# Evaluation and Restoration Method of Old Urban Area in Small and Medium-sized Cities of Zhejiang Province Based on "Grey Relational Analysis":

# In the Case of Qinyang Area in Quzhou City

A Dissertation Submitted for the Degree of Master

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# Abstract

China's urbanization has entered the era of stock, and Urban Restoration has become an important means to promote the high-quality development of cities. In this context, this paper discusses the problems and Restoration methods of urban old area renewal in small and medium-sized cities in Zhejiang based on grey relational analysis. This paper selects several small and medium-sized urban renewal projects in Zhejiang Province as cases, and through grey relational analysis model, quantitatively evaluates the key influencing factors in urban old area renewal, and reveals the internal logic and action mechanism of urban old area renewal. The study finds that urban old area Restoration is not only a change of physical space, but also a complex feedback process on human behavioral patterns and social activities.

The study reviews academic research on Urban Restoration, focuses on studies related to urban old area renewal, and introduces the grey relational analysis model as a quantitative tool. By combing the current situation of old districts in Zhejiang, the problems existing in the context of Urban Restoration are analyzed. Subsequently, a model for Urban Restoration of old urban areas based on grey relational analysis was established, and through data analysis of several Zhejiang Province small and medium-sized cities' renewal cases, the renewal focuses for creating old areas in small and medium-sized cities in Zhejiang Province were put forward, and the technical paths and renewal standards were identified for urban renewal projects in other small and medium-sized cities in Zhejiang Province. The study proposes that the urban old area renewal in small and medium-sized cities in Zhejiang Province needs to take into account the coordinated development of environmental repair, functional optimization, social and cultural values and economic benefits. Grey Relational Analysis is an effective tool for quantifying the correlation of multiple factors in a complex system, which provides a scientific and quantitative assessment method for urban old area renewal, and helps decision makers to identify the key influencing factors, Optimize resource allocation, and enhance the science and effectiveness of the Restoration strategy. As a typical representative of small and medium-sized urban old areas in Zhejiang, Qinyang Area demonstrates the feasibility of applying the theory to actual Restoration

projects, provides a reference template for urban Restoration in other areas, and at the same time reduces the cost of urban Restoration routes and provides new solution ideas.

The research results show that the urban old area Restoration method based on grey relational analysis can effectively sort out the main conflicts in urban old area Restoration, so as to put forward effective and accurate Restoration methods, thus improving the quality of life of urban residents and promoting the sustainable development of the city. This study provides new perspectives and methods for urban old area Restoration in small and medium-sized cities in Zhejiang Province, innovatively applies the grey relational analysis model to the field of small and medium-sized cities' old area Restoration, expands the scope of application of quantitative assessment tools, and provides theoretical references and practical paths for stock renewal in other small and medium-sized cities.

**Keyword:** Small And Medium-Sized Cities; Old Urban Area; Urban Restoration; grey Relation.

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# Chapter 1: Introduction

## 1.1 Background

### 1.1.1 Zhejiang enters regular restoration

With the new normal of economic development, China's urban construction has gradually shifted from incremental development to a new model of urban development based on stock restoration. The development and construction of the city gradually get rid of the big open and big construction, and rapidly change to the development mode to improve the urban ecology and improve the spatial quality of human habitat, these evaluation indexes have become an important basis and standard for the level of urban management. [1] From the economic point of view, China's economic boom gradually from the coastal wave inland, large cities expand to small cities, driving the rapid economic and social development of small and medium-sized cities throughout the country.

In the era of inventory, Zhejiang's urbanization rate has slowed down as Table 1-1 Shows. Zhejiang Province took the lead in introducing a series of initiatives for the restoration of old cities.2020 mentioned the need to promote the construction of characteristic areas and future communities, innovate construction and operation modes, and strengthen the organic restoration of cities and the transformation and upgrading of housing stock.2022 Zhejiang Province added supplements to the content of urban restoration, adding ecologically weakened areas and the restoration of old infrastructure systems, which made the scope of Zhejiang Province's restoration wider and more comprehensive.2023 Zhejiang Province added a series of initiatives for the restoration of small and medium-sized cities. more comprehensive.2023 Hangzhou's implementation opinion on comprehensively promoting urban urban restoration put forward the need to strictly control large-scale demolition and construction, and encourage micro-remodeling to become an important principle of urban restoration at this stage, to create a number of replicable and popularized pilot projects of urban restoration.[2] As of 2023, Zhejiang Province has more than 5,000 real-time restoration projects, and in 2024, Zhejiang will start a new renovation of 450 old neighborhoods and 4,200 buildings. [3]

| Year | Total Population (10K) | Urbanization Rate（%） | Urban Population （10K） | Rural Population （10K） | Natural Growth Rate（‰） | Aged 65+ （%） | Migrant Population （%） |
|------|------|------|------|------|------|------|------|
| 1995 | 4319 | 32 | 1382 | 2937 | 6 | 7 | 5 |
| 2000 | 4677 | 39 | 1824 | 2853 | 4 | 9 | 10 |
| 2005 | 4898 | 46 | 2253 | 2645 | 3 | 10 | 15 |
| 2010 | 5443 | 61 | 3320 | 2123 | 2 | 11 | 20 |
| 2015 | 5539 | 65 | 3600 | 1939 | 1 | 12 | 22 |
| 2020 | 6457 | 72 | 4649 | 1808 | 0 | 14 | 25 |
| 2022 | 6577 | 73.5 | 4834 | 1743 | -0.5 | 16 | 23 |

Table 1-1 Data on population change in Zhejiang

Source：Reference[6]

With the rapid development of urbanization, the spatial structure and layout of cities are constantly changing to meet the requirements of The Times. The old urban area is not only a place for urban residents to conduct public activities and socialize, but also serves all urban residents together. It is also a place for urban residents to communicate with the city and nature, and an important manifestation venue of the city [4].

Due to economic development, small and medium-sized cities in Zhejiang are in a period of rapid spatial structure adjustment, which is also an opportunity for the old urban areas to play a strategic role at the macro level nowadays [5]. In 1978, Zhejiang Province's GDP was only 12.4 billion yuan. By 2024, its GDP had reached 9,013.1 billion yuan. The per capita GDP had increased 400 times, from 332 yuan to 135,900 yuan. The per capita disposable income has consistently ranked first in the province, reaching as high as 67,000 yuan. [6] The quality of life and demands of residents in Zhejiang Province for cities are constantly improving. People are no longer satisfied with the old urban areas of the past, which have single functions and forms and backward supporting facilities. These deficiencies have also driven urban residents to be willing to express their dissatisfaction. People have put forward higher social attributes and demands for cities. The highly private economic feature of Zhejiang Province has led to the continuous decline of many employees who were originally engaged in the primary and secondary industries, creating a social environment where a large number of technical personnel have switched to the tertiary industry. The tertiary industry plays a huge role in promoting urban renewal and enriching the spiritual civilization of urban residents. The demands and development of cities are

also constantly evolving towards diversification. The Zhejiang provincial government strongly supports and encourages small and medium-sized cities to carry out urban renewal. According to statistics, since Zhejiang Province was designated as a socialist common prosperity demonstration zone in 2020, it has driven the launch of a large number of urban renewal projects in small and medium-sized cities in Zhejiang, with the number reaching nearly a thousand each year. With the support of the provincial government, a large number of projects have taken Hangzhou as a demonstration zone. The areas of Lishui, Quzhou and Hangzhou counties have been designated as the assistance zones, and a vigorous urban renewal campaign has been launched.

| Year | GDP （trillion yuan ） | Growth Rate（%） | Population （10K） | GDP per capita (10K yuan/person) |
|---|---|---|---|---|
| 2023 | 8.24 | 6.0 | 6627 | 12.43 |
| 2022 | 7.77 | 3.1 | 6577 | 11.82 |
| 2021 | 7.35 | 8.5 | 6540 | 11.24 |
| 2020 | 6.46 | 3.6 | 6457 | 10.00 |
| 2015 | 4.29 | 8.0 | 5539 | 7.74 |
| 2010 | 2.77 | 11.8 | 5447 | 5.09 |
| 2005 | 1.34 | 12.8 | 4898 | 2.74 |
| 2000 | 0.61 | 11.0 | 4677 | 1.30 |
| 1995 | 0.35 | 16.7 | 4319 | 0.81 |
| 1990 | 0.09 | 5.6 | 4238 | 0.21 |
| 1985 | 0.04 | 14.3 | 3993 | 0.10 |
| 1980 | 0.02 | 12.5 | 3826 | 0.05 |

Table 1-2 Data on economic development in Zhejiang

Source：Reference[6]

## 1.1.2 The problem of urban restoration in Zhejiang

Verify the problem of mismatch [8]. A large number of urban old district Spaces, including squares, parks, streets, etc., have become the core and hotspots of urban renewal projects, as shown in Figure 1-1.

Compared with large cities, small and medium-sized cities are more likely to pursue the urban form, the beautification and image of the city, while neglecting the actual connotation of the city. They have fallen into the vicious circle of the old district space of small and medium-sized cities being "all show and no substance", and have not organically combined the urban area with the entire urban system. This is undoubtedly a waste of urban space [7]. Secondly, in many small and medium-sized

cities, the old areas are ineffectively connected with the actual municipal facilities. Large cities are more prone to developing the infrastructure of the old urban areas. In contrast, in small and medium-sized cities, due to the lack of motivation for the renewal of old urban areas, a large number of supporting facilities have been relocated to new urban areas, resulting in a mismatch between the functions of the old urban areas and the user population [9].

The old districts of small and medium-sized cities are also more likely to intensify various pressures and contradictions in the city and generate new urban problems [10], such as traffic pressure and population aggregation. Furthermore, the renewal of old urban areas in small and medium-sized cities is more likely to damage the original urban environmental system, sever the urban cultural context, cut off the connection of urban Spaces, and also lack regional characteristics and the atmosphere of life culture. This is because the cultural particularity of small and medium-sized cities is relatively weaker, making it difficult to form unique urban culture and urban imprints [11]. This is also a problem that small and medium-sized cities often encounter in their pursuit of economic benefits. Emphasizing the economic and commercial intelligence of the city while neglecting its original cultural attributes will also lead to the gradual disappearance of the city's diversity and multiplicity.



Figure 1-1 Small and medium-sized cities in Zhejiang Province

Source：web

Since urban renewal takes priority in large cities, many cases and methods of urban renewal have been blindly copied by small and medium-sized cities, resulting in the lack of unique and effective urban renewal approaches in these cities. Small and medium-sized cities find it difficult to coordinate mismatched renewal plans, such as large-scale investments, misaligned functional structures, and unmanageable foot traffic.

Finally, the renewal of small and medium-sized cities is often top-down. This renewal model usually depends on decision-makers, and it often has political purposes

and goals. Therefore, the entire project may fall into effective and correct guidance. This model will lead to some problems, such as the disconnection between management operation and construction, as well as the lack of relevant policy guidance. As a result, many projects are out of place and end up causing huge economic losses, and even leading to the uniformity of all cities [12].Therefore, compared with the renewal of larger cities, small and medium-sized cities must shift to "refined governance" [13], replacing standardized templates with local adaptability, so as to retain diverse genes in the process of urbanization.

| Stage | Issue Description | Outcome | Stage |
|---|---|---|---|
| Decision-maker | Strategic goal setting | Political aims formed | Decision-maker |
| Political goal | Political focus | Top-down model | Political goal |
| Top-down model | Administrative reliance, no public input | Guidance lacking | Top-down model |
| Guidance missing | Resource/demand imbalance (65% community demand missing) | Management disconnect | Guidance missing |
| Management disconnected | Planning/construction/operation split (12% operation investment) | Policy gaps | Management disconnected |
| Policy missing | Chaotic standards, tool abuse (>70% mandatory tools) | Low-quality projects | Policy missing |
| Low-quality projects | Spatial/functional chaos | Economic losses | Low-quality projects |
| Economic losses | Fiscal waste (200-300% over budget), asset devaluation, tax base shrinkage | Development hindered | Economic losses |

Table 1-3 Urban restoration policy conduction process

Source：author

Against this background, the author hopes that through the research of this article, the similarities and common problems faced by small and medium-sized cities in Zhejiang can be clarified, and attempts to find a series of strategies that can revitalize the old areas of small and medium-sized cities in Zhejiang, improve their quality, organically integrate into the urban system, and try to find a solution for the sustainable development of the city in the future.

## 1.1.3 Urban Restoration Policy and Financial Background

In the next 20 years, small and medium-sized cities in Zhejiang will become the main battlefield for Zhejiang to enhance the quality of urbanization and

accelerate its progress. [14] Zhejiang Province has actively responded to the national urban renewal policy and issued a series of policy documents, such as the "Opinions of the General Office of the Zhejiang Provincial People's Government on Comprehensively Promoting the Renovation of Old Urban Residential Areas" (Zhejiang Government Office Document No. 62 [2020]) [2]. The Department of Housing and Urban-Rural Development of Zhejiang Province has publicly solicited opinions on the "Guiding Opinions on Comprehensively Implementing Urban Renewal Actions and Promoting High-Quality Development of Urban Construction (Draft for Public Comment)". This indicates that the government attaches great importance to public participation and feedback during the urban renewal process to achieve broader social consensus and support, adhering to the principle of "government guidance and owner subjectivity". Encourage the active participation of property owners.
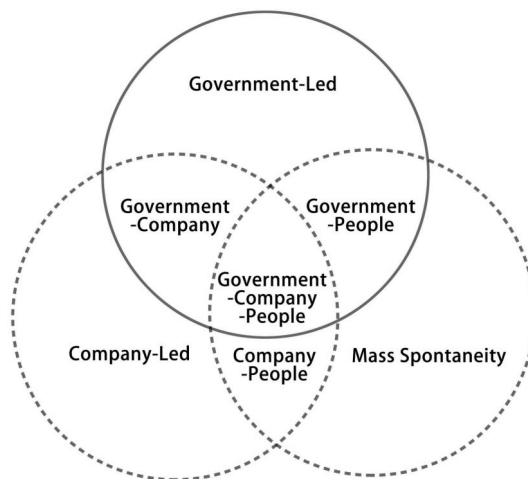


Figure 1-2 The urban restoration model

Source：author

Zhejiang Province has initially established a provincial urban renewal policy system covering planning, assessment, implementation, guarantee and supervision. A total of over 5,000 urban renewal projects have been implemented throughout the province, with a total investment exceeding one trillion yuan, effectively promoting the dual optimization of urban functions and spatial forms [15].

The funds for urban renewal in Zhejiang Province mainly come from:

① Zhejiang Province supports small and medium-sized urban renewal projects through fiscal appropriations, including central government subsidies and central budgetary investment. For instance, in 2021, 2.566 billion yuan was secured for the renovation of old residential areas in small and medium-sized towns.

② Special debts for small and medium-sized cities in Zhejiang Province: Zhejiang Province attracts market entities to participate in project implementation by using special bonds for urban renewal. Through a combined financing form of "fiscal funds + special bond funds + market-oriented financing", it maximizes the cost advantage of special bonds.

③ Policy-based bank loans in small and medium-sized cities provide a financial foundation for urban renewal by using low-interest and public weld-oriented urban construction loans.

④ Participation of social capital: Zhejiang Province encourages market entities to invest funds in the renewal of small and medium-sized cities. Through cooperation forms such as the PPP model, social capital is introduced to enhance the efficiency of renewal and operational value. Zhejiang has a mature PPP operation model, from the Yongqiang Airport in Wenzhou, Zhejiang at the beginning of this century, to the Hangzhou-Shaoxing-Taizhou High-Speed Railway and Hangzhou-Wenzhou High-Speed Railway in recent years [16]. This kind of operation and investment model has strong capital appeal and scalability.

⑤ Urban residents' self-raised funds: The atmosphere and weight of Zhejiang residents' participation in government decision-making are prominent. For instance, the self-renewal model of Zhejiang Industrial New Village mainly relies on residents' self-raised funds.

⑥ Special Funds for Small and Medium-sized Cities, Special Funds for Housing and Urban Construction in Zhejiang Province. The sources of funds for urban renewal in Zhejiang Province are diverse and abundant, providing a solid foundation for the shift of urban construction in Zhejiang Province from increment to stock [17].

| Funding Source | Description | PPP Model Application |
|---|---|---|
| Government Fiscal Funds | Government support via budget arrangements and special funds. | Provides seed funding or subsidies to attract social capital. |
| Social Capital | Investments from non-government entities like businesses and financial institutions. | Core participant in construction, operation, and maintenance of urban restoration projects. |

| Funding Source | Description | PPP Model Application |
|:---:|:---:|:---:|
| Bank Loans | Financing obtained from commercial banks and other financial institutions. | Project financing to reduce capital costs. |
| Bond Issuance | Funds raised through municipal bonds or other financial instruments. | Project revenue bonds issued to support construction and operation. |
| Other Funds | Includes land sale proceeds, tax incentives, etc. | Government provides land use rights and tax breaks to mitigate investment risks for social capital. |

Table 1-4 Sources of funding for the PPP model

Source：author

## 1.2 Research Objects and Basic Concepts

### 1.2.1 Grey relation

Most economic models can carry out relational analysis, such as regression analysis, principal component analysis, etc. However, most economic models require more accurate sample data, higher quality independent variables, and the interdependence of each element. However, the restoration of old urban area is affected by a variety of factors, including economy, region, street aspect ratio, history and other factors, and many factors do not have high-quality relevant data, so the relationship between them is not accurate and fuzzy [18].

Compared with sequence, reference sequence, and grey relational theory, a mathematical analysis method proposed by Professor Deng Julong in China at the end of last century to solve the problem of incomplete information is a method to solve the problem in the case of lack of information. Since it was proposed, it has been widely applied to decision analysis and system modeling in natural science, social economy and other fields [19]. Grey relational does not require a high number of samples, but the calculation logic is clear, which can solve some fuzzy data and logic. The basic mathematical logic of grey relational lies in observing the difference and relational of various elements in the system, and by analyzing the relational of elements, arranging the sequence curves associated with the system for comparison, and then conducting geometric comparison with curves. If the relational degree between curves is greater,

the similarity between curves is higher, and the trend of change is closer to the reference sequence. At the same time, the quality of an object can be evaluated by its relational degree. The greater the relational degree, the better the evaluation object [20]. The weight of the factor can be calculated by the coefficient of variation generated by the grey relational, which can reflect the variation of each coefficient.

## 1.2.2 Small and medium-sized cities in Zhejiang

According to the definition in the "Green Book of Small and Medium-sized Cities" in 2010 and in light of the current situation of the urban population size in China, new standards have been set for the urban population size in China: Cities with a permanent urban population of less than 500,000 are classified as small cities, those with a population of 500,000 to 1 million as medium-sized cities, those with a population of 1 million to 3 million as large cities, those with a population of 3 million to 10 million as megacities, and those with a population of over 10 million as megacities [21].

The "National New-Type Urbanization Plan (2014-2020)" [22] classifies cities into six grades based on the changes in the number and scale of cities. Cities with a population of less than 500,000, 500,000 to 1,000,000, 1,000,000 to 3,000,000, 3,000,000 to 5,000,000, 5,000,000 to 10,000,000, and over 10,000,000. This article refers to small and medium-sized cities in Zhejiang as those with a permanent urban resident population of less than one million, including the urban areas of prefecture-level cities with a permanent resident population of less than one million in Zhejiang, as well as counties and central towns within county-level and above administrative divisions. Secondly, the small and medium-sized cities in this article also include the central urban areas of district-level administrative units in prefecture-level cities that are not connected to the main urban areas, such as Nanxun District of Huzhou City with a population of less than one million, Lin 'an District of Hangzhou City, and the urban area of Zhoushan City, etc. By the end of 2022, Zhejiang Province had a total of 11 prefecture-level cities, 37 municipal districts, 20 county-level cities and 33 counties (one autonomous county). Zhejiang Province has a total of 33 medium and small cities, accounting for 51.6%, slightly lower than the national average of 57.2%, presenting a layout pattern of urban population in Zhejiang: a model of population concentration in Hangzhou, Ningbo and Wenzhou, and population dispersion in county towns [23].

| Population Size | County | County level City | Prefecture level City (Independent Type) | Prefecture level City (Combined Type) |
|---|---|---|---|---|
| Below 100,000 | Qingyuan (79,000), Jingning (92,000), Shengsi (68,000) | None | None | None |
| 100,000 -500,000 | Pan'an (172,000), Taishun (193,000), Wencheng (285,000), Kaihua (256,000), Changshan (221,000), Suichang (169,000), Songyang (184,000), Yunhe (113,000), Daishan (121,000) | Longquan (249,000) | Wenzhou Dongtou (133,000), Zhoushan Putuo (382,000) | Quzhou (Kecheng + Qujiang, 872,000) |
| 500,000 -1,000,000 | Anji (586,000), Xinchang (419,000), Xianju (352,000), Sanmen (338,000), Wuyi (345,000), Jingyun (401,000), Qingtian (503,000), Chun'an (328,000) | Jiangshan (493,000), Jiande (442,000), Lanxi (471,000), Pinghu (671,000), Shaoxing Shangyu (556,000), Yongkang (964,000) | Hangzhou Lin'an (635,000), Lishui Lian (565,000), Ningbo Zhenhai (512,000) | None |

Table 1-5 Classification of Small and Medium-sized Cities in Zhejiang Province

Source：author

## 1.2.3 Old Urban Area

During the rapid development of Chinese cities, the original urban areas are bound to face the limitations of The Times and fail to meet the living and usage needs of modern residents. Their spatial structure, restoration and industrial carrying capacity are bound to decline. Therefore, cities are bound to develop a series of new urban areas to meet the demands of the expansion of the urban population and economic development. In contrast to the new urban area, the original urban area is the old urban area. The old city often refers to the overall city with historical accumulation, while the old urban area focuses on a specific area within it.

old urban area refer to the regions within a city that have been built and developed maturely, but due to various reasons, have not been restoration and transformed in a timely manner, making it difficult to adapt to the city's own development and failing to meet the satisfaction of residents. These areas usually have problems such as aging facilities, poor environmental quality and high building density, which affect the overall image and development of the city. They are regions that need to further improve the material environment, restoration and repair the land use structure and functions, and improve the way of social governance. The old area are often the areas where a city's history accumulates. They are the regions that best record a city's cultural, historical and economic development. Only when the new urban areas and the old area complement and coordinate in function and structure can the overall harmonious development of the city be promoted [24]. From the perspective of the restoration characteristics of different plots, old urban area should be divided into dilapidated areas and historical relic areas, etc. Urban decaying areas are often accompanied by material backwardness, functional decline and structural imbalance. Historical and cultural conservation areas have become key zones for protecting a large number of cultural relics of today. It is a historical protection area, an important cultural relic protection unit and a construction and maintenance section. In this article, the author takes the dilapidated areas as the main object of elaboration. Therefore, the scope of the old urban area mentioned in the article refers to the backward sections, where historical and style blocks have also been built.

The restoration of old urban area often starts from two aspects: The first is to restoration the physical entities within the old areas, such as the reconstruction, reconstruction, functional reconfiguration or comprehensive improvement of

buildings and facilities. Maximize the value of creating wealth with the least material resources, promote urban development, improve the urban environment, and enhance the quality of living, etc. The second is that on the premise of improved infrastructure conditions, attention should be paid to the transformation of the humanistic environment, enhancing residents' sense of happiness, ensuring their social welfare, and preventing the interests of vulnerable groups from being infringed upon.

## 1.3 Purpose and Significance

### 1.3.1 Study Purpose

The old urban area is a comprehensive manifestation of the city's cultural and economic life. During the period of rapid urban development, due to its high-density population, its advantages in economic life are relatively prominent. However, in the new era, the contradiction between their living standards and the development of The Times has become increasingly prominent. Many problems have been left behind, such as the deterioration of the living environment and prominent issues. Small and medium-sized cities in Zhejiang Province are the main components of the urban system in Zhejiang. Compared with large cities, the urban restoration of small and medium-sized cities pays more attention to refinement, locality, capital utilization and social and cultural protection, and has greater promotion and demonstration value. Based on the current background of the continuous advancement of urban restoration, this article delves deeply into the core of old urban areas, focuses on the practical projects of old urban area restoration in small and medium-sized cities in Zhejiang Province, and conducts an in-depth study of a series of urban restoration projects carried out in Zhejiang Province under this background. Pay attention to the current situation of the renovation of old areas in small and medium-sized cities in Zhejiang Province, focus on the problems and deficiencies existing in the renovation, and use the grey relational analysis method to correlate the elements that determine the restoration impact of old areas in small and medium-sized cities in Zhejiang. Through the key factors influencing the urban restoration system, use the grey relational analysis method to study innovative, feasible renovation strategies and methods with Zhejiang characteristics. This article hopes to study the existing successful cases of urban restoration in small and medium-sized cities in Zhejiang, attempt to find the common points of success in these cases, and utilize these common points to activate the vitality of old residential areas in the city, so as to achieve the purpose of repair

the functions and environment of the old area, and thereby construct old urban area with excellent living quality, complete functional facilities and active space.

## 1.3.2 Study Significance

At present, there are only a series of practical projects for "grey relational analysis", and its integration with urban systems is mostly reflected in the overall system, such as transportation, industry, or comparisons between cities. However, a set of practical applications and theoretical measures for urban systems has not yet been formed. Exploring the practical research of "grey relation" can enrich the practical methods and evaluation models for restoration of old urban area. At the same time, a series of discussions can also be conducted on the restoration direction of the old area. In terms of relevant research, efforts are made to grasp the contradiction between the rapid economic growth of old urban areas and the slow environmental protection effect in urban development. Therefore, on the premise of taking urban restoration and the old urban area system as the research background, this paper takes small and medium-sized cities in Zhejiang as the research object and introduces the "grey relational analysis" model in the data model analysis method. It summarizes a set of convenient, highly operational, hierarchical and Zhejiang regional characteristic improvement strategies for the restoration of old urban area in small and medium-sized cities in Zhejiang, to achieve the refinement of the urban texture. A series of measures such as the repair of urban functions and the repair of the urban environment have been taken to sort out a set of urban restoration guidelines that are highly exemplary, convenient, simple and suitable for promotion. These guidelines provide a reference template for urban restoration in other areas, while reducing the route cost of urban restoration and offering new solutions. It is also a flexible implementation, application and practical demonstration of "urban restoration in old urban area".

## 1.4 Study Content, Methodology and Framework

## 1.4.1 Study Content

This study takes the restoration of old urban areas in small and medium-sized cities in Zhejiang Province as the research background. It integrates the grey relational analysis model, combines theoretical analysis and current situation investigation, constructs the grey relation system for the restoration of old urban areas

in small and medium-sized cities in Zhejiang Province, establishes the index system factors, and calculates various factors for the improvement of old urban area, providing an analytical method for restoration.

① Basic research on relevant theories

The background of the topic selection, research significance, research methods and research framework of this paper have been clarified, and the grey relation, small and medium-sized cities in Zhejiang, and old urban area have been defined. The logic of urban restoration was sorted out, and the application logic of the grey relational analysis method, the adaptability in the application of small and medium-sized urban restoration in Zhejiang and the application scope of the scheme were studied.

② Research on the grey relation Model of Old Districts in Small and Medium-sized Cities in Zhejiang

Based on the current situation, research objects, research processes and index selection of the old areas in small and medium-sized cities in Zhejiang Province, a grey relation model for restoration of old area with Zhejiang characteristics was established. It can cover the main influencing factors of restoration in the old old urban area of small and medium-sized cities in Zhejiang Province, and provide guidance and direction for the subsequent design of restoration plans for old urban area.

③ Case Study on restoration of Old Districts in Small and Medium-sized Cities in Zhejiang Province

Through the investigation and research on the old urban area restoration projects of three small and medium-sized cities in Zhejiang Province, namely Quzhou, Shengsi and Linhai, a comprehensive comparative analysis was conducted on the elements such as the geographical location, economic development and population of the cities in combination with the current situation of the urban old areas. The phenomena and problems of the cases in the urban restoration and development were clarified. Thus, the same predicaments and solutions faced by small and medium-sized cities in Zhejiang Province in urban restoration were derived. It provides a basis for the research of this article.

④ Research on Strategies for Upgrading old urban area

Based on the commonalities of urban restoration cases in old areas of small and medium-sized cities in Zhejiang in Chapter Four, it provides a factual basis for the

establishment of the grey relation system in this paper, which is the research focus of this paper to screen out advantageous strategies, and determines the development goals, development principles, ideas and choices. Finally, the exploration of restoration in old urban areas is carried out from several perspectives such as functional repair, environmental repair, improvement of economic benefits, and social and cultural restoration.

## 1.4.2 Study Methodology

(1) Literature Study Method

By reviewing relevant literature at home and abroad, this paper reviews the academic research progress of restoration of urban old urban area at home and abroad, comprehensively explores its application in urban and rural planning, architecture, environment and other multidisciplinary fields, and defines the concept of restoration of small and medium-sized old urban area in Zhejiang. Based on the existing data, this paper summarizes the current research status and research prospects, finds out the object and content of the research and its relational, and lays a good foundation for the research.

(2) Logical Study

The author puts forward a theoretical framework for the renewal of old districts in small and medium-sized cities in Zhejiang province based on grey relational analysis, with the aim of providing a theoretical method for the grey relational analysis of old districts in similar cities in Zhejiang province. This paper adopts logical research and systematic research methods to conclude and summarize the theoretical framework of restoration of old urban area. The following case studies are used to verify the scientificity, universality and practicability of the theoretical framework.

(3) Field Study Method

This paper takes Qianyang District of Kaihua County of Zhejiang Province and three outstanding cases of Zhejiang Province as the research object, conducts field investigation through in-depth study of the area in person, and carries out field investigation by taking photos, visiting and recording, etc., to understand the current situation and existing prominent contradictions of the local old district space. On the basis of literature research, field research can grasp the most time-effective and

practical problems in reality.

(4) Mathematical statistics

In terms of general research methods, the research also uses the mathematical model "gray relational" model to construct the model to conduct quantitative analysis of target factors. Through mathematical calculation and application of software, combined with expert scores, a rational and objective analysis system suitable for the promotion of old districts in small and medium-sized cities in Zhejiang is established to guide the application of urban restoration strategy.

## 1.4.3 Study Framework
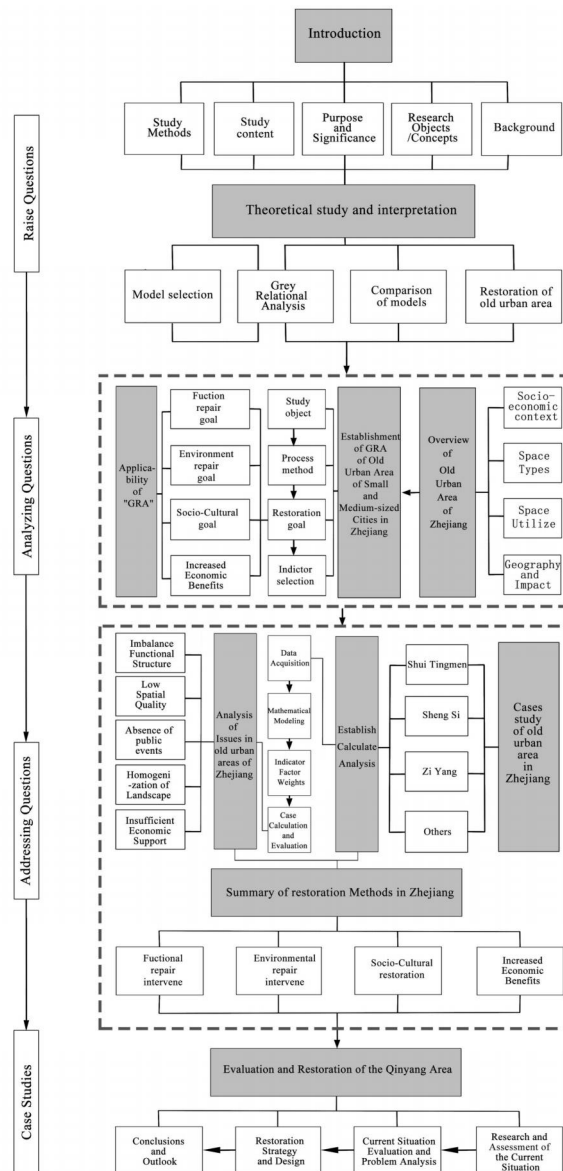


Figure 1-3 Study framework

Source：author

## 1.5 Summary of the chapter

This chapter, as the opening of the thesis, systematically elaborates and analyzes aspects such as the research background, research object, basic concepts, research purpose and significance, research content, methods and framework of restoration in old areas of small and medium-sized cities in Zhejiang Province.

Firstly, this chapter clarifies the background of the research and points out that China's urbanization has entered the era of stock, and urban restoration has become the main means of urban development. The author points out that small and medium-sized cities in Zhejiang Province are facing an urgent need for restoration of old area and are an important part of urban restoration in Zhejiang. Compared with restoration in large cities, they have extremely high demonstration value and restoration significance. This chapter defines the research objects and basic concepts, including "grey relation", small and medium-sized cities in Zhejiang, and old urban area. It clarifies that the old urban area in this paper are weak urban areas, providing a clear research scope and objects for subsequent studies. Furthermore, this chapter also expounds the purpose and significance of the research, emphasizing its value in enriching the theory of the optimized development of urban built-up areas, exploring the path of urban transformation, and improving the quality of life of residents.

In the section on research content, methods and framework, this chapter elaborately introduces the research content of the thesis, including theoretical interpretation, case analysis, current situation analysis, establishment and calculation of the grey model, etc. It clarifies the research methods, such as literature research method, logical research, field investigation method and mathematical statistics method, and constructs the research framework, providing clear guidance and planning for the research of subsequent chapters.

# Chapter 2: Theoretical study and interpretation

## 2.1 Study on restoration of old urban area

### 2.1.1 Study on restoration of old urban area abroad

After the end of World War II, the United States enacted the Housing Act (the Housing Act) marked the beginning of the comprehensive transformation of the old city in Western countries, which is mainly embodied in four aspects: regional industrial upgrading, optimal allocation of resources, urban ecological environment, and urban public space [25].

(1) The most urgent core problem of regional restoration and development of old cities is the transformation of regional industries. This is also the core driving requirement of urban development [26]. Many non-traditional handicrafts and new economy have gradually replaced the original traditional handicrafts. Most Western countries focus on new creative industries, and have achieved many remarkable results, making the traditional regional industry gradually adapted to contemporary needs. Focusing on the upgrading and inheritance of regional traditional culture, cultural lineage and local resources, and driving the upgrading of related infrastructure is the key to the benign cycle of regional industries, and is also the key to the efficient, economic, and renewed vitality of urban restoration in old cities [27].

(2) Optimized allocation of resources is a prerequisite for improving the efficiency and quality of old city restoration. The rational allocation of land resources, volume and allocation methods, and the allocation and supply level of public resources are the main areas involved in the optimal allocation of resources for the restoration of old cities [28].Patsy Healey suggests that, in the period of rapid development of the city, the urban construction is often characterized by the irrational allocation of land resources, and the capital and the company tend to break through the convenience of the allocation of resources in order to pursue the interests [29]. Rational allocation of land resources and public resources can effectively release the stock of space, improve the allocation efficiency, and revitalize the new vitality of old urban areas. Jane Jacobs in the book "the life and death of America's big cities" that the current city blocks are too single, functional programming, so the urban housing and transportation systems have been over the expansion and demolition of the city's housing and transportation systems have been over the expansion and demolition of

the city's original pluralistic social and neighborhood functional attributes [30].

(3) The inevitable requirement for the restoration of the old city stock is the improvement of the urban ecological environment. Eco-city is being widely welcomed by cities around the world due to its concept of green, low-carbon and sustainable development, as well as the logic of building cities in harmony with nature [31]. And urban restoration is to some extent the urban stock restoration based on the concepts of ecological ring construction and eco-city and other concepts established. The application of landscape ecology and various theories derived from landscape ecology [32] in the field of urban restoration is an important initiative to form a living system of ecological environment, society and economy and to guide the sustainable development of cities.

(4) Urban public space is the carrier of people's daily activities and an important window to show the city's image, with strong openness and sociality. Public space in a broad sense refers to the space place where people can freely enter and exit, gather and disperse, communicate and act, thus constructing a social group with relatively the same characteristics, and in a narrow sense refers to the outdoor space for the public use of the daily life and social life of urban residents [33].
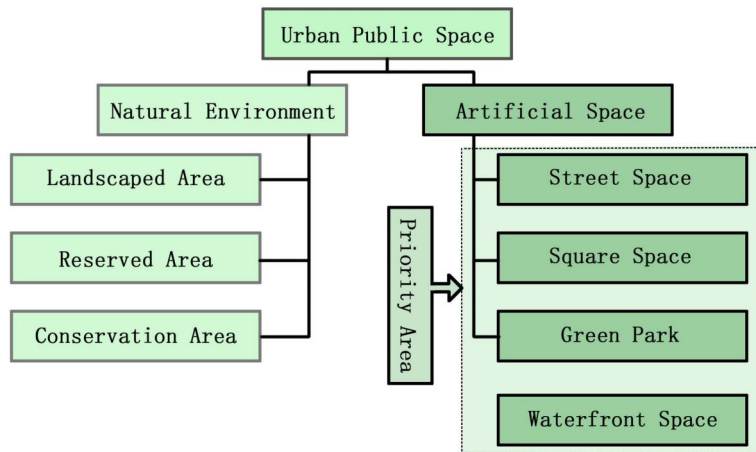


Figure 2-1 Classification of urban public space

Source：author

(5) The scientific optimization and adjustment of urban planning is the key to implementing the restoration of old area. Sally McDonald[34] took the restoration of an old community in the UK as an example and pointed out that the restoration of old area should, on the basis of strictly defining the land use scale of the city, the urban development boundary, and ensuring the ecological red line, propose new ideas for urban restoration and development. At the same time, it also seeks solutions to a

series of problems such as environmental, ecological and economic decline caused by the decline of urban functions in the past. In recent years, the protection of cultural heritage, the construction of green and water networks, the increase of public green Spaces, and the enrichment of infrastructure, etc. [35] have also become important contents of urban restoration planning. In his renowned economic work "Small is Beautiful", economist Schumacher mentioned that while industrial civilization has developed rapidly, it has brought inevitable negative impacts on the ecological environment, urban space and all aspects of human life. He believes that the development of society should be people-oriented, and the actual needs of people in all aspects of life and production should be the focus of development and construction. It is also proposed that the development of society and the progress of the economy should be a gradual process. While attaching importance to urban development, attention should also be paid to the related issues of rural area development [36]. Colin Rowe, a British urban architect, criticized the idealized way of urban planning in his book "The Collage City". He advocated that urban designers should pay more attention to the exploration of the original characteristics of the city. The construction of a city does not come out of thin air, nor does its development occur overnight. The development of a city is composed of the continuous connection between new and old factors, their mutual interaction and influence. The collage city theory he proposed is not only a collage of old and new features, but also an analysis of the restoration of urban functions. The development of old cities should start from respecting the original features, and the new planning of cities should recreate the site space in a "collage" way, so that the new and old environments can achieve perfect integration under the requirements of the new era [37]. Dutch planner Hugo Primos expressed some views on the restoration and transformation of urban residences as stipulated in the "Acceleration and Deceleration of urban restoration" released by the Netherlands. He believes that the transformation of urban residential areas should start from the actual demands of local residents and should not cause significant disturbances to their original customs and living habits. It is advocated to transform urban residential areas through micro-intervention and gradual progress[38].

The theory of old urban area after World War II has undergone more restoration and practices against the backdrop of the great global economic development.

① Post-World War II-1960s

The urgent housing problems brought about by the war triggered a large-scale

renovation movement, which destroyed the original spatial pattern of the city, damaged the original cultural lineage of the city, and ultimately exacerbated urban decay and caused acute social conflicts. Therefore, the restoration movement during this period was influenced by the modernist architectural theories centered around form planning, among which the representative theories are: Howard's "idyllic city", Le Corbusier's "city of light", and the Smithsonian's "clustered city". The concept of "cluster city" of the Smithsonian couple in Britain.

② 1960s-1980s

After the 1960s, large-scale urban redevelopment brought about a huge increase in the number of cities.

Large-scale urban redevelopment brought great negative impacts, and urban restoration began to reflect on the trend. In this period, urban restoration began to be guided by "humanistic thinking" and advocated "people-oriented". Lewis Mumford, in his book A History of Urban Development, proposed that "the city and the region are inextricably intertwined", and suggested that in the construction process, attention should be paid to the relationship between buildings and the natural environment, urban scale and people [39]. In "Oregon Campus Urban Planning Experiment", Alexander criticized the spatial development of large area and large scale, and proposed the spatial development mode of zoning and small scale, and emphasized that urban residents should be involved in the construction of the city [37].

③ 1980s-1990s

Due to the global economic downturn, large-scale private investment became the backbone of urban restoration in this phase; however, at the same time, problems such as low participation of residents and neglect of residents' needs emerged [40]. The aim of "economic revitalization" has brought urban restoration back to the past state where "physical environment improvement" was the single goal, and such a real estate development-oriented urban restoration violates the principle of "people-centeredness". This kind of urban restoration led by real estate development is against the principle of "people-oriented".

