization of climatic suitability, and activation of landscape resources. It emphasizes improving the district's capacity, through public space, to support

everyday behaviors such as passing through, resting, social interaction, and collective activities, while gradually enhancing place attractiveness and external accessibility on this basis.

At the strategy level, this chapter develops approaches of optimizing spatial interfaces and scale, releasing space and optimizing paths, inserting facilities and improving the staying environment, and enabling flexible use and temporary activation, thereby forming an overall spatial organization framework for the district. The overall strategy takes improvement of district connectivity and public space quality as its main line. It organizes a continuous waterfront slow-traffic route along the moat and links it with north–south passages, thereby strengthening pedestrian connections between the district and surrounding residential areas. At the same time, spatial enlargement and guidance are used at key entrances and nodes to enhance gathering and staying capacity. The district's public space is further summarized into four functional zones, corresponding respectively to the composite zone of open commerce and community activities in the central water street, the eastern zone of multilayer public activity systems, the western zone of linear water-street commercial interfaces, and the cultural leisure zone formed by the bunker and the plaza at the western end. In this way, a composite use structure for multiple time periods and multiple user groups is formed.

At the node-implementation level, this chapter selects six representative spatial nodes as renewal examples. Through differentiated treatment of different spatial types, the strategic requirements are translated into operable spatial organization and activity scenes.

Conclusion and Prospects

This study takes the Laoximen District in Changde as a case study and examines the formation mechanism and optimization path of public space vitality in characteristic commercial districts in Small and Medium-sized Cities with the features of community-based everyday use. It develops a relatively complete research framework across three levels, namely theoretical framework, empirical analysis, and renewal strategies. The main conclusions are as follows.

(1) District vitality is mainly dominated by residents' everyday use and shows a spatial pattern characterized by both linear waterfront distribution and node-based concentration.

Based on multi-period behavioral observation and kernel density analysis, the vitality of public space in the Laoximen District is mainly supported by the everyday activities of surrounding middle-aged and elderly residents. Walking, sitting, talking, and dancing are the most frequent activity types, while sightseeing and viewing activities are relatively limited. In spatial terms, vitality generally extends in a linear pattern along the waterfront interface of the moat and forms local hotspots in the western square, the central node, and the eastern street space. This indicates that, at the level of actual use, the district has already shown typical characteristics of a Community Commercial Street District. Its vitality foundation does not primarily rely on commercial consumption, but is more strongly supported by residents' frequent and continuous everyday use.

(2) The influence mechanism of the built environment on district vitality is mainly centered on accessibility, staying conditions, and microclimatic conditions.

The study constructs a built environment indicator system comprising 13 indicators from four dimensions, namely spatial structure, functional supply, environmental conditions, and staying facilities, and identifies four significant influencing factors through multiple linear regression. Local integration is the most significant variable and shapes the basic pattern of pedestrian flow distribution. However, high integration does not necessarily lead to high vitality, as inadequate interface conditions and insufficient staying support may prevent accessibility advantages from being transformed into activity concentration. Seating density has a direct promoting effect on staying and social interaction, but if the form, material, and

layout of facilities do not match actual use needs, an increase in quantity alone is insufficient to generate stable staying behavior. The significance of sunshine duration and shade coverage ratio reflects the influence of microclimatic conditions on spatial choice under the winter observation background. These two factors correspond to daytime and nighttime use preferences respectively and constitute important environmental support for outdoor activities.

(3) The district faces five major spatial problems, which constrain the release of its vitality potential.

Based on the comparison of hotspot areas and the analysis of spatial characteristics, the main problems of the district can be summarized into five aspects: highly accessible spaces lack staying support, microclimatic resources are mismatched with patterns of use organization, facility provision does not match behavioral needs, commercial interfaces are continuous but enclosed, and landscape resources are difficult to transform into actual staying and use. The common feature of these problems is that, although the district possesses a certain foundation of spatial resources, there are still multiple mismatches between material environmental conditions and everyday use needs. As a result, some spaces with potential are unable to form stable concentrations of activity.

(4) Taking small-scale and incremental intervention as the main path, the study develops a public space optimization system oriented toward everyday use.

In response to the above problems, the study proposes five renewal principles, namely coordination between everyday use and commercial activities, optimization of staying conditions, adaptation to user groups, priority to climate suitability, and activation of landscape resources. It further develops four types of strategic responses, including interface and scale optimization, space release and path optimization, facility implantation and staying environment optimization, and flexible use and temporary activation. At the level of typical nodes, the study demonstrates how these strategies can be applied to different spatial types through the spatial translation of six nodes, including the waterfront walkway, the covered waterside street, the eastern street space, the central square, the eastern entrance, and the bunker square. The study shows that vitality enhancement in Community Commercial Street

Districts in Small and Medium-sized Cities depends more on the refined adjustment and continuous optimization of existing spatial conditions than on large-scale reconstruction.