④ From the 1990s to the present

The governance mode of urban restoration began to emphasize community participation, and the power of the public plays an increasingly important role in urban restoration. The mayor of Curitiba, Brazil, Jami Lerner, published the book

"Urban Acupuncture" and proposed to realize the improvement of the urban environment through low-cost and precise interventions without large-scale renovation [41] 1987, the chairman of the United Nations Commission on Environment and Development firstly put forward the idea of "sustainable development", which became a brand-new concept of urban development. In 1987, the chairman of the United Nations Commission on Environment and Development first put forward the idea of "sustainable development", which became a new concept of urban development. The focus of foreign research on urban restoration has shifted from single physical space restoration to multiple restoration modes, which is of great reference value and significance.

The foreign urban restoration concept of old urban areas has high reference value. However, after entering the new century, the foreign urban restoration concept is constantly iterated, but it lacks the application and practice of practical projects, and lacks the complement of Chinese experience. The author hopes to pay more attention to the concept and application of old urban area renewal in China.

## 2.1.2 Study on restoration of old urban area in China

Although the restoration of old urban area in China started later than that in the West, this is also because China's urbanization was still in a stage of rapid development before the 2020s. The rapid development of new urban areas has to some extent dispersed the population in old urban areas, and the neglect of old urban areas has also led to the relatively insufficient theory of urban restoration in the era of increment in China. In today's era of stock, there are already a large number of practical foundations and restoration cases in the old urban area of our country. They have achieved remarkable accomplishments in a relatively short period of time and have given rise to many urban restoration theories and practices rooted in Chinese characteristics.

Since the reform and opening up, the research on urban restoration in China has gradually deepened. Its development trajectory can be divided into three characteristics: distinct stages. The period from 1990 to 2000 was the benefit-oriented stage, with the maximization of economic benefits as the core driving force for urban restoration. From 2000 to 2010, it entered the stage of functional improvement, focusing on the functional optimization of urban space and the improvement of infrastructure. Since 2010, it has developed into a comprehensive benefit-oriented

stage, emphasizing the coordinated development of multi-dimensional values such as society, economy and culture [42]. It reflects the continuous deepening of the understanding of urban space in the process of urbanization in our country.

(1) Paradigm shift of value orientation: from economic dominance to social orientation.

In the early stage of "economic urban restoration", the main goal was land appreciation [43]. With the improvement of citizens' demands for quality of life, the concept of restoration gradually shifted to social benefits. Before the 1990s, the level of urbanization was low, and China's urban restoration was still concentrated on the demolition and reconstruction of other dilapidated houses. Since the 1990s, with the implementation of the housing reform policy, urban restoration has officially started [44]. Cities such as Beijing, Shanghai and Guangzhou have entered a stage of rapid development, and urban construction led by real estate has a strong market tendency, which is called "real estate development-oriented urban restoration" [45]. In 1994, Professor Wu Liangyong proposed "organic restoration" on the basis of his research on the planning and construction of Beijing's old urban areas. He defined the concept as follows: "The so-called 'organic restoration' means to properly handle the relationship between the present and the future with appropriate scale and scale according to the content and requirements of the transformation, and constantly improve the quality of planning and design, so that the development of each area can achieve relative integrity" [46]. The humanistic design theory proposed by Professor Wang Jianguo has important guiding significance, emphasizing the continuation of place context, the respect of existing living habits, and the reconstruction of spiritual space. This shift is embodied as follows: the goal of restoration changes from a single economic index to multiple values such as social equity and cultural inheritance; The participation subject changes from government leading to public participation. The evaluation system introduces social indicators such as community satisfaction [47]. Professor Wang Peng systematically combined the research and theoretical basis of urban public space, proposed a set of systematic theoretical framework, and proposed a train of thought with high reference significance for the systematic study of urban public space [4].

(2) Morphological transformation of restoration mode: from radical replacement to organic restoration, from large-scale demolition and construction to retention transformation and micro-transformation.

At present, the restoration methods presented by urban restoration are becoming more and more diversified, including comprehensive governance, function optimization, demolition and reconstruction and other means [48]. The composite mode of "reservation-renovation-micro-demolition" replaces the traditional way of demolition and reconstruction. However, under the urban restoration and development mode dominated by large-scale real estate development, the main demand of urban restoration is still the pursuit of economic benefits, and "demolishing and rebuilding" is still the main means of restoration. The "restoration theory of humanistic connotation" proposed by Zhang Genli emphasizes that the real urban restoration should include the balance of community interests and the dimension of humanistic care [39]. old urban area is still the most direct manifestation of the residents' living habits and customs in the urban area, and it is also the most important embodiment of the humanistic care and living environment in the regional activities. For this reason, Huang Jianwen's public space integration theory provides methodological support. By means of pedestrian system reconstruction and traffic organization optimization, Huang Jianwen achieves a balance between historical texture protection and functional upgrading in the reconstruction of Dachong Village in Shenzhen [49]. It is worth noting that although the academic community has reached a consensus, the real estate driven restoration still has the realistic contradiction of excessive pursuit of plot ratio. However, there are still many scholars trying to criticize this phenomenon by multiple means. Huang Jianwen also tried to reshape the pedestrian system of public space in the old district of the city, so as to establish an urban transportation system oriented by pedestrian demand, systematically integrate the overall shaping of space into all aspects of the old district from the perspective of people, and realize true humanism [50]. In 2022, Professor Wu Chen emphasized the impact of human settlement science on the development of urban restoration, as well as the holistic view and sustainability of the restoration process. Since 2007, the restoration project of the old city began to appear. Professor Yu Jin proposed that in the restoration procedure, in addition to the objective physical transformation, attention should be paid to the continuation and restoration of the environment, spatial environment and neighborhood social network.

(3) Expansion of types of restoration objects and diversification of urban restoration concepts

China's urban restoration originally originated from the overall renovation and

environmental governance of shanty towns. After the reform and opening up, a large number of practice cases are concentrated in old urban area and villages in cities. Therefore, with the development of cities, the target lineages of renewal show a significant trend of diversification, and old industrial land has become an important carrier for the inventory of renewal [51]. Data show that the proportion of industrial land fluctuated from 33.4% to 33.2% during 2000-2014 [52], and this structural adjustment provides new opportunities for urban restoration. Zhang Zhiyan's spatial system methodology has been verified in practice in the renovation of Shougang Park. Through traffic reorganization, landscape reconstruction and other strategies, industrial sites are transformed into innovative industrial agglomeration areas. This transformation requires the establishment of industrial land efficiency evaluation system, perfect land transfer mechanism, strengthen supervision to avoid space vacancy.

In 2012, Qiu Baoxing put forward the theory of "rebuilding micro circulation", among which "micro-renewal" is the most influential one, advocating exploring potential urban space to improve land utilization rate and actively expanding "micro space" for "organic revitalization" [53] Since 2013, large cities across the country have started large-scale urban restoration. Shenzhen launched the "Fun City Plan" [54], Shanghai proposed to encourage residents to participate in the restoration of community space [55], and Guangzhou began to implement the "Guangzhou urban restoration Measures" in 2016 to make active use of inefficient stock construction land [56].

(4) China has already made attempts at an evaluation system related to the restoration of old urban areas

Based on the combination of relevant cases and field research, Chen Gong (2004) conducted a comprehensive and integrated analysis of the influences in aspects such as historical culture, political policies and residents' demands, and thereby proposed renovation measures [57]. Guo Ya (2006) constructed a multi-category evaluation index system through the AHP method, covering multiple aspects such as economy, society and ecology, and summarized the evaluation results to define the timing sequence of the three renovation projects [58]. Lu Bin (2013) used the Analytic Hierarchy Process (AHP) to evaluate the effect satisfaction of the relevant plans for the protection and development of Nanluoguxiang five years after their implementation. This evaluation system provides a more scientific adjustment basis for future planning work [59].

Zhang Yupeng (2017), based on the old city renovation in Yaohai District, Hefei City, constructed an evaluation system for renovation risks and benefits, selected the index factors of feasibility indicators, economic evaluation and social evaluation, and adopted a multi-factor study to provide a scientific, reasonable and rapid evaluation method for old city restoration [60]. However, at present, it still remains at the stage of regionalized research and lacks replicable attempts.

Finally, from a spatial perspective, the practice of urban restoration in China is related to the level of urban urbanization. It has developed from a few large cities such as Beijing, Shanghai and Guangzhou to second-tier cities like provincial capitals Hangzhou, Chengdu, Wuhan and Nanjing, then to the vast majority of prefecture-level cities in China, and finally to the medium and small cities that make up the largest urban system in China. Objectively speaking, the restoration of old area in small and medium-sized cities remains the main direction of urban restoration in the future.

## 2.2 Study on the grey relational analysis

### 2.2.1 Development of the grey relational Model

grey relational analysis (GRA), an important part of grey system theory, was proposed by Chinese scholar Professor Deng Julong in the 1980s to solve the problem of complex systems with incomplete and uncertain information. Its development process can be divided into three stages: theory foundation, method improvement and multi-field application, and gradually become an important tool for data analysis and decision support.

① Theoretical foundation (1980s - early 1990s)

The grey system theory originated from Deng Julong's Control Problem of Grey System published in 1982, which introduced the concept of "grey" into system science for the first time, emphasizing the "grey" of some information known and some unknown. As one of its core methods, grey relational analysis reveals the internal relationship of the system by quantifying the degree of similarity or correlation between sequences. The early grey relation model proposed the initial correlation degree calculation formula based on the geometric similarity of the data series, which laid the foundation for the subsequent research. At this stage, the theory is mainly applied to small sample and low-information scenarios such as agricultural yield prediction and industrial process control[19].

② Improvement and expansion of methods (1990-2010)

With the development of the theory, scholars have improved on the limitations of the original model. For example, standardized methods are introduced to eliminate dimensional differences and weighted correlation degrees are proposed to reflect the weight differences of different indicators[18]. In addition, the combination of fuzzy mathematics, analytic hierarchy process (AHP) and grey relational analysis forms a composite model such as fuzzy grey relation and grey hierarchy correlation, which enhances the flexibility and applicability of the analysis. After 2000, the progress of computer technology has promoted the algorithm optimization of grey relational analysis, such as dynamic correlation degree calculation and multidimensional data association analysis. The application fields of this stage rapidly expanded to economic forecasting (such as regional industrial collaboration), environmental assessment (such as ecological repair effect assessment) and project management (such as project risk ranking).

③ Modern integration and interdisciplinary application (2010-present)

In recent years, grey relational analysis has gained new vitality in the context of data science and big data. On the one hand, its combination with machine learning and deep learning technology improves high-dimensional data processing capabilities. For example, feature selection algorithm based on grey relation optimizes the performance of classification models[20]. On the other hand, researchers are exploring its applications in emerging fields such as sustainable development and smart cities. For example, in carbon neutral path analysis, grey relation is used to identify key influencing factors; In the evaluation of urban restoration, GIS technology is used to realize dynamic correlation analysis of spatial data. In addition, interdisciplinary research continues to emerge, such as disease risk association analysis in the medical field, and green travel mode optimization in the transportation field. The increase in the number of relevant papers in international journals also signals that grey relational analysis has gradually become a method of global academic attention.

## 2.2.2 Grey relational analysis technology path

① Determine the reference series reflecting the characteristics of the system's behavior and the comparison series affecting the system's behavior The data series reflecting the characteristics of the system's behavior is called the reference series. The data series composed of factors affecting system behavior is called the

comparison series.

② The reference series and comparative series are dimensionless due to the physical significance of the factors in the system is different, resulting in the data may not necessarily be the same, not easy to compare, or difficult to get the correct conclusion in the comparison. Therefore, when conducting grey relational analysis, the data processing of dimensionless is generally carried out. Using the formula $C_{ij}=x_{ij}/x_{0j}$ Initialized data. The individual data will then be compared against the chosen indicator, thus utilizing the equation $X_{0j}=$（1,1,1....1）, figure out $d_{ij}=|c_{ij}-x_{0j}|$, Composition of the $D_{ij}$ matrix，

$$C_{ij}=x_{ij}/x_{0j} \qquad\qquad （2\text{-}1）$$

$$d_{ij}=|c_{ij}-x_{0j}| \qquad\qquad （2\text{-}2）$$

③ Finding the grey relational coefficient between the reference series and the comparison series $\xi$（$Xi$）The degree of association is essentially the degree of difference in geometry between the curves. Therefore, the size of the difference between the curves can be used as a measure of the degree of association. $\xi$（$Xi$）：

$$l_i\ （j） = \frac{\triangle\text{Min}+p.\triangle\text{Max}}{\triangle_i（t）+p.\triangle\text{Max}} \qquad\qquad （2\text{-}3）$$

④ Calculate the weights, because most of the data analysis is too subjective, resulting in data results may be involved in some personal emotional factors, so the choice of grey relational method for analysis can effectively reduce the inaccuracy and variability of the results caused by such subjectivity. We calculate the weights through the coefficient of variation of the grey relational coefficient, which can better and clearly reflect the variability of each coefficient. The larger the coefficient of variation, the better it reflects the difference between different items, so its weight is larger, while the smaller the coefficient of variation, the smaller the difference between items, so it is divided into its smaller weight, therefore, according to the formula to calculate the weight of each indicator needed for this matrix:

A. First, calculate the average value of the indicator relational coefficient

B. Calculate the coefficient of variation of the coefficient of relational of the indicators.

C. Finally, the coefficient of variation is uniformly normalized to determine the weight coefficient of each indicator.

$$\bar{l}_j = \frac{1}{n} \sum_{i=1}^{n} l_i(j) \tag{2-4}$$

$$Cv = \frac{1}{\bar{l}_j} = \sqrt{\frac{\sum_{i=1}^{n} \left[ l_i(j) - \bar{l}_j \right]^2}{n-1}} \tag{2-5}$$

$$Wj = \frac{C_v}{\sum_{i=1}^{n} C_v} \tag{2-6}$$

⑤ Calculating grey relational After calculating the weights of each indicator, we can use the formula to calculate the scores of different indicators.

$$ri = \sum_{j=1}^{n} l_i(j) w_j \tag{2-7}$$

## 2.2.3 Advantages of grey relational analysis

① Wide applicability

Small sample and poor information processing: suitable for systems with small sample size, incomplete data or no obvious rules, especially good at handling the problem of "few data and poor information". Cross-field application: can be used in economy, agriculture, energy, medical care, ecological environment and other fields complex system analysis .

② The calculation is simple and efficient

Low computational complexity: The correlation degree can be judged by geometric shape similarity without complex mathematical model, and the calculation is small and easy to realize. No need for strict data distribution: Data is not required to follow a specific distribution (such as normal distribution), the same applies to nonlinear and non-normal data

③ The results are intuitive and reliable

Direct use of the original data: Without normalization or strict data preprocessing, retain the features of the original data, the result is more close to the actual . clear correlation degree ranking: By quantifying correlation degree ranking, the main influencing factors can be intuitively identified to assist decision makers to quickly locate key factors.

④ Strong dynamic analysis ability

Trend consistency analysis: Reflect the dynamic changes of the system through

time series data and capture the correlation of synchronous changes among factors.

⑤ Flexibility and fault tolerance

Indicators can be adjusted: Reference sequence and comparison sequence can be flexibly selected according to actual needs to adapt to different evaluation objectives. Compatible with qualitative analysis: The calculated results are consistent with those of qualitative analysis to avoid possible contradictions in statistical methods .

## 2.3 Comparison of relevant model Study

### 2.3.1 Method for determining index weights

Whether the method selected for determining the index weight is reasonable affects and determines the accuracy and authenticity of the comparison and evaluation results. At present, there are various methods for determining the weight values of indicators, which can usually be divided into two categories: One type is the subjective weighting method, which generally requires experts to make subjective judgments on complex goals or objects based on their years of experience and comprehensive capabilities, thereby determining the weights of each indicator. This type of method is suitable for use when data is scarce or missing or when conducting qualitative analysis. Common subjective weighting methods include the Delphi method, adjacent comparison method, and analytic hierarchy process, etc. Another type is the objective weighting method. It analyzes the relevant data of the target object by means of mathematical principles or statistical methods, "speaking with data", and extracts information from the differences among the indicator data to determine the weights. Since it is not affected by human factors, it is more commonly used when there is a sufficient amount of relevant sample data and a large amount of information. Objective weighting methods mainly include principal component analysis, coefficient of variation method, correlation information method, entropy weighting method, etc. [61] Through comparison, it is found that both subjective and objective empowerment methods have their advantages and disadvantages: The subjective empowerment method, due to its complete reliance on the personal subjective opinions of experts, results are highly arbitrary, lack data support, and different experts have different understandings of the same object. Usually, the results are also less convincing. However, the objective method merely relies on data information and lacks subjective consciousness judgment. It may lead to situations

where the calculated values of indicators that should have larger weight values are actually smaller, making it difficult to ensure that the results are consistent with the actual situation. Whether it is a subjective method or an objective method, if different methods are used for a specific object, the results obtained are often not the same.

## 2.3.2 Analytic hierarchy Process

The Analytic Hierarchy Process (AHP for short) was proposed by American operations research authority T.L.Saaty and others in the early 1970s. It is an analytical method that can combine qualitative analysis with quantitative analysis and systematize and stratify the Study target object [62]. Since its introduction to China in the early 1980s, the Analytic Hierarchy Process (AHP) has undergone nearly four decades of development. Due to its remarkable characteristics such as flexibility and applicability, simplicity and clarity, clear hierarchy and strong systematicness, it has been widely applied in various fields including economy, military and engineering for scheme comparison and project evaluation.

Under normal circumstances, when the number of elements contained in the Study object is very small and simple, relying on the existing cognitive ability, people can often easily analyze and identify the interrelationships among the attributes of different elements and compare and obtain the differences existing among the attributes of each element. However, once the number of elements of the target object is too large or the structure of the Study object is relatively complex, human intuitive judgment may have deviations and errors. In such cases, the advantages of the Analytic Hierarchy process begin to emerge [63]. Quantifying the empirical judgment of decision-makers is the core content of the Analytic Hierarchy Process. By pairwise comparing the relationships and differences among the attributes of each element, the importance of each element attribute is judged and determined. Therefore, relatively good results can generally be obtained [64]. Due to the simple calculation process, it can combine quantitative analysis and qualitative analysis, and process them uniformly in the system. This improves the accuracy of decision-making results in actual decision-making analysis. The Analytic Hierarchy Process (AHP) is particularly applicable when the problem is complex and ambiguous or lacks statistical data.

The basic principle of determining the weights of evaluation indicators by using the Analytic Hierarchy Process (AHP) is to decompose complex practical problems,

divide all elements related to the target object into several levels according to different attributes, thereby establishing an ordered and hierarchical multi-level analysis structure model. By comparing the relative importance of each element, the weights of each indicator can be calculated [65].

## 2.3.3 Entropy weight method

The concept of entropy originated in thermodynamics and is used to describe the irreversible phenomena of ion or molecular movement, indicating the uniformity of energy distribution in space. Later, it was introduced into information theory by the renowned mathematician Shannon to measure the stability and information volume of a system[66]. The entropy weight method is based on the principle of "difference-driven", thus it can highlight the local differences among indicators, obtain the optimal weight through the actual data of each sample, reflect the practical value of the entropy value of indicator information, avoid the influence of human subjective factors, and therefore the calculated indicator weights are relatively objective [67]. Due to its high credibility, transparency, reproducibility and robustness, the entropy weight method has been widely applied in fields such as engineering technology and social economy at present.

In the actual evaluation or decision-making process, after the set of evaluation objects is given and the values of each evaluation index are determined, the positions of different indicators are different, and the degree of effective information they carry is also not the same. If the values of the evaluated object on a certain indicator differ significantly, it indicates that the greater the amount of information provided by this indicator, the smaller the uncertainty and the smaller the entropy value. According to the characteristics of entropy, the larger the entropy value, the weaker the degree of variation dispersion of the index, and the smaller the value role of the index in the comprehensive evaluation. Therefore, the weight in the evaluation should also be smaller. Conversely, if the information entropy of a certain index is smaller, it indicates that the index value provides more information, and the corresponding weight is also larger [68].

As an objective weighting method, the basic principle of the entropy weighting method is mainly to determine the weight of each index based on the amount of information conveyed by each index. The size of the weight of each index reflects the relative intensity of competition among the indicators.

## 2.3.4 Model selection

The Analytic Hierarchy Process (AHP) is a subjective weighting method. When the number of consulting experts is sufficient, the evaluation results obtained are relatively reasonable. However, due to its strong subjectivity, it is also prone to cause greater arbitrariness. The entropy weight method for weighting is relatively objective. It obtains the weights by processing the original data and conducts in-depth mining of the information carried by the original data. However, it is only derived from the data and speaks purely based on the data. It cannot be combined with the experience of experts and the opinions of decision-makers, which is very likely to result in the calculated weight values not matching the actual situation. It can be seen from this that whether the Analytic Hierarchy Process (AHP) or the entropy weight method is used to determine the index weights, if only one method is used, it is very likely to affect the accuracy of the evaluation results.

One of the advantages of the grey relation model is that it combines the Analytic Hierarchy Process (AHP) and the entropy weight method to a certain extent. It can not only integrate the opinions of experts and decision-makers, but also objectively conduct in-depth mining of the original data to form a dynamic restoration grey relation model [19].

## 2.4 Summary of the chapter

This chapter first reviews and Study the development history of restoration in old urban area, Study and discusses the concepts and characteristics of restoration in different old urban area at home and abroad, and at the same time grasps some core links and restoration elements of restoration in old urban area. Furthermore, the development logic of the grey relation theory was sorted out, the mathematical model and application of the grey relation were understood, the connection between the relevant Study on restoration of old urban area and the grey relation theory was discussed, and the mathematical operation logic of the grey relation was revealed. Immediately after that, the mathematical models related to grey relation were sorted out. By Study and comparing them, the advantages of the grey relation model in urban complex systems were proved, and the reasons for choosing grey relational analysis in urban systems were clarified. Through the Study of this chapter, the relevant theories and practices of old urban area restoration can be clearly sorted out and understood, as well as the ability to understand the grey

relation theory, providing a good Study foundation for the establishment of the grey relation model for restoration of small and medium-sized old urban area in Zhejiang Province in the following text.

# Chapter 3: Establishment of the "GRA" of old urban area in Zhejiang

## 3.1 Overview of Small and Medium-sized old urban area in Zhejiang

This section requires a preliminary understanding of the old old urban area of small and medium-sized cities in Zhejiang Province, clarifying the commonalities and classifications of the old old urban area of small and medium-sized cities in Zhejiang in urban restoration. Only by grasping the key elements and links in restoration among the commonalities and particularities of small and medium-sized cities in Zhejiang can a solid Study foundation be provided for the subsequent establishment of the grey relation model.

### 3.1.1 The connection between new and old urban areas

At present, the integration and development of new and old urban areas in Chinese cities is an important issue in urban development. New and old urban areas have certain value to be explored in terms of resource integration, planning convergence, transportation convergence, cultural exchanges, and integration of residents, etc. In the process of integration, there are challenges and opportunities coexisting in the relationship. The construction of new areas in most Chinese cities is mainly divided into: relying on the old city to establish new areas (in a parcel type, parallel type), and re-establishing new areas in new plots of land. Cases in point are Suzhou, Hangzhou, and Guangzhou. During the construction of new cities, the resources and advantages of the old city inevitably flow to the new city, resulting in a slow restoration of the infrastructure of the old city and a rapid demographic decline. The historical and cultural features of the old city are preserved, but the pace of urban restoration will slow down. Due to the huge cost of demolition and restoration, the old city will fall into a negative cycle: the speed of urban restoration can not keep up with the speed of decline of the old city, or the restoration of the old city can not attract the stay of the urban residents, and the gap between the old city and the new city, such as the infrastructure and supporting facilities, is too large. Many cities have taken the lead in solving the problem of connecting the old and new cities by expanding the urban framework and integrating the old and new cities at the physical level under the influence of human beings. And increase the transformation of shantyareas in the old

city to give back urban space to green space, public space and public transportation facilities. And use the transportation system to improve the communication distance between the new and old cities and the communication cost. However, it seems that these initiatives do not organically integrate the old and new cities, only in the physical level of urban communication to reduce the cost of the city, and seems to accelerate the relocation of residents of the old city.

The development space of the old and new cities depends on the residential and work attributes, but the old city will still maintain its own advantages if the old city has stronger hospitals, education and commercial attributes. We talk about the protection of the old city, which is more for the protection of the historical and cultural memory of the residents of the old city, but the historical and cultural memory and touching the residents' own interests at the same time, it will explode a lot of contradictory points. Therefore, when the cost of living and the feeling of living are not greatly increased to the balance point of the conflict between interests and memories, the population of the old city will be rapidly lost, resulting in an imbalance in the age structure of the old city.



Figure 3-1 Types of old areas in Zhejiang

Source：author

Therefore, this paper attempts to alleviate the fragmentation of the old and new urban areas, as well as the lack of functional mobility, through the restoration of public space in the old urban areas. This will speed up the self-restoration of the old

city and accelerate the return of industry and population. It is also an opportunity to promote the restoration and upgrading of the infrastructure of the old city. The upgrading of the old city or the restoration of the old city should not only be done from the material level, but should be based on the diversified and spiritual communication to answer the question of the interface between the new and old city.

## 3.1.2 Sorting out the status quo of the old urban areas

Small and medium-sized cities in Zhejiang are roughly divided into several categories: coastal cities, mountainous cities, and plains cities. There are 48 mountainous cities in the province, accounting for more than half of the province's number. In addition to Jinhua city, Yiwu city, Dongyang city, Yongkang city in mountainous areas, the size of all cities are below one million, belonging to the category of small and medium-sized cities. Small and medium-sized cities in Zhejiang spatial layout, form has great similarity. In the author's opinion, they are mainly divided into the development mode of encircling the old city and establishing a new city (Kaihua County, Yunhe County and other cities with small populations) and the two modes of development of the old city and the new city (Quzhou City, Lishui City and other cities with large populations). Most cities in Zhejiang have good environment and pay attention to the synchronous development of environment and human settlements. Focus on the urban restoration of the old city and the development of multiple Spaces. Small and medium-sized cities in Zhejiang focus on urban development and construction according to local conditions, combined with local topography and environment, and rely on traditional blocks to carry out the layout of urban axis, traffic and public space. The green space system of the city is composed of local water system, mountain range, community park, residential central green space, street green space, small square, etc. However, the layout of the surface open space is scattered. At the same time, in addition to the old urban areas and historic districts, other urban core areas lack characteristics and identification.

Small and medium-sized cities in Zhejiang pay special attention to the protection of the old city in the development, but it will also lead to the problems of dense buildings and poor quality in the old city, and the population density is too large, which also leads to the current situation of the old area of the city is not optimistic. Most of Zhejiang's old urban areas after the 80's and 90's restoration, put in a lot of new functional Spaces, such as squares, Linhai City for example, Linhai has built

several city squares, including municipal square, Range Gate square, etc., effectively alleviated the problem of excessive density in the old city. However, because the green space is not systematic, the classification and functional zoning are not prominent, the facilities are insufficient, and the lack of logic and connection. This is also the common spatial status of small and medium-sized cities in Zhejiang: attention is paid to the protection of historical and cultural heritage, and the linkage between public space and landscape forms a landscape interface with landscape characteristics. At the same time, the space types of old urban area are chaotic, repetitive, and the utilization rate is low, resulting in logical confusion.

"Zhejiang Land Space Planning (2021-2035)" mentions the need to improve the interaction between the city and the natural environment, to actively utilize the environmental resources, and to do a good job of converting the resources of green mountains into silver mountains. It actively promotes urbanization and does a good job of developing public space and green space in cities.

### 3.1.3 Utilization of old urban areas

The space of small and medium-sized old urban area in Zhejiang mainly has the following characteristics:

① The frequency of use by the population is inconsistent, and the frequency of use by children and the elderly is larger. Because of the high density of the old district, the difference of the usage frequency of different people in the old urban area of the city can be analyzed. In the morning and evening peak, the suitable crowd in the old urban areas is mainly the traffic flow crowd, and in addition, almost the elderly and children. The proportion of young people using weekends has increased.

② It can be concluded from this that the main user group is the elderly. Due to the special attributes of the old urban area of the city, the proportion of the elderly population in the old urban area is relatively high. The 2023 Statistical Bulletin on the Elderly Population and Aging Affairs in Zhejiang Province pointed out that by the end of 2023, the elderly population aged 60 and above in Zhejiang Province was 13.394 million, accounting for 26.17% of the total population, and it is still increasing rapidly at a rate of 0.6 percentage points each year. Therefore, aging has always been a prominent issue in Zhejiang's development, especially in the old urban area. Through visiting dozens of cities in Zhejiang Province, the author learned that the users in the old urban areas are mainly the elderly and some children. Therefore, more

attention should be paid to the improvement of humanized aspects and elderly-friendly facilities.

③ The forms of public activities in the old urban area are monotonous and the sense of participation is not high. In the daily activities of a city, the public Spaces in the old urban areas play a role in guiding the occurrence of urban activities, and residents will choose different public Spaces according to the types of their own activities. The daily activities of residents can be classified into: leisure activities, consumption activities and essential activities. Leisure activities are conducive to including fitness activities and leisure activities. Consumption-oriented activities include those mainly for consumption and shopping. Essential activities refer to those related to life, production and daily work. At present, the activities generated in urban public Spaces in Zhejiang Province are mainly leisure activities.
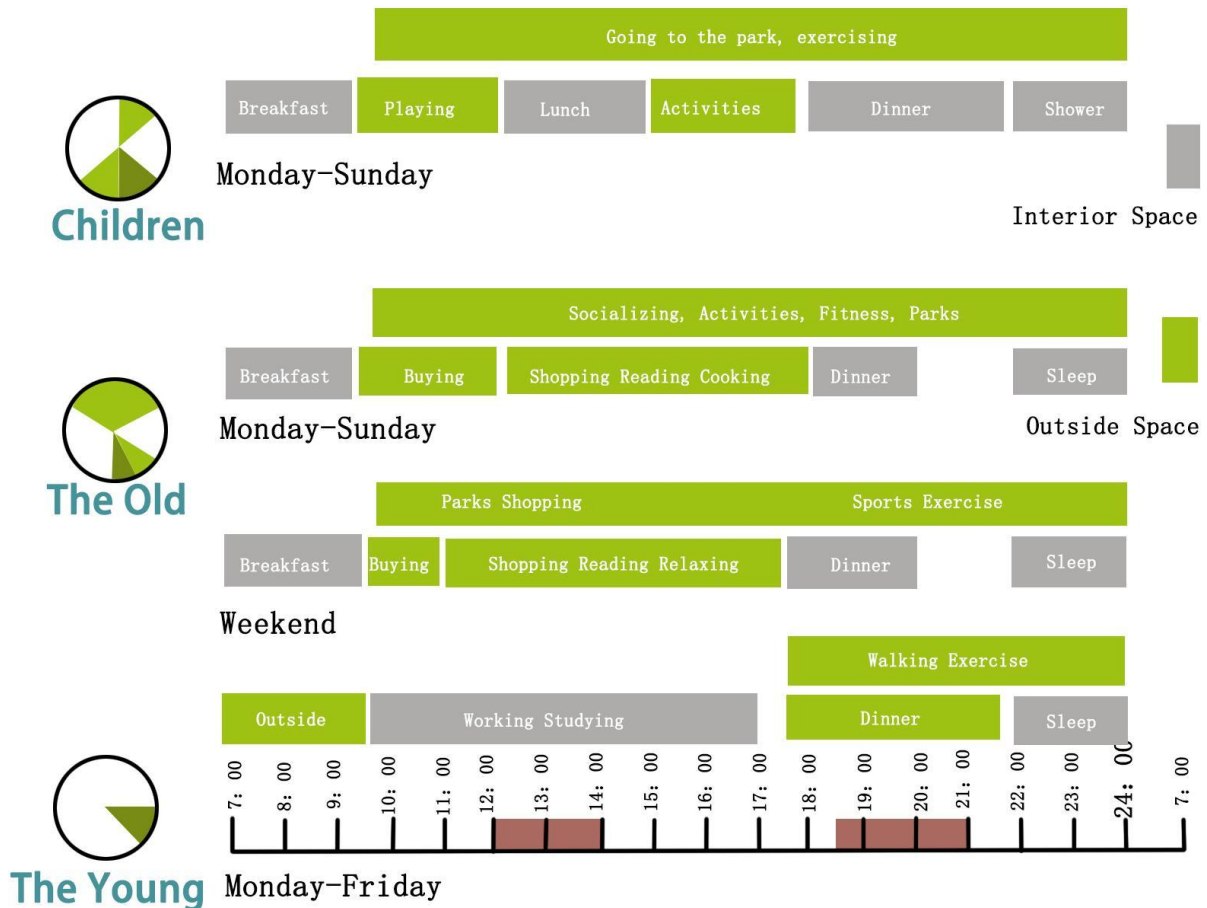


Figure 3-2 Public space utilization

Source：author

Here, residents spontaneously form various activities including exercise and fitness, and social activities, which are mostly classified into cultural and entertainment, sports and fitness, and leisure and social activities. And it is

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supplemented by a small number of consumption-oriented activities. Since the end of the last century, Zhejiang has been engaged in large-scale urban construction. The quality of public Spaces in old urban areas is not high, and the content of activities is restricted, resulting in a lack of active participation and attention from residents to the urban environment and space. In urban development, the types and styles of public Spaces are overly monotonous, resulting in relatively simple activity forms in public Spaces and a low sense of participation among residents.

### 3.1.4 Regionalism and thinking of old urban areas

The overall topography of Zhejiang shows a trend of high in the southwest and low in the northeast, with a lot of mountains and water systems and few plains, and there is the saying of "seven mountains, one water and two fields" since ancient times. The main geographic unit pattern is divided into north Zhejiang plains, southwest Zhejiang hilly mountains, central Zhejiang basin, coastal islands and plains and so on. Most of the small and medium-sized cities in Zhejiang are developed in areas with Jiangnan characteristics, and the logic of public space generation is determined by the local terrain. The generative texture is relatively similar, and the traditional street space and courtyard, spatial scale all have the characteristics of Zhejiang and regionality. At the beginning of urban construction, the city consciously combines the natural landscape with the urban landscape to form a characteristic place space. Since the reform and opening up, urban construction has accelerated, and the high-density construction has gradually destroyed the traditional urban texture and space. In addition, due to the lack of planning of spatial form and layout, the public space naturally formed in old urban area has been gradually replaced by large-scale parks and squares, and the spatial sequence has become homogenized and gradually disappeared. Rapid urbanization quickly disintegrates the bearing capacity of infrastructure and public space, which is eliminated because it cannot keep up with the progress of urban development, forming a negative space. Various green Spaces and riverside Spaces are separated from the public nature, and the construction, planning and formation of a system have not been completed. Large squares and Spaces are relatively backward and lack of iconic urban space. However, compared with large cities, the urbanization rate of small and medium-sized cities in Zhejiang still has a large room for increase. However, the negative population growth of the whole country has not affected the upward trend of the population in Zhejiang, and the

functional environment and other attributes of the existing old urban areas can no longer meet the growing needs of the residents. Zhejiang quickly invested in the pace of urban restoration in the 10th century, among which there were many successful attempts, including Shengsi Old town and Linhai Old Town, but most of them concentrated in the ancient urban areas, lack of exploration and attempt of the old areas in the 8th and 90s of the last century, so under the background of the national stock restoration, Zhejiang Province also quickly followed the response, focusing on the transformation of urban old areas restoration. Including city squares, streets, parks and so on have different degrees of change, systematic old urban area is gradually established and restoration.

## 3.1.5 Influencing factors of old urban areas

Zhejiang urban restoration cannot be separated from the influence of the following perspectives. Social development, economic development, cultural environment, and value orientation of participating subjects [7]. Social development is mainly reflected in the change of urban population. With social development, the original population of small and medium-sized cities is mostly one tenth of that of large cities, but the increase in population leads to a rapid change in the size of its built-up area and land use, and the type, proportion, and area of its public space are also changing rapidly. As the urbanization rate of Zhejiang's small and medium-sized cities is rapidly climbing to over fifty percent, the city scale and framework are rapidly expanding, and the spatial form is also rapidly changing. With the influence of big cities, the intervention of advanced lifestyles, the increase in population and the introduction of more new information, the pace and pace of life of local residents are also changing. Therefore, people's demand for lifestyle is also increasing, and they are no longer satisfied with the original several ways, but also put forward higher requirements for the type, style, scale and diversification of space in old urban area. It also accelerates the rapid change and adjustment of urban spatial structure and builds a more complex old urban area spatial system. Compared with big cities, the functions of old urban area in small and medium-sized cities tend to be more comprehensive. Due to the small land use scale, cities are more susceptible to the impact of natural environment and urban spatial scale, and the layout structure of cities is also dominated by nature.

The development of small and medium-sized old urban area in Zhejiang is

especially bound up with the urban economic base, so the economic base almost directly determines the quality and development of urban public space. From the above three cases, the GDP, per capita disposable income and fiscal revenue of these three cities are growing at a rapid pace, but the development trend has slowed down in recent years, but their rich economic base is at a higher level in the country. Therefore, it also provides a rich material basis for the restoration of the old urban areas in Zhejiang. In addition, the urban industries in these cases are being further optimized. Due to the development concept of large market and small government of Zhejiang Government, different industries can be reasonably allocated to different cities to reduce resource waste caused by resource mismatch and competition. As the secondary industry foundation of small and medium-sized cities in Zhejiang is generally good, the rapid development of the tertiary industry also creates a more diversified urban lifestyle, and promotes the transformation and development of old urban areas, which also attracts foreign population. 2023 Zhejiang Province ranked the first in the country in terms of the increase in resident population with 500,000 people, which creates a good cyclic relationship.

Urban culture contains both material and non-material culture. The former contains urban architecture, public recreational facilities, gardens and parks, etc.; the latter contains social psychology, values, etc. and urban lifestyle. Therefore, a good public space must contain urban culture, which helps to enhance the sense of identity and belonging to the city. Most of the cities in Zhejiang have a good natural environment and a high sense of social identity, so most of the small and medium-sized cities are trying to dig deep into the local culture and natural resources in the process of urban restoration. Including Songyang, Lishui's old area protection, Panan, Jinhua's landscape city concept, and Yunhe County, Lishui's small county and big city development mode, all of which are based on small and medium-sized cities' more traditional urban development paths, urban texture, and natural characteristics.

Finally, the participation groups of restoration in old urban area include three categories: decision makers, developers and users. These three aspects involve the government, enterprises, residents and other levels, their common goal and purpose is to participate in the activation and utilization of old urban area space, their starting points and functions are different, their social positions and interests are also different, but the three can participate in various aspects to varying degrees. Small and medium-sized cities have fewer stakeholders, so it is easier to implement policies and

measures. In addition, compared with big cities, residents in small and medium-sized cities have a stronger sense of participation, so the implementation of the program can be easier to promote and implement.

| Factor | Specific Content | Manifestation and Impact |
|---|---|---|
| Social Development | Urban population growth, rising urbanization, lifestyle changes | The needs of old urban area are diversified, the urban spatial structure is adjusted rapidly, and a more complex spatial system is built. |
| Economic Development | GDP growth, industrial optimization, incoming population | Economic foundation determines old area quality, industrial transformation upgrades space. |
| Cultural Environment | Material and intangible culture (architecture, lifestyle, values) | Leverage local culture and nature, enhance urban identity. |
| Participating Entities | Government, enterprises, residents (decision-makers, developers, users) | The implementation of policies is easy, the participation of residents is high, and the activation and utilization of old urban area are jointly promoted. |

Table 3-1 Influencing factors of old urban area

Source：author

## 3.2 Study object: small and medium-sized old urban area in Zhejiang

### 3.2.1 Types of space structures of old urban area

Due to the inconsistency of economic, social and cultural backgrounds, the spatial structure of the generated old urban area is influenced by many aspects such as urban population, economic functions, urban nature and regional topography. Therefore, the spatial structure of the city is complex and diverse. The small and medium-sized cities selected in this paper in Zhejiang Province have mostly the same influencing factors such as construction background and construction environment. Therefore, the generation logic of the old urban area space in these cities also tends to be the same. Thus, they have good demonstration value and reference value. The urban structure of small and medium-sized cities in Zhejiang is relatively simple, and the influencing factors of the old urban area space are also relatively small. Therefore, the evaluation criteria are relatively uniform, which is very suitable for using the "grey relation" to digitize the influencing factors, and can clarify the role of many small influencing factors on the urban space. Many scholars divide urban space into a

hierarchical structure of macro - meso - micro. The macro level provides qualitative guidance, the meso level refines qualitative analysis, and the micro level refines quantitative analysis. The interaction among these three levels influences the overall image of the control space. The hierarchical structure of space is conducive to the goal determination of the grey relation model in this paper, including the entire urban structure from the whole to specific details, corresponding to the relevant index system factors [7].
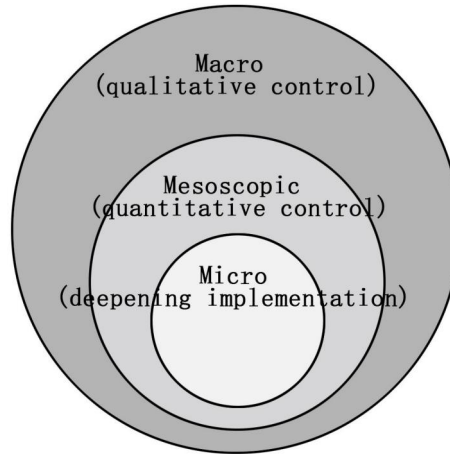


Figure 3-3 Spatial structure diagram

Source：Reference[7]

## 3.2.2 Evaluation elements of old urban area

The selection of evaluation elements mainly refers to Yang. Relevant impact factors in Gale's "Spatial Criteria" [69]. Due to the spatial influencing factors of the old urban areas, we can divide them into material elements and non-material elements, and each element influences and combines to form a complete spatial system. After a certain summary of the old urban area space, it will become the basis for the construction of target factors. After understanding the functions and relationships of these impact factors, the positioning and development goals of the composite urban space are proposed and corresponding evaluation methods are put forward. On this basis, the two elements are divided into material space elements and non-material space elements, which contain several small indicators respectively.

Among the elements of material space, there are forms and images. Among the forms, there are objective and subjective spatial forms. Since urban restoration mainly focuses on the way that forms influence images, this paper mainly analyzes the objective spatial forms in spatial forms. Objective spatial forms are mainly divided

into artificial elements and natural elements. Artificial elements refer to all inanimate material forms formed by human activities, which can be classified according to usage requirements and characteristics as: urban squares, urban parks, streets, waterfront Spaces, etc. Urban squares are urban public activity centers characterized by comprehensive and multi-functional features. The connection between streets and different Spaces in the city lies in the fact that streets cover the pedestrian system. Urban parks, compared with squares, have certain attributes of play and rest. Waterfront Spaces are generally urban green axis Spaces and are the convergence and important boundaries of urban Spaces. These artificial elements can be further classified by type into buildings, structures, squares, infrastructure, etc. These elements are the main body of artificial elements. Secondly, the main body composed of these elements also includes material structure and social structure. The material structure is the explicit part in the relative space, while the social structure mainly includes interpersonal relationships, values and social organizations, etc. It contains the operational logic part within the system, and the spiritual significance and spatial characteristics formed are implicitly reflected in the objective material space.
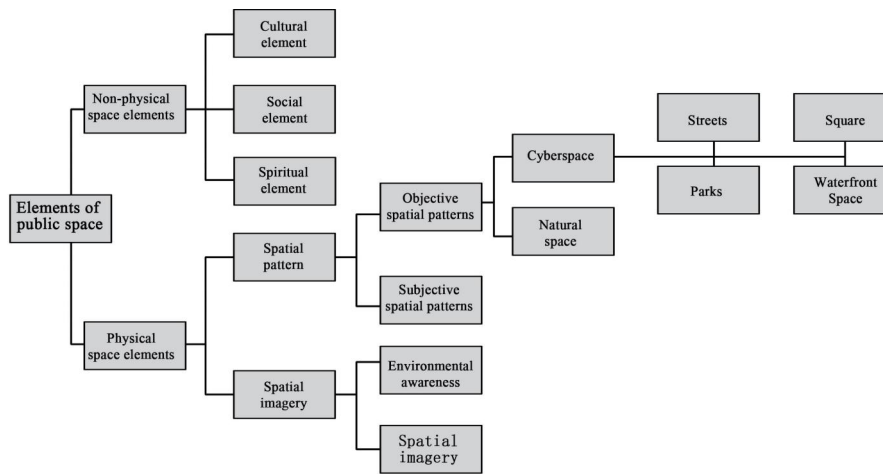
Figure 3-4 Classification of public elements

Source：Reference[7]

Non-material spatial elements refer to the sense of atmosphere that people experience under the influence of the environment in urban space, and are usually called the spirit of place [64]. The different images such as roads, boundaries, landmarks, regions and nodes proposed by Kevin Lynch constitute the whole of spatial images in urban composition. Under normal circumstances, intangible spatial elements are classified into three major categories: culture, society and spirit. However, since it does not directly act on the urban space, this paper can adopt the

operation logic of selecting the corresponding influencing factors to reflect its effect. People's experience and cognition of space are important factors and bases for the evaluation of urban space, as shown in Figure 3-4.

Due to the mutual influence and interaction between material and immaterial spatial elements, when establishing the evaluation criteria, more intuitive influencing factors should be adopted as much as possible, which include four aspects in sequence: functional repair, environmental repair, social and cultural restoration, and economic benefit improvement goals, and refer to Yang. Gail's evaluation criteria and the actual restoration demands of small and medium-sized cities in Zhejiang Province are used to screen the evaluation criteria for the old urban area space.

### 3.2.3 The complexity of "GRA" in old urban area

old urban area is a complex system, the social organization structure and life style of people in the city are a complex system, old urban area has multiple levels, the basic types and target elements have the characteristics of diversity, they influence, interact with each other, restrict and promote. Therefore, the "grey correlation" of old urban areas is more complicated. First of all, the material aspect of old urban area space is not only the simple spatial influence, but also includes many aspects such as political economy, urban society, etc., as well as the embodiment of various functions of traditional and modern urban life. Therefore, in the determined old urban area space, various elements play games with each other, which contribute to the change and development of the old urban district. For the "grey correlation" system of old urban area space, its levels are more diverse, covering more diverse levels.

old urban area also contains the intersection of many fields, involving planning, architecture, landscape, municipal, road, fire and other projects in the construction, its nature is both open and integrated. Because of the huge size of these systems, the elements of grey correlation are more complex, so that their objectives will also change dynamically and have uncertainty. In addition, due to the change of urban concept and the acceleration of urban communication, people's requirements for urban old areas are enhanced, and the space of old urban area is given an important window to display urban life and image. Finally, in the process of restoration of old urban area space, the diversity of its subjects also brings uncertainty of restoration, and the interest game and aesthetic level will change with the adjustment of the project. Therefore, we should make comprehensive use of grey correlation, sort out the

restoration logic and operation system of old urban area space at multiple levels, coordinate the interests of all parties, and put forward a set of reasonable evaluation criteria using grey correlation to reduce the occurrence of misjudgment. At the same time, it is more regional characteristics of Zhejiang and makes value judgment according to the unique urban generation logic of Zhejiang.

## 3.3 Process methods: establishment of "GRA" model in old urban areas

### 3.3.1 Setting up the analytical methodology

According to the logic of the "grey relational" analysis method, we need to list all the elements and carry out a series of hierarchies, which can be summarized in the steps in Figure 3-5. In this step, we can make clear what each step represents in the whole grey relational, so the target we choose can have an important influence on the evaluation of each step. Since old urban area is a complex system with a large number of design elements, including various disciplines, systems and variables, and the system is relatively independent after decomposition, we can decompose it by grey relation method to determine the weight ratio of different systems in the restoration of old districts of small and medium-sized cities in Zhejiang Province, so as to guide the urban renewal logic of other counties.

Due to the underlying operational logic of the grey relational, which needs to be based on the elemental classification method, it is necessary to select the relevant expert group, inquire about the opinions of the relevant elements, and classify the determined elements, and establish the relevant system model here, and determine the subsequent matrix data.
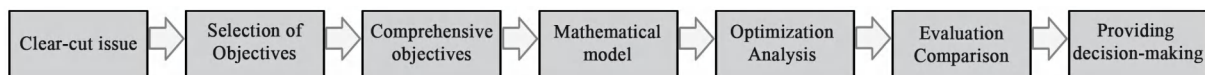


Figure 3-5 grey relational analysis logic

Source：author

### 3.3.2 Analysis of factors influencing the "GRA" model

The establishment of grey relation model in old areas of small and medium-sized cities in Zhejiang province is affected by many problems. The core influencing factor of urban restoration is the material and social situation of the city, which limits the quality and scale of urban restoration and is the core element of the model. As the

economic situation in Zhejiang Province is not so different from the whole country, the reference and basis of the model in Zhejiang Province is more reliable and the related elements are more easily unified. Secondly, in the process of urban Restoration, different groups are involved, including designers, policy makers, developers and urban residents. Each group stands for different value perspectives and has different standards of concern and judgment. However, the advantage of grey relational is that it can eliminate subjectivity, use different successful cases and regional urban characteristics to weaken subjectivity, and objectively calculate the weights and impacts of different elements, so as to realize the transformation from qualitative to quantitative. Furthermore, Restoration is not a quick fix, it is a dynamic, comprehensive and multi-dimensional process, therefore, the elements affecting urban restoration will also change dynamically, with strong uncertainty, and the advantage of grey relational also lies in the ability to make a certain degree of prediction and guidance for urban restoration based on the current status of urban development. Of course, the author would like to point out that the current grey relational model is based on the current status of urban development, which has a higher degree of timeliness.

### 3.3.3 Principles for constructing a "GRA" model

The restoration of old districts in small and medium-sized cities in Zhejiang is characterized by complexity. Therefore, it is necessary to evaluate the weight of factors, which requires objectivity and comprehensiveness. It is necessary to accurately reflect that the transformation of an element in the excellent case of Zhejiang old urban area can rapidly improve old urban area. The first is the practicability and operability of factor determination. The evaluation criteria of many influencing factors do not contain accurate values, which are abstract to a certain extent. The abstract evaluation factors can be digested by circumstantial evidence. It can be concluded that operability is reflected in the feasibility of data collection and data operability. The second is the principle of representativeness. There are many types and contents of old urban area space, so it is necessary to have a certain degree of strength in operating factors, and more highly summarize and summarize the capacity and scope of urban restoration, and promote and apply it within a certain range. Furthermore, it is a principle of The Times. urban restoration is a dynamic and diversified process, and people in different times have different demands on the old

urban areas. It is hoped that the old urban area of the city can have certain ability of revision and self-development. Finally, it is the principle of multiple layers. It is hoped that in the process of urban restoration, the restoration requirements of different links of urban restoration can be completed at different levels with a common and local characteristics as the main goal, and can be implemented in different cities within this framework.

### 3.3.4 "GRA" framework identified

(1) Urban Restoration Related Subjects Identified

There are numerous participants in the old districts of small and medium-sized cities, including designers, users, developers, decision-makers, etc. These decision-makers will all be involved and influence the selection of relevant factors. Therefore, it is hoped that this article can improve the various interests of the participants from multiple perspectives, as shown in Figure 4-4.

① Designers: Most of them are urban planners, landscape designers and architects, who are the creators of the old urban areas. They are more rational, reasonable and aesthetic needs to participate in the restoration of the old urban areas, but at the same time, they are affected by the top-down, so their professional views are not necessarily practical application.

② Users: most of them are actual urban residents, who are the most direct participants in old urban area and the core group of public activities. Due to the large number of people, their demands are the most prominent and complex, and it is difficult to reach a consensus.

③ Developers: the main body of the old urban areas, which includes more roles, including government, property, owners, developers, investors, etc., starting from the perspective of maximizing commercial profits. It has the simplest purpose and is likely to have the greatest negative impact.

④ Decision-makers: mainly government and related departments. They need to formulate the development goals of the old urban areas, but also need to review the relevant plans and coordinate the demands of all parties, and at the same time, the development of the old urban areas is linked to their own political achievements, in fact, the most important subject.
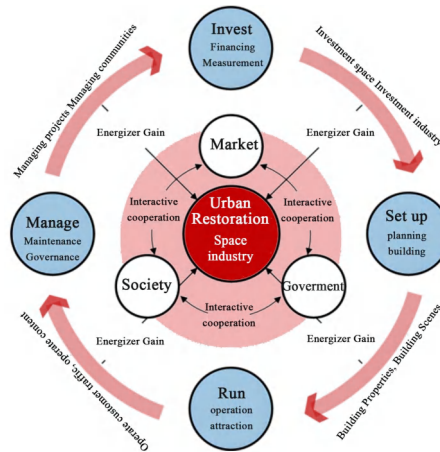
Figure 3-6 Urban Restoration Subjects

Source：author

(2) Stratification of **"GRA"**

grey relation can make a series of layers of the data that need to be associated, which is the initial stage of building a database. According to the needs, the whole process can be divided into four levels, target level, sub-item target level, element level and indicator level.

① Goal level: First of all, our goal is to improve the quality and level of life of urban residents. This paper starts from the perspective of "old urban area", so this is a decision-making goal, with integrity and overall, without the ability to deal with objective concrete, so it is a target level.

② Sub-item goal level: The author wants to start from the two perspectives of functional repair and environmental repair, and then supplement the important conditions that support the social culture and economic benefits of the operation of urban public space. Because a city is a large collection of systems, public space is one of the systems, and the elements involved are very complex, and these four major elements can well control and summarize the objectives and strategies to be discussed in this paper.

③ Element level: It is a more specific sub-item of the upper level, because the sub-item target layer is still an abstract sum of concepts, some concrete elements are needed to demonstrate the sub-item to achieve the sub-item goal.

④ Indicator level: with the most specific data and the most direct impact and measurement, it can be operable in reality to collect and judge the operational evaluation of public space. The indicator level is the most executable and can affect

specific operational matters.

## 3.4 Indicator selection: old urban area restoration of the "GRA" factor

This chapter is mainly in the grey relational framework for the construction of the relevant variables of the influence factor system, which contains objective factors also contains subjective feelings, complex elements can then be decomposed to provide data models for the construction of guidelines for the text.

### 3.4.1 Functional Repair Objectives

Functional repair is one of the core elements of urban restoration. The goal of the functional structure is to improve the inactive urban functions in the old urban area and repair the backward Spaces in the old urban area, so as to achieve high-quality construction of old urban area Spaces and good operation of old urban area Spaces.

(1) Location

The location conditions of the old urban areas include the specific location of the old urban area in the county and provinces and cities, mainly the concrete material coordinates of the traffic space and functional system. On the other hand, location conditions play a central role in the functional pattern and nature orientation of public space. It is the regulation of old urban area itself, and also the associated influence on the whole region.

① Location layout: The reasonable layout of the old area of the city can have a positive impact on the functional structure system of the whole area, and the original planning indicators can be used for analysis, such as distribution, scale, land organization, etc.

② Service area: The service radius of old urban area can effectively balance the layout of functional space and meet the continuity requirements of urban residents for functional services in the old district. Data collection can be carried out with reference to the green space service radius.

(2) Land use indicators

It is the control and advance planning of land use in old urban area. The development intensity of urban old area can be determined by land use index, and the reasonable development of old urban area can improve the perception of urban old

area.

① Land use ratio: It involves the scale, land use scale, green rate, activity space proportion, population capacity and traffic area of multiple Spaces in old urban area. The reasonability of land use is determined according to different needs, functions and categories of public activities.

② Functional satisfaction: the needs of urban residents can be met, and the utilization rate of space is higher. The first is whether the needs of urban residents are met, the second is the rationality of the functional layout of the activity venue, and the third is the frequency of use of the old area space to reduce the vacancy rate of the old area space.

③ Land use level: per capita construction land area, this indicator can reflect the level of urban construction and the degree of urban land use, small and medium-sized cities per capita land use index in 10-20 square meters is more appropriate.

(3) Service

The activities of urban public space support the source of the corresponding supporting facilities, rich urban activity needs infrastructure public, open, practical and artistic system, to improve the richness and convenience of the activities of urban residents, including the number of facilities, the distribution of the location, the use of comfort and aesthetics and so on.

① Infrastructure: To ensure the completeness and rationality of the activity system. This indicator encompasses multiple aspects such as lighting systems, power supply, and fire protection, as well as its radiation range. It involves objective data collection and residents' satisfaction.

② Service facilities: Ensure the rationality of the facilities, including sanitation facilities, guidance indicators, cultural facilities, etc., mainly related to open space, open space also needs to include the environment to improve the sense of spatial experience, such as trees, architectural vignettes, etc.. Cultural facilities, environmental health facilities and information and communication facilities are mainly selected for the evaluation of indicators.

③ Public Facilities: mainly refers to a series of structures serving urban residents, these facilities do not play a decisive role, but can reflect the characteristics of the space, and at the same time can change the monotonous and uniform characteristics of

the space.

(4) Space structure

It mainly covers the spatial structure system, traffic organization, spatial scale and spatial interface of different functions in the old urban area, which can improve the spatial structure and function of the city on the original basis. The diversity and layout of the structure can be combined with the city, strengthen the integration of different systems of old urban area, and enrich the urban texture and landscape sequence of the old city.

① Traffic organization: the organization of convenient and reasonable traffic system, including traffic and related space organization, the second is the organization of the pedestrian system, including multiple elements such as the guide; the third is the combination of traffic and function, including the integration of pedestrian and rest platforms, to reach the sex and so on.

② Spatial interface and scale: the coordination between each space, the integration of landscape, visual cognition, etc. The interface formed by space enclosure, the sense of belonging to the space, and aesthetic demand. Different spaces have continuous logic and reasonable spatial scale, such as the height and width ratio of the street, the scale of the square and other factors.

③ Structural layout: Openness of structure, diversification of layout, and integration with the urban system. Urban space can be classified into different grades, and more coverage can be achieved in the structure of points, lines and surfaces. Urban Spaces at different levels and in different situations form an integrated spatial system of old urban area, repair urban functions.

## 3.4.2 Environment Repair Objectives

In the process of urban restoration in the old urban areas of small and medium-sized cities, the urban environmental system is an important component and one of the core points of urban restoration. The urban environment is also one of the components of the goal of "Mountain and Water Zhejiang" in Zhejiang's urban construction. Zhejiang Province is committed to integrating urban life with the natural environment to form a complete set of harmonious and beautiful natural environment small and medium-sized old urban area spatial system. By controlling appropriate technical indicators, it aims to improve the environmental landscape of urban old

areas and establish an urban landscape system where humans and nature develop in harmony.

(1) Geographical environment

Urban environment should pay attention to the borrowing and construction of regional natural conditions and natural environment, and involve the advantages of natural environment in the restoration construction of old urban areas, and make use of local environment to improve and shape suitable urban environment and landscape according to local conditions.

① Adaptability: Based on the city's climate and natural conditions, including multiple elements such as terrain, hydrology, vegetation and humanity, and considering the different environments of Zhejiang (mountains, hills, oceans and plains), a suitable urban environmental system and human settlement environment for hard land should be created.

② Continuity: pay attention to the integration of the natural environment into the old urban area, need to pay attention to the construction of the urban internal environmental system, pay attention to the cultivation of local plants, with local characteristics. And native plants are more adaptable to the environment.

(2) Environmental protection

In the process of urban restoration, we should study the planning and design of old urban areas from the perspective of urban environment system, make reasonable use of urban resources, protect and develop the natural space structure of old urban areas. At the same time, it focuses on the application of materials and environmental technologies, such as clean energy, green materials, intelligent management, etc.

① Construction materials: In the process of restoration, whether to make full use of biological materials, extend the life of materials, save resources, etc., and whether to use the original spatial materials to reduce the cost of construction and strengthen the regionality of the old urban area.

② Energy use: whether to use clean energy and reduce the use of electric energy.

③ Operating costs: Whether it has low consumption, in the construction process of old urban areas, it will experience a dynamic process, some areas will self-update, some areas will be deactivated, balance the influence of various factors to reduce operating costs.

(3) Green landscape

It refers to the elements of natural environment in old urban area, including natural parks, green vegetation, water landscape and so on. The green elements of the old urban areas are not only the elements of environmental improvement, but also the effective means to divide the space rationally. At the same time, it is also a way to harmoniously coexist and narrow people and nature. People can feel the changes of seasons and environment in the natural landscape, and narrow the distance between the city and nature to form a set of efficient and continuous green landscape.

① Green space quality: green space rate, green coverage rate, green space per capita, the number of natural parks and the proportion of green space can be used to assess. The stage where green is about 25% of the visual space is the most comfortable level for human vision.

② Plant situation: embodied in a tree vegetation protection, such as the age of trees, treasured resource species, etc.; Second, in the effective space, the configuration of vegetation, pay attention to the high and low levels of different species of trees, seasonal changes and the feeling of the five senses.

③ Scenic aesthetics: including the collocation of various elements, the satisfaction of the masses, and whether the elements can solve some aesthetic problems for the urban military and civilians and the urban environment.

(4) Environmental quality

The quality of the environment determines the quality and frequency of public activities in the city, and with better material conditions, the length of public activities will be extended, based on which more activities will occur naturally, thus contributing to the spontaneous transformation of the space and catalyzing the expansion of activities, which has a more important impact.

① Clean environment: a clean environment includes surrounding buildings, roads, structures, etc., which can effectively meet the psychological needs of urban residents for a clean environment to avoid negative factors of the city, as well as the management and supervision ability of the city.

② Air quality: Air quality in China is mostly measured by pm2.5, pm10, NO concentration and other indicators, and finally converted into a unified standard urban environmental score, which can be evaluated using the annual Air index (AQI) of the

air quality report of various environmental homes.

(3) Water quality: The "five water co-treatment" project in Zhejiang Province will improve the water quality in Zhejiang Province by many levels, and you can refer to the surface water treatment reports of various regions for water assessment.

④ Noise conditions: noise is an important indicator to reflect the urban environment. old urban area need to meet the noise environment of different functions, and the impact of urban noise can be judged from multiple perspectives such as the retreat of buildings, blocking vegetation, and scale.

### 3.4.3 Socio-cultural objectives

China has more than 300 prefecture-level cities, different cities grow history and natural environment is different, its development of economic, cultural, social environment are different, each city because of its social and cultural background and change unique, can not be copied. Therefore, from the perspective of social culture, this paper reveals the connotation of old urban areas produced in different regions, sorts out the growth logic of old urban areas, and brings valuable social and cultural background and foundation for future urban restoration.

(1) Publicity

When the public receives the attraction of a certain urban space, the urban space shows the publicity, and the size and degree of the affected groups can reflect the size and strength of the publicity of the space. In the end, this shape has to be implemented into the behavior, so the behavior is the dominant and influential public representation

① Accessibility: The degree of difficulty for people to reach a certain urban space. Accessibility can be broken down into five parts, including service radius, walking system, public transportation, indicating system, and clear structure. Analysis of accessibility can increase the rationality of space and the occurrence of activities.

② Diversification of activities: the diversification of activities brings more upgrades and vitality to the city, and a good urban space is an important factor constituting the diversification of urban activities, such as the occurrence of activities at different times and the corresponding population.

(2) Comfortableness

The evaluation of an urban space comes from people's feelings, and people's

comfort comes from psychological and environmental perception needs and environmental cognition feelings. In short, to understand the feeling of space and users, the restoration of urban space is to give people better welcome and use needs.

① Vitality: With behavioral psychology as the basic condition for the generation of urban space, it can stimulate the sense of belonging of urban residents, generate active urban public activities, and improve people's residence time and frequency of use.

② Quality: Through the study of the activities of urban residents, the relationship between spatial environment and public life is explored, and the urban spatial quality is evaluated according to the relationship and linkage between environment and behavior.

③ Proximity: is the willingness of urban residents to actively approach urban space, is the subjective feeling of urban space, generally from the creation and introduction of the natural environment, good natural landscape linkage will greatly strengthen people's willingness to use.

(3) Cultural attraction

A culture that creates attraction, then this culture is for the masses of some kind of universal truth, precisely regional culture, historical changes caused by cultural heritage, the city residents have a universal urban imprint and sense of identity, which is a kind of psychological needs and habits, so in the Restoration need to focus on the creation of emotional space.

① Regional characteristics: To create a old urban area with local characteristics, we can start from the perspective of local economic development level, values, social customs and other local characteristics, and use distinctive urban texture, spatial form, visual effect and material color to create urban regional characteristics.

② Cultural activities: old urban area can provide activities with distinct characteristics. Characteristics are typical representatives of typical events at a certain time and place, often recording major events and activities in the city.

③ Humanistic landscape: also known as cultural landscape, in order to meet the material and spiritual needs of urban residents, superimposed on the natural landscape and other historical, cultural and spiritual qualities of certain physical and spiritual places.

(4) Cultural heritage

Cultural heritage, with its rich cultural connotation, is a monument to urban civilization, reflecting the creativity of urban residents and proof of the symbiosis between people and the environment. Cultural heritage in the city plays a subtle role in shaping the cityscape and influencing the lives of residents.

① Material heritage: The material cultural heritage can be displayed through the space of old urban area, including historical relics, buildings, sites, etc., and the local regional cultural connotation can be displayed from the aspects of form, spatial details, building materials and color.

② Intangible Heritage: Cultural carriers that represent urban residents linked to the natural environment, history and culture by means of practices, performances, knowledge, skills and other tools, objects, crafts, etc., which can promote cultural diversity and the creativity of residents.

## 3.4.4 Economic efficiency targets

Old urban area is a kind of material resources and has relative economic value. Due to the shortage of land resources in the city, reasonable development and utilization of land resources and the maximum value of land are the inevitable options for the construction of old urban area. The optimization of space and the development of economic allocation complement each other and can become a virtuous interaction and cycle. Good restoration of old urban area can add advantages to the economic benefits of the city.

(1) Building development

① Construction funds: construction funds need to match the development level of the city. The cost of construction comes from land price, demolition and resettlement costs, engineering costs, professional consultation, management costs, etc. The source of funds is linked to the development level of the city and the degree of market optimism, such as fiscal revenue, land transfer income, government fund income and other different sources. The main measurement criteria are urban per capita GDP, fiscal revenue, and the proportion of tertiary industries.

② Construction cycle: The restoration construction of old urban areas is a dynamic process, and the process of urban restoration should adapt to the development of the market and the situation of The Times and change dynamically.

Reasonable construction cycle can measure the effect of city investment and the rationality of operation of old urban area.

(2) Economic benefit

① Land benefit: including land utilization rate and land income, it depends on whether the land resources in the old urban areas have been fully utilized, whether there is a good integration of the existing resources in the old urban area and the rational use of the surrounding environment, the added value of land, the improvement of future construction space and land price, and whether the surrounding environment and land development have been well guided and adjusted. Whether it can improve the economic benefits of the old urban areas, whether there are advanced industries or service industries that can drive the income level of the old urban areas, and whether the vitality of the old urban areas can be significantly improved.
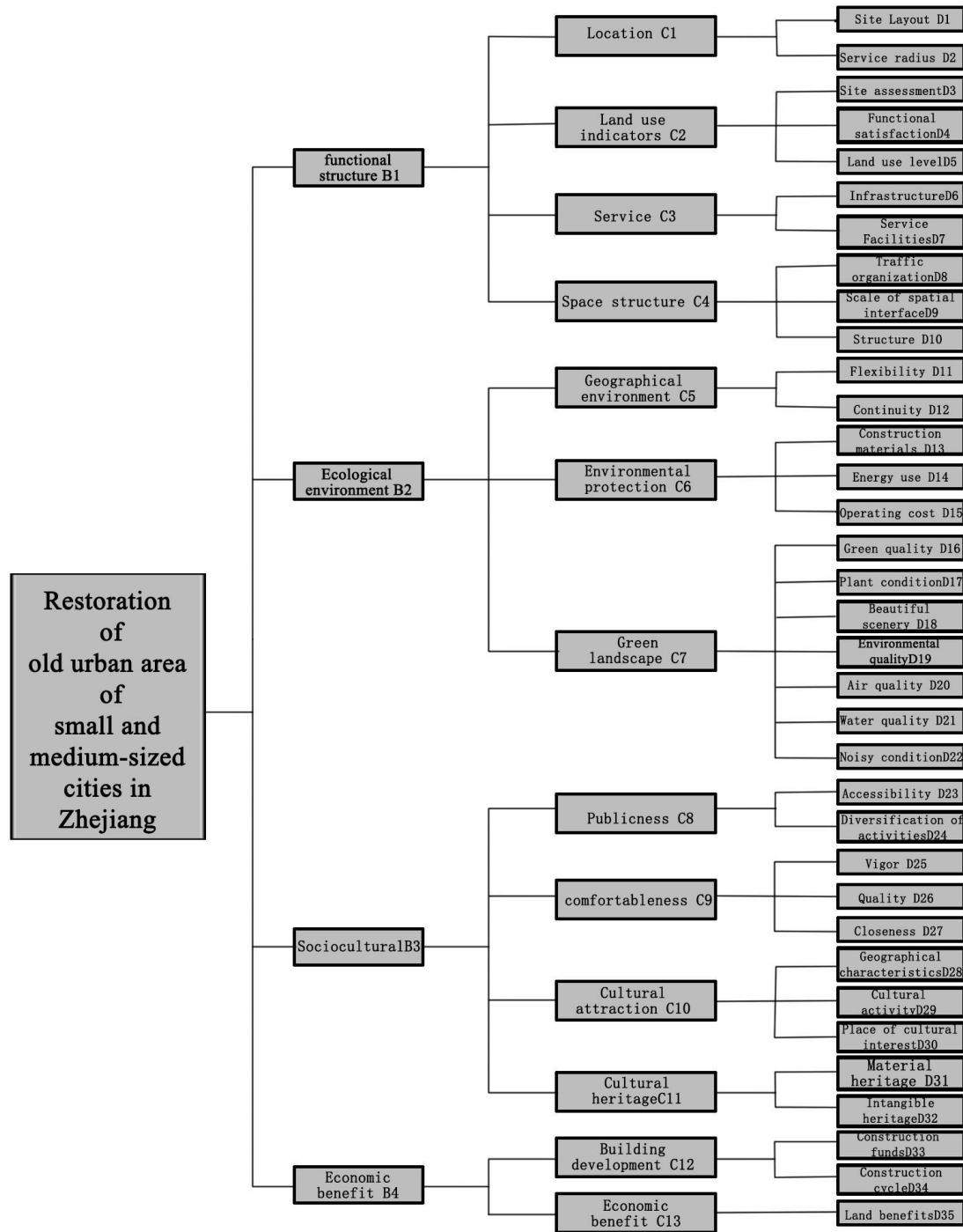
Figure 3-7 Target hierarchy

Source：author

Based on the above stratified elements, the author finally sorted out and obtained the indicator stratification diagram as shown in Figure 3-7.

## 3.4.5 grey relational model indicator table details

| Target hierarchy | Sub-objective hierarchy | Hierarchy of elements | Indicator level | Segmentation indicators | Rating /unit |
|---|---|---|---|---|---|
| The old area of small and medium-size cities in Zhejiang restoration | Functional repair goals | Location | Layout | Size | ㎡ |
| | | | | Distribution | 100 |
| | | | | Land use | 100 |
| | | | Service radius | Gap | km |
| | | | | Time | min |
| | | Land use indicators | Site assessment | Percentage of public space | % |
| | | | | Design capacity | |
| | | | | Traffic area | ㎡ |
| | | | Functional satisfaction | Public Satisfaction | % |
| | | | | Functional rationality | 100 |
| | | | | Frequency of use | /Day |
| | | | Level of land use | Vacancy rate | % |
| | | | | Construction area per capita | ㎡ |
| | | Service | Infrastructure | Illumination | /ha |
| | | | | Electrical power | 100 |
| | | | | fire-fighting | /ha |
| | | | | Radiation area | ㎡ |
| | | | Service Facilities | Sanitation | /ha |
| | | | | Guide sign | 100 |
| | | | | Cultural facility | /ha |
| | | | | Open space | % |
| | | | Utility | Service structures | /ha |
| | | Space structure | Traffic organization | Parking space | ㎡ |
| | | | | Pedestrian space | ㎡ |
| | | | | Visualization system | 100 |
| | | | | Accessibility | % |
| | | | Scale of spatial interface | Landscape coordination | 100 |
| | | | | Spatial logic | 100 |
| | | | | Street Aspect Ratio | 1 |
| | | | | Plaza scale | ㎡ |
| | | | Structure | Spatial integration | 100 |
| | Environment repair goals | Geographical environment | Flexibility | Score | 100 |
| | | | Continuity | Local Characteristics | 100 |
| | | Environmental protection | Construction materials | Bio-materials | 1 |
| | | | | Economize on resources | 100 |
| | | | | Construction cost | Yuan |
| | | | Energy use | Clean energy | 1 |
| | | | Operating cost | Dynamic update | 100 |
| | | | | Manpower inputs | Yuan |

| Target hierarchy | Sub-objective hierarchy | Hierarchy of elements | Indicator level | Segmentation indicators | Rating /unit |
|---|---|---|---|---|---|
| | | Green landscape | Green space quality | Geen area ratio | % |
| | | | | Green space per capita | m² |
| | | | | Number of natural parks | |
| | | | | Green area | m² |
| | | | | Visual weighting | % |
| | | | Plant condition | Protection of vegetation | 100 |
| | | | | Vegetation ratio | 100 |
| | | | Scenic beauty | Essentials | 100 |
| | | | | Public Satisfaction | % |
| | | | | Aesthetic resolution | 100 |
| | | | Environment quality | Clean and tidy environment | 100 |
| | | | Air quality | AQI | |
| | | | Water quality | Hierarchy | |
| | | | Noise condition | Public space noise | Hz |
| | Sociocultural goal | publicness | Accessibility | Pedestrian system | 100 |
| | | | | Mass transit | 100 |
| | | | | Indication system | 100 |
| | | | | Structural clarity | 100 |
| | | | Activities | Variegation | 100 |
| | | Comfortableness | Vigor | Retention time | H |
| | | | | Frequency of use | times |
| | | | Quality | Environmental Behavioral Linkages | 100 |
| | | | Intimacy | Willingness | 100 |
| | | Cultural attraction | Geographical characteristic | score | 100 |
| | | | Cultural activity | Frequency | times |
| | | | Place of cultural interest | Densities | /ha |
| | | | | Values | 100 |
| | | Cultural heritage | Material heritage | Historical relic | |
| | | | | Historical building | |
| | | | | Historic relics | |
| | | | Intangible heritage | Quantities | |
| | | | | Historical relevance | 100 |
| | Economic efficiency | Building development | Construction funds | Land price | Yuan |
| | | | | Engineering costs | Yuan |

| Target hierarchy | Sub -objective hierarchy | Hierarchy of elements | Indicator level | Segmentation indicators | Rating /unit |
|---|---|---|---|---|---|
| | targets | | | Management costs | Yuan |
| | | | | Revenue | Yuan |
| | | | | GDP | 100M |
| | | | construction cycle | Cycle time | Year |
| | Economic benefit | | Land benefits | Utilization factor | % |
| | | | | Proceeds | % |
| | | | | Value-added level | % |
| | | | | Value added of land | 10K |
| | | | | Peripheral Development | 100 |
| | | | | Industrial Enhancement | 100 |

Table 3-2 Table of grey Model Indicators

Source：author

## 3.5 Applicability of "GRA" in small and medium-sized cities in Zhejiang

### 3.5.1 The fit between GRA and urban restoration needs

① Small sample processing capability matching data fragmentation characteristics

There is a common problem of historical data fault in old districts of small and medium-sized cities in Zhejiang. For example, Wuma Street in Wenzhou only retains the data of merchants from 2018 to 2020 (sample size n=12), which makes it difficult for traditional statistical methods to support effective analysis. grey relational analysis (GRA) reconstructed the discrete data into a continuous time series curve using cumulative generation technology , and extracted the correlation degree γ=0.82 (p<0.05) between walking accessibility (coverage rate of 300 meters is 82%) and commercial activity (turnover growth rate per unit area is 15%) [71]. This method breaks through the dependence of large samples and provides a feasible path for restoration design in data scarce areas.

② Dynamic trend analysis meets the needs of spatial evolution

The spatial vitality of old areas is affected by many nonlinear factors such as policy, business type and population flow. Taking the Old Bund in Ningbo as an example, the monitoring from 2016 to 2020 shows that the correlation between the building renovation rate (an average annual increase of 8.7%) and the growth of tourist volume has jumped from 0.62 to 0.79, and its periodic jump is directly related

to the implementation of the Regulations on the Protection of Ningbo History and Culture in 2018 [72]. GRA captures the dynamic coupling rule between policy intervention and spatial value by comparing geometric curve similarity with , and provides time series decision basis for progressive restoration[73].

③ Multi-source data fusion supports multi-dimensional contradiction coordination

restoration of old urban area needs to coordinate the contradictions between spatial form, economic operation and social perception. It is difficult for traditional methods to integrate heterogeneous data such as walking time (min) and visual coordination degree (1-5 min) due to dimensional differences. GRA treated by very poor dimensionless. In the case of Shaoxing Shusheng's hometown, it identified that the influence weight of feature integrity ($\gamma=0.78$) on spatial identity far outweighs functional convenience ($\gamma=0.63$), and directly directed the "weaving restoration" to give priority to repair historical interface [74].

## 3.5.2 The "Grey Attribute" of Small and medium-sized Cities in Zhejiang

① poor information data completion technology

To solve the problem of missing monitoring in small and micro space (<500 ㎡), the ratio boundary generation algorithm was used to reconstruct the data. In Jiaxing Yuehe District, a bus IC card (time resolution 15 minutes) and POS transaction record (spatial accuracy 10 meters) were combined to generate a pedestrian density curve with an error rate of less than 15% (MAPE value) [75], significantly better than the traditional interpolation method (23.6%), providing accurate traffic prediction for the transformation of street corner green space.

② Objectified transformation of subjective evaluation

Residents' comfort scores (1-5 marks) were quantified through trend correlation degree verification . In the case of Quzhou Shuitingmen, the correlation between subjective scores (mean 3.8 points) and the average daily stay time recorded by infrared sensors (126 minutes) was $\gamma=0.76$ ($p<0.01$), and was negatively correlated with heat island intensity ($\Delta T=2.3℃$) ($\gamma=-0.53$) [76]. This method provides the design team with a "perception-behavior" mapping relationship and avoids the one-sidedness of purely physical index decision making.

③ Short-period forecast and optimization restoration efficiency

Combine the model to predict the restoration effect. The Lishui Ancient Weir

Painting Village project used the flow data of the first three months (n=90) to predict the subsequent trend, with an error rate of only 11% [77], supporting the dynamic optimization of the guided tour route and increasing the uniformity of tourist distribution in the core area by 27%. This method adapts to the rapid iteration demand of "micro-update" in Zhejiang and shortens the design verification cycle by more than 40%.

### 3.5.3 Verification path in the Zhejiang scenario

① Virtual deduction to verify policy compatibility

The multi-variable model of Taizhou Ziyang Street was constructed (density of intangible cultural heritage display points is 0.8 / ha, night lighting intensity is 150-300lux), and the correlation degree of output cultural elements is $\gamma=0.84$, which is highly consistent with the "live protection" strategy of Zhejiang Cultural and Tourism Integration Development Plan. This method provides a quantitative validation tool for policy-oriented restoration design.

② The comparison of methods highlights the advantages of the model

The comparison of 7 old areas in Zhejiang Province shows that GRA is superior to PCA and entropy method in data efficiency (minimum sample size n=4), nonlinear processing (dynamic correlation degree calculation) and small sample stability (variation rate CV=7.3%). Especially in the mixed degree analysis, the ranking stability of GRA reaches 91.2%, which is 23 percentage points higher than the traditional method.

③ Parameter sensitivity adjustment improves stability

Monte Carlo simulation showed that the correlation order variation rate was the lowest (<5%) when the resolution coefficient $\rho=0.6$. In the application of Qiaoxi historical District of Hangzhou, the adaptive $\rho$ value algorithm can reduce the fluctuation range of correlation degree from ±0.15 to ±0.07, so as to avoid the decision error caused by parameter deviation.

### 3.5.4 Limitations and optimization direction

① Space topology relationship analysis is insufficient

The existing model is weak in analyzing the connectivity of street network (such as permeability and accessibility). In the case of Anchang Ancient Town in Shaoxing, after coupling the visual integration index of space syntax, the correlation between

commercial layout rationality and passenger flow increases from 0.61 to 0.73 ($\Delta\gamma$=12%), revealing the deep influence of topological structure on spatial vitality [78].

② Adaptability to extreme events to be enhanced

Sudden policies such as the Asian Games traffic ban may destabilize the relationship. It is suggested to introduce    time-varying weight function    and dynamically adjust indicator weights through a sliding time window (30 days), which can reduce the prediction error rate of the model under the scenario of sudden policy changes on the Old Bund in Ningbo by 9.3%.

③ Social equity indicators are missing

The current model focuses on spatial efficiency and ignores the needs of vulnerable groups. In the restoration of Qiaoxi Historical District in Hangzhou, the correlation analysis of accessibility facilities coverage rate (58% at present) was supplemented, and it was found that it had a weak correlation with the frequency of elderly use of $\gamma$=0.42, which exposed the design blind spot.

## 3.5.5 The adaptation stage of the GRA for restoration in Zhejiang

The restoration of old areas of small and medium-sized cities in Zhejiang not only includes the restoration of urban physical space, but also extends to several elements such as architecture, economy, environment, function and landscape. Therefore, it is necessary to take urban public space as a complex whole and conduct comprehensive research from the aspects of environment, function, economy, technology, environment, etc. Only in this way can the contradictions be prevented from being single and solved.

This paper holds that old urban area is a highly integrated and complex system with interwoven elements, fuzzy and complex evaluation indicators, and "gray correlation" can study less data and less samples to solve the uncertainty of information. This theory takes the "small sample" and "information-poor" uncertain system with "part of information known and part of information unknown" as the research object. By generating and extracting useful information from the known information, the correct description and effective monitoring of the system's operating behavior and evolution law can be realized. There are a large number of uncertain "small sample" and "poor information" uncertain systems in urban public space, which provide a sufficient basis for the model construction of grey relation [79].