This study still has several limitations that need to be addressed in future research. At the data level, behavioral observation was concentrated in the winter period from December 2025 to January 2026, and both the temporal and seasonal coverage were limited. The significance of sunshine duration and shade coverage ratio in the regression analysis is closely related to the winter background. If the analysis were extended to summer or transitional seasons, the direction and strength of these factors might change, and the seasonal representativeness of the conclusions still needs to be verified. At the level of the indicator system, the study constructs its framework mainly around built environment factors and pays insufficient attention to non-material factors such as commercial operation status, spatial management mechanisms, and users' subjective perceptions, which creates certain explanatory boundaries. At the case level, the study focuses on the Laoximen District as a single case. Its waterfront interface, historical remains, and climatic conditions are relatively distinctive, and the applicability of the conclusions and strategies to other types of districts still needs to be tested through cross-case comparison. At the level of research perspective, the study mainly relies on observation and spatial analysis, while giving limited attention to users' subjective experience, emotional identity, and sense of community belonging. If interviews and participatory observation were introduced, the generation mechanism of everyday use and place meaning could be interpreted more comprehensively.

Future research may be further developed in the following directions. At the methodological level, continuous multi-season recording may be introduced to obtain vitality dynamics over a longer time span, thereby improving the explanation of temporal changes in vitality. At the level of research objects, comparative studies may be conducted on multiple Community Commercial Street Districts in Small and Medium-sized Cities under different climatic regions, city scales, and development backgrounds, so as to test the broader applicability of the conclusions and identify the differentiated effects of built environment factors under different contexts. At the level of analytical framework, community operation modes, resident participation mechanisms, and district governance approaches may be further incorporated into the research to support a more systematic understanding of the conditions

for the sustained formation of district vitality. At the level of implementation evaluation, future studies may establish continuous monitoring indicators such as pedestrian flow, number of people staying, average staying duration, and user satisfaction, so as to assess the actual effects of renewal strategies on the improvement of public space vitality and provide a more practical basis for the renewal of characteristic commercial districts in Small and Medium-sized Cities.

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攻读硕士学位期间取得的研究成果

一、已发表（包括已接受待发表）的论文，以及已投稿、或已成文打算投稿、或拟成文投稿的论文情况**（只填写与学位论文内容相关的部分）：**

序号	作者（全体作者，按顺序排列）	题　　目	发表或投稿刊物名称、级别	发表的卷期、年月、页码	与学位论文哪一部分（章、节）相关	被索引收录情况

注：在“发表的卷期、年月、页码”栏：
1 如果论文已发表，请填写发表的卷期、年月、页码；
2 如果论文已被接受，填写将要发表的卷期、年月；
3 以上都不是，请据实填写“已投稿”，“拟投稿”。
不够请另加页。

二、与学位内容相关的其它成果（包括专利、著作、获奖项目等）

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The completion of this thesis marks both the end of one stage and the beginning of another. In the future, I will continue to carry forward the knowledge and experience gained during this period, and keep exploring the relationship between cities, public space, and everyday life.

四、答辩委员会决议书

答辩委员会对学位（毕业）论文的评语（主要内容包括：1.论文选题与综述；2.学术水平与创新性；3.论文综合能力表现；4.学位（毕业）论文答辩情况；5.存在的不足之处和建议等）

论文围绕中小城市社区型商业街区公共空间活力问题展开研究，选题具有一定的现实意义。论文结合行为观察、建成环境量化分析和回归分析提出了影响街区活力的主要因素，并提出了相应的空间优化策略。

论文结构完整，文献梳理较系统，研究方法基本合理，达到硕士学位论文要求。答辩过程中，作者能够较清晰地陈述论文主要内容。

根据投票结果，答辩委员会一致同意莫欣嘉通过硕士学位论文答辩，同意其毕业，并建议授予建筑学硕士学位。

论文答辩日期：2026年5月22日　　答辩委员会委员5人

毕业表决票数：通过（5）票；不通过（0）票

学位表决票数：通过（5）票；不通过（0）票

答辩委员会决议（打“√”）：

毕业：通过（√）；不通过（　）

学位：通过（√）；不通过（　）

答辩成员签名	（主席）　　Mauro Berta（外文名）
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