The grey relational model has no specific requirements on the sample of elements

and the law of data, but the results of the grey relation are consistent with the actual system operation logic. In simple terms, the data of the influencing factors of the urban public space system can be processed without dimension first, then the correlation coefficient of each index can be calculated, and finally the correlation degree of each evaluation index can be obtained according to the correlation number, and the size can be sorted according to the correlation degree. For example, grey relational analysis shows its own advantages in the calculation of industrial relation of cities in the Greater Bay Area, which can quickly and easily obtain the cooperation and competitiveness of different cities in different industries [80].

Traditional mathematical models tend to carry out detailed analysis of each element, with many related design logic, and finally get a very complex and redundant design model. Therefore, grey relation has great advantages in urban public space, and it can be easily constructed to obtain the correlation degree of each impact factor, and explore diversity for the application of grey relation.

Therefore, the grey relation model of old old urban area in small and medium-sized cities in Zhejiang has a wide range of applicability. This model is applicable in the three stages of current situation analysis, planning scheme analysis, and outcome analysis of old urban areas in small and medium-sized cities in Zhejiang . However, the data input and analysis logic need to be adjusted according to the goals of different stages. The following is the specific adaptation analysis:

3.5.5.1 Application Stage and Scenario Analysis

1. Analysis of the Current Situation of Old Districts in Small and Medium-sized old urban area in Zhejiang Province

(1)Objective: To identify the core contradictions and key influencing factors in the restoration of old areas in small and medium-sized cities in Zhejiang Province at present.

(2)model application:

①Input data: Current status indicator data (such as current population density, scale of old buildings, economic vitality, etc.).

②Output result:

A. Rank the correlation between each element (such as scale, population, economy, etc.) and the restoration demand, and clearly define the priority (for example, population outflow may have the highest correlation).

B. Diagnose current problems (such as the correlation between lagging economic development and insufficient infrastructure).

(3) Example: Through current data calculation, it is found that the grey correlation between "population aging" and "insufficient community service facilities" is the highest and needs to be prioritized in planning.

2. Analysis of the old area restoration　Planning Scheme

(1) Objective: To evaluate the feasibility and effectiveness of different planning schemes and optimize resource allocation.

(2) model application　:

①Input data: Predicted or simulated data for different schemes (such as the area of new public space, investment in traffic renovation, etc.).

②Output result　:

A. Determine the correlation among various indicators within the plan and screen out restoration strategies that require less investment but have high efficiency (such as prioritizing the development of small and micro businesses rather than large-scale demolition).

B. Compare the total score of grey correlation among multiple schemes to assist in decision-making (for example, Scheme A has a significantly better correlation than Scheme b in the dimension of "economic activation").

(3) Example: Comparing the two schemes of "preserving the appearance of historical districts" and "commercial development", it is found that the former has a higher correlation with "cultural gene protection", while the latter has a more significant effect on "short-term economic benefits".

3. Analysis of results

(1) Objective: Verify the implementation effect of the restoration and provide feedback to adjust the subsequent strategy.

(2) model application:

①Input data: restoration actual monitoring data (such as the population return rate after the transformation, GDP growth rate, etc.).

②Output result:

A. The difference in the correlation between the actual effect and the planned goal, and the identification of implementation deviations (for example, the expected "industrial upgrading" has a high correlation, but the actual "insufficient job

positions" drag down the effect).

B. Dynamically optimize the model weights to enhance the accuracy of future predictions (for example, it is found that the actual impact weight of "public service support" needs to be increased).

(3) Example: After the transformation, the economic indicators have improved, but the grey relational analysis shows that the "younger population structure" has not met expectations. It is necessary to supplement the talent introduction policy.

3.5.5.2 Verification of Model universality

(1) Cross-stage basis for application

Method Uniformity: The core of GRA is through dimensionless data and correlation calculation, which is not dependent on specific time points and is suitable for horizontal (current situation comparison) and vertical (time series change) analysis.

Metric flexibility: The model weights can be dynamically adjusted (for example, focusing on "feasibility" in the planning stage and "effectiveness" after implementation) to adapt to the goals of different stages.

(2)Notes

Timeliness of data: Ensure that the data at all stages are consistent (such as the demographic range, the basis for measuring economic indicators).

Dynamic calibration of weights: It is recommended to regularly adjust the weights based on implementation feedback (e.g., increase the weight of "ecological environment" after outcome analysis).

(3) Summary of the Universality of the Grey Model

The grey relation model has full-cycle applicability , but the data input and weight calibration strategies need to be adjusted for different stages. Recommendation ：

Current situation analysis: Identify the core problem, clarify the planning direction;

Planning stage: Comparison of multiple options, precise allocation of resources;

Result analysis: Effect validation, model iterative upgrade.

Through the three-stage closed-loop application, not only can the scientific nature of restoration in the old area be enhanced, but also the dynamic adaptability of the model can be strengthened.

## 3.6 Summary of the chapter

This chapter conducts an in-depth exploration of the old urban areas of small and medium-sized old urban area in Zhejiang Province, and the evaluation indicators of the old urban areas of small and medium-sized cities in Zhejiang established based on commonalities and particularities. Firstly, a detailed review was conducted on the old old urban area of small and medium-sized cities in Zhejiang Province, including the connection issues between new and old urban areas, the utilization status of old urban areas, regional characteristics and influencing factors. This revealed the commonalities and particularities existing in the current situation of old urban area, providing a solid foundation for the selection and establishment of grey relation evaluation indicators. Furthermore, the objects and process methods in the grey relation model were clarified. Based on the commonalities and characteristics existing in the old areas of small and medium-sized old urban area in Zhejiang Province, the corresponding four major restoration goals were proposed, including the functional repair goal, the environmental repair goal, the social and cultural restoration goal, and the economic benefit improvement goal. Based on the corresponding urban restoration evaluation index cases, an evaluation system, rating logic and evaluation levels for the restoration of old areas in small and medium-sized cities in Zhejiang were established. Eventually, evaluation indicators with the characteristics of old areas in small and medium-sized cities in Zhejiang and the corresponding restoration goals were screened out, and a grey relation evaluation system for old areas in small and medium-sized cities in Zhejiang that can be vertically compared, horizontally compared and self-dynamically restoration was comprehensively formed. Finally, the configuration of each element and each design process of the grey relation model in the restoration of old areas in small and medium-sized cities in Zhejiang Province was demonstrated, and it was proved that it has the adaptability of each link and each stage. This chapter provides the basis of the evaluation system for the subsequent proposal of restoration strategies and practices, and clarifies the necessity and urgency of the Study on the evaluation system of old districts in small and medium-sized old urban area in Zhejiang.

# Chapter 4: Evaluation and Analysis of Restoration Cases in Zhejiang

## 4.1 Case study on optimization of old urban area in Zhejiang

During the development process of a city, different types of old urban area are generated. Therefore, their spatial forms and the development logic of the environment are also different, and their responses to restoration logics and methods are also different. This paper selects three representative high-density old urban area restoration cases with Zhejiang characteristics for analysis.

### 4.1.1 Quzhou Shuitingmen Restoration

(1) Overview of the Shuitingmen Project

Located in the western part of Zhejiang Province, Quzhou has a population of 2.27 million, of which 950,000 are in the urban area, which belongs to the category of small and medium-sized cities. Quzhou benefits from its excellent geographic location and superior shipping value, thus gaining the reputation as a thoroughfare of four provinces and becoming the center of commerce and trade in western Zhejiang. Since the era of the Southern Song Dynasty when the Northern Kong moved south, Quzhou has integrated the cultural and social customs of the whole country and combined them with the local regional characteristics of Zhejiang, building a large number of clan temples and clubs in the Shuitinmen area, and gradually expanding on this basis to become a cluster of civic buildings in the Ming and Qing Dynasties. However, with the development of modern cities and the rise of land transportation railroads, the Shuitinmen neighborhood gradually fell into disrepair, the functions of the area were gradually deactivated, and the neighborhood texture gradually declined. 2013 Quzhou government responded to the policy of urban restoration, and with the goal of revitalizing the historical ancient neighborhoods, a series of restoration measures were made in the Shuitinmen neighborhood, which, through the three-year attempts, succeeded in revitalizing the neighborhood's public space, and became an early successful case of urban restoration in Zhejiang Province, which has the characteristics of a successful case. It has become an early successful case of urban restoration in Zhejiang Province, and its traditional characteristics of the district have guiding value in the restoration projects of similar traditional old cities in the remaining counties in Zhejiang Province. Its exploration of public space and the

success of functional environmental repair fits the author's concern for the restoration of old cities in Zhejiang.



Figure 4-1 The old landscape of Shuitingmen

Source：Author

(2) Restoration strategies and processes

Shuitinmen was intervened by the Quzhou Municipal Government in 2013 to carry out the renovation and protection of the relevant cultural neighborhood.

As the Shuitinmen Historical and Cultural Block is one of the only two historical and cultural blocks in Quzhou, it is also the block with the highest concentration of traditional features and historical and cultural sites in Quzhou. Therefore, the Quzhou government has been committed to the protection and transformation of this block, and has invited experts to research and demonstrate several times: in 1997 and 2001, experts in ancient architecture from Tongji University did the protection planning, and in 2010, Zhejiang University organized the "Shuitimen Cultural Heritage Report" to lay the foundation, and in 2012, the Quzhou government took the lead in demonstrating the protection and utilization of Shuitimen's historical and cultural

block for many times, and architect Wang Shu put forward the idea of "Shuitimen Historical and Cultural Block", which is the most important historical and cultural block in Quzhou. Architect Wang Shu put forward "to store its truth, inject architectural cultural elements, symbols" to weave the "Shuitinmen Historical and Cultural Neighborhood Protection Plan", and issued the "Quzhou City Historical and Cultural Neighborhood Protection and Management Measures" in 2013 to promote the protection project in terms of mechanism, and ultimately formed a point-line-face protection mode.
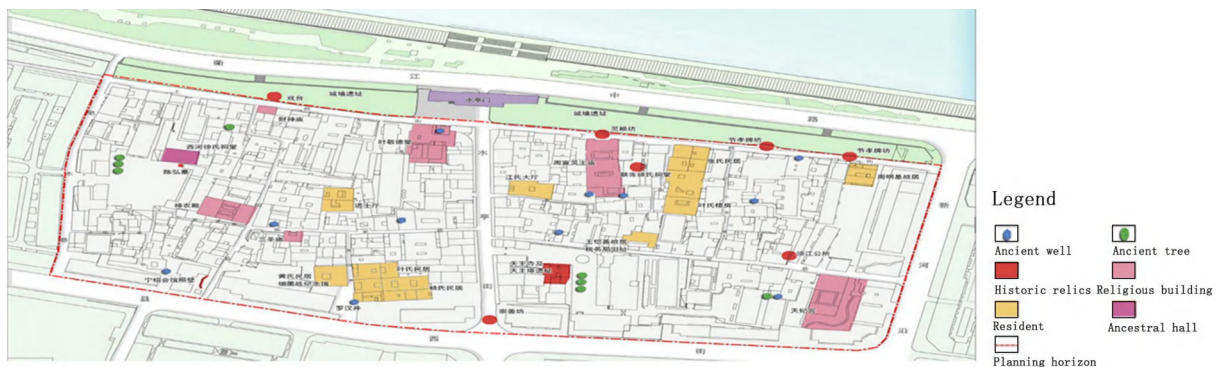


Figure 4-2 Shuitingmen protected buildings distribution

Source：Reference[82]

In 2013, the government finalized the Shuitinmen urban restoration approach: to carry out preservation and restoration of the old buildings and most of the old houses in the neighborhood, the innovative model of "acquisition in front, expropriation in tandem" involves a total of 387 households, with a total floor area of 3,978 square meters. Which take "market operation, government-led" mode, flexibility to increase the protection and utilization of the area of the special incentives, improve the compensation fee, at the same time the introduction of three-party owners to buy, the purpose of weakening the dominant position of the government, but also to strengthen the enthusiasm of the head of household. This model completed the recovery of property rights in just three months [81].

Shuitingmen Area adopts a phase I and phase II phased development mode, the first phase was carried out in 2013, involving the area of the area covers an area of about 10 hectares, focusing on the implementation of the upper and lower Yingjie Street, Tianwangtian Pagoda Yard, Ye Jingde Hall, Xinmin Elementary School's restoration and architectural whitewashing, etc., covering a land area of 43,000 square meters, a housing floor area of 27,469 square meters, 5,500 square meters of complementary architecture, and the restoration of Tianwangtian Pagoda Yard of

3,200 square meters . It has formulated the Measures for the Management of Businesses in Shuitinmen Historical and Cultural Neighborhood and the Daily Mechanism for the Settlement of Merchants in Shuitinmen Historical and Cultural Neighborhood, forming a leisure place for cafes, restaurants and specialties, and rearranging the layout of the residential area, the living area, and the commercial area to adapt to the needs of the times. The second phase of the project is dedicated to the construction of "Confucianism Culture Industry Demonstration Zone", which connects the Water Pavilion Gate to the Confucius Temple by using public spaces such as sky corridors, forming a cultural corridor with strong interaction and publicity to activate the space along the city. Since the project was completed in September 2016, it has received more than 25 million tourists, opened 50 shops, with an opening rate of 95%, becoming a new landmark for cultural tourism in Quzhou[82].

As of 2023, the area of the Shuitingmen neighborhood is 12 hectares. There are 14 national, provincial and municipal key cultural relics protection units, 59 historical buildings, and more than 120 ancient residences. The city wall of more than 1,500 meters and 1,000 meters of the city wall site, six city gates and a complete moat are among the best in the protection of city walls at the prefectural and state levels in China. In the process of restoration, the maintenance project is based on the principle of minimum intervention, repairing and restoring historical buildings, and implementing street repairs and facade renovation on Huangnian Alley, Tianwangxiang Alley, and Chaijia Alley, etc. The project is also based on the principle of "identity". Taking Nankong Confucianism, which is the core of the "sense of identity", as a carrier, the project builds small landscapes to connect and activate the public relevance among the historical buildings.



Figure 4-3 Shujingmen Shop Distribution

Source：Reference[82]

(3) The thoughts of restoration in old areas
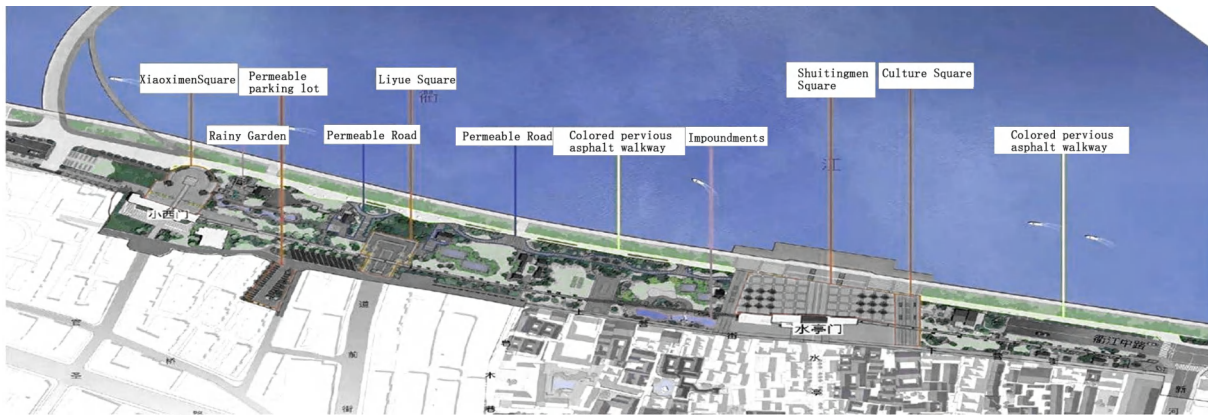


Figure 4-4 Shujingmen Public Space Structure

Source：Reference[81]

Shuitingmen Area explores the way of interaction between individual groups and space, with the first purpose of restoring the collective impression and culture of the city, and adopts many means to activate the public nature of Shuitingmen, which is especially significant in the consumer function and waterfront ecology. Due to the weakening of traditional industries, the neighborhood life has been weakened, and the traditional businesses have been declining. Due to the rough development, the industrial level of the neighborhood is low and lacks the relevance of the neighborhood, which does not match with the contemporary consumption and leisure. Therefore, Shuitingmen has created a government-led, protection-oriented public-private partnership PPP model, determined the positioning of "tourism, culture and leisure area", promoted the specific business investment and commercial operations and transformation of the neighborhood, and formed a repair of commercial functions for the purpose of cultural propaganda, and a mode of business enhancement for the development of non-heritage culture. It has formed a mode of business enhancement for the purpose of cultural promotion and the expansion of non-heritage culture. In the Shuitinmen neighborhood, the catering industry accounts for the largest part of the industry, more than one-third of the volume. Secondly, the expansion of ecological space focuses on the repair of the water system: the hardware of the old city lags far behind that of the new city, and the old sewerage system has always been a problem of flooding in the old city, and the long rainy season in Zhejiang is also the core of the problem of ecological measures. Therefore, Shuitinmen Phase II took the opportunity of "Zhejiang Sponge City Pilot" to take the relevant construction in 2016. Shuitinmen sponge city renovation of a total of 16,000

square meters, involving savings 4 parks (8,742 square meters), 1 rain garden, 2 cisterns, etc., the construction of sponge city has improved the water storage capacity of the Shuitinmen, and the construction of waterfront space has also strengthened the connection between Shuitinmen and nature, reflecting the "landscape Zhejiang" construction concept. Construction concept.

## 4.1.2 Shengsi Old Area Restoration

(1) Overview of Shengsi Old area Project

Shengsi Old area is located on the main island of Shengsi, Sijiao Island, with the government stationed in Caiyuan area, which is one of the few established island counties in China. With a population of just over 60,000, a GDP of 12 billion in 2023, a per capita GDP of up to more than 200,000 RMB, and a per capita disposable income of 63,000 RMB, Shengsi belongs to China's highly-developed island counties, and is considered to be one of China's only four island counties whose urban areas are not connected to the mainland by highways. Shengsi Old area is located on the west side of Caiyuan area, belonging to the mountain plain terrain, with higher terrain in the southwest and east directions, the slope of the majority of houses is lower than 25°, and the overall northward, Shengsi Old area has a better mountain pass system. The Old area was built during the Northern Song Dynasty and gradually formed into a sizable areaship in the late Qing Dynasty and early Republic of China. Since the beginning of the new century, Caiyuan area has expanded to the east, but due to its high concentration of stores and historical districts, it is still the bustling commercial center of Shengsi.
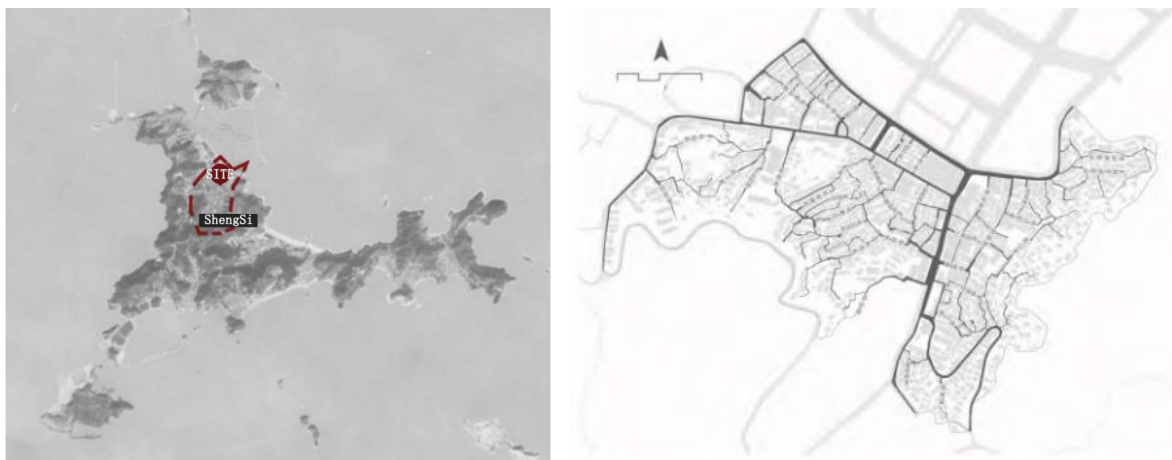


Figure 4-5 Shengsi Old Area

Source：author

Due to the parallel development pattern of the old and the new in Shengsi County, a strong contrast in spatial texture is gradually formed: the old city has a highly dense population with predominantly ground-floor buildings, while the new city is spatially well-ordered and predominantly multi-storey. The external streets of the old city are appropriately scaled for vehicular traffic, while the internal space of the old city is tightly packed, with intricate and confined alleys that resemble mazes and blood vessels [83]. But at the same time, the historical development of the old city exists in the natural growth of the texture, is in line with the history and fisheries function of the spatial survival, the building is built according to the mountains and the sea, the density of the street is large density of the mountain is small, very mountain and sea characteristics. And the old city streets are mostly between 1-3m, width to height ratio between 0.1-0.6, scale changes are rich, bringing multi-level spatial experience, and therefore the types of streets can be divided into three types: flat slope type, ramp type and stairway type. The combination of streets with various scales and forms forms the richly changing spatial experience of Shengsi's Old area, which is adapted to nature and local conditions, and is also the best expression of Shengsi's Old area's style. The complex and varied spatial forms of Shengsi are the bearers of Shengsi's mountain and sea life and urban memory.



Figure 4-6 Old appearance of Shengsi Tiger Stove

Source：Reference[83]

(2) Restoration strategies

Shengsi Old City transformation began in 2021, the core area of the street opened in early 2022, the transformation including the function and environment repair repair and Zhejiang urban renewal power and background. The old city's restoration draws on Shanghai's micro-restoration: progressive community political transformation, quick decision-making, point by point, precise cuts into public areas such as buildings,

courtyards, parks, facades, and environmental streets and alleys in the old district in order to improve the comprehensive upgrading of the community. At the same time, Shengsi Old area prioritizes the assessment and protection of historical resources and traditional architectural areas. Due to the successful promotion and application of the PPP model by the Zhejiang Provincial Government, Shengsi Old area has also adopted a model that focuses on the government's capital investment, drives third-party intervention, and coordinates the interests of all parties, so that the historical neighborhoods are able to enter into the positive feedback of restoration quickly. As for the old city's lack of value of the contiguous dangerous housing areas, through the demolition and redevelopment, the government tenders to take the lead, leading the demolition and resettlement program, and selecting the best developers to carry out the upgrading of the blocks to improve the vitality and quality of the old city. At the same time, the old city is actively carrying out facility restoration for public buildings such as hospitals schools parks.
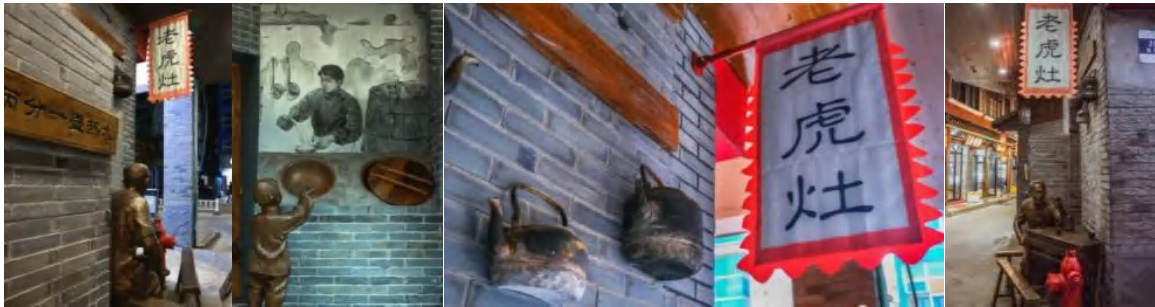


Figure 4-7 Shengsi Tiger Stove Restoration

Source：Author

The restoration strategies of Shengsi old city are revitalization of old streets, beautification of homes, improvement of facilities and street parks, and these four strategies have a certain construction sequence. First of all, the streets and alleys of Shengsi Old area are the most important spatial carriers of culture and materials, and also the foundation of revitalizing the old streets. After analyzing the hierarchy, characteristics and overall pattern of the street space, Shengsi Old area has sorted out the direction of street reconstruction and put forward the main orientation of "community life, style enhancement and cultural display", which repairs and preserves the traditional living space and order of the streets in the old area. The use of traditional courtyards and corner spaces creates nodes and public spaces with the characteristics of the old city, increasing the unique flavor and attractiveness of the old city. Secondly, it avoids large-scale demolition and construction, sorts out and

organizes the landscape according to the regional characteristics of the old city, summarizes the material and humanistic characteristics of the region from the perspectives of architectural style, volume, height, etc., and puts forward specific strategies from the façade, courtyard, etc., so as to protect the order and characteristics of the original old street space.
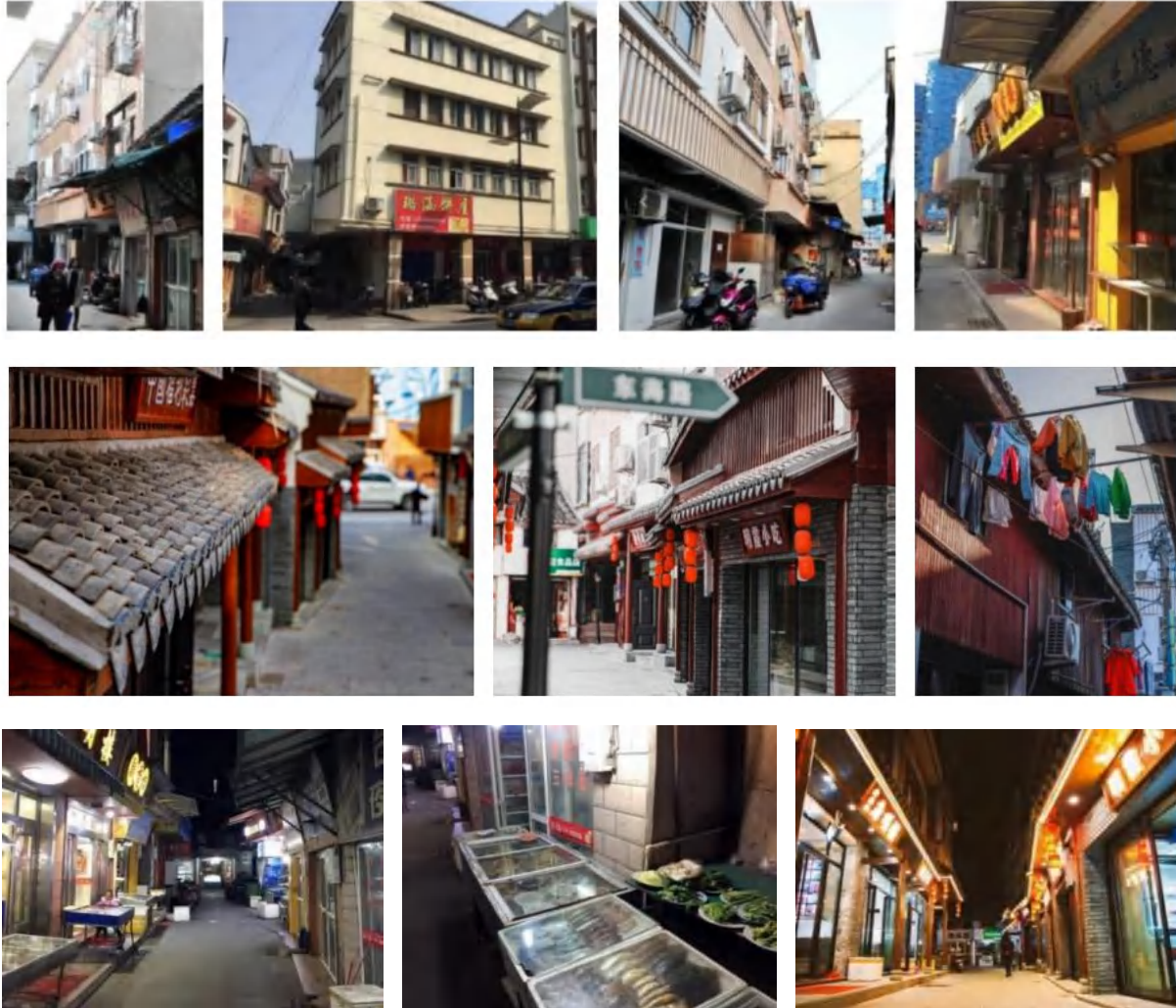


Figure 4-8 Comparison of Shengsi Old Area Restoration

Source：Web

At the same time, demolish illegal buildings, dangerous houses, etc., and carry out repairs and restoration of building facades, courtyards and roofs. In addition, according to the actual demand for public facilities restoration and renovation, combined with the community's needs, focusing on the transformation of community recreation, office, parking and other needs. Build parking lots, increase non-motorized parking space, and focus on the installation of fire fighting facilities to deal with the fire fighting problems in small streets and alleys. Finally, the restoration and construction of street parks, research and integration of old city spaces, combined

with the intentions of local residents, updating the pedestrian street and landscaped water bodies on Shahe Road, encouraging commercial outward swing, which improves the vitality of the old city's commercial; at the same time, construction and renovation of mountain parks, the addition of walking trestles and resting places, and so on. The above restoration strategy has been proposed since 2021 and started to be implemented in 2022, responding to the call for urban restoration in Zhejiang and gradually achieving certain results.

## 4.1.3 Linhai Ziyang Area Restoration

(1) Linhai Ziyang Area Project Overview

Linhai City is located in the western coast of Zhejiang Province, the ancient name of Taizhou Prefecture, was founded in the Sui and Tang dynasties, has a long history and economic prosperity - population of one million people, GDP of 89.2 billion in 2023, per capita disposable income of 55,100 yuan, fiscal revenues amounted to 6.8 billion yuan, is a medium-sized county in Zhejiang Province, the economic aspects of the weak, but is still among the more affluent county-level units. Linhai ancient city, formed in the Tang and Song dynasties, north to the foot of Beigu Mountain, an area of 231.6 hectares. 49,000 people live in 2.29 square kilometers of narrow space, per capita land of 46.71 square meters, Ziyang Street, the entire street length of 1,080 meters, width of 4-5 meters, the street was high in the north and south of the low trend, to the green stone brick pavement, through the entire ancient city of Linhai, linking up the Linhai many historical monuments along the street, shop houses still retain the Ming and Qing dynasties. The stores and houses along the street still retain the style and pattern of the Ming and Qing Dynasties, condensing all of Linhai's history, culture and urban imprints, so Ziyang Ancient Street has been protected by the first batch of national funding, and is a symbol of Linhai's cultural tourism. The characteristics of Ziyang Ancient Street are centered on architecture and culture: there are many historical monuments in Ziyang Street, including ancient wells, square walls, horse head walls, etc., which are very characteristic of Jiangnan. Among them, there are many ancient wells, including the Republic of China to the Ming and Qing dynasties, the oldest of which is still in use for more than 300 years. The ancient wells are well laid out according to the actual needs, with different depths but mostly about three meters, and the water temperature is warm in winter and cool in summer. The water is warm in winter and cool in summer, and the wells are protected by stone

circles because they have been well cared for by the residents over the generations. The most famous stone well when the thousand Buddha well, because of its well wall tattooed with a thousand Buddha statues named, but also because of its proximity to the Xing Shanmen with double holes, also known as "double well". Ziyang Street has a long history, so there are five walls preserved, the walls are mostly built of green bricks, wall height of more than 10 meters. Street on both sides of the building for the front store after the house or under the store on the house, the architectural style close to the Huizhou architecture, there is a horse-head wall separation, fire prevention, but also appears to be staggered, with the dynamic beauty of the undulation of the high and low. In addition, Ziyang Street is famous for the protection of traditional culture, the street retains a large number of Linhai's traditional skills and food, including Linhai paper-cutting, straw weaving and making ancient technology.
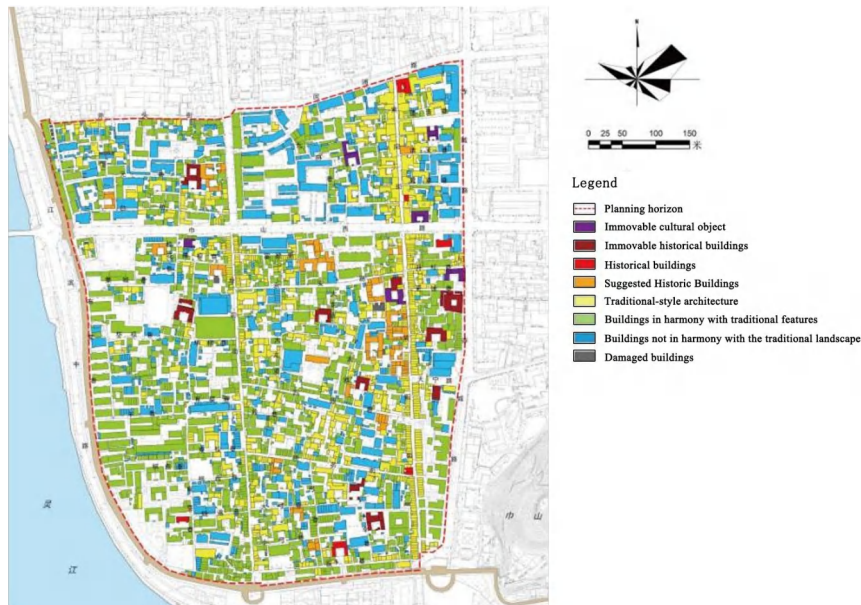


Figure 4-9 Distribution of ancient architectural heritage

Source：Reference[7]

At the beginning of the 21st century, the Linhai Ziyang area went through several renovations and urban restoration, and the turnover of the Ziyang neighborhood in 2021 reached more than 300 million yuan, which is five times as much as that before the renovation, and the traffic volume also exceeded 12 million passengers.

(2) Strategies for the restoration

It can be summarized into four directions: architectural heritage protection and restoration, integration of old and new industries, updating of supporting facilities and integration of the natural environment. Architectural heritage protection and

restoration is a prerequisite for maintaining the architectural appearance and cultural landscape through repairs, while fully exploring its value in the new era. For example, the ancient buildings in the streets of Ziyang have been restored by incorporating the functions required by today's life and restoring the lack of modernity in the old neighborhoods, such as the People's Bank of China and the Zhu Ziqing Memorial Hall, etc. Also, through the historical buildings, Linhai's characteristic skills and non-legacy are actively displayed: straw weaving, clay sculpture, paper-cutting and so on. The "Thousand Buddha Well" was repaired to restore its real appearance and its value as a well. At the same time, the use value of the building was assessed, including the identification of dangerous buildings, based on which the demolition of dangerous buildings and illegal constructions was actively promoted. Secondly, the needs of the residents of the old street were also improved. During the restoration process, attention was paid to the actual needs of both tourists and residents, including the redistribution of the parking lot, so that the parking problems of the residents were actively improved.



Figure 4-10 Architectural Restoration and Preservation

Source：author

The remodeling and upgrading of small clinics, post offices, express delivery services, and schools, as well as the improvement of the pipeline system, have upgraded the basic hardware to meet the needs of the residents' lives. Moreover, Linhai Old area actively introduces new industries to attract young people to revitalize the neighborhood. Therefore, Linhai Old area actively introduces the trend operation team, devotes itself to excavating the historical value behind, and designs and develops many peripheral products to inject new vitality. At the same time, it has linked many neighboring industries, including the combination of food and drink, the collision of traditional and modern, and tried to make new innovations according to local conditions, which has also triggered a large number of tourists to come to visit the neighborhood. Finally, Linhai Ziyang Street actively tries to solve the

environmental problems on the ground, restores the natural slope, actively tries to link the construction of the old city with the sponge city, actively restores the shoreline of Lingjiang River on the west and south sides, and increases the construction of eco-parks in the high-density old city as a way of perfecting the drainage problems of the old city. The remnants of the mountain system in the north are actively constructed to become the scenic spot of Jiangnan City Wall, forming a natural linkage of the old city, and the East Lake Park in the east has become a good node of the water storage system. The east, west, south and north of the old city form a good ecological system to solve the excessive density of the old city, the urban fabric can also be stretched.



Figure 4-11 Linhai Ancient City Node

Source：author

## 4.1.4 Case summaries

These three cases are all based on the author's on-site research and visits, and they have high value and reference significance in the urban restoration and development in Zhejiang. All three cases can highly summarize and generalize the difficulties and key points faced in the restoration of old areas in small and medium-sized cities in Zhejiang Province, and have a very high Zhejiang regional character.

The restoration models, restoration scales, restoration methods and restoration characteristics involved all possess extremely high regional value. Therefore, the model construction of grey relation carried out by its three schemes has fundamental significance for the restoration of old areas in other small and medium-sized cities in Zhejiang.

After studying the cases of restoration in old areas of three medium and small-sized cities in Zhejiang Province, the author has summarized them into the following table.

| Name | Pics | Goals | Year | Main Factors | Effect |
|------|------|-------|------|--------------|--------|
| Shui Ting Men Old Area | | Revitalizing Historic Neighborhoods and Repairing Functional and Ecological Spaces | 2013 - 2016 | 1. Government-led and social capital cooperation; 2. Protection of historical buildings and culture; 3. Combination of ecological repair and functional repair | 1. become a new landmark of culture and tourism, receiving more than 25 million tourists; 2. 95% commercial opening rate; 3. improving ecology and public space |
| Shengsi Old Area | | Enhancing the function and environment of the Old area and preserving historical resources | 2021 - 2022 | 1. Progressive micro-restoration; 2. government funding and third-party cooperation; 3. Preservation of historic districts and buildings | 1. Enhancing the vitality and quality of the old city; 2. to improve public facilities; 3. enhance community attractiveness and commercial vitality |
| Ziyang Old area | | Preserve historical buildings, integrate old and new industries, and upgrade supporting facilities | - 2021 | 1. architectural heritage conservation and restoration; 2. Integration of old and new industries; 3. integration of ecology and the natural environment | 1. neighborhood turnover boosted to over $300 million; 2. Passenger flow exceeded 12 million; 3. Improvement of ecology and infrastructure |

Table 4-1 Case Restoration Comparison

Source：author

## 4.2 "GRA" data acquisition and evaluation of cases

### 4.2.1 "GRA" data collection

The data adopted are the three urban restoration cases in Zhejiang Province mentioned above and the Study objects of this paper, namely the Shuitingmen area of Quzhou City, Zhejiang Province, the old urban area of Shengsi City, Zhejiang Province, the Ziyang area of Linhai City, Zhejiang Province, and the Qinyang Area of Quzhou City, Zhejiang Province.

Data source: Through the author's on-site visits to the old districts of four small and medium-sized old urban area in Zhejiang Province, internship experiences, project experiences, relevant databases of Zhejiang provincial government departments, and combined with the division and calculation of AVC Maps, it is found that the data source is accurate and the data can mutually prove each other.

| Indicator | Shuitingmen | Shengsi Old Area | Linhai Old area | Qinyang |
|---|---|---|---|---|
| E1 | 141000 | 921510 | 2316000 | 521500 |
| E2 | 90 | 80 | 85 | 70 |
| E3 | 85 | 75 | 85 | 75 |
| E4 | 3 | 4 | 2 | 3 |
| E5 | 45 | 30 | 20 | 20 |
| E6 | 55235/39.2 | 160094/17.4 | 651057/28.1 | 108900/20.9 |
| E7 | 50000 | 30000 | 140000 | 15000 |
| E8 | 19207 | 121417 | 631889 | 39800 |
| E9 | 92 | 80 | 95 | 70 |
| E10 | 90 | 75 | 93 | 75 |
| E11 | 20000 | 13697 | 54794 | 1534 |
| E12 | 5 | 2.93 | <1 | 5% |
| E13 | 88 | 24.9 | 46.71 | 36 |
| E14 | 76 | 10.9 | 4.3 | 4.9 |
| E15 | 99 | 99 | 99 | 99 |
| E16 | 0.75 | 1.34 | 0.94 | 0.72 |
| E17 | 2 | 6.5 | 1.6 | 2.2 |
| E18 | 0.35 | 0.07 | 0.08 | 0.15 |
| E19 | 85 | 80 | 90 | 75 |
| E20 | 0.14 | 0.04 | 0.04 | 0.06 |
| E21 | 3.2 | 4.3 | 6.6 | 1.9 |
| E22 | 0.36 | 0.27 | 0.11 | 0.06 |
| E23 | 3757 | 30354 | 423365 | 27860 |
| E24 | 15450 | 91062 | 208523 | 11940 |
| E25 | 90 | 85 | 87 | 75 |
| E26 | 98 | 95 | 99 | 95 |
| E27 | 95 | 93 | 98 | 65 |
| E28 | 90 | 85 | 95 | 70 |
| E29 | 1.25 | 3 | 1.25 | 0.6 |
| E30 | 11021 | 23149 | 153087 | 21200 |
| E31 | 92 | 80 | 95 | 68 |
| E32 | 99 | 98 | 99 | 70 |
| E33 | 94 | 97 | 99 | 75 |
| E34 | 1 | 1 | 1 | 0.5 |
| E35 | 85 | 95 | 90 | 90 |
| E36 | 13.4 | 25.62 | 4 | 0.37 |
| E37 | 1 | 1 | 1 | 0.25 |
| E38 | 95 | 98 | 99 | 65 |
| E39 | 1845 | 1873 | 15000 | 4400 |
| E40 | 30.1 | 25.9 | 26.9 | 5.8 |
| E41 | 26.5 | 6.4 | 22.2 | 2.1 |
| E42 | 4 | 11 | 5 | 6 |

| Indicator | Shuitingmen | Shengsi Old Area | Linhai Old area | Qinyang |
|---|---|---|---|---|
| E43 | 42384 | 238344 | 622203 | 30300 |
| E44 | 27 | 20 | 25 | 12 |
| E45 | 80 | 95 | 98 | 75 |
| E46 | 90 | 70 | 80 | 60 |
| E47 | 92 | 85 | 90 | 50 |
| E48 | 95 | 78 | 97 | 65 |
| E49 | 85 | 80 | 90 | 55 |
| E50 | 98 | 95 | 90 | 75 |
| E51 | 31/94% | 13/97.2% | 22/99.2% | 20/99.2% |
| E52 | II | I/100% | I/100% | I/100% |
| E53 | 64.6 | 51.7 | 51.1 | 52.1 |
| E54 | 99 | 85 | 95 | 97 |
| E55 | 90 | 70 | 90 | 75 |
| E56 | 95 | 85 | 90 | 70 |
| E57 | 88 | 80 | 95 | 75 |
| E58 | 95 | 97 | 98 | 65 |
| E59 | 1.5 | 0.6 | 3.5 | 1.8 |
| E60 | 7.6 | 12.7 | 16.7 | 24.3 |
| E61 | 75 | 95 | 93 | 63 |
| E62 | 93 | 90 | 98 | 65 |
| E63 | 98 | 95 | 99 | 76 |
| E64 | 16 | 7.6 | 10.8 | 4.7 |
| E65 | 8.5 | 0.13 | 0.12 | 0.08 |
| E66 | 95 | 85 | 97 | 77 |
| E67 | 14 | 22 | 139 | 0 |
| E68 | 59 | 31 | 96 | 0 |
| E69 | 40 | 38 | 21 | 5 |
| E70 | 3 | 54 | 5 | 3 |
| E71 | 80 | 95 | 98 | 65 |
| E72 | 0.26 | 0.41 | 0.64 | 0.58 |
| E73 | 13.4 | 25.62 | 16.75 | 10 |
| E74 | 1845 | 1873 | 15000 | 4400 |
| E75 | 96 | 16.52 | 68 | 22.6 |
| E76 | 998 | 142 | 892 | 188 |
| E77 | 6 | 2 | 1 | 1 |
| E78 | 95 | 95 | 97 | 89 |
| E79 | 1.188 | 23 | 63 | 0.75 |
| E80 | 98.7 | 14.6 | 25 | 3.4 |
| E81 | 0.26 | 0.06 | 0.8 | 0.02 |
| E82 | 80 | 95 | 95 | 80 |
| E83 | 95 | 80 | 85 | 60 |

Table 4-2 grey Model Data Collection Form

Source：author

## 4.2.2 "GRA" factor weight and its ranking results and analysis

4.2.2.1 Initialization data

(1) Functional structure objectives

① Location

$$C_{11}=\begin{bmatrix} 0.1530 & 1.0000 & 1.0000 & 1.0000 & 2.2500 \\ 1.0000 & 0.8889 & 0.8824 & 1.3333 & 1.5000 \\ 2.5133 & 0.9444 & 1.0000 & 0.6667 & 1.0000 \\ 0.5659 & 0.7778 & 0.8824 & 1.0000 & 1.0000 \end{bmatrix}$$

② Land use indicators

$$C_{12}=\begin{bmatrix} 1.3950 & 1.0000 & 0.1582 & 0.9684 & 0.9677 & 0.3650 & 5.0000 & 1.8840 \\ 0.6192 & 0.6000 & 1.0000 & 0.8421 & 0.8065 & 0.2500 & 2.9300 & 0.5311 \\ 1.0000 & 2.8000 & 1.0000 & 1.0000 & 1.0000 & 1.0000 & 1.0000 & 1.0000 \\ 0.7438 & 0.3000 & 0.3278 & 0.7368 & 0.8065 & 0.0280 & 5.0000 & 0.7707 \end{bmatrix}$$

③ Service

$$C_{13}=\begin{bmatrix} 6.9725 & 1.0000 & 0.5597 & 0.3077 & 1.0000 & 0.9444 & 1.0000 & 0.4848 & 1.0000 \\ 1.0000 & 1.0000 & 1.0000 & 1.0000 & 0.2000 & 0.8889 & 0.2857 & 0.6515 & 0.7500 \\ 0.3945 & 1.0000 & 0.7015 & 0.2462 & 0.2286 & 1.0000 & 0.2857 & 1.0000 & 0.3056 \\ 0.4495 & 1.0000 & 0.5373 & 0.3385 & 0.4286 & 0.8333 & 0.4286 & 0.2879 & 0.5455 \end{bmatrix}$$

④ Space structure

$$C_{14}=\begin{bmatrix} 0.0413 & 0.5090 & 1.0000 & 0.9899 & 0.9694 & 0.9474 & 1.0000 & 0.4761 & 0.9684 \\ 1.0000 & 1.0000 & 0.9444 & 0.9596 & 0.9490 & 0.8947 & 2.4000 & 1.0000 & 0.8421 \\ 4.6492 & 6.8697 & 0.9667 & 1.0000 & 1.0000 & 1.0000 & 1.0000 & 6.6131 & 1.0000 \\ 0.3059 & 0.3934 & 0.8333 & 0.9596 & 0.6633 & 0.7368 & 0.4800 & 0.9158 & 0.7158 \end{bmatrix}$$

(2) Ecological objective

① Geographical environment, environmental protection

$$C_{21}=\begin{bmatrix} 1.0000 & 0.9691 & 1.0000 & 0.8947 & 3.3500 & 1.0000 & 0.9596 & 1.0000 \\ 0.9899 & 0.9798 & 1.0000 & 1.0000 & 6.4050 & 1.0000 & 0.9899 & 1.0152 \\ 1.0000 & 1.0000 & 1.0000 & 0.9474 & 1.0000 & 1.0000 & 1.0000 & 8.0085 \\ 0.4040 & 0.7576 & 1.0000 & 0.9474 & 0.0925 & 0.2500 & 0.6566 & 2.3848 \end{bmatrix}$$

② Green landscape

$$C_{22}=\begin{bmatrix} 1.0000 & 1.0000 & 0.3636 & 0.6812 & 1.0800 & 0.8163 & 1.0000 & 1.0000 & 0.9794 & 0.9444 \\ 0.8605 & 0.2415 & 1.0000 & 0.3831 & 0.8000 & 0.9694 & 0.7778 & 0.9240 & 0.8041 & 0.8889 \\ 1.0386 & 0.8377 & 0.4545 & 1.0000 & 1.0000 & 1.0000 & 0.8889 & 0.9783 & 1.0000 & 1.0000 \\ 0.2239 & 0.0792 & 0.5455 & 0.0487 & 0.4800 & 0.7653 & 0.6667 & 0.5435 & 0.6701 & 0.6111 \end{bmatrix}$$

③ Greening quality

$$C_{23}=\begin{bmatrix} 1.0000 & 0.9476 & 0.7500 & 1.2495 \\ 0.9694 & 0.9798 & 1.0000 & 1.0117 \\ 0.9184 & 1.0000 & 1.0000 & 1.0000 \\ 0.7653 & 1.0000 & 1.0000 & 1.0196 \end{bmatrix}$$

(3) Socio-cultural objectives

① Publicity

$$C_{31}=\begin{bmatrix} 1.0000 & 1.0000 & 1.0000 & 0.9263 & 0.9694 \\ 0.8586 & 0.7778 & 0.8947 & 0.8421 & 0.9898 \\ 0.9596 & 1.0000 & 0.9474 & 1.0000 & 1.0000 \\ 0.9798 & 0.8333 & 0.7368 & 0.7895 & 0.6633 \end{bmatrix}$$

② Comfortableness

$$C_{32}=\begin{bmatrix} 0.4286 & 0.4551 & 0.7895 & 0.9490 \\ 0.1714 & 0.7605 & 1.0000 & 0.9184 \\ 1.0000 & 1.0000 & 0.9789 & 1.0000 \\ 0.5143 & 1.3807 & 0.6774 & 0.6633 \end{bmatrix}$$

③ Cultural attraction

$$C_{33}=\begin{bmatrix} 0.9899 & 1.0000 & 1.0000 & 0.9794 \\ 0.9596 & 0.4750 & 0.0153 & 0.8763 \\ 1.0000 & 0.6750 & 0.0141 & 1.0000 \\ 0.7677 & 0.2938 & 0.0094 & 0.7938 \end{bmatrix}$$

④ Cultural heritage

$$C_{34}=\begin{bmatrix} 0.1007 & 0.6146 & 1.0000 & 0.0556 & 0.8163 \\ 0.1583 & 0.3229 & 0.9500 & 1.0000 & 0.9694 \\ 1.0000 & 1.0000 & 0.5250 & 0.0926 & 1.0000 \\ 0.0000 & 0.0000 & 0.1250 & 0.0556 & 0.6633 \end{bmatrix}$$

(4) Economic efficiency targets

① Building development

$$C_{41}=\begin{bmatrix} 0.4063 & 1.0000 & 1.0000 & 1.0000 & 1.0000 & 3.0000 \\ 0.6406 & 1.9119 & 1.0152 & 0.1721 & 0.1423 & 1.0000 \\ 1.0000 & 1.2500 & 8.1301 & 0.7083 & 0.8938 & 0.5000 \\ 0.9063 & 0.7463 & 2.3848 & 0.2354 & 0.1884 & 0.5000 \end{bmatrix}$$

② Economic benefit

$$C_{42}=\begin{bmatrix} 0.9794 & 0.0189 & 1.0000 & 0.3250 & 0.8421 & 1.0000 \\ 0.9794 & 0.3651 & 0.1479 & 0.0750 & 1.0000 & 0.8421 \\ 1.0000 & 1.0000 & 0.2533 & 1.0000 & 1.0000 & 0.8947 \\ 0.9175 & 0.0190 & 0.0344 & 0.0250 & 0.8421 & 0.6316 \end{bmatrix}$$

## 4.2.2.2 Composition of the $D_{ij}$ matrix

(1) Functional structure objectives

① Location

$$D_{11}=\begin{bmatrix} 0.8470 & 0.0000 & 0.0000 & 0.0000 & 1.2500 \\ 0.0000 & 0.1111 & 0.1176 & 0.3333 & 0.5000 \\ 1.5133 & 0.0006 & 0.0000 & 0.3333 & 0.0000 \\ 0.4341 & 0.2222 & 0.1176 & 0.0000 & 0.0000 \end{bmatrix}$$

② Land use indicators

$$D_{12}=\begin{bmatrix} 0.3950 & 0.0000 & 0.8418 & 0.0316 & 0.0323 & 0.6350 & 4.0000 & 0.8840 \\ 0.3808 & 0.4000 & 0.0000 & 0.1579 & 0.1935 & 0.7500 & 1.9300 & 0.4689 \\ 0.0000 & 1.8000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ 0.2562 & 0.7000 & 0.6722 & 0.2632 & 0.1935 & 0.9720 & 4.0000 & 0.2293 \end{bmatrix}$$

③ Service

$$D_{13}=\begin{bmatrix} 5.9725 & 0.0000 & 0.4403 & 0.6923 & 0.0000 & 0.0556 & 0.0000 & 0.5152 & 0.0000 \\ 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.8000 & 0.1111 & 0.7143 & 0.3485 & 0.2500 \\ 0.6055 & 0.0000 & 0.2985 & 0.7538 & 0.7714 & 0.0000 & 0.7143 & 0.0000 & 0.6944 \\ 0.5505 & 0.0000 & 0.4627 & 0.6615 & 0.5714 & 0.1667 & 0.5714 & 0.7121 & 0.4545 \end{bmatrix}$$

④ Space structure

$$D_{14}=\begin{bmatrix} 0.9587 & 0.4940 & 0.0000 & 0.0101 & 0.0306 & 0.0526 & 0.0000 & 0.5239 & 0.0316 \\ 0.0000 & 0.0000 & 0.0556 & 0.0404 & 0.0510 & 0.1053 & 1.4000 & 0.0000 & 0.1579 \\ 3.6492 & 5.8697 & 0.0333 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 5.6131 & 0.0000 \\ 0.6941 & 0.6066 & 0.1667 & 0.0404 & 0.3367 & 0.2632 & 0.5200 & 0.0842 & 0.2842 \end{bmatrix}$$

(2) Ecological objective

① Geographical environment, environmental protection

$$D_{21}=\begin{bmatrix} 0.0000 & 0.0309 & 0.0000 & 0.1053 & 2.3500 & 0.0000 & 0.0404 & 0.0000 \\ 0.0101 & 0.0202 & 0.0000 & 0.0000 & 5.4050 & 0.0000 & 0.0101 & 0.0152 \\ 0.0000 & 0.0000 & 0.0000 & 0.0526 & 0.0000 & 0.0000 & 0.0000 & 7.0085 \\ 0.5960 & 0.2424 & 0.5000 & 0.0526 & 0.9075 & 0.7500 & 0.3434 & 1.3848 \end{bmatrix}$$

② Green landscape

$$D_{22}=\begin{bmatrix} 0.0000 & 0.0000 & 0.6364 & 0.3188 & 0.0800 & 0.1837 & 0.0000 & 0.0000 & 0.0206 & 0.0556 \\ 0.1395 & 0.7585 & 0.0000 & 0.6169 & 0.2000 & 0.0306 & 0.2222 & 0.0760 & 0.1959 & 0.1111 \\ 0.0386 & 0.1623 & 0.5455 & 0.0000 & 0.0000 & 0.0000 & 0.1111 & 0.0217 & 0.0000 & 0.0000 \\ 0.7761 & 0.9208 & 0.4545 & 0.9513 & 0.5200 & 0.2347 & 0.3333 & 0.4565 & 0.3299 & 0.3889 \end{bmatrix}$$

③ Greening quality

$$D_{23}=\begin{bmatrix} 0.0000 & 0.0524 & 0.2500 & 0.2495 \\ 0.0306 & 0.0208 & 0.0000 & 0.0117 \\ 0.0816 & 0.0000 & 0.0000 & 0.0000 \\ 0.2347 & 0.0000 & 0.0000 & 0.0196 \end{bmatrix}$$

(3) Socio-cultural objectives

① Public character

$$D_{31}=\begin{bmatrix} 0.0000 & 0.0000 & 0.0000 & 0.0737 & 0.0306 \\ 0.1414 & 0.2222 & 0.1053 & 0.1579 & 0.0202 \\ 0.0404 & 0.0000 & 0.0526 & 0.0000 & 0.0000 \\ 0.0202 & 0.1667 & 0.2632 & 0.2105 & 0.3367 \end{bmatrix}$$

② Comfortableness

$$D_{32}=\begin{bmatrix} 0.5714 & 0.5449 & 0.2105 & 0.0510 \\ 0.8286 & 0.2395 & 0.0000 & 0.0816 \\ 0.0000 & 0.0000 & 0.0211 & 0.0000 \\ 0.4857 & 0.3807 & 0.3226 & 0.3367 \end{bmatrix}$$

③ Cultural attraction

$$D_{33}=\begin{bmatrix} 0.0101 & 0.0000 & 0.0000 & 0.0206 \\ 0.0404 & 0.5250 & 0.9847 & 0.1237 \\ 0.0000 & 0.3250 & 0.9859 & 0.0000 \\ 0.2323 & 0.7062 & 0.9906 & 0.2062 \end{bmatrix}$$

④ Cultural heritage

$$D_{34}=\begin{bmatrix} 0.8993 & 0.3854 & 0.0000 & 0.9444 & 0.1837 \\ 0.8417 & 0.6771 & 0.0500 & 0.0000 & 0.0306 \\ 0.0000 & 0.0000 & 0.4750 & 0.9074 & 0.0000 \\ 1.0000 & 1.0000 & 0.8750 & 0.9444 & 0.3367 \end{bmatrix}$$

(4) Economic efficiency targets

    ① Building development

$$D_{41}=\begin{bmatrix} 0.5437 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 2.0000 \\ 0.3594 & 0.9119 & 0.0152 & 0.8379 & 0.8577 & 0.0000 \\ 0.0000 & 0.2500 & 7.1301 & 0.2917 & 0.1062 & 0.5000 \\ 0.0937 & 0.2537 & 1.3848 & 0.7646 & 0.8116 & 0.5000 \end{bmatrix}$$

    ② Economic benefit

$$D_{42}=\begin{bmatrix} 0.0206 & 0.9811 & 0.0000 & 0.6750 & 0.1579 & 0.0000 \\ 0.0206 & 0.6349 & 0.8521 & 0.9250 & 0.0000 & 0.1579 \\ 0.0000 & 0.0000 & 0.7467 & 0.0000 & 0.0000 & 0.1053 \\ 0.0825 & 0.9810 & 0.9656 & 0.9750 & 0.1579 & 0.3684 \end{bmatrix}$$

4.2.2.3 Composition of the $L_{ij}$ matrix

(1) Functional structure objectives

    ① Location

$$L_{11}=\begin{bmatrix} 1.0000 & 1.0000 & 1.0000 & 1.0000 & 0.3771 \\ 1.0000 & 0.8720 & 0.8655 & 0.6942 & 0.6021 \\ 0.3333 & 0.9992 & 1.0000 & 0.6942 & 1.0000 \\ 0.6355 & 0.7730 & 0.8655 & 1.0000 & 1.0000 \end{bmatrix}$$

    ② Land use indicators

$$L_{12}=\begin{bmatrix} 0.8351 & 1.0000 & 0.7038 & 0.9844 & 0.9841 & 0.7590 & 0.3333 & 0.6935 \\ 0.8401 & 0.8333 & 1.0000 & 0.9268 & 0.9118 & 0.7273 & 0.5089 & 0.8101 \\ 1.0000 & 0.5263 & 1.0000 & 1.0000 & 1.0000 & 1.0000 & 1.0000 & 1.0000 \\ 0.4699 & 0.7407 & 0.7484 & 0.8837 & 0.9118 & 0.6729 & 0.3333 & 0.8971 \end{bmatrix}$$

    ③ Service

$$L_{13}=\begin{bmatrix} 0.3333 & 1.0000 & 0.8715 & 0.8118 & 0.9817 & 0.9817 & 1.0000 & 0.8529 & 1.0000 \\ 1.0000 & 1.0000 & 1.0000 & 1.0000 & 0.7887 & 0.9641 & 0.8070 & 0.8955 & 0.9228 \\ 0.8314 & 1.0000 & 0.9091 & 0.7985 & 0.7947 & 1.0000 & 0.8070 & 1.0000 & 0.8113 \\ 0.8552 & 1.0000 & 0.8658 & 0.8187 & 0.8394 & 0.9471 & 0.8394 & 0.8075 & 0.8679 \end{bmatrix}$$

    ④ Space structure

$$L_{14} = \begin{bmatrix} 0.7538 & 0.8559 & 1.0000 & 0.9966 & 0.9897 & 0.9824 & 1.0000 & 0.8485 & 0.9893 \\ 1.0000 & 1.0000 & 0.9814 & 0.9864 & 0.9829 & 0.9654 & 0.6770 & 1.0000 & 0.9489 \\ 0.4458 & 0.3333 & 0.9888 & 1.0000 & 1.0000 & 1.0000 & 1.0000 & 0.3433 & 1.0000 \\ 0.8087 & 0.8287 & 0.9463 & 0.9864 & 0.8970 & 0.9177 & 0.8495 & 0.9721 & 0.9117 \end{bmatrix}$$

(2) Ecological objective

① Geographical environment, environmental protection

$$L_{21} = \begin{bmatrix} 1.0000 & 0.9913 & 1.0000 & 0.9708 & 0.5986 & 1.0000 & 0.9886 & 1.0000 \\ 0.9971 & 0.9943 & 1.0000 & 1.0000 & 0.3933 & 1.0000 & 0.9971 & 0.9957 \\ 1.0000 & 1.0000 & 1.0000 & 0.9852 & 1.0000 & 1.0000 & 1.0000 & 0.3333 \\ 0.8546 & 0.9353 & 0.8751 & 0.9852 & 0.7943 & 0.8237 & 0.9108 & 0.7168 \end{bmatrix}$$

② Green landscape

$$L_{22} = \begin{bmatrix} 1.0000 & 1.0000 & 0.4202 & 0.5987 & 0.8560 & 0.7214 & 1.0000 & 1.0000 & 0.9585 & 0.8954 \\ 0.7732 & 0.3854 & 1.0000 & 0.4354 & 0.7040 & 0.9396 & 0.6816 & 0.8622 & 0.7083 & 0.8107 \\ 0.9249 & 0.7456 & 0.4658 & 1.0000 & 1.0000 & 1.0000 & 0.8107 & 0.9564 & 1.0000 & 1.0000 \\ 0.3800 & 0.3406 & 0.5114 & 0.3333 & 0.4778 & 0.6696 & 0.5880 & 0.5103 & 0.5905 & 0.5502 \end{bmatrix}$$

③ Greening quality

$$L_{23} = \begin{bmatrix} 1.0000 & 0.7046 & 0.3333 & 0.3338 \\ 0.8033 & 0.8573 & 1.0000 & 0.9144 \\ 0.6050 & 1.0000 & 1.0000 & 1.0000 \\ 0.3475 & 1.0000 & 1.0000 & 0.8645 \end{bmatrix}$$

(3) Socio-cultural objectives

① Public character

$$L_{31} = \begin{bmatrix} 1.0000 & 1.0000 & 1.0000 & 0.6956 & 0.8462 \\ 0.5436 & 0.4311 & 0.6153 & 0.5161 & 0.8929 \\ 0.8065 & 1.0000 & 0.7620 & 1.0000 & 1.0000 \\ 0.8929 & 0.5025 & 0.3902 & 0.4444 & 0.3333 \end{bmatrix}$$

② Comfortableness

$$L_{32} = \begin{bmatrix} 0.4203 & 0.4319 & 0.6631 & 0.8904 \\ 0.3333 & 0.6337 & 1.0000 & 0.8355 \\ 1.0000 & 1.0000 & 0.9515 & 1.0000 \\ 0.4603 & 0.5211 & 0.5622 & 0.5517 \end{bmatrix}$$

③ Cultural attraction

$$L_{33} = \begin{bmatrix} 0.9800 & 1.0000 & 1.0000 & 0.9601 \\ 0.9246 & 0.4854 & 0.3347 & 0.8002 \\ 1.0000 & 0.6038 & 0.3344 & 1.0000 \\ 0.6807 & 0.4122 & 0.3333 & 0.7061 \end{bmatrix}$$

④ Cultural heritage

$$L_{34} = \begin{bmatrix} 0.3573 & 0.5647 & 1.0000 & 0.3462 & 0.7313 \\ 0.3727 & 0.4248 & 0.9091 & 1.0000 & 0.9423 \\ 1.0000 & 1.0000 & 0.5128 & 0.3553 & 1.0000 \\ 0.3333 & 0.3333 & 0.3636 & 0.3462 & 0.5976 \end{bmatrix}$$

(4) Economic efficiency targets

① Construction and development

$$L_{41} = \begin{bmatrix} 0.8677 & 1.0000 & 1.0000 & 1.0000 & 1.0000 & 0.6406 \\ 0.9084 & 0.7963 & 0.9958 & 0.8097 & 0.8061 & 1.0000 \\ 1.0000 & 0.9345 & 0.3333 & 0.9244 & 0.9711 & 0.8770 \\ 0.9744 & 0.9336 & 0.7202 & 0.8234 & 0.8146 & 0.8770 \end{bmatrix}$$

② Economic benefit

$$L_{42} = \begin{bmatrix} 0.9597 & 0.3333 & 1.0000 & 0.4209 & 0.7565 & 1.0000 \\ 0.9597 & 0.4359 & 0.3654 & 0.3466 & 1.0000 & 0.7565 \\ 1.0000 & 1.0000 & 0.3965 & 1.0000 & 1.0000 & 0.8233 \\ 0.8560 & 0.3334 & 0.3369 & 0.3347 & 0.7565 & 0.5711 \end{bmatrix}$$

4.2.2.4 Calculation of weights

| Indicator | $\bar{l}_j$ | $C_v$ | $W_j$ | W total |
|---|---|---|---|---|
| E1 | 0.7778 | 0.4445 | 0.4086 | |
| E2 | 0.9571 | 0.0737 | 0.0678 | |
| E3 | 0.9552 | 0.0777 | 0.0714 | 1.0000 |
| E4 | 0.7961 | 0.1766 | 0.1623 | |
| E5 | 0.6597 | 0.3154 | 0.2899 | |
| E6 | 0.8917 | 0.0938 | 0.0756 | |
| E7 | 0.7865 | 0.2402 | 0.1937 | |
| E8 | 0.9013 | 0.1710 | 0.1379 | |
| E9 | 0.9704 | 0.0386 | 0.0311 | |
| E10 | 0.9653 | 0.0471 | 0.0380 | 1.0000 |
| E11 | 0.8288 | 0.1492 | 0.1203 | |
| E12 | 0.6141 | 0.3456 | 0.2786 | |
| E13 | 0.8345 | 0.1548 | 0.1248 | |
| E14 | 0.7216 | 0.3467 | 0.3235 | |
| E15 | 1.0000 | 0.0000 | 0.0000 | 1.0000 |

| Indicator | $\bar{l}_j$ | $C_v$ | $W_j$ | W total |
|-----------|-------------|-------|-------|---------|
| E16 | 0.9269 | 0.0661 | 0.0617 | |
| E17 | 0.8701 | 0.1752 | 0.1635 | |
| E18 | 0.8550 | 0.1097 | 0.1024 | |
| E19 | 0.9819 | 0.0180 | 0.0168 | |
| E20 | 0.9713 | 0.1854 | 0.1730 | |
| E21 | 0.9161 | 0.0757 | 0.0706 | |
| E22 | 0.9114 | 0.0949 | 0.0886 | |
| E23 | 0.7332 | 0.2777 | 0.2134 | |
| E24 | 0.7297 | 0.3508 | 0.2696 | |
| E25 | 0.9901 | 0.0094 | 0.0072 | |
| E26 | 0.9943 | 0.0842 | 0.0647 | |
| E27 | 0.9909 | 0.0086 | 0.0066 | 1.0000 |
| E28 | 0.9826 | 0.0133 | 0.0102 | |
| E29 | 0.8923 | 0.1865 | 0.1433 | |
| E30 | 0.7306 | 0.3439 | 0.2643 | |
| E31 | 0.9794 | 0.0270 | 0.0207 | |
| E32 | 0.9990 | 0.0017 | 0.0024 | |
| E33 | 0.9952 | 0.0044 | 0.0061 | |
| E34 | 1.0000 | 0.0000 | 0.0000 | |
| E35 | 0.9853 | 0.0146 | 0.0203 | |
| E36 | 0.6640 | 0.3086 | 0.4293 | 1.0000 |
| E37 | 1.0000 | 0.0000 | 0.0000 | |
| E38 | 0.9952 | 0.0059 | 0.0082 | |
| E39 | 0.7763 | 0.3837 | 0.5337 | |
| E40 | 0.8994 | 0.1155 | 0.0636 | |
| E41 | 0.7103 | 0.3135 | 0.1725 | |
| E42 | 0.6287 | 0.3222 | 0.1773 | |
| E43 | 0.6780 | 0.2905 | 0.1598 | |
| E44 | 0.8533 | 0.1481 | 0.0815 | 1.0000 |
| E45 | 0.8870 | 0.1466 | 0.0807 | |
| E46 | 0.8308 | 0.1601 | 0.0881 | |
| E47 | 0.9395 | 0.0704 | 0.0387 | |
| E48 | 0.8889 | 0.1557 | 0.0857 | |
| E49 | 0.9020 | 0.0948 | 0.0522 | |
| E50 | 0.8028 | 0.2526 | 0.2044 | |
| E51 | 0.8540 | 0.1477 | 0.1195 | 1.0000 |
| E52 | 0.7778 | 0.3849 | 0.3114 | |
| E53 | 0.9682 | 0.4508 | 0.3647 | |
| E54 | 0.6964 | 0.2526 | 0.1595 | |
| E55 | 0.5564 | 0.4524 | 0.2856 | 1.0000 |
| E56 | 0.9201 | 0.2493 | 0.1574 | |
| E57 | 0.5767 | 0.3138 | 0.1981 | |

| Indicator | $\bar{l}_j$ | $C_v$ | $W_j$ | W total |
|-----------|-------------|-------|-------|---------|
| E58 | 0.6632 | 0.3160 | 0.1995 | |
| E59 | 0.8073 | 0.4536 | 0.4344 | |
| E60 | 0.5672 | 0.3231 | 0.3094 | 1.0000 |
| E61 | 0.8912 | 0.1837 | 0.1759 | |
| E62 | 0.9086 | 0.0838 | 0.0803 | |
| E63 | 0.9681 | 0.0391 | 0.0490 | |
| E64 | 0.6957 | 0.2695 | 0.3375 | 1.0000 |
| E65 | 0.5556 | 0.3842 | 0.4812 | |
| E66 | 0.9198 | 0.1057 | 0.1324 | |
| E67 | 0.5679 | 0.3986 | 0.2697 | |
| E68 | 0.6538 | 0.3002 | 0.2031 | |
| E69 | 0.8006 | 0.2592 | 0.1754 | 1.0000 |
| E70 | 0.5585 | 0.3750 | 0.3591 | |
| E71 | 0.8663 | 0.1448 | 0.0980 | |
| E72 | 0.9254 | 0.0678 | 0.0681 | |
| E73 | 0.9103 | 0.1045 | 0.1050 | |
| E74 | 0.7764 | 0.3837 | 0.3854 | 1.0000 |
| E75 | 0.9114 | 0.0958 | 0.0962 | |
| E76 | 0.8257 | 0.1611 | 0.1618 | |
| E77 | 0.8392 | 0.1827 | 0.1835 | |
| E78 | 0.9731 | 0.0233 | 0.0171 | |
| E79 | 0.5897 | 0.3590 | 0.2632 | |
| E80 | 0.5873 | 0.3577 | 0.2622 | 1.0000 |
| E81 | 0.5892 | 0.3577 | 0.2622 | |
| E82 | 0.9188 | 0.1406 | 0.1031 | |
| E83 | 0.8599 | 0.1258 | 0.0922 | |

Table 4-3 grey model indicator weights table

Source：author

## 4.2.2.5 Calculating grey relation

| Category | Indicator | Shuitingmen | Shengsi Old Area | Linhai Old area | Average value |
|----------|-----------|-------------|------------------|-----------------|---------------|
| | E1 | 0.4086 | 0.4086 | 0.1362 | 0.3178 |
| | E2 | 0.0678 | 0.0591 | 0.0677 | 0.0749 |
| C1 | E3 | 0.0714 | 0.0618 | 0.0714 | 0.0682 |
| | E4 | 0.1623 | 0.1127 | 0.1129 | 0.1293 |
| | E5 | 0.1089 | 0.1745 | 0.2899 | 0.1911 |
| | Subtotal | 0.8190 | 0.8167 | 0.6781 | 0.7713 |
| | E6 | 0.0631 | 0.0635 | 0.0756 | 0.0674 |
| | E7 | 0.1937 | 0.1614 | 0.1019 | 0.1523 |
| C2 | E8 | 0.0971 | 0.1379 | 0.1379 | 0.1243 |
| | E9 | 0.0306 | 0.0288 | 0.0311 | 0.0302 |
| | E10 | 0.0374 | 0.0346 | 0.0380 | 0.0367 |

| Category | Indicator | Shuitingmen | Shengsi Old Area | Linhai Old area | Average value |
|---|---|---|---|---|---|
|  | E11 | 0.0913 | 0.0875 | 0.1203 | 0.0997 |
|  | E12 | 0.0929 | 0.1418 | 0.2786 | 0.1711 |
|  | E13 | 0.0865 | 0.1011 | 0.1248 | 0.1041 |
|  | Subtotal | 0.6326 | 0.7566 | 0.9082 | 0.7658 |
|  | E14 | 0.1078 | 0.3235 | 0.2690 | 0.2334 |
|  | E15 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
|  | E16 | 0.0538 | 0.0617 | 0.0561 | 0.0572 |
| C3 | E17 | 0.1327 | 0.1635 | 0.1306 | 0.1423 |
|  | E18 | 0.1005 | 0.0808 | 0.0814 | 0.0876 |
|  | E19 | 0.1649 | 0.0162 | 0.0168 | 0.0660 |
|  | E20 | 0.1730 | 0.1396 | 0.1396 | 0.1507 |
|  | E21 | 0.0602 | 0.0632 | 0.0706 | 0.0647 |
|  | E22 | 0.0886 | 0.0818 | 0.0719 | 0.0808 |
|  | Subtotal | 0.8815 | 0.9309 | 0.8363 | 0.8829 |
|  | E23 | 0.1609 | 0.2134 | 0.0951 | 0.1565 |
|  | E24 | 0.2308 | 0.2696 | 0.0899 | 0.1968 |
|  | E25 | 0.0072 | 0.0071 | 0.0072 | 0.0072 |
|  | E26 | 0.0645 | 0.0638 | 0.0647 | 0.0643 |
| C4 | E27 | 0.0065 | 0.0065 | 0.0066 | 0.0065 |
|  | E28 | 0.0100 | 0.0098 | 0.0102 | 0.0100 |
|  | E29 | 0.1433 | 0.0970 | 0.1433 | 0.1279 |
|  | E30 | 0.2243 | 0.2463 | 0.0907 | 0.1871 |
|  | E31 | 0.0205 | 0.0196 | 0.0207 | 0.0203 |
|  | Subtotal | 0.8680 | 0.9330 | 0.5284 | 0.7765 |
|  | E32 | 0.0024 | 0.0024 | 0.0024 | 0.0024 |
|  | E33 | 0.0060 | 0.0061 | 0.0061 | 0.0061 |
|  | E34 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
|  | E35 | 0.0197 | 0.0203 | 0.0200 | 0.0200 |
| C5 | E36 | 0.2570 | 0.1688 | 0.4293 | 0.2850 |
|  | E37 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
|  | E38 | 0.0081 | 0.0082 | 0.0082 | 0.0082 |
|  | E39 | 0.5337 | 0.5314 | 0.1779 | 0.4143 |
|  | Subtotal | 0.8269 | 0.7372 | 0.6439 | 0.7360 |
|  | E40 | 0.0636 | 0.0492 | 0.0588 | 0.0572 |
|  | E41 | 0.1725 | 0.0665 | 0.1286 | 0.1225 |
|  | E42 | 0.0745 | 0.1773 | 0.0826 | 0.1115 |
|  | E43 | 0.0957 | 0.0696 | 0.1598 | 0.1084 |
| C6 | E44 | 0.0698 | 0.0574 | 0.0815 | 0.0696 |
|  | E45 | 0.0582 | 0.0758 | 0.0807 | 0.0716 |
|  | E46 | 0.0881 | 0.0600 | 0.0714 | 0.0732 |
|  | E47 | 0.0387 | 0.0334 | 0.0370 | 0.0364 |
|  | E48 | 0.0821 | 0.0607 | 0.0857 | 0.0762 |
|  | E49 | 0.0467 | 0.0423 | 0.0522 | 0.0471 |

| Category | Indicator | Shuitingmen | Shengsi Old Area | Linhai Old area | Average value |
|---|---|---|---|---|---|
| | Subtotal | 0.7899 | 0.6922 | 0.8383 | 0.7735 |
| | E50 | 0.2044 | 0.1642 | 0.1236 | 0.1641 |
| | E51 | 0.0842 | 0.1024 | 0.1195 | 0.1020 |
| C7 | E52 | 0.1038 | 0.3114 | 0.3114 | 0.2422 |
| | E53 | 0.1217 | 0.3335 | 0.3647 | 0.2733 |
| | Subtotal | 0.5141 | 0.9115 | 0.9192 | 0.7816 |
| | E54 | 0.1595 | 0.0867 | 0.1286 | 0.1248 |
| | E55 | 0.2856 | 0.1231 | 0.2856 | 0.2314 |
| C8 | E56 | 0.1574 | 0.0968 | 0.1199 | 0.1247 |
| | E57 | 0.1378 | 0.1022 | 0.1981 | 0.1460 |
| | E58 | 0.1688 | 0.1781 | 0.1995 | 0.1821 |
| | Subtotal | 0.9091 | 0.5869 | 0.9317 | 0.8092 |
| | E59 | 0.1826 | 0.1448 | 0.4344 | 0.2539 |
| | E60 | 0.1336 | 0.1961 | 0.3094 | 0.2130 |
| C9 | E61 | 0.1166 | 0.1759 | 0.1674 | 0.1533 |
| | E62 | 0.0715 | 0.0671 | 0.0803 | 0.0730 |
| | Subtotal | 0.5043 | 0.5839 | 0.9915 | 0.6932 |
| | E63 | 0.0480 | 0.0453 | 0.0490 | 0.0474 |
| | E64 | 0.3375 | 0.1638 | 0.2038 | 0.2350 |
| C10 | E65 | 0.4812 | 0.1611 | 0.1609 | 0.2677 |
| | E66 | 0.1271 | 0.1059 | 0.1324 | 0.1218 |
| | Subtotal | 0.9938 | 0.4761 | 0.5461 | 0.6720 |
| | E67 | 0.0964 | 0.2450 | 0.2697 | 0.2037 |
| | E68 | 0.1147 | 0.0863 | 0.2031 | 0.1347 |
| C11 | E69 | 0.1754 | 0.1595 | 0.0899 | 0.1416 |
| | E70 | 0.1243 | 0.3591 | 0.1276 | 0.2037 |
| | E71 | 0.0717 | 0.0923 | 0.0980 | 0.0873 |
| | Subtotal | 0.5825 | 0.9422 | 0.7883 | 0.7710 |
| | E72 | 0.0591 | 0.0619 | 0.0681 | 0.0630 |
| | E73 | 0.1050 | 0.0836 | 0.0981 | 0.0956 |
| | E74 | 0.3854 | 0.3838 | 0.1285 | 0.2992 |
| C12 | E75 | 0.0962 | 0.0779 | 0.0889 | 0.0877 |
| | E76 | 0.1618 | 0.1304 | 0.1571 | 0.1498 |
| | E77 | 0.1176 | 0.1835 | 0.1609 | 0.1540 |
| | Subtotal | 0.9251 | 0.9211 | 0.7016 | 0.8493 |
| | E78 | 0.0164 | 0.0164 | 0.0171 | 0.0166 |
| | E79 | 0.0877 | 0.1147 | 0.2632 | 0.1552 |
| C13 | E80 | 0.2622 | 0.0958 | 0.1040 | 0.1540 |
| | E81 | 0.1104 | 0.0909 | 0.2622 | 0.1545 |
| | E82 | 0.0780 | 0.1031 | 0.1031 | 0.0947 |
| | E83 | 0.0922 | 0.0697 | 0.0759 | 0.0793 |

Table 4-4 Case Scoring Sheet

Source：author

## 4.3 Analysis of Issues in Old Urban Areas of Zhejiang

Based on the calculation and evaluation results of the grey relation model of the restoration cases of old areas in small and medium-sized cities in Zhejiang Province in the previous section, this paper can obtain some common problems in the restoration process of old areas in small and medium-sized cities in Zhejiang Province. At the same time, it also clarifies that the restoration of different types of old urban area has corresponding particularities. The final evaluation score can help the author identify the key difficulties and problems existing in the restoration of different cases. On this basis, the common problems summarized in this paper provide some restoration ideas for the subsequent restoration practice of old areas in small and medium-sized cities in Zhejiang.

### 4.3.1 Imbalance and homogenization of functional structure in old area

It can be clearly stated in the C4 (functional structure) in the evaluation that there is still a certain imbalance in the functional structure of the restoration of old areas in small and medium-sized cities in Zhejiang Province, with their weights and scores being lower than 0.1, namely E25 (wayreading system 0.0072), E27 (style coordination 0.0065), E28 (spatial logic 0.0100), and E31 (spatial integration 0.0203). It indicates that during the restoration process, the restoration of the functions of the old urban area has been neglected at the factual level. Most of the urbanization in Zhejiang Province is, in a sense, a "destructive" way of reshaping the urban layout by starting from scratch, and rarely takes into account the overall renovation or restoration to carry out urban transformation and restoration. High-intensity urbanization and the lack of specificity in urban restoration have led to the fact that although the public Spaces in small towns are brand-new, they have not created places suitable for residents' activities. The construction of many Spaces is lacking in thought and is more for the sake of the city's image. Although it has created a good urban appearance and image to some extent, the lack of systematic consideration has instead exacerbated the shortage of land for related facilities and municipal facilities, and brought more pressure to urban infrastructure and transportation. Meanwhile, the brand-new system also lacks the ability to alleviate the dense population in the old city, bringing more new problems to the city. This rapid restoration brings more about the beautification of composition rather than a genuine solution. It is a waste of urban

land resources and lacks organic connections among spatial units.



Figure 4-12 Fast urban restoration process

Source：Web

The trend of rapid urbanization has transformed all urban areas into similar appearances. But unfortunately, the charm of a city stems from its characteristics and culture. Rapid urbanization has continuously accelerated the pace of urban pattern transformation. Small cities have changed rapidly in just a few decades, and any location and structure of cities have undergone earth-shaking changes. With the rapid changes of the information age, there is more and more communication among cities, which accelerates the homogenization and convergence of cities. Most cities copy the successful experiences of big cities without Study their own advantages and urban characteristics clearly, without considering their own development structure and previous patterns. Eventually, this has led to the predicament of "all cities looking the same". The above three cases are examples. The Linhai Ziyang area has been well protected, and the regional characteristics and cultural customs of the old urban area have been preserved. However, it is a pity that the space, roads and alleyways of the new urban area have been completely separated from the old urban area, blending into the rest of the city. All the traditional Spaces and landscapes have been severed. The connection between the Shuitingmen area of Quzhou City and the old area and the new area of Shengsi is also very fragmented. It seems that there is no possibility of continuity in social culture, architectural style and functional environment between the old area and the new area. Most small and medium-sized cities in Zhejiang only consider short-term economic benefits and focus on the commercial attributes of the city. Therefore, they only imitate some relatively simple experiences of reshaping commercial Spaces. After a brief period of prosperity, they fall into decline, but at the same time, they also destroy the diversity and uniqueness of the original old urban space of the city. It can be seen that from the perspective of design, merely considering the transformation of traditional Spaces into Spaces with modern

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attributes is not enough. It is necessary to enhance the exploration of regional humanistic characteristics and culture.

## 4.3.2 High-density construction destroys environmental quality

The scores of C5 (Environmental protection 0.7360), C6 (green landscape 0.7735), and C7 (environmental quality 0.7816) in the evaluation were generally lower than 0.8. Among them, the scores and weights of E32 (adaptability 0.0024), E33 (continuity 0.0061), E37 (dynamic restoration 0.0082), E40 (green space ratio 0.0572), and the plant ratio and landscape aesthetics in area D were all lower than 0.1. Due to the dual influence of scarce land resources and economic interests, high-density buildings (especially residential buildings) have rapidly filled the entire city in the old urban area of Zhejiang Province, and there is also a trend of large-scale expansion. The outdoor open space is constantly being squeezed. Although high-density urban space is conducive to the improvement of urban efficiency, it will also damage the environmental quality of the city. It is obvious that it will damage the green space of the city, reduce the open space, etc. Secondly, the restoration of cities and the addition of green Spaces can only be carried out whenever possible. For instance, the restoration of the old urban area in Shengsi. However, due to the spatial limitations of Shengsi, most of the urban supporting facilities are built in the new urban area, which is disconnected from the old one. As a result, problems have emerged in the service radius and spatial distribution of the city. Furthermore, the central square of the old city of Shengsi is clearly insufficient in capacity. Due to the significant increase in tourists, the influx of urban residents, and the intensity of commercial activities, a large number of people have also brought a huge impact on the surrounding traffic and parking. The high density of the old city cannot alleviate the dispersion of people either. The aimless flow of people exacerbated the congestion in the square, bringing a huge negative impact to the surrounding environment. In pursuit of floor area ratio and usable space, the layout of additional buildings closely adhering to the red line has made the external space uniform and monotonous, lacking interaction with the city and connection with the urban space.

Figure 4-13 Zhejiang city old area scenery

Source：author

Dense cities will bring a large number of motor vehicles, electric vehicles, etc., which will occupy the already scarce urban space. The dense and congested transportation system will greatly damage the urban space. The problems of air, noise and pollution caused by traffic are quite serious, exerting great pressure on the external space. Meanwhile, urban restoration often focuses on the plots themselves, neglecting the interaction and organization with the urban traffic space, which also superimposed the occurrence of problems.

## 4.3.3 Lack of public events due to changing times

From the E6 (public space 0.0674), E9 (functional satisfaction 0.0302), E10 (functional rationality 0.0367), and E11 (usage frequency 0.0997) in the evaluated C2 (land use index 0.7658), Indicators such as E21 (recreational space 0.0647) and E22 (service structures 0.0808) in C3 (supporting facilities) can all prove that the old areas of small and medium-sized old urban area in Zhejiang Province are generally lacking in the planning, design and attention of public Spaces, and their core performance weights and scores are both lower than 0.1. The core function of the public space in the old urban area is the place where various urban activities take place, which is an objective material space. Through on-site research and interviews, it has been proved that with the rapid development of cities and the information age, the experience of big cities can easily influence the construction of medium and small cities, and the living patterns and ideological concepts of cities will also be affected and change rapidly. Residents in small and medium-sized cities are no longer confined to their original lifestyles but have turned to more social activities and spontaneous activities. The demand for the original essential activities has gradually been exhausted, and the public Spaces in the city have also been rejuvenated. This indicates that public Spaces can guide residents to engage in various urban activities. However, as the logic of most current urban restoration conflicts with the changes in residents' lifestyles, it cannot keep up with the pace of such changes. During on-site visits, it was found that

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many residents voluntarily engage in square dancing or bring in benches and tables for activities. Among them, the Qinyang Area stands out the most.



Figure 4-14 Zhejiang Old Area Public Space

Source：author

### 4.3.4 Deactivation of economic value of old urban area

It is known from E78 (utilization rate 0.0166), E82 (Surrounding development 0.0947), and E82 (industrial upgrading 0.0793) in C12 (Construction and development 0.8493) and C13 (economic benefits 0.6543) that although urban restoration in Zhejiang has achieved a huge improvement in economic benefits in the restoration of old urban area, However, it still fails to break away from the fact that the old urban area cannot support the improvement of the overall functional industries and economic benefits of the city. Even a certain suction phenomenon has emerged, and the urban restoration of the old area has significant limitations. Meanwhile, the old districts of small and medium-sized old urban area in Zhejiang Province scored relatively high in construction and development, but their scores in economic benefits were generally not high, being the lowest among all C-level indicators. The Study points out that the main body and the source of funds for the development of old urban area are both government and fiscal expenditures. Its characteristics lie in that the economic value is difficult to be reflected in the short term, and the value created by commercial individuals in the old urban areas is not directly linked to the surrounding areas of the old area and the city as a whole. Therefore, nowadays, the development of old urban area in cities mostly focuses on large-scale and single land development and utilization. This model emphasizes land use and the development and utilization of surrounding real estate, lacking the overall development awareness and linkage of the city. Its main purpose is to improve the "political achievements" of

the city's image, pursuing scale and form, and shifting towards functional and aesthetic design. Due to the lack of feasibility Study in the early stage and its own value, the functional, social, environmental and cultural values of the old urban area space have all been ignored, and it is difficult to sustain the long-term economic benefits.



Figure 4-15 Commercial decline

Source：https://www.163.com/dy/article/J7T0MNA20525904A.html

## 4.3.5 Urban fiscal constraints and funding shortages

Since the outbreak of the pandemic in 2020, the domestic economy has slowed down and fiscal problems have become prominent in various regions. As a touchstone of the national economy, Zhejiang's fiscal problems have also become prominent. In the first half of 2024, although Zhejiang's general budget revenue reached 550.5 billion yuan, ranking third in the country, it still saw a slight decline compared to the same period last year, dropping by 0.6%. Government fund revenue is mainly related to the transfer of government land, which is an important component of the total government revenue in various regions. In 2023, the government fund revenue in Zhejiang Province showed a significant decline, with a drop of up to 25% during the same period. This indicates that the land efficiency in Zhejiang Province has declined, and the land turnover situation has become tight. Moreover, in the first three quarters of 2024, The downward trend continues on the basis of last year's austerity, and the situation of urban restoration and urban expansion remains unclear. However, due to the relatively good economic development trend in Zhejiang, its debt problem is relatively minor. As of 2023, the local debt balance of Zhejiang Province was 2,288.6 billion yuan, accounting for approximately 27.7% of the province's GDP. But due to the economic slowdown in recent years, Zhejiang's debt has continued to rise rapidly, increasing by 13.5% in the same period of 2023. Specifically for counties and cities in Zhejiang Province, Kaihua County, as an economically backward county with relatively large fiscal expenditure and revenue in Zhejiang, has a rather prominent issue of fiscal support.

| Name | Fiscal Revenue (100 million yuan) | Fiscal Expenditure (100 million yuan) | Ratio (Expenditure/ Revenue) | Main Character |
|---|---|---|---|---|
| Wencheng County | 5.00 | 25.00 | 5.00 | Mountainous county, weak economic base, reliant on transfers |
| Taishun County | 6.00 | 28.00 | 4.67 | Ecological protection area, industrial development restricted |
| Jingning County | 4.50 | 28.00 | 6.22 | Minority county, high demand for public services |
| Qingyuan County | 3.80 | 20.00 | 5.26 | Remote mountainous area, severe population outflow |
| Pan'an County | 7.00 | 25.00 | 3.57 | Ecotourism - based, weak industrial foundation |
| Chun'an County | 15.00 | 50.00 | 3.33 | Location of Qiandao Lake, large environmental protection investment |

Table 4-5 Cities in Zhejiang facing fiscal challenges

Source：author

## 4.4 Summary of restoration Methods in Zhejiang

Based on the generation, calculation and Study of the grey relation model mentioned above, this paper can obtain the common problems of the old areas in small and medium-sized cities in Zhejiang. In view of these weak points, this paper can summarize and propose corresponding restoration methods and priorities in the restoration cases of the old areas in small and medium-sized old urban area in Zhejiang.

(1)Environmental repair intervene

① Sort out idle land and illegal buildings in the city. Make use of urban grey Spaces and low-utilization Spaces for improvement and restoration, and create dynamic regional Spaces in idle volumes through diversified means and improvement methods.

② Through the protection and repair of the existing green Spaces, the current sheet-like, strip-like and point-like green Spaces are organically connected to form an organic network system of the environment. There are deficiencies in environmental adaptability, which are reflected in urban restoration. The application of vegetation lacks regionality and distinctiveness, resulting in the creation of an environment in old urban area lacking urban characteristics and locality. Therefore, a large number of environmental landscapes also have homogeneity and similarity.

③ Waterfront Spaces are important activity venues for urban residents. Therefore, the improvement and reshaping of waterfront Spaces is a crucial key point to meet the higher living environment requirements of citizens. Reasonable re-planning of elements such as the environment and transportation of waterfront Spaces should be carried out.

④ The application of environmentally friendly materials is still limited to large cities. Environmental protection issues in medium and small cities have not received high attention from local governments, and the structure of energy usage is still relatively traditional. This is a common difficulty faced by small and medium-sized cities in Zhejiang Province. Therefore, urban restoration is a good entry point to accelerate the intervention of new materials and environmentally friendly materials.

(2) Functional repair intervene

The coordination issue between the protection of old urban area and modern lifestyles. Cities are physical Spaces that carry people's activities, communication, life and development. With the progress of The Times, the spatial characteristics of old urban areas can no longer meet the spatial demands of current lifestyles. The issue of rationally coordinating the protection of old area with modern lifestyles is also one of the difficulties in the restoration of old area, mainly including:

① Upgrading of infrastructure such as transportation, municipal facilities and fire protection; The implantation of modern service facilities such as business, culture,

entertainment and sports; Deep-seated construction demands such as landscape, environment and style.

The so-called development and utilization of the old urban area is actually about rationally handling the issue of coordinated coexistence between the protection of the old city and the construction of the new city. On the one hand, the issue of coordination and continuation between architectural style and spatial layout should be properly handled. On the other hand, the issues of restoration and integration of industrial formats into the old urban area, as well as the protection and utilization of architectural space, should be properly addressed, so that the development of the old city can not only continue the original historical imprints and inherit cultural information, but also organically integrate with modern civilization.

③ repair and increase urban public Spaces

A good urban public space not only depends on the space itself, but also requires the common growth and integration of the surrounding Spaces. This is another process of mutual progress. All three cases have created better basic conditions for the public Spaces in the old areas through the synchronous restoration and control of the project itself and the surrounding areas of the site.

(3) Social culture restoration

The issue of extracting and identifying the historical and cultural resources of the old city has been identified through visits and research to the residents of the old urban area. The residents of the old city have a strong sense of identity and dependence on the place where they grew up. Most of them expressed that as long as the infrastructure conditions are improved, they are unwilling to leave the old urban area. Therefore, the exploration and reshaping of characteristics that combine historical features with local identity are particularly important.

While endowing the area with new functions and integrating the original spirit and memory of the site, it is also necessary to respect the original behavioral norms of the site and attempt to introduce a development model that combines the old and the new. Therefore, while improving the regional infrastructure, it is necessary to adapt to local conditions, absorb the unique site spirit and historical culture from within the area, and become an organic combination of tradition and modernity.

① Characteristic exploration: Conduct in-depth analysis of the location characteristics, cultural background, development and construction history of the old

urban districts, extract and summarize the Kaihua spirit with strong local characteristics, and combine it with modern spiritual civilization construction to form a positive and upward new Kaihua spirit. This is also the connotation and driving force of local development.

② Element extraction: Starting from both material and immaterial aspects, such as architecture, street and alley Spaces, folk customs, craftsmanship, celebrities, legends, etc., extract the core elements that the planning needs to clearly protect and control, guide and develop.

③ Hierarchical demarcation: The purpose of extracting and identifying historical and cultural resources is to demarcate various historical and cultural resources at different levels and by different subjects based on the protected elements, and formulate reasonable protection measures.

④ People-oriented approach: The users of urban space are urban residents, and the main participants are people. We should start from the actual usage needs of people, guide the design of urban space based on the daily living habits and emotional perception of residents, and consider the spiritual and usage needs of participants to increase the usage frequency of different Spaces in old urban area.

(4) Economic benefits improvement

① A urban restoration system with reporting value and a positive cycle is formed, which is led by the government, involves the public, and encourages diverse capital participation.

② The timing and funding issues of the protection and restoration of old urban area: Clarifying the protection content, formulating a reasonable restoration plan, taking time as the axis, establishing a scientific and reasonable development sequence, clarifying nodes and tasks, fund-raising plans, etc., are also one of the key tasks of restoration.

## 4.5 Case Study Summary and Insights

### 4.5.1 Zhejiang characteristic restoration model

The PPP model in Zhejiang Province, namely the Public-Private Partnership (PPP for short) model, refers to the long-term cooperative relationship and institutional arrangement established by the government and social capital for the

construction of infrastructure and the provision of Public services. Zhejiang Province has launched multiple PPP demonstration projects, covering various fields such as transportation, affordable housing, municipal facilities, environmental governance, education, elderly care, and medical care, and spanning multiple cities and counties. Moreover, Zhejiang is actively promoting the application of the PPP model in urban restoration to reduce the input of government funds. At the same time, due to the joint efforts of multiple parties, it is easier to activate the vitality and subsequent operation of urban restoration projects. The Department of Finance of Zhejiang Province has issued the "Interim Measures for the Management of Comprehensive Award and Subsidy Funds for Promoting the Government and Social Capital Cooperation Model in Zhejiang Province", providing awards and subsidies to PPP demonstration counties and cities, encouraging them to take the lead in trials and exert a demonstration effect. Zhejiang Province is exploring the establishment of a coordinated mechanism for existing resources, resolutely preventing large-scale demolition and construction, establishing a multi-subject participation mechanism, encouraging social forces to participate in urban restoration, optimizing the market access environment, and improving the exit mechanism. Through the PPP model, the government and private enterprises can share resources and risks, promoting the infrastructure construction and public service supply of the small town.
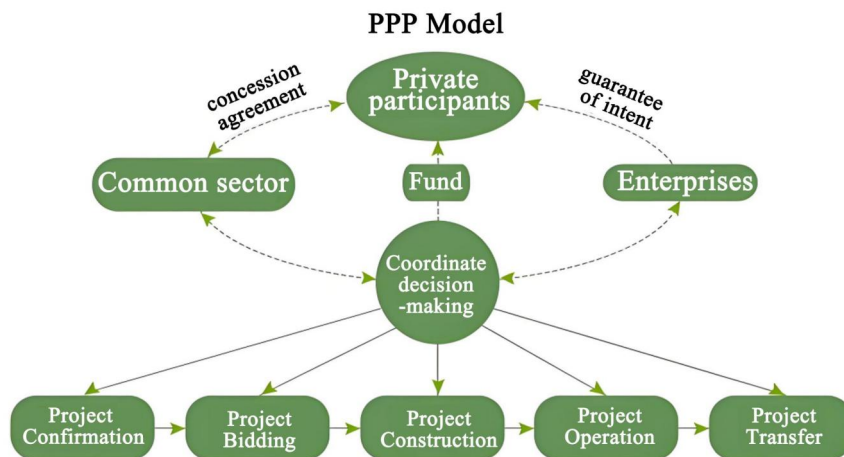


Figure 4-16 PPP Model

Source：author

In the restoration of multiple projects throughout Zhejiang Province, the concept of diversity has been adopted as the guiding ideology for the projects, and different urban restoration strategies have been proposed accordingly. A series of policies and

guiding opinions have been issued, such as "On Fully Implementing the urban restoration Action to Promote High-Quality Development of Urban Construction", which has clarified the basic principles and goals of urban restoration in Zhejiang and required each city to formulate implementation plans. Complete a batch of demonstration projects. For instance, in the construction of the central sponge city in Jiangshan City, Zhejiang Province, urban restoration work has been carried out in response to problems such as the lack of distinctive urban landscape features, the occupation of urban open Spaces, poor accessibility of urban public Spaces, unsmooth urban flood control and drainage, and insufficient protection of urban historical and cultural resources. In terms of the environment, the main focus is on the environmental governance of urban water systems and the construction of sponge cities. As for urban functions, the emphasis is on the improvement and repair of three aspects: landscapes and gateway nodes, open Spaces, and chronic systems. On the basis of repair the cultural context, Jiashan County in Zhejiang Province also attaches great importance to the repair of urban functions and the repair of the environmental system. Since the era of large-scale urban restoration in Zhejiang - the new round of urban restoration in 2015, emphasis has been placed on the repair and restoration of urban functions, urban environment and historical context. On this basis, the PPP restoration model with Zhejiang characteristics has been combined, and it has been localized based on the goal of building a mountain-water city with Zhejiang characteristics within the province, adapting to local conditions.

| Time | Key Policies | Spatial characteristics and practice | Progress | Case |
|------|-------------|-----------------------------------|----------|------|
| 2000 - 2010 | "Zhejiang Province Urban Housing Demolition and Relocation Regulations", "Guiding Opinions on Old Residential Area Reconstruction" | - Demolition of dilapidated buildings and widening of roads (urban repair) - Construction of basic green space (preliminary repair of environment) | The skeleton of public space is initially established, but the concept of repair of systematic environment is lacking | Hang zhou Wang jiang |
| 2011 - 2015 | "12th Five-Year Plan for New Urbanization", "Regulations on the Protection of Historical and Cultural Cities" | - Historic district repair (cultural repair) - Channel dredging and waterfront opening (environmental repair) | Combining environmental repair with historical repair for the first time, the principle of "stay, change and demolish" | Ning bo Old Bund |

| Time | Key Policies | Spatial characteristics and practice | Progress | Case |
|---|---|---|---|---|
| 2016 - 2020 | "Urban restoration Action Plan", "Future Community Pilot Program" | - Community level "micro-infrastructure" (pocket park, rain garden)<br>- Industrial site renovation (functional repair) | Achieves ecological and functional dual repair through "small-scale, incremental" updates, increasing built-up area green space rate from 38% to 42% | Hang zhou Xiaohe Zhijie |
| 2021 - Now | "Urban restoration Regulations", "Opinions on Comprehensive Future Community Construction", "Three-Year Action Plan for Urban Dual Repair" | - Connecting the blue and green network (systematic environmental repair)<br>- Public ownership of private space (repair innovation) | Environment restoration incorporated into mandatory urban restoration indicators (e.g., green space ratio ≥30%), innovates "ecological bank" compensation mechanism | Jia xing South Lake |

Table 4-6 Zhejiang double urban repairs practice

Source：author

## 4.5.2 The uniqueness of Zhejiang's urban restoration

Zhejiang's urban restoration model is unique and still has strong uniqueness and reference value compared to such urban restoration pioneers in Guangdong Province:

① Policy system construction

Zhejiang emphasizes legislative leadership and institutional unification, forming a practical and systematic policy framework. For example, Hangzhou has incorporated " Hangzhou Urban Restoration Regulations " into its legislative preparation program, providing a legislative model for the whole province. As a pioneer in urban restoration, Guangdong has been vigorously promoting urban restoration since 2009, and has introduced a series of old reform policies across the province, which have provided safeguards and injected vitality into Guangdong's high-quality development.

② Optimization of synergy mechanism

Zhejiang has formed a "government-enterprise-private" model of restoration. For example, a large number of PPP models have been promoted, not only in urban restoration, but also in some large-scale public construction, which is a mature model,

and this model strengthens the cooperation between the builder and operator, and pays more attention to the community's participation and urban operation. Guangdong in recent years is also exploring the government-led, market-operated, public-participation urban restoration model, building multiple cooperation to meet multiple needs, but compared to Zhejiang its maturity is later, more aggravated in the stage of cooperation between the government and the developer, the participation of market forces is more obvious.
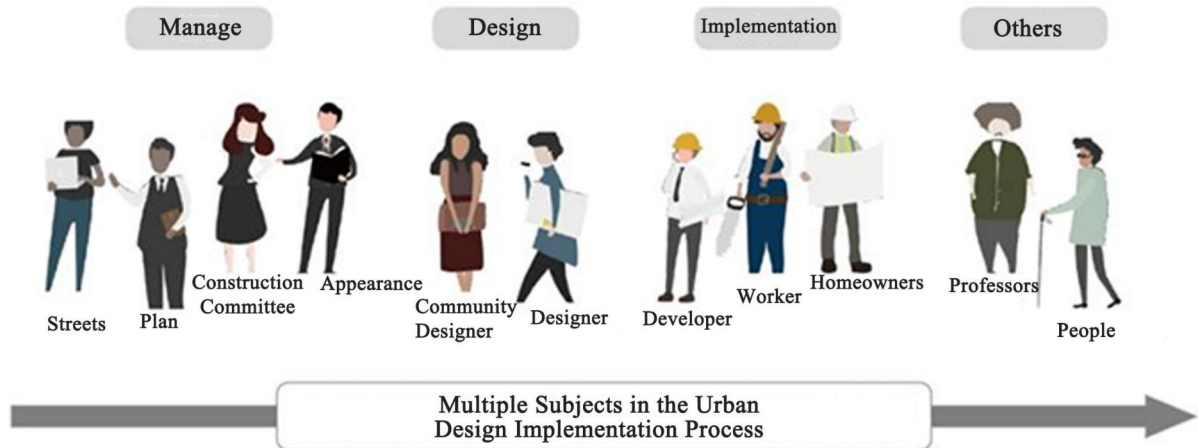


Figure 4-17 Diversified subjects of urban restoration

Source：author

③ Long-term planning and implementation

| Comparison Dimension | Zhejiang Province | Canton Province |
|---|---|---|
| Policy System Construction | Emphasizes legislative leadership and institutional integration, forming a systematic policy framework, such as Hangzhou's inclusion of the "Hangzhou Urban restoration Regulation" in the legislative preparation project. | Has vigorously promoted "Three Olds" renovation since 2009, introducing a series of related policies, and the policy system is mature. |
| Collaborative Mechanism Optimization | Forms a "Government-Enterprise-People" joint restoration model, widely promotes the PPP model, emphasizes cooperation between constructors and operators, focuses on community participation and urban operations, as seen in projects like the Hangtai High-Speed Railway. | Explores a government-guided, market-operated, and public-participated model, with a greater focus on government-developer collaboration and obvious market participation. |

| Comparison Dimension | Zhejiang Province | Canton Province |
|---|---|---|
| Long-term Planning Implementation | Stresses forward-looking and differentiated strategies, focuses on dual restoration of residential and industrial zones, such as Huzhou's "Macro-Meso-Micro restoration" pattern. | Prioritizes industrial introduction and job-residence balance, pays attention to fairness and efficiency, and emphasizes efficient resource allocation by the market. |
| restoration Philosophy | Focuses on systematic integration and legislative guidance, emphasizes community participation and social benefits, reflecting a "people-oriented" restoration philosophy. | Places more emphasis on market operations and industry-driven approaches, focuses on economic efficiency and efficient land resource use, reflecting a "market-oriented" restoration philosophy. |
| Implementation Effect | restoration model is mature, focuses on sustainable development, excels in ecological protection and cultural heritage, and has more stable restoration outcomes due to legislative and policy support. | Fast restoration speed, significant economic benefits, remarkable achievements in industrial transformation and urban function enhancement, but potential resource allocation imbalance in some areas under market dominance. |
| Regional Characteristics | Relatively smaller city scale, restoration focuses on refinement and differentiation, suitable for small and medium-sized cities and historical and cultural cities. | Larger city scale, restoration focuses on efficiency and industry drive, suitable for large cities and economically developed regions. |

Table 4-7 Zhejiang-Guangdong Restoration Comparison

Source：author

Zhejiang emphasizes forward-looking and differentiated strategies, pays attention to the double restoration of residential areas and industrial areas, pays attention to the rational allocation of resource elements and the optimization of spatial structure. Guangdong pays more attention to industrial introduction and job-housing balance, pays more attention to the relationship between fairness and efficiency, and pays more attention to multi-level housing needs.

In conclusion, Zhejiang's urban restoration model pays more attention to legislative guidance, system integration, joint efforts between government and enterprises and forward-looking planning, while Guangdong puts more emphasis on market operation and industrial introduction in urban restoration, both of which reflect the characteristics and advantages of their respective regions.

## 4.6 Summary of the chapter

This chapter first analyzes the restoration cases of old areas in small and medium-sized cities in Zhejiang Province, including the Shuitingmen area in Quzhou City, the old area in Shengsi, and the Ziyang area in Linhai. After analyzing the cases, the relevant data in each case were investigated and collected. Based on these data, the author used the grey relation model to conduct data analysis and result evaluation of the cases. Based on the final evaluation results and cases, the common problems faced by the old areas of small and medium-sized old urban area in Zhejiang were summarized, such as the imbalance and homogeneity of functional structure caused by rapid restoration, the destruction of environmental quality by high-density construction, and the absence of public activities caused by the changes of The Times. These problems not only affect the quality of life of urban residents, but also restrict the sustainable development of cities. In response to these common problems, the author, at the macro level, proposed the corresponding restoration priorities and restoration guidelines for the old areas of small and medium-sized cities in Zhejiang in four directions, including functional repair intervention, environmental repair intervention, social and cultural restoration, and economic benefit improvement. Eventually, during the Study process, the special models and uniqueness of restoration for the old areas of small and medium-sized cities in Zhejiang were clarified. Based on the restoration cases of old areas in small and medium-sized cities in Zhejiang Province, this chapter clarifies the key and difficult points in the restoration of old areas in small and medium-sized old urban area in Zhejiang Province, and conducts corresponding data practices using the grey relation model. It provides a theoretical basis for understanding the mechanism and internal mechanism of grey relational analysis in the restoration of old areas in small and medium-sized old urban area in Zhejiang Province, and offers factual evidence for the restoration practice of the Qinyang Area in the following text.

# Chapter 5: Evaluation and Restoration Practice of Qianyang Area

## 5.1 Outline of the current situation

### 5.1.1 Location

Kaihua County is located in the source of the mother river of Zhejiang - Qiantang River, belonging to Quzhou City, the county is adjacent to Huining County in Anhui Province in the north, intersecting with Yushan, Dexing and Wuyuan counties in Jiangxi Province in the west, bordering with Chun'an County in the east, and Changshan County in the south, which is the western gateway of Zhejiang Province. Kaihua County is located two hours from Hangzhou, four hours from Shanghai and Ningbo, and two hours from the central cities around Fujian, Anhui and Jiangxi, with a unique location and excellent overall transportation conditions. Among them, the county is 80 kilometers away from Quzhou Airport, 115 kilometers away from Huangshan Airport, Beijing-Taiwan Expressway and National Highway 205 running through the north and south, docking with Huangshan Scenic Spot, Sanqing Mountain Scenic Spot and Qiandao Lake Scenic Spot, and the Jiu Jing Qu Railway to enhance its overall transportation location.
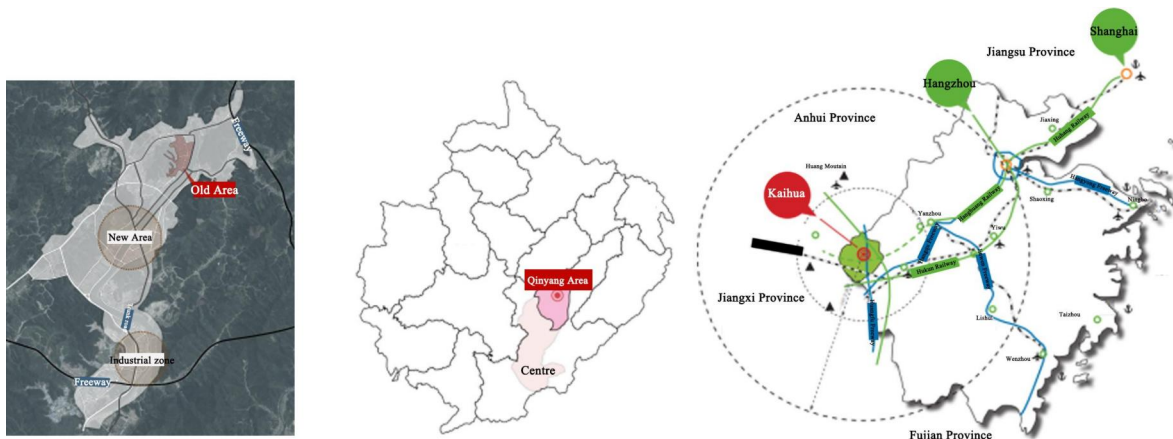


Figure 5-1 Location Map of Qinyang Area

Source：author

According to the 2023 Statistical Bulletin, the GDP of Kaihua County realized 18.135 billion yuan, a year-on-year growth of 4.2% at comparable prices. By industry, the added value of primary industry was 1.471 billion yuan, an increase of 5.1%; the added value of secondary industry was 6.947 billion yuan, an increase of 5.6%. The overall economic strength of Kaifa County has a comprehensive score of 50.4,

ranking 571/1698th among counties and cities nationwide, surpassing 66.4% of counties and cities nationwide.

## 5.1.2 Reasons for choosing Qinyang area

Kaihua County is this paper attempts to the theory "GRA" in the city, through the grey relational of Zhejiang's excellent Urban Restoration cases derived from the restoration strategy to transform the urban blocks.

① For such cities as Kaihua County, it is a more typical and relatively backward urban block in Zhejiang, and the architectural texture has the characteristics of Zhejiang mountain county

② Kaihua County is the most backward small and medium-sized city in Zhejiang province, and the urban restoration has a high demonstration value. Therefore, it is inevitable that such counties will have a strong executive force and transformation efforts.

③ Qinyang Area of Kaihua County is the core block of Kaihua urban restoration, which concentrates the urban memory and urban context of Kaihua County, and has the typical features of Zhejiang old district.

④ Zhejiang attaches great importance to the restoration of the old areas of small and medium-sized cities in Quzhou and Lishui, especially the backward mountain counties in Zhejiang, which has extremely high research value and restoration significance. Qinyang Area meets all the characteristics.
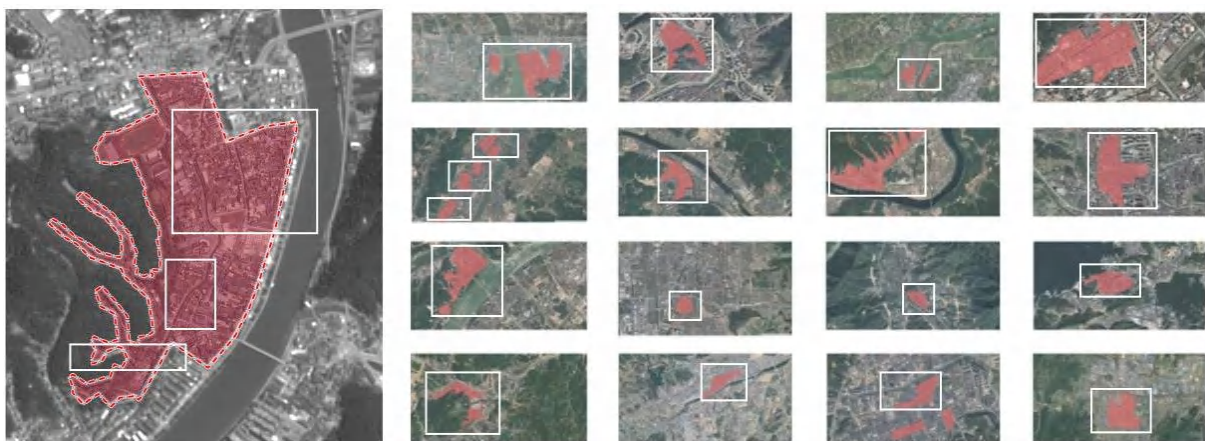


Figure 5-2 Qinyang Area Composition Similarities

Source：author

During this period, the author invested a lot of research and learning in the early stage, combined with the theoretical methods and analytical logic explored in this

paper, established the "grey relation in old areas of small and medium-sized cities in Zhejiang", obtained the weight of different evaluation factors and the restoration logic, and used its weight and experimental results to carry out specific operation practice. The purpose and significance of this paper is to illustrate that the grey relational analysis model puts forward the guiding logic of Zhejiang urban restoration and attempts to use mathematical logic to model and generalize it.

## 5.1.3 Project Background

Since the reform and opening up of Kaihua County, with the rapid development of social economy and the rapid improvement of urbanization rate, the urban development has also entered the fast lane. The urban spatial framework is subject to the influence of terrain, and the urban clusters are divided and restricted by mountains and rivers, resulting in the rapid development of the city from west to south with Qinyang Area as the core, and a large number of new urban areas have moved the original urban functions of Qinyang Area. The construction land of Qinyang Area is compressed, and the urban density is constantly stacked, resulting in the old area being squeezed and compressed.



Figure 5-3 Qinyang Area Current Landscape Map

Source：author

From the Kaihua County Master Plan (2021-2035) and Kaihua County Master Plan (2006-2020) comparison found that the core position of Qinyang area in Kaihua County is still prominent, and the urban framework is rapidly enlarged, relying on the old urban area to integrate the core resources of Kaihua County, integrating the surrounding symbolic resources, and combining the urban area's landscapes resources.

## 5.1.4 Overview and the current status of the project
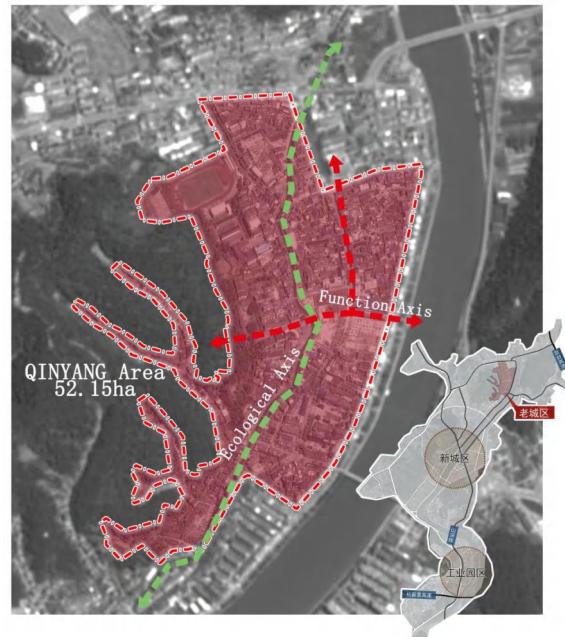


Figure 5-4 Qinyang Area Location

Source：author

① Planning scope: Qinyang area in the center of Kaihua old area. In the area, three axes along the west canal, Jiefang Road and Jiangbin Road pass through the city from north to south. Qinyang area is located in the east side of Yuping Park, east through the Shangxi Bridge and the Beijing-Taiwan Expressway Kaihua Interchange, west through the Qinyang North Road and 205 National Highway connection. It extends from Jiangbin North Road in the east to Yuecheng Road in the south, from Yuping Park in the west to Qinbei Road in the north. The planning area is about 52.15 hectares.
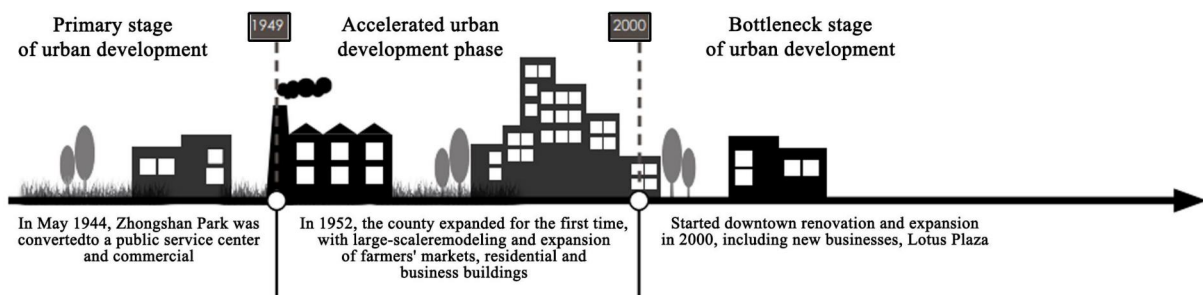


Figure 5-5 Stages of Kaihua's urban development

Source：author

Figure 5-6 Comparison of Qinyang's Urban Development

Source：author

② Development Element: Kaihua County "West Drainage", anciently known as Wangbianxi, "through the Tianxiang Academy, Nandun Academy from the south gate into the Majinxi" This is the history of the West Drainage in the old history books. Historically, there were five times of remodeling, expanding and repairing the West Drainage Canal. The current situation after the renovation and expansion of the West Drainage, the water of the Majin River, from north to south, over the celery North Road, folded into Zhongshan Road, through the downarea area, over the celery South Road, slowly into the South Lake. In the West Drainage, every 100 meters or so, set up a stone arch bridge, convenient for residents on both sides of the West Drainage to and from the top of the canal wall every ten meters on both sides of a port for residents to wash with. West canal, by Kaihua people known as the woman canal, a thousand years of clear canal; West canal ring belt for Kaihua one of the ancient eight scenic spots, now the West canal is Kaihua County, a unique humanities landscape. Kaihua old city wall according to " Kaihua County Records - City ' records Kaihua '

Kaihua old city ", the old city gate and city wall as early as to date back to the Ming Zhengde seven years (1512), after several repairs, become Kaihua people into a city, against foreign enemies, the city's development of the evidence. There were 6 gates at the beginning of the city wall, namely: Yingen Gate, Wangji Gate, Qianmen Gate, Tongji Gate, Qifeng Gate and Zhongxiu Gate, and only one of them is still preserved today.
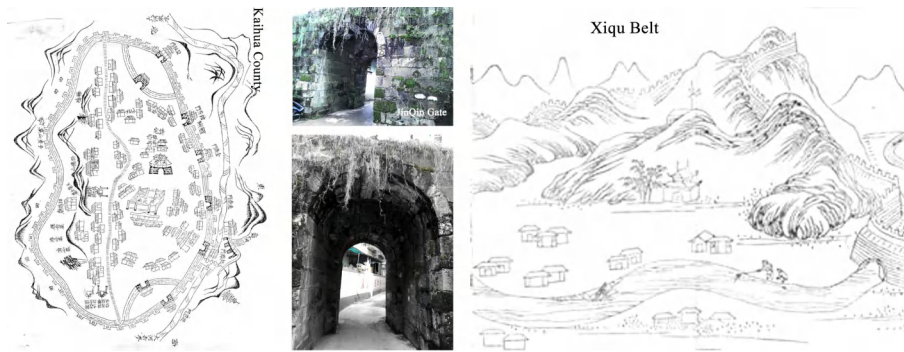


Figure 5-7 Elements of Kaihua Culture

Source：author

③ Cultural qualities: Kaihua enjoys the titles of the homearea of China's famous Long Ding tea, the homearea of China's root carving art, the homearea of China's Golden Needle Mushroom, the homearea of China's black fungus, the national high-level weightlifting talent cultivation base, and the homearea of the Olympic Champion, etc., and possesses rich intangible cultural heritages such as skills, folklore, and folk songs.
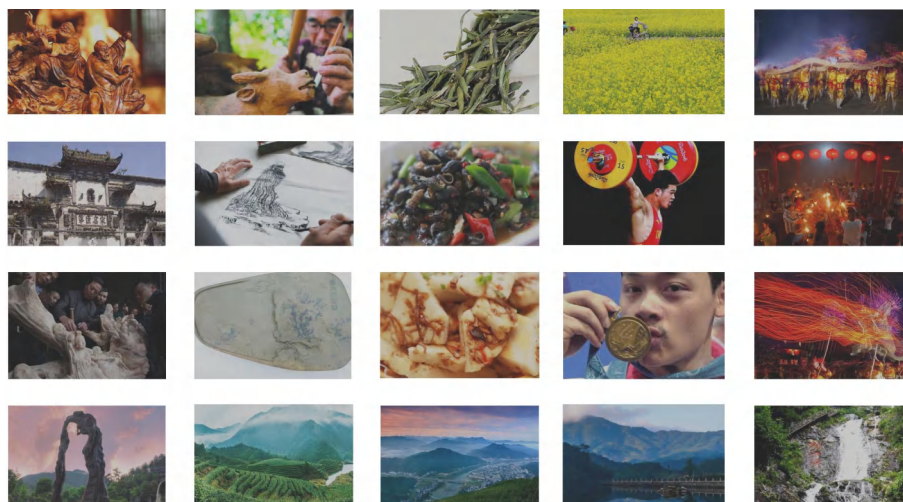


Figure 5-8 Kaihua Cultural Traits Map

Source：author

④ Urban status quo: Kaihua Old area has a relatively compact overall layout, the construction land in the area is mainly residential land, public management and public

service facilities are relatively complete, but the proportion of green space and plaza is relatively small, the details of the site are shown in the table below.



| Code | Name | | Area (hm²) | Percentage (%) |
|------|------|------|------------|----------------|
| R | residential land | | 24.81 | 47.66% |
| | Included | Class II residential land | 24.07 | 46.24% |
| | | Land for service facilities | 0.3 | 0.58% |
| | | Residential land use III | 0.74 | 1.42% |
| B/R | Commercial and residential land | | 5.5 | 10.56% |
| A | Public administration /service facilities | | 10.44 | 20.05% |
| | Included | Administrative office space | 3.23 | 6.20% |
| | | Land for cultural facilities | 0.12 | 0.23% |
| | | Educational/scientific research | 7.09 | 13.62% |
| B | Commercial service facilities | | 2.57 | 4.94% |
| | Included | Commercial land | 2.08 | 4.00% |
| | | Business Land | 0.08 | 0.15% |
| | | Utility outlets | 0.41 | 0.79% |
| M | Industrial Land | | 1.02 | 1.96% |
| W | Land for logistics and warehousing | | 0.5 | 0.96% |
| S | Land for roads/ transportation facilities | | 3.98 | 7.65% |
| | Included | Urban road land | 3.85 | 7.40% |
| | | Transportation hubs | 0.13 | 0.25% |
| U | Serviced land | | 0.21 | 0.40% |
| | Supply/facility land | | 0.21 | 0.40% |
| G | Green space and plaza land | | 3.03 | 5.82% |
| | Garden area | | 0.91 | 1.75% |
| H11 | Urban building land | | 52.06 | 100.00% |
| | Waters and others | | 1.09 | |

Figure 5-9 Land use status

Source：author

According to the current land use situation, the main functions of Kaihua Old area are dominated by residential and public administration and public service facilities. All kinds of public service facilities in Kaihua Old area are relatively perfect, but the municipalities are uneven, and the facilities in the residential areas of the Old area are poor. The sanitation facilities have been improved after the renovation in recent years, but the west canal is still relatively messy along the route.
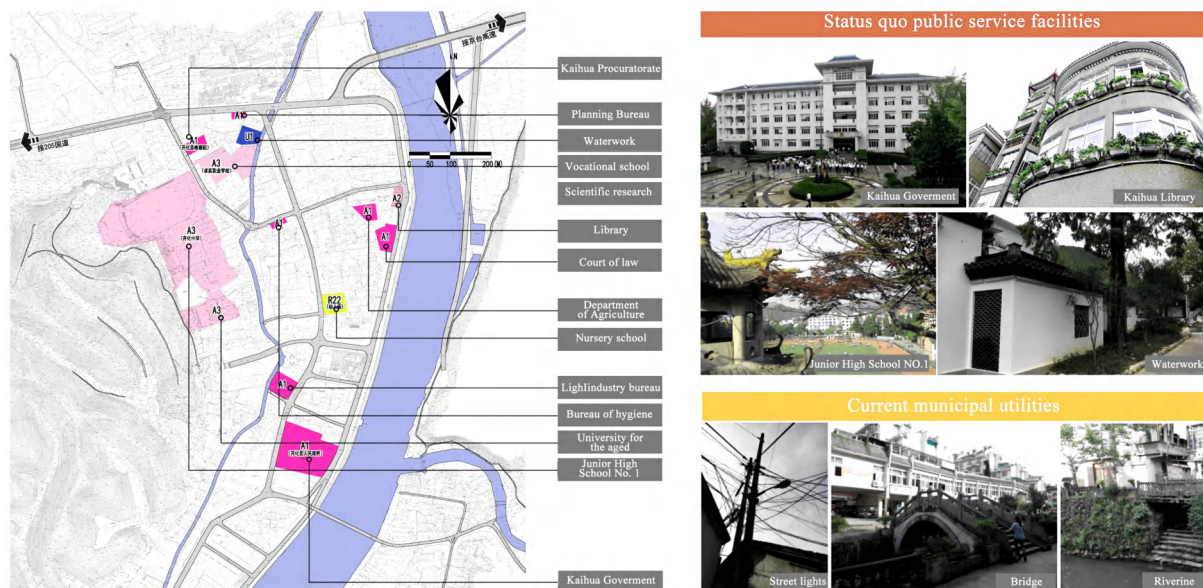


Figure 5-10 Infrastructure of Qinyang Area

Source：author

The supporting facilities of Kaihua County are facing the aging of hardware and software can not keep up with the needs of Kaihua residents, most of the basic supporting and hardware facilities were built at the end of the last century, in the field research process, we found that the city supporting the existence of the problem of low utilization, and young people do not understand the actual use of supporting facilities.

⑤ Road traffic: After years of development, the road system in Kaihua Old area has formed a major road structure of "three horizontal and three vertical", and the overall framework is relatively complete.

Kaihua old city's main road access is relatively good, the road is 6-12 meters wide, the rest of the road is mainly lanes, alleys and halls, accessibility is poor. West canal in the old city due to the obstruction of the water system, resulting in poor accessibility, internal traffic is mainly based on narrow alleys, motor vehicles can not pass.
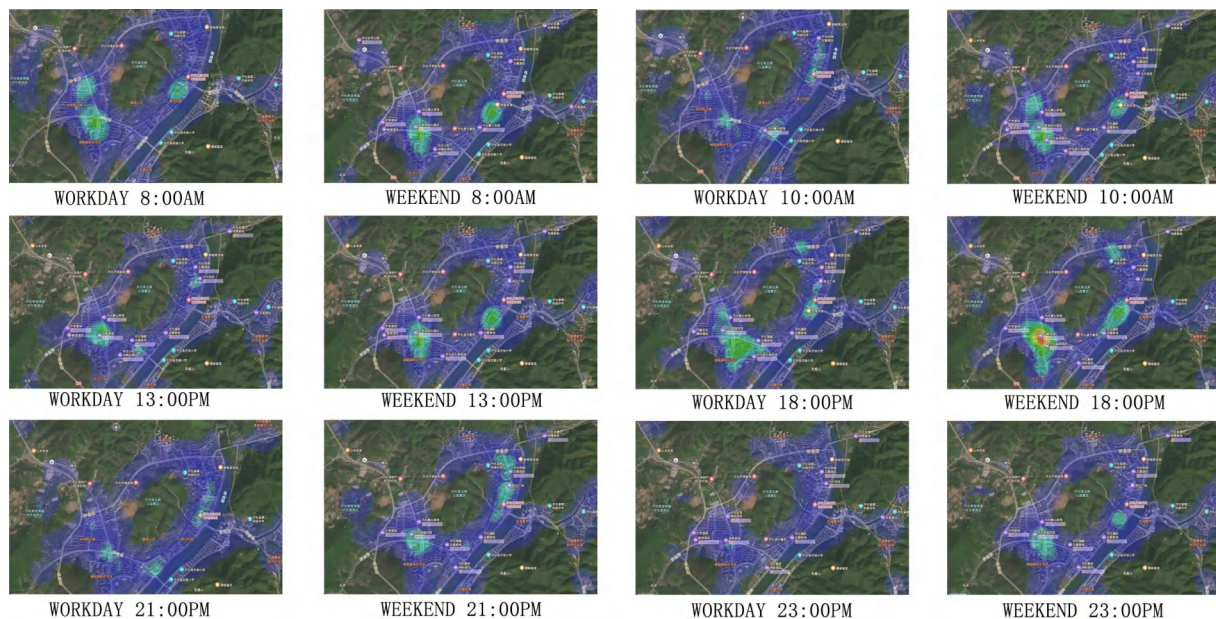


Figure 5-11 Changes in foot traffic in Qinyang area

Source：author

Traffic travel and crowd density in the old city of Kaihua fluctuates considerably on weekdays and holidays, and overall due to the higher number of people traveling on weekends, resulting in an increase in the density of people in the urban area on weekends compared to weekdays, and smaller fluctuations in density throughout the day compared to weekdays, which is more active on the whole. Weekday commuting peak period is more obvious, at 8:00, 18:00 two peak hours crowd density has a

significant climb. Secondly, in Qinyang area, the crowd is still mainly concentrated around Lotus Square, and the crowd density in the residential area and West Drainage Channel fluctuates less in a single day.

Due to the early construction of most residential areas, parking facilities are seriously lacking, especially along the West Drainage Channel, which is more prominent, and the phenomenon of unauthorized parking of private cars is serious, seriously affecting the travel of nearby residents. Alleys in the old city are mostly of original dimensions, with a width of 2-4 meters. The road surface material is mostly cement, and some of them are modern floor tiles with poor landscape effect.

A large number of urban alleyways have very poor space lighting due to high building density. The denseness of localized grip buildings has led to a reduction in the accessibility of urban lanes, creating numerous negative spaces. The unauthorized construction of buildings adds to the height of the buildings also exacerbates the acuteness of this problem.



Figure 5-12 Qinyang Area Traffic Analysis

Source：author

⑥ Architectural texture: the old city buildings are mostly residential buildings, along the street for the strip of commercial and residential buildings, in addition to sporadic layout of commercial buildings and public buildings. Architectural texture is more chaotic, the buildings built after the 1980s are mostly houses and clusters. Some old buildings are mixed and wrapped in some new buildings, and due to the serious phenomenon of illegal construction, the architectural texture is not obvious and lacks

local characteristics. At the same time, the architectural texture of Kaihua County has a certain degree of contradiction, which has the regional characteristics of the old urban areas of small and medium-sized cities in Zhejiang Province, but also has the problem of urban homogenization.



Figure 5-13 Qinyang Area Architectural Texture

Source：author

⑦ Architectural function: the planning of Kaihua old city buildings are classified according to architectural function. The buildings in Kaihua Old area are mainly residential buildings, with commercial and residential buildings along Jiefang Street, in addition to sporadic layout of commercial buildings and public buildings. The high density and the lack of public space reflect the extreme demand for Restoration of the site.
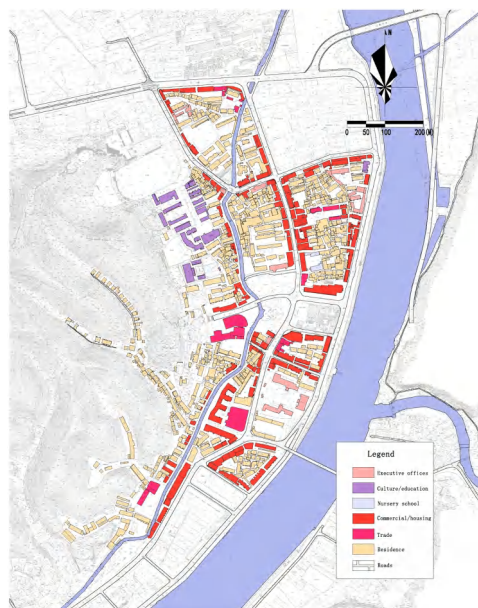


Figure 5-14 Building Functions in Qinyang Area

Source：author

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⑧ Building quality: the planning of the building quality situation in the old city is divided into the following three categories. Building quality is good: the building structure is intact, mostly brick structure or reinforced concrete structure, the external wall surface is newer, mainly in recent years, new public buildings. General building quality: the building structure is intact, mostly brick and mixed structure of two or three-story buildings. As well as structurally sound wooden buildings. Poor building quality: the building structure has some damage, the wall surface is seriously damaged, doors and windows are missing. Most of them are one-storey buildings of wooden structure and some accessory houses built illegally. The distribution of building quality levels is relatively decentralized, with Class I, Class II and Class III buildings distributed, and the majority of the buildings are of average or good quality, but about 20% of the buildings are of poor quality.
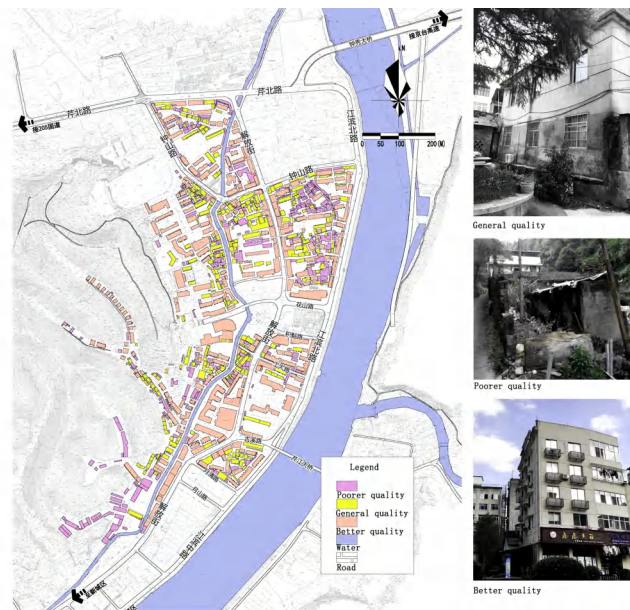


Figure 5-15 Quality of construction in Qinyang area

Source：author

⑨ Building height: the plan is divided into six categories according to the number of floors: one-storey, two-storey, three-storey, four-storey, five-storey, six-storey and above buildings. The existing buildings in the old city mainly consist of 2-4-story buildings, mainly distributed in the west side of the west canal and the inner part of the old city wall plots. 5-story buildings are mainly distributed on both sides of the main roads, and a small number of 6-story or above buildings are sporadically distributed in various parts of the old city.
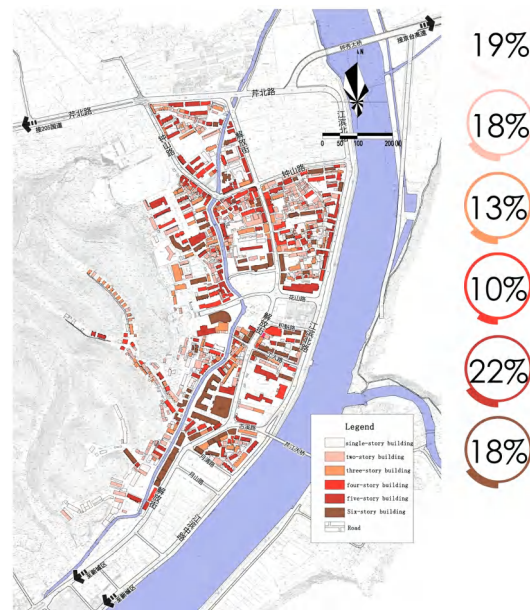
Figure 5-16 Qinyang Area Building Levels

Source：author

⑩ Architectural style: The architectural style is graded into four categories, one of which is well-preserved historical buildings with a complete architectural pattern and remaining sealing wheat, which can show the local traditional architectural characteristics. The other is the modern buildings that carry the common memory of the residents of the old city. The second type of building is the recent construction of public buildings in harmony with the overall style, and the other is the facade is damaged but in line with the architectural style of the modern construction of the building. The third type of building is the building that is basically in line with the architectural style of the old city, and is not abrupt in the overall environment, and can be localized to improve the façade to coordinate with the environment. Four types of buildings are not coordinated with the overall style of the old city, and in the environment of the sudden and general quality of construction of buildings, mostly for some illegal buildings and shanty buildings. Kaihua Old area is a mixed architectural style, with good quality buildings mainly along the main roads of the city. The poor and average quality buildings are mainly wrapped inside the good quality buildings and on both sides of the West Drainage Canal, and the phenomenon of urban village is more serious.
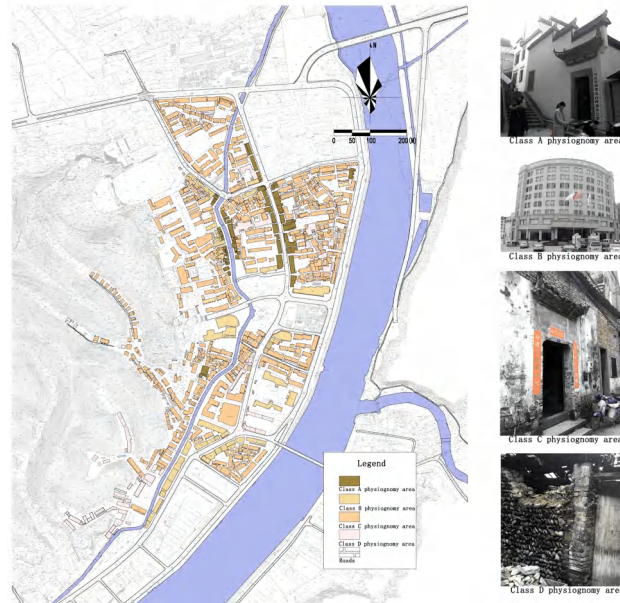
Figure 5-17 Qinyang Area Architectural Landscape

Source：author

⑪ Landscape environment and public space: the old city has high building density, compact land, and modern greening mainly focuses on spot greening and greening along the river. The public space in front of and behind the houses in the Old area is narrow, and some of the larger spaces have outdated facilities and randomly discarded sundries, so the overall environment needs to be improved. Greening in the old city is relatively lacking, and not systematic, mainly along the water system and lotus square. Although the old area is west of Huashan, but it has not been melted into the mountain, the mountain utilization rate is not high. In recent years after a unified remediation, public toilets in the old city has greatly improved hygiene. In addition, sanitary facilities along the main roads are more complete, but inside the old city plots, some of the garbage collection points are in poor sanitary condition due to older sanitary facilities.

Most of the public space is deserted, due to the long years of use of public space, a large number of debris piled up therein, and the old public facilities can not meet the needs of modern residents, so that the value of the use of the space is gradually dying out. There are also a large number of demolished and relocated vacant lots in the old district, due to the lack of Restoration motivation, a large number of valuable spaces have been abandoned, forming a garbage dumping area in the old district. Each public space is scattered, and there is no unified, linked public space system, which reduces the organic nature of the public space, and also reduces the demand and motivation of

the residents to use the space.



Figure 5-18 Status of landscape environment in Qinyang area

Source：author

⑫ Dynamic development: Lotus Plaza is located in the center of Kaihua County, the former Kaihua Cinema and Lotus Plaza site. East of the celery river, west of the west canal and yuping park. Ancient old Kaihua has a rhythmic celery city eight scenes from the "mountains, water, sky, land, people" and other aspects of the "West Drainage Belt", "Square Pond Yang Yue" is in the site, because of the topography of the reasons, the Kaihua link between the north and south of the city. Because of the topography, Jiefang Road and Binjiang Road, the main roads linking the north and south of Kaihua, run through the site. Therefore, it can be reflected that no matter once or now, this site has always been the status of the city center in the hearts of Kaihua people. The new square has three floors above and below the ground, integrating many functions such as public gathering, leisure, entertainment, parking, etc. Its completion will inject new vitality into the old city. At present, the new square is in use. However, there are problems such as high rental price of stores and insufficient attraction.

Kaihua West Drainage Canal was built in the Southern Song Dynasty before the capital moved to Lin'an, from north to south through the city, witnessed the history and future of Kaihua County, is the common memory of Kaihua citizens. However, due to the lack of appropriate maintenance, the overall environment on both sides of

the West Drainage Channel is poor, and the water quality is also subject to a certain degree of pollution. Kaihua County on the overall landscape of the West Drainage Channel transformation and upgrading, the introduction of a variety of functions, to create a green waterfront living space. The new West Drainage, relying on humanistic memories and sentiments, focuses on emphasizing the way the site is experienced and the dialogue between people and history. It is a new commercial district in the city that integrates citizens' recreation, water-friendly entertainment, commercial shopping and tourism distribution. At present, the upstream barge section has been initially completed. However, there are problems such as poor traffic along the western canal and obstruction of the reconstruction of the surrounding buildings.

After investigation, there are three demolished, six renovated and repaired, three repaired and two walled houses in Qinyang old area. There are two potential construction sites: Xiajia Compound and Telecom Building.
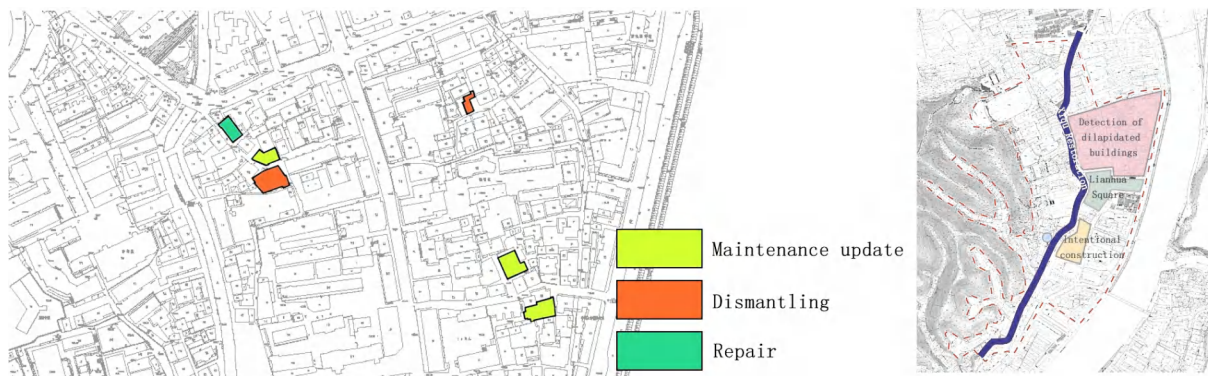


Figure 5-19 Qinyang Area Development Intentions

Source：author

## 5.1.5 Questionnaires and interviews

In order to promote the design process of the Qinyang Area, the author visited the Qinyang Area twice, in August 2023 and July 2024, and collected on-site data through questionnaires and interviews. A total of 57 valid questionnaires were collected in this research. Through the statistics and analysis of the data, the current usage status of the Qinyang Area can be presented in a relatively macroscopic way. The composition of the questionnaire and the respondents, as well as some data, are as follows.Although the questionnaire is random, some conclusions can still be drawn based on the data.

According to the source of the interviewees' identities, the users of the Qinyang Area are mainly permanent residents, accounting for as high as 68.4%, while only

5.26% are tourists from outside. Therefore, it is not very attractive to tourists. In contrast, the usage frequency of space in the Qinyang Area is not low. Over 90% of the residents use it once a week or more. A large number of commercial shops and old abandoned Spaces provide daily life services for urban residents and meet their usage needs. Due to the severe outflow of population, the majority of users in the old urban areas are women and left-behind children, with a male-to-female ratio of 2:3. In contrast, the backwardness of the functions in the Qinyang Area is the core issue that needs to be urgently addressed, indicating that there is still great potential and value for improvement in the restoration and construction of the Qinyang Area. Nearly half of the residents hold a negative attitude towards the Qinyang Area, and the restoration and transformation of the Qinyang Area is extremely urgent.



Figure 5-20 Qinyang Area Research Data

Source：author

Although questionnaires and interviews were conducted randomly, this paper shows that the usage demands of different groups of people and users for the Qinyang Area are highly similar, all focusing on whether the improvement of the old urban area space can improve the living environment and living standards of urban residents.

Its demand and enthusiasm for improving the old urban areas are unprecedentedly consistent.

## 5.2 Evaluation and analysis of Qinyang Area

### 5.2.1 Evaluation of Qinyang Area based on "GRA"

Based on the weights calculated from the matrix of grey relation and the scores of each detail to conduct Study and calculation on the case, the scores of each element level and the sub-scores of each sub-index can be obtained. The sub-scores can reflect the performance degree of the Qinyang Area in this aspect. By comparing the scores with those of other cases, this paper can quantify the characteristics, advantages and disadvantages of this area. To directly and accurately identify the advantages or disadvantages of this indicator, thereby deepening the in-depth understanding of this item in the Qinyang Area, analyzing the reasons for its high or low score, and thus clarifying the direction and strategy of a certain indicator in subsequent restoration.

| Sub -objective hierarchy | Hierarchy of elements | Indicator level | Segmentation indicators | Weight | Rating | Average value/ Subtotal |
|---|---|---|---|---|---|---|
| Functional structure objectives | Location | Layout | Size | 0.4086 | 0.2597 | 0.7713 0.8261 |
| | | | Distribution | 0.0678 | 0.0524 | |
| | | | Land use | 0.0714 | 0.0618 | |
| | | Service radius | Gap | 0.1623 | 0.1623 | |
| | | | Time | 0.2899 | 0.2899 | |
| | Land use indicators | Site assessment | Percentage of public space | 0.0756 | 0.0355 | 0.7658 0.6301 |
| | | | Design capacity | 0.1937 | 0.1435 | |
| | | | Traffic area | 0.1379 | 0.1032 | |
| | | Functional satisfaction | Public Satisfaction | 0.0311 | 0.0275 | |
| | | | Functional rationality | 0.0380 | 0.0346 | |
| | | | Frequency of use | 0.1203 | 0.0809 | |
| | | Level of land use | Vacancy rate | 0.2786 | 0.0929 | |
| | | | Construction area per capita | 0.1248 | 0.1120 | |
| | Service | Infrastructure | Illumination | 0.3235 | 0.2767 | 0.8829 0.7681 |
| | | | Electrical power | 0.0000 | 0.0000 | |
| | | | fire-fighting | 0.0617 | 0.0534 | |
| | | | Radiation area | 0.1635 | 0.1339 | |
| | | Service Facilities | Sanitation | 0.1024 | 0.0860 | |
| | | | Guide sign | 0.0168 | 0.0159 | |
| | | | Cultural facility | 0.1730 | 0.1452 | |

| Sub-objective hierarchy | Hierarchy of elements | Indicator level | Segmentation indicators | Weight | Rating | Average value/ Subtotal |
|---|---|---|---|---|---|---|
| | | | Open space | 0.0706 | 0.0570 | |
| | | Utility | Service structures | 0.0886 | 0.0769 | |
| | | Traffic organization | Parking space | 0.2134 | 0.1726 | |
| | | | Pedestrian space | 0.2696 | 0.2234 | |
| | | | Visualization system | 0.0072 | 0.0068 | |
| | | | Accessibility | 0.0647 | 0.0638 | |
| | Space structure | Scale of spatial interface | Landscape coordination | 0.0066 | 0.0059 | 0.7765 0.8793 |
| | | | Spatial logic | 0.0102 | 0.0094 | |
| | | | Street Aspect Ratio | 0.1433 | 0.1217 | |
| | | | Plaza scale | 0.2643 | 0.2569 | |
| | | Structure | Spatial integration | 0.0207 | 0.0188 | |
| | Geographical environment | Flexibility | Score | 0.0024 | 0.0021 | |
| | | Continuity | Local Characteristics | 0.0061 | 0.0057 | |
| | | Construction materials | Bio-materials | 0.0000 | 0.0000 | |
| | Environment protection | | Economize on resources | 0.0203 | 0.0200 | 0.7360 0.7132 |
| | | | Construction cost | 0.4293 | 0.3410 | |
| | | Energy use | Clean energy | 0.0000 | 0.0000 | |
| | | Operating cost | Dynamic update | 0.0082 | 0.0075 | |
| | | | Manpower inputs | 0.5337 | 0.3969 | |
| | | Green space quality | Geen area ratio | 0.0636 | 0.0242 | |
| | | | Green space per capita | 0.1725 | 0.0588 | |
| Environment objective | | | Number of natural parks | 0.1773 | 0.0907 | |
| | | | Green area | 0.1598 | 0.0533 | 0.7735 0.4707 |
| | | | Visual weighting | 0.0815 | 0.0389 | |
| | | Plant condition | Protection of vegetation | 0.0807 | 0.0540 | |
| | Green landscape | | Vegetation ratio | 0.0881 | 0.0518 | |
| | | Scenic beauty | Essentials | 0.0387 | 0.0197 | |
| | | | Public Satisfaction | 0.0857 | 0.0506 | |
| | | | Aesthetic resolution | 0.0522 | 0.0287 | |
| | | Environment quality | Clean and tidy environment | 0.2044 | 0.0710 | |
| | | Air quality | AQI | 0.1195 | 0.1195 | |
| | | Water quality | Hierarchy | 0.3114 | 0.3114 | 0.7816 0.8172 |
| | | Noise condition | Public space noise | 0.3647 | 0.3153 | |

| Sub-objective hierarchy | Hierarchy of elements | Indicator level | Segmentation indicators | Weight | Rating | Average value/ Subtotal |
|---|---|---|---|---|---|---|
| Sociocultural goal | publicity | Accessibility | Pedestrian system | 0.1595 | 0.1424 | 0.8092 0.5018 |
| | | | Mass transit | 0.2856 | 0.1435 | |
| | | | Indication system | 0.1574 | 0.0614 | |
| | | | Structural clarity | 0.1981 | 0.0880 | |
| | | Activities | Variegation | 0.1995 | 0.0665 | |
| | Comfortableness | Vigor | Retention time | 0.4344 | 0.3153 | 0.6932 0.8184 |
| | | | Frequency of use | 0.3094 | 0.2172 | |
| | | Quality | Environmental Behavioral Linkages | 0.1759 | 0.1424 | |
| | | Intimacy | Willingness | 0.0803 | 0.1435 | |
| | Cultural attraction | Geographical characteristic | score | 0.0490 | 0.2957 | 0.6720 0.6001 |
| | | Cultural activity | Frequency | 0.3375 | 0.1612 | |
| | | Place of cultural interest | Densities | 0.4812 | 0.0989 | |
| | | | Values | 0.1324 | 0.0443 | |
| | Cultural heritage | Material heritage | Historical relic | 0.2697 | 0.2628 | 0.7710 0.5772 |
| | | | Historical building | 0.2031 | 0.0677 | |
| | | | Historic relics | 0.1754 | 0.0638 | |
| | | Intangible heritage | Quantities | 0.3591 | 0.1243 | |
| | | | Historical relevance | 0.0980 | 0.0586 | |
| Economic efficiency targets | Building development | Construction funds | Land price | 0.0681 | 0.0664 | 0.8493 0.8139 |
| | | | Engineering costs | 0.1050 | 0.0980 | |
| | | | Management costs | 0.3854 | 0.2776 | |
| | | | Revenue | 0.0962 | 0.0792 | |
| | | | GDP | 0.1618 | 0.1318 | |
| | | construction cycle | Cycle time | 0.1835 | 0.1609 | |
| | Economic benefit | Land benefits | Utilization factor | 0.0171 | 0.0146 | 0.6543 0.4090 |
| | | | Proceeds | 0.2632 | 0.0878 | |
| | | | Value-added level | 0.2622 | 0.0883 | |
| | | | Value added of land | 0.2622 | 0.0876 | |
| | | | Peripheral Development | 0.1031 | 0.0780 | |
| | | | Industrial Enhancement | 0.0922 | 0.0527 | |

Table 5-1 Qinyang Area Status Score

Source：author

## 5.2.2 The problem analysis of Qinyang Area

Through grey relational, after calculating the performance of Qinyang Area in different sub-indicators and comparing it with other cases in Zhejiang, we can conclude that Qinyang Area in Quzhou is deficient in regional environment/environmental protection, green landscape, publicity, cultural heritage, economic benefits, and also weak in the rest of the sub-indicators.

| | Strengths | Weaknesses | Opportunities | Threatens |
|---|---|---|---|---|
| **Functional repair** | Fully functional, densely populated with retail and highly utilized | Outdated functionality, poor periodization and outdated facilities | Strong willingness of urban residents to Restoration and more generous financial subsidies | Low incentive for functional Restoration due to exodus of urban residents |
| **Environmental repair** | Highly landscaped with beautiful views and complete landscaping | Poor ecological greening system connectivity and inadequate public space connectivity | Better ecological base and low repair costs | Cities face seasonal flooding, waterlogging and other problems |
| **Sociocultural** | Deep historical and cultural heritage and a large number of intangible heritages | Poor protection mechanisms and awareness of maintenance | The Government emphasizes the establishment of mechanisms for the protection and preservation of social culture | The aging of the urban population leads to the disappearance of social and cultural breaks |
| **Economic benefit** | Low Cost of Urban Restoration, Located in the Heart of the City | Low return on the city's retained financial revenues | Zhejiang Government's Provincial Urban Restoration Funding and Willingness | Uncertain return on investment and commercial commitment leading to destruction of cultural atmosphere |

Table 5-2 Qinyang Area SWOT Analysis

Source：author

① Outdated functional facilities

The degree of functional richness of the public space in Qinyang area, as well as the frequency of use, etc. do not have a big problem, the main problem focuses on the functional hard and software Restoration does not keep up with the development of the times and the use of urban residents' needs: the unclear guidance system, the lack of service facilities, the confusion of traffic flow, the lack of spatial logic, the lack of communication of functional systems and so on, there are a number of problems, but the severity of their degree of prominence is not prominent.

② Low utilization rate of ecological environment

Qinyang Area has a good ecological environment foundation, but the problems of environmental protection and environmental greening are outstanding, which are specifically manifested in the failure to utilize its own environmental foundation, inconspicuous territoriality, low manpower investment and maintenance, low green space rate of public space, low abundance of parks, insufficient aesthetics and mass satisfaction, and lack of logical linkage and communication of the park system. The environmental system grows wild and unmanaged.

③ Lack of publicity in public space

The low types and types of activities provided by old urban area also lead to the extinction of publicity due to the backward accessibility and facilities. The entrance of a large number of public Spaces in old urban area is unclear, resulting in a lack of awareness of the foreign population, and becoming a "secret" place for local residents, resulting in a serious phenomenon of exclusive public space in the old urban areas.

④ Lack of cultural heritage

Compared with other cases, the public space in Qinyang Area lacks a relative amount of tangible cultural heritage, resulting in a low level of cultural attributes and a lack of prominence of landmarks in the area, and due to the inheritance of intangible heritage, the homogenization of the urban landscape in Qinyang Area is obvious.

⑤ Low land efficiency

The loss of population in Qinyang Area has resulted in the low expectation of capital and the private sector for the Restoration of public space, which has also led to the low expected income, and has gradually resulted in the underground land efficiency, which requires strong promotion and landing of the government and policies, as well as a large amount of financial support to build up the confidence of Restoration.

## 5.2.3 Qinyang Area restoration design principle

In the previous section, relevant indicators are calculated for Qinyang Area of Quzhou according to the grey relation combing model, and the shortcomings faced by Qinyang Area are analyzed. In the actual operation process, relevant strategic basis is drawn up for the project according to the branches of different indicators, which serves as the design basis of the guidance.

It focuses on the main items such as D5 regional environment and environmental protection, D6 greening and landscape, D8 publicity, D10 cultural attraction, D11 cultural heritage, and D13 economic benefits, and is supplemented by the impact of the detailed E-level indicators on the overall score of the project.

The first is to strengthen the environmental and ecological protection of Qinyang Area in Quzhou, to improve the quality of parks and greening ecology, to make ecological repairs to the western Huashan and the eastern water system, and to introduce the natural landscape into the construction and Restoration of the old urban area, so as to improve the ecological environment and the regional characteristics of the old urban area.

The second is to strengthen the publicity of Qinyang Area, enhance the vitality and attractiveness of public space in the old urban area, open up the city's broken road, strengthen the density of traffic flow lines in the region, and reduce the unaccessibility of buildings.

The fourth is to save the cost of urban restoration and try to introduce Zhejiang's excellent urban restoration capital cases, such as PPP mode of learning and adoption, reduce the unilateral financial expenditure and utilization, stimulate the vitality of social capital and the people's conscious participation in the Restoration, to formulate a reasonable time to update the plan to coordinate the nodes of the task of the financing of the development of the sustainable and scientific sequence of time.

The fifth is to make up for the remaining functions and deficiencies, considering the comprehensive layout of residence, commerce, entertainment, culture and leisure functions in this area, to re-organize and layout the urban multiple space, guide the self-update of the multiple space in the old urban area, and coordinate the demands of the restoration of different municipal systems.

The final Restoration plan can also be based on the weight of the grey relational elements to evaluate the rationality of the plan.



Figure 5-21 Full view of Qinyang

Source：http://dz.cppfoto.com/news/Detail.aspx?id=833

## 5.2.4 Design framework

Due to the serious economic problems and population loss in Qinyang Area, the problems of old urban area are old and backward and insufficient supporting facilities are prominent. To solve these problems, the focus is on the open space in the old urban areas as the core, and the corresponding Qinyang Area strategy and logic are adopted to renewal old urban area. The grey relation is taken as the evaluation criterion to carry out the dynamic grey relation in Qinyang Area to achieve multiple goals.
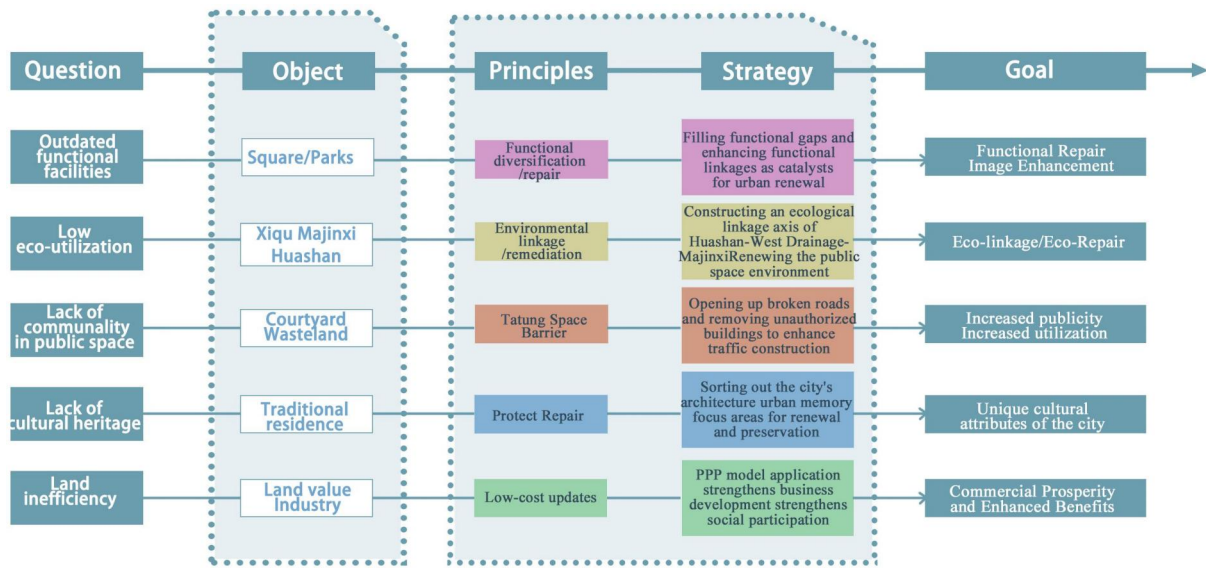


Figure 5-22 Qinyang Area Design Framework

Source：author

## 5.3 Restoration method in Qinyang Area

## 5.3.1 Functional repair intervention

(1) Functional Repair Strategy

① Re-sorting the spatial relationship between human and old area

From the perspective of human activities, the current situation of human activities and places where activities take place will be sorted out, the functional spaces with human activities will be arranged, and the insufficient functions will be labeled and arranged, and then imported into the areas that can be Restoration of Qinyang Area.

Figure 5-23 Qinyang Area Function Extraction

Source：author

② Removal of unauthorized building works

Provide abundant spatial power for the subsequent Restoration of Qinyang Area. Qinyang Area is the earliest urban construction site in Kaihua County. Since the large-scale urban construction in the 1980s, there are unclear property rights division and a large number of unauthorized buildings, so it needs to be recounted and reasonably demolished in this round of urban Restoration.



Figure 5-24 Distribution of unauthorized structures in Qinyang

Source：author

③ The relation between man and space

Focusing on the five senses of association between people and space, utilizing the existing base of pedestrian flow in Liqun Business District to create a piece of commercial space with special characteristics, and guiding the direction of pedestrian flow through historical and cultural streets and lanes. At the same time, it is necessary to sort out the main traffic routes to ensure smooth access, as well as to create different spatial scales.

To focus on the meeting and revitalization of business, the innovative placement

of functional forms. Economically, it is necessary to stimulate the concentration of population, upgrade the commercial system, add part of the business building, and design tourism-related service routes. Functionally, the old city should maintain the original street space pattern, to maintain the fit with Jiefang Street, the West Drainage to create more waterfront residential space.
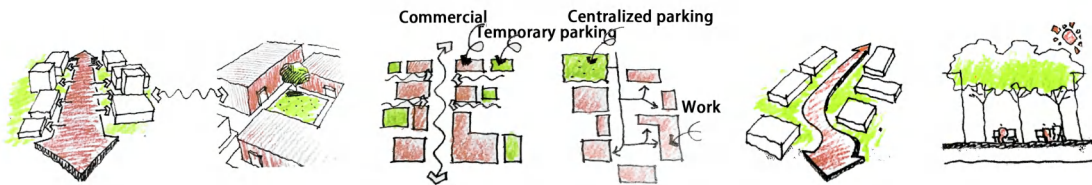


Figure 5-25 Public Space Form Chart

Source：author

(2) Reconstructing functional structure
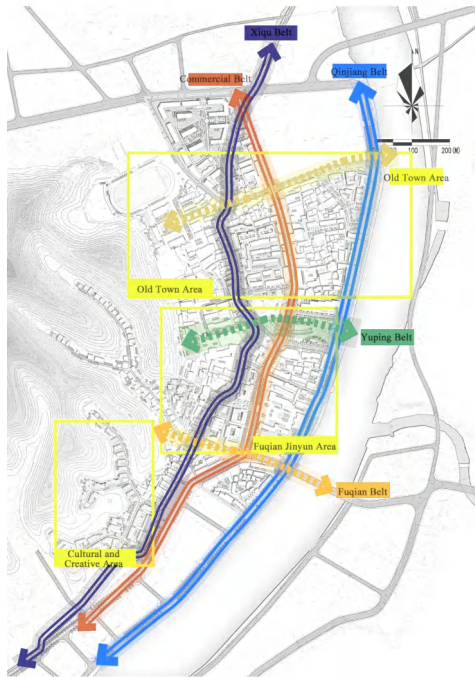


Figure 5-26 Functional Structure of Qinyang Area

Source：author

The plan continues the three north-south development axes of West Drainage, Jiefang Street and Jiangbin Road, supplemented by the three east-west development sub-axes of Zhongshan Road, Jiekui Road-Lotus Square and Guxi Road-Pedestrian Street, and builds the three plates of the historical and cultural block of the Old City in the north, the administrative and commercial service block in the middle and the cultural and creative industry block in the south, systematically integrates and upgrades the tourism resources and supporting facilities within the scope of the plan,

and constructs nodes of special characteristics themed on administration, culture, commerce, entertainment, tourism, recreation and creativity to realize the dynamic remodeling and innovative development of the Old City. It will construct characteristic nodes with the themes of administration, culture, commerce, entertainment, tourism, leisure and creativity, so as to realize the vitality remodeling and innovative development of the Old City.

(3) Traffic guidance enhancement

① Traffic guidance

The road levels are re-sorted, the road levels are clearly divided, and the traffic system of main road, secondary road and parking lot is organically combined to reduce the broken road and improve the accessibility rate of the urban traffic system. The southern area with the focus of human flow will be guided to the whole area of Qinyang Area through the commercial and reasonable spatial axis, and the open space of Qinyang Area will be activated.



Legend
Trunk road
Secondary road
Branch road
P  Parking lot
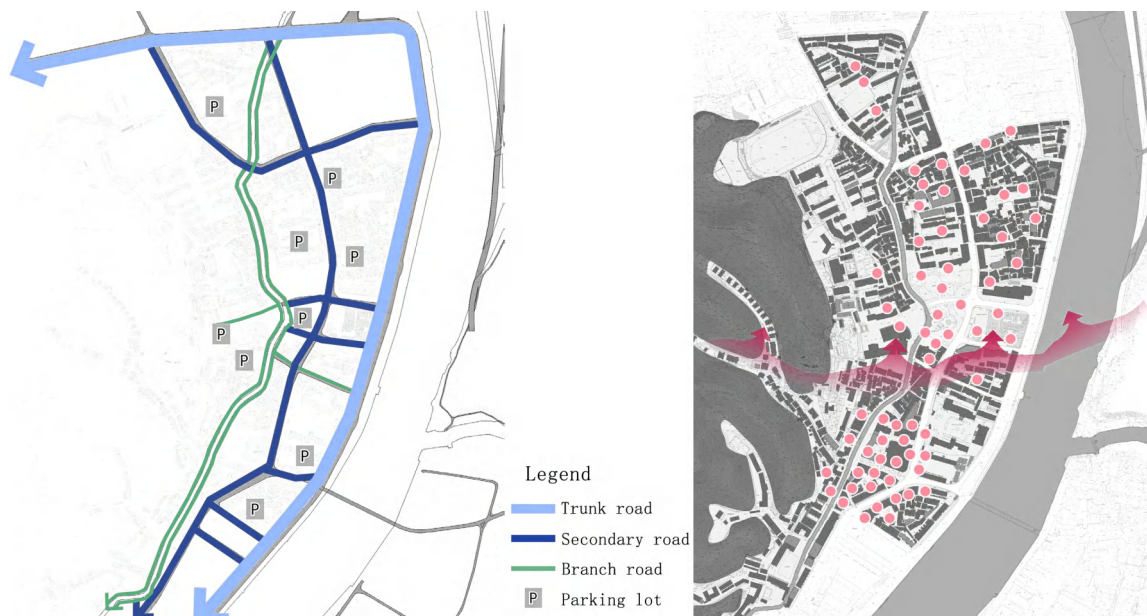
Figure 5-27 Qinyang Area Transportation Conceptualization Map

Source：author

Figure 5-28 Qinyang Area Traffic Guide Map

Source：author

② The planning of the carriage-way framework is mainly based on inheriting the existing planning, cleaning up the internal land use structure and grade functions, reasonable traffic diversion, and realizing the overall coordination of the road network. 2. Considering the demand of traffic connection and fire safety within the plot,

increase the density of branch roads, appropriately widen and open the internal end roads, improve the accessibility within the roads, increase the number of motor vehicle parking Spaces, and meet the parking needs of residents. 3. Improve the site layout to reduce unnecessary vehicular traffic along the Western Canal. 4. Strengthen traffic demand management and strictly control the right of way of vehicles. 5. Guide the construction of passenger-vehicle diversion system to create a comfortable and pleasant walking system.

③ Street space is an important spatial element of the cultural relics of the old city. The original street space form is planned to continue, and local streets are broadened and connected. By combing and constructing local Spaces, the public space activity nodes within the block are shaped around the street space. The identifiability of streets and lanes is enhanced through the construction of signs and door plates.



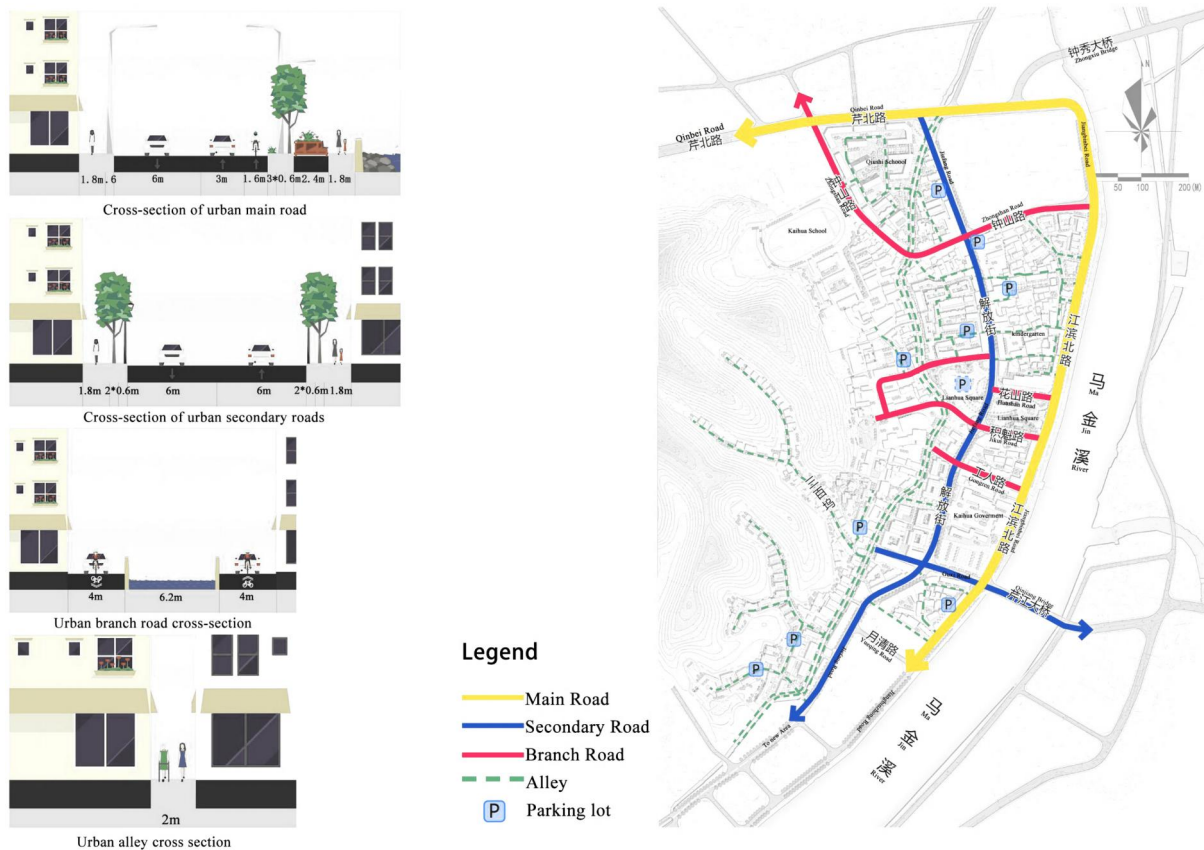Figure 5-29 Qinyang Area Transportation System Map

Source：author

④ The planning highlights the leisure and tourism functions of the old city, and the various characteristic nodes are communicated through the tour line planning. In the Lotus Square north side, West Drainage Street, set up a tourist service center, combined with the Lotus can be built to provide foreign tourists bus parking public

parking lot. Tourists can enter Qinyang old area through Lotus Square. Tourism nodes are set up to focus on "static and dynamic separation", with the West Drainage Channel as a dynamic and the interior of the neighborhood as a static area to satisfy both tourists and residents.
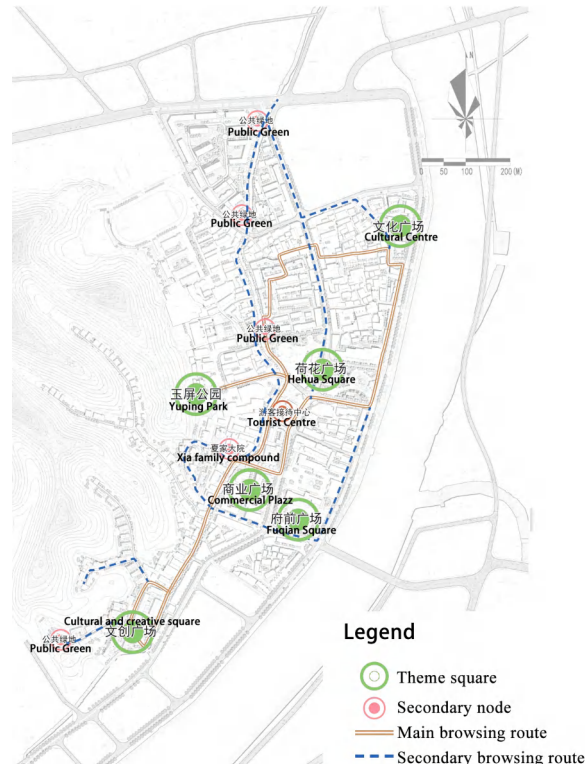


Figure 5-30 Qinyang Area Browse Plans

Source：author

(4) Improve supporting facilities

① The first contains the abolition of industrial land use, restoration of the land nature, and functional replacement and Restoration. In this area, the residential function has been converted into the form of family workshops and small-scale factories, and such industrial land has been canceled in the old city area, and the nature of the land has been restored to the original residential land. In addition, combing the original texture, to create the old city cultural lineage, in keeping the premise of the existing neighborhood pattern to improve the quality of life of residents, and the introduction of modern residential facilities; highlight the historical and cultural flavor of the area, and improve the degree of internal and commercial areas, waterfront areas closely linked. The final continuation of the watery life, activate the waterfront space, the transformation of the West Drainage Channel at the same time combined with the current urban life pattern, to strengthen the link between

the West Drainage Channel and Jiefang Street, injecting fresh elements, promoting the culture of the West Drainage Channel, activate the waterfront space.
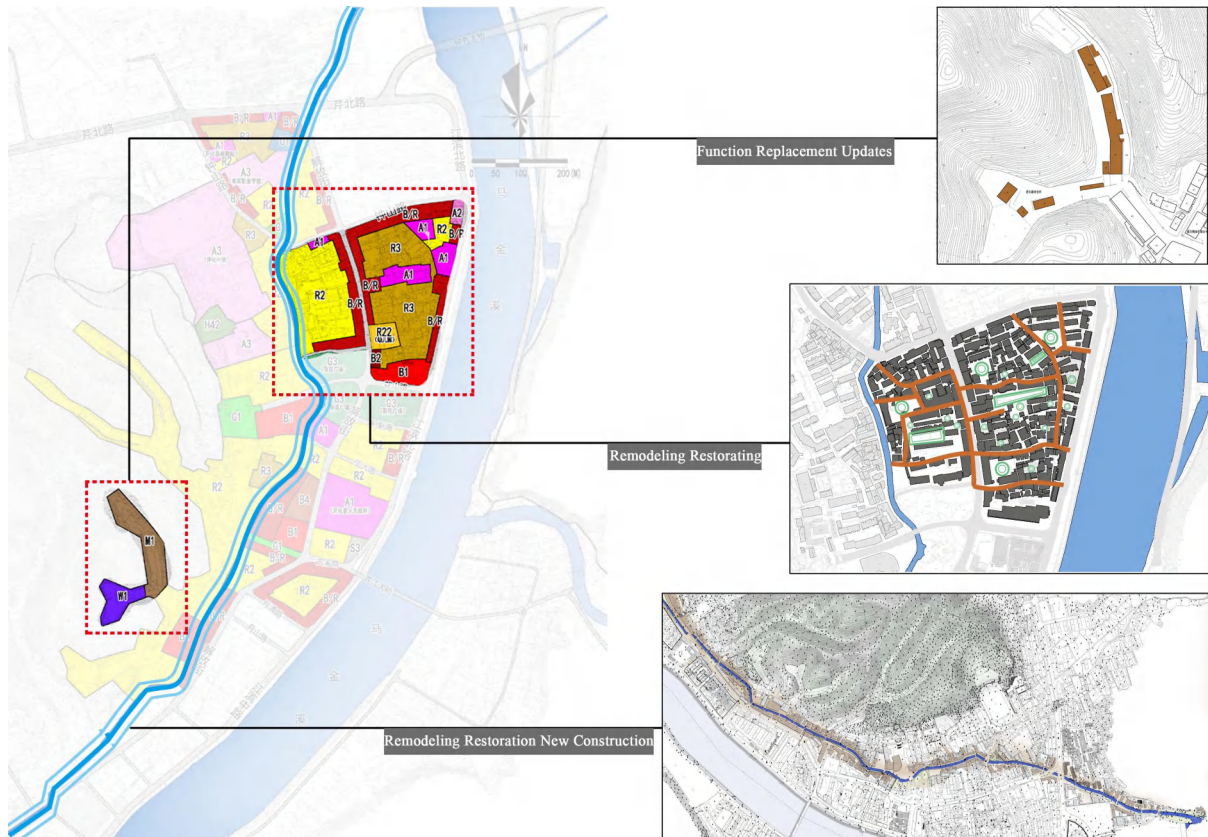


Figure 5-31 Qinyang Area Key Project Enhancement Map

Source：author

② New project construction and development

With the demolition of a large number of unauthorized buildings and the relocation of old buildings in some areas, a large amount of open space has been released for Qinyang Area. Along with the completion of Lotus Square, the proportion of public space in Qinyang Area has reached a new height, but the overall proportion is still lacking. Therefore, the construction of the square in front of the county government is considered, and the three landscape belts of Huashan-West Drainage-Majinxi are linked to form an active public space linkage sub-axis.
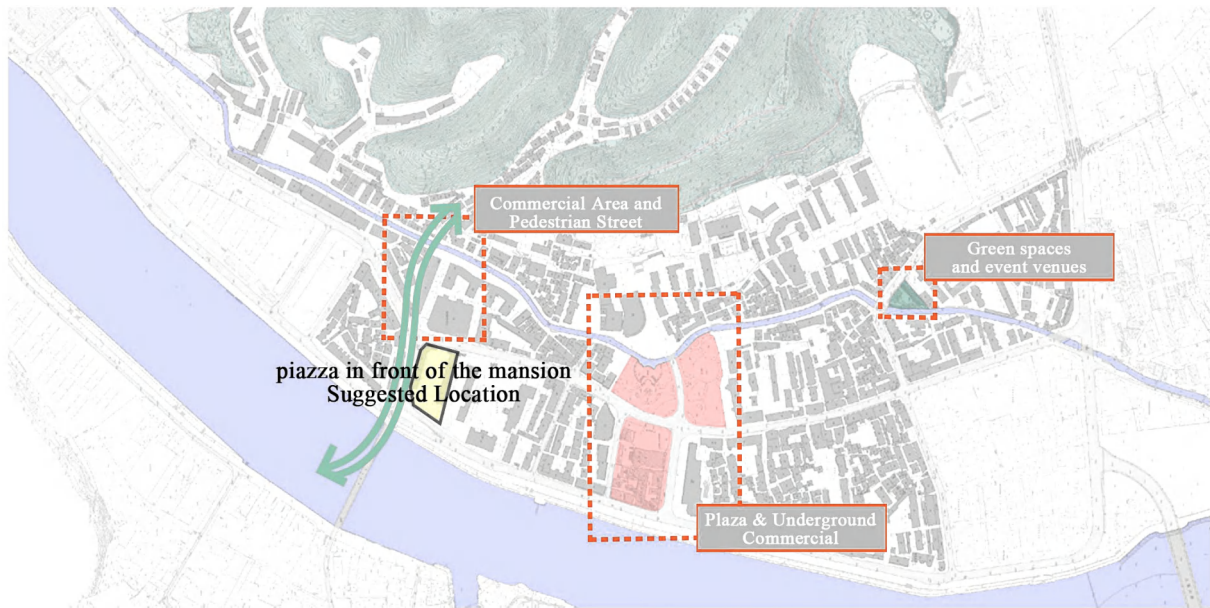
Figure 5-32 New project in Qianyang area

Source：author

It plans to retain public service facilities such as kindergartens, middle schools, universities for the elderly, libraries and administrative centers within the current planning scope, increase modern service facilities such as cultural centers, famous streets, tourism services, creative culture, conferences and exhibitions, catering and entertainment, leisure and vacation, and add health and fitness facilities in combination with parks.
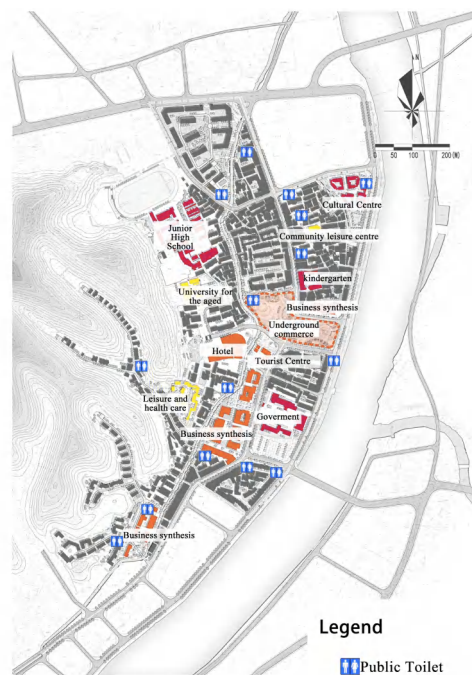


Figure 5-33 Supporting facilities of Qinyang Area

Source：author

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## 5.4.2 Environmental repair intervention

(1) Environmental repair method

① Landscape penetration

Make good use of the ecological foundation of Huashan - West Drainage - Majin Creek, the natural landscape well penetrated into the old urban areas, early in the morning the natural potential of high mountains and low water, resulting in the landscape ecological energy cycle flow, the natural ecology to a kind of echo, mutual attraction of the trend to create a landscape city of the imagery. At the same time the construction of a certain amount of integrated facilities, the relationship between man and nature using functional space closely linked.



Figure 5-34 Qinyang Area Landscape Infiltration Map

Source：author

② Newly built and remodeled city parks

Part of the space of demolished unauthorized buildings will be released to build a number of new urban parks, so as to realize year-by-year coverage of greening in the old areas of the city. Gradually develop green open space, while focusing on the preferred selection of unique local plants to create a green space system and ecological space with local characteristics to realize the evolution of urban ecology.

Figure 5-35 Qinyang Area Landscape Evolution Map

Source：author

③ Ecological activation

Focusing on the activation of the area along the West Drainage Channel, the ecological corridor should be utilized in combination with the commercial space and pedestrian system. The construction of ecological corridors is to enhance the human environment, while focusing on the needs of people close to nature to meet, at the same time, the ecological environment is to create a good basis for the vitality of commercial space elements, so the architectural design of public space and ecological need to have echo.

**(2)** Reconstruct landscape structure

Plan to form a spatial landscape structure of "one axis, two belts and multiple nodes". Axis One: Jiefang Street Urban Landscape Axis. Two belts: the waterfront landscape belt of Ma Jinxi and Xiqu. Multiple nodes: Lotus Square, Old City Gate Cultural Square, Xiqu Commercial Square, Creative Culture Square, Xipingshan Park and other nodes. The planning aims to shape spatial landscapes based on the historical and cultural imprints and local cultural symbols of the old urban area, deepen the guiding and leading role of the Lotus Square in the secondary landscape Spaces of the surrounding blocks, and carry out planning and design around water body Spaces, historical relics, etc. For instance, a distinctive city wall park is created around the old city gate (Money Gate) by adopting landscape design techniques, and public nodes are designed around the turning point of the West Canal water body, etc.
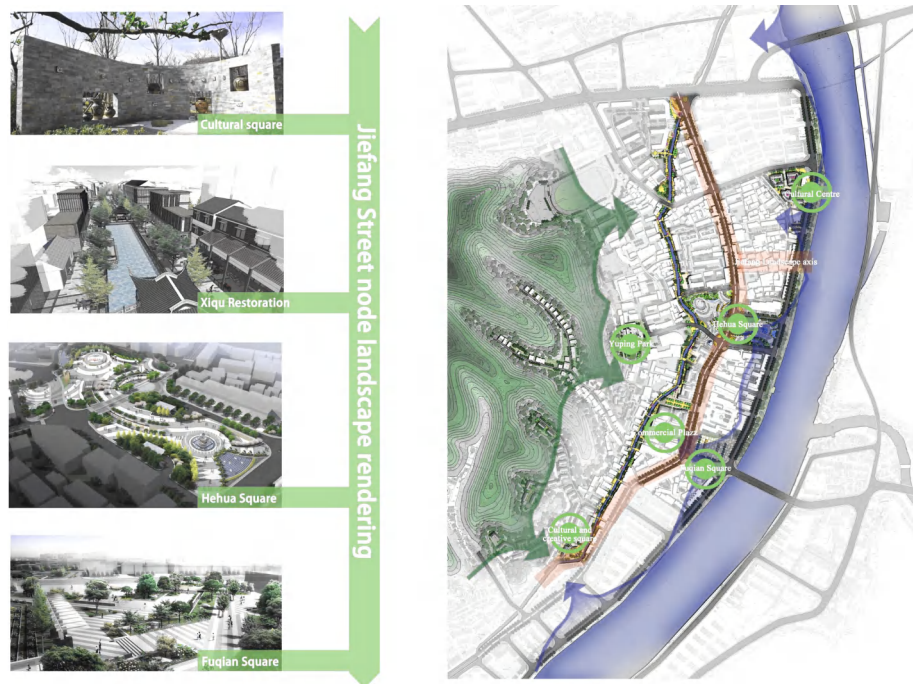
Figure 5-36 Qinyang Area Spatial Landscape Node

Source：author

**(3)** Plant ratio

In order to ensure that each public space has a good landscape effect in different seasons, plant species that are adapted to the local climate, easy to maintain and have ornamental value were mainly selected.
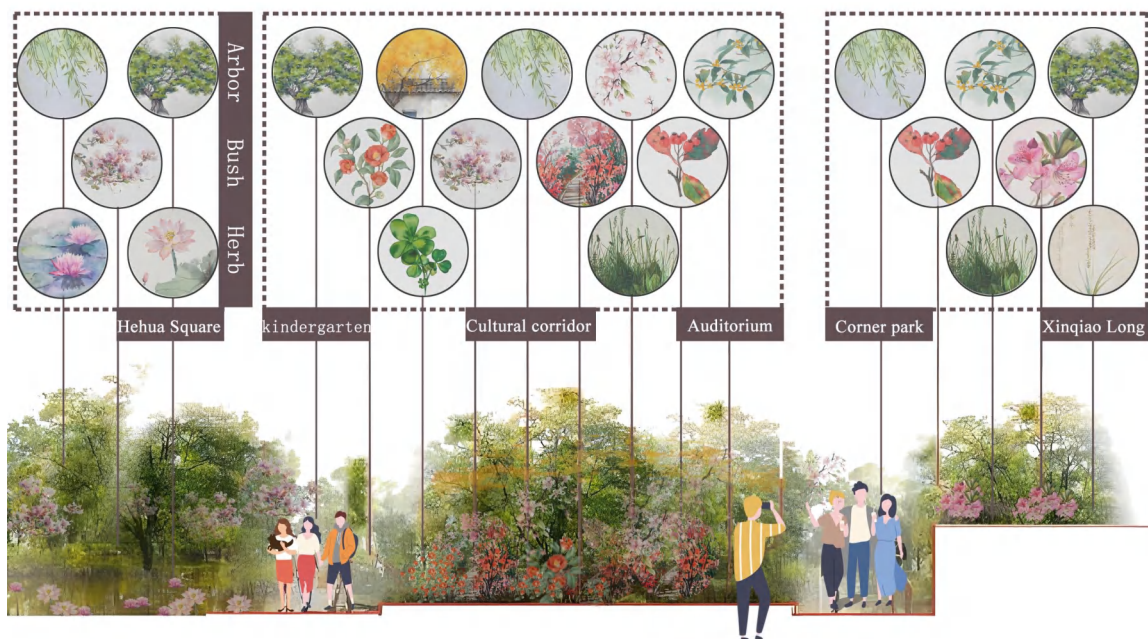


Figure 5-37 Plant ratio of Qinyang tablet

Source：author

Through this plant ratio, each landscape space can present a rich landscape effect

in different seasons, and the selection of plants also takes into account the characteristics of easy maintenance and strong adaptability, ensuring long-term beauty and practicality.
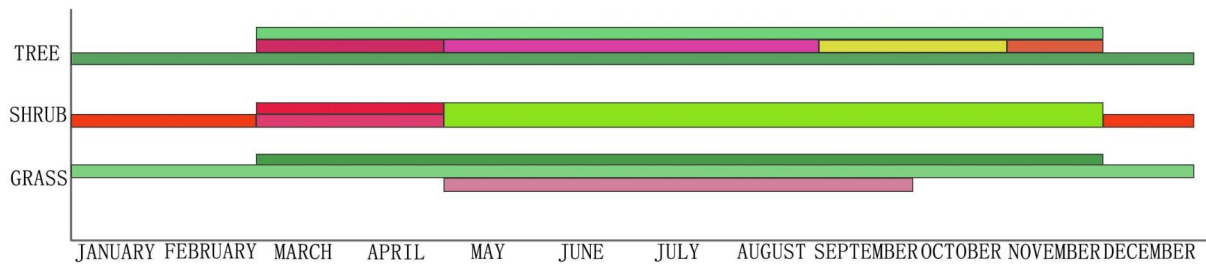


Figure 5-38 Qinyang Area Landscape Color Scheme

Source：author

(4) Park renovation

The purpose of this park renovation is to improve the quality of public space in Qinyang area and to create a multi-functional park integrating ecology, leisure and culture. The renovation plan includes the following key points: ecological repair and greening enhancement. The natural ecology of the park will be restored by increasing the area of green space and planting plants with local characteristics. The design will introduce the concept of "sponge city", building rain gardens and ecological wetlands to improve the drainage system and enhance the ecological resilience of the park. Optimization of recreational facilities, children's play area and elderly activity space will be planned to enhance the inclusiveness and practicality of the park.



Figure 5-39 Qinyang Area Park Renovation

Source：author

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### 5.4.3 Socio-cultural Restoration

(1) Protection of cultural heritage

In the urban restoration of Kaihua Old area, the focus is on the relationship between protection and Restoration. Restoration within the planning scope is based on taking positive and appropriate protection and development measures, and its reasonable utilization. ① Space: Protecting and retaining important historical streets and alleys is the basic premise, and under the premise of not destroying the original street pattern and historical courtyards, the streets and alleys inside the plots are appropriately widened and dredged, so as to make them into a network, increase the accessibility inside the plots, and meet the requirements for the construction of urban fire-fighting and municipal support facilities. ② Architecture: Rescue restoration is carried out for the buildings with certain historical value in the old city, and through appropriate business forms, the buildings are restored to a more suitable state. so as to highlight the charm and value of the old buildings. The new buildings and building groups around the old neighborhoods should be coordinated with the traditional buildings in terms of building materials, style, height and sympathy. ③ Environment: The spatial environment and facilities should focus on humanized facilities and be integrated with the original humanities and natural landscapes. Combined with the public space, the facilities can reflect the Qinyang elements of landscape sketches, such as root carving, tea rhyme, Buddha and other cultural elements of the references, etc., to implement the cultural construction to the spatial environment construction.



Figure 5-40 Qinyang Area Cultural Heritage

Source：Web

(2) Cultural Space Restoration

Looking towards long-term goals, taking the optimization of spatial layout as the carrier, we will refine and summarize the spatial places with the characteristics of the old city, rationally handle the relationship between protection and utilization, continuation and restoration, follow the concept of organic restoration, and promote

the organic restoration among social structure, urban form, resources, industries and urban management.

After the restoration of the cultural space, the landmark places in the old urban area (such as the area along the West Canal and historical buildings) will be refined. Through repair and renovation, a space that combines historical display and modern functions will be formed. The restoration adheres to the concept of "organic restoration", balancing protection and utilization. Historical buildings are transformed into cultural exhibition halls, intangible cultural heritage workshops, etc., while introducing diverse cultural activities (such as folk performances and art exhibitions) to enhance residents' cultural identity. Cultural Spaces also focus on optimizing the social structure, encourage community participation in management, and promote the development of cultural tourism and creative industries to enhance economic vitality. Through intelligent management and meticulous design, cultural Spaces will become the bond connecting the old city and the new city, promoting sustainable urban development and social harmony.
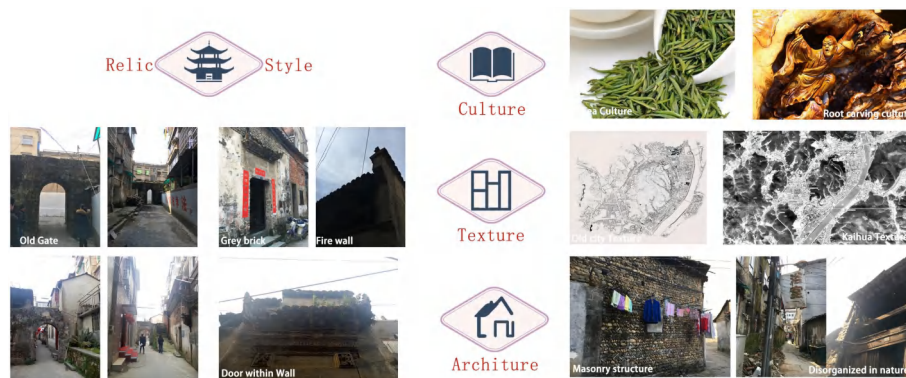


Figure 5-41 Cultural DNA of Qinyang Area

Source：author

Combining the historical and cultural characteristics of Qinyang Area with the integration of cultural elements, the waterfront cultural corridor is designed by using the historical background of the West Canal.

Figure 5-42 Qinyang Area Cultural Exhibition Space

Source：author

### 5.4.4 Increased economic benefits

(1) Management mode application

At present, there exist four ways of demolition and relocation by the government, which contain the dominant control mode, the dominant restriction mode, the guiding control mode, and the guiding restriction mode. The Qinyang area studied in this paper has a large volume and a diversified and complicated distribution of property rights, so the large area can be subdivided into multiple projects.
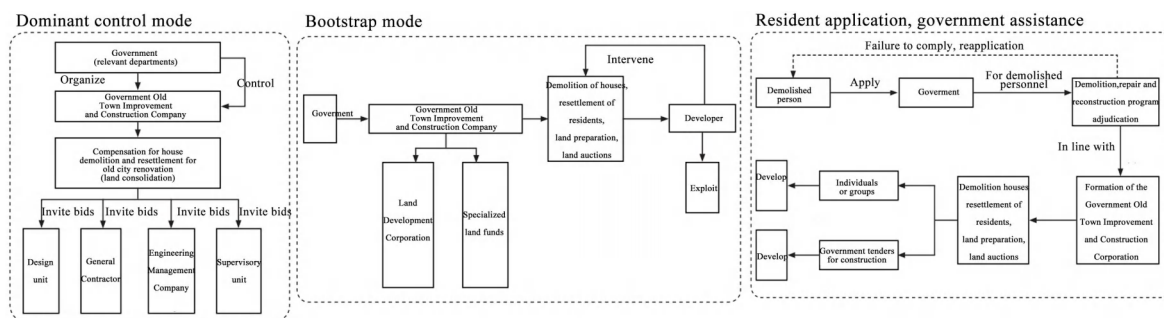


Figure 5-43 Management model application

Source：author

Aiming at the urban restoration of different blocks in Qinyang Area, the author believes that the advantages of each block should be analyzed according to local conditions, and different Qinyang Area modes should be adopted accordingly.

Figure 5-44 Qinyang Area Project Development Model

Source：author

(2) Development timeframe
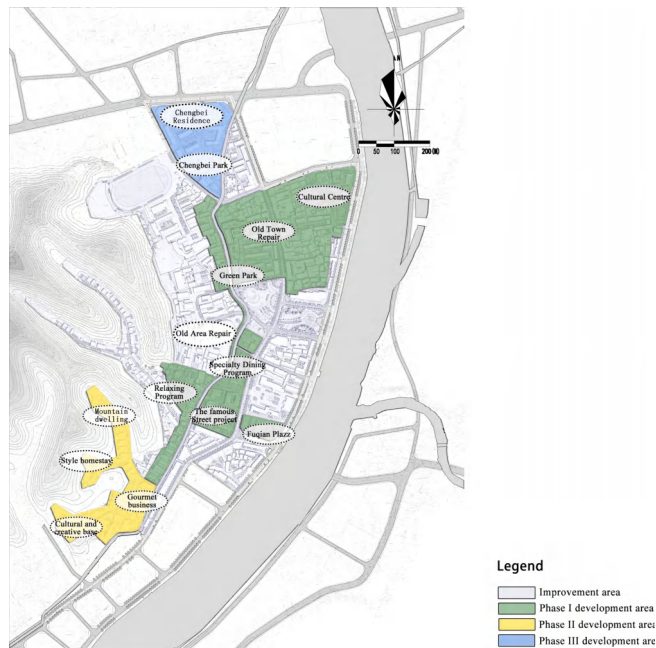


Figure 5-45 Qinyang Area Development Timeline

Source：author

From the overall planning considerations, taking into account the adaptability of planning and management, on the basis of ensuring the rigidity of the development of key lots, for general lots, full consideration of the flexibility of the implementation process, through the development of a variety of options to meet the design of a certain degree of flexibility, in order to cope with the risks and uncertainties in the

development process.

| No | Project Name | Years | Remarks |
|---|---|---|---|
| 1 | Old City Renovation Project | 2025 | Renovate the old city to enhance living standards |
| 2 | Old Street Renovation Project | 2026 | Beautify the facades of Liberation Street and renovate alleys in the old city |
| 3 | Park and Green Space Project | 2026 - 2027 | Renovate parks and squares along the West Channel and improve the environment in the old city |
| 4 | Government Front Square Project | 2027 | Increase public building accessibility and citizen activity space |
| 5 | Cultural Center Project | 2027 - 2029 | Construct a new cultural center with a library, celebrity museum, and teahouse |
| 6 | Specialty Restaurant Project | 2028 - 2029 | Build specialty buildings for dining services |
| 7 | Name Brand Street Project | 2029 | Construct specialty buildings for selling name brands |
| 8 | Leisure and Health Project | 2029 - 2030 | Develop hillside specialty buildings with hotels and restaurants |
| 9 | Food City Project | 2030 - 2031 | Create specialty buildings and consolidate existing food stalls |
| 10 | Hillside Residential Project | 2031 | Build hillside characteristic residences |
| 11 | Style Guesthouse Project | 2031 - 2032 | Construct hillside specialty guesthouses |
| 12 | Cultural and Creative Base Project | 2034 | Develop specialty buildings for commercial and cultural creative industries |
| 13 | North City Park Project | 2035 - 2037 | Enhance the North City landscape along the West Channel |
| 14 | North City Residential New Area Project | 2035 | Develop a new high-rise residential area |

Table 5-3 Qinyang Area Project Development Timeline

Source：author

## 5.4 Qinyang Area Design Plan Generation

## 5.4.1 Master Plan

(1) General layout



Figure 5-46 Qinyang Area Master Plan

Source：author

The overall planning of Qinyang Area is guided by the result score of grey relational analysis and based on the update. Through function replacement, business

model implantation and space activation, the organic Qinyang Area of Qinyang Area is reasonably guided. At the same time, the cultural connotation and historical relics of the civilized old city are deeply excavated, the spatial texture of the old city is continued in the scheme layout, the architecture and environment are organically updated, and the public space nodes with cultural characteristics are shaped.

(2) Land use planning

On the basis of the current land use, the new land use types are mainly commercial, cultural facilities and parks, while mixing some public service functions in the current residential land use to meet the demand of the residents of the old city for different land use functions, and to make the land use functions of the whole old city more composite, scientific and reasonable. At the same time, it emphasizes the introduction of the flower hill and water system to strengthen the connection and integration between different functions.



| Code | Name | | Area (hm²) | Percentage (%) |
|------|------|------|------|------|
| R | residential land | | 13.85 | 26.60% |
| | Included | Class II residential land | 13.57 | 26.07% |
| | | Land for service facilities | 0.28 | 0.54% |
| B/R | Commercial and residential land | | 12.66 | 24.32% |
| A | Public administration /service | | 10.19 | 19.57% |
| | Included | Administrative office space | 2.24 | 4.30% |
| | | Land for cultural facilities | 1.35 | 2.59% |
| | | Educational/scientific | 6.6 | 12.68% |
| B | Commercial service facilities | | 4.05 | 7.78% |
| | Included | Commercial land | 3.98 | 7.65% |
| | | Business Land | 0.07 | 0.13% |
| S | Land for roads/ transportation | | 7.33 | 14.08% |
| | Included | Urban road land | 7.14 | 13.71% |
| | | Transportation hubs | 0.19 | 0.36% |
| G | Green space and plaza land | | 3.98 | 7.65% |
| | Garden area | | 2.64 | 5.07% |
| H11 | Urban building land | | 52.06 | 100.00% |
| | Waters and others | | 1.09 | |

Figure 5-47 Qinyang Area Land Use Planning

Source：author

## 5.4.2 Node rendering

The planning of Qinyang Area is mainly based on the environment, landscape corridor and functional axis of the West Canal to generate and restoration, so the important nodes in this area are located on both sides of the West Canal. There are a large number of restoration nodes and restoration projects on both sides of the West Canal because of the restoration, renovation and new service space, commercial space and public space.

Figure 5-48 Qinyang area node rendering

Source：author

(Figure 5-48) mainly shows the restoration effect of pedestrian walkways and landscape on both sides of the West Canal, the restoration effect of commercial blocks

and the control effect of urban style. We can clearly see from these renderings that after the restoration, the hydrophilicity of the West Canal has been significantly improved, and the commercial space is scattered and connected with different functional Spaces, forming a strong, organic functional and green axis. Abundant walking space and commercial facilities strengthen the walking location of Qinyang Area, integrate the pedestrian space transportation system into every area of the old urban district, and increase the accessibility and vitality of Qinyang Area. The urban style has also been greatly improved, resulting in the enhancement of urban integrity, making the coordination of the old urban area and the urban interface have a complete organic extension.

These core nodes describe the restoration state and integrity of Qinyang Area. It mainly reflects the influence and guidance of environment, function and social culture influencing factors in the area, and also shows how the evaluation system of grey relation model guides and controls the generation of restoration plan in the area.

Different areas contain different subjects, and different restoration modes and restoration subjects. Therefore, the author intends to use the mathematical model of "grey relation" analysis to explore the different impacts of different restoration methods on the same area, and whether the same theory and unified model can be used to create different directions of design.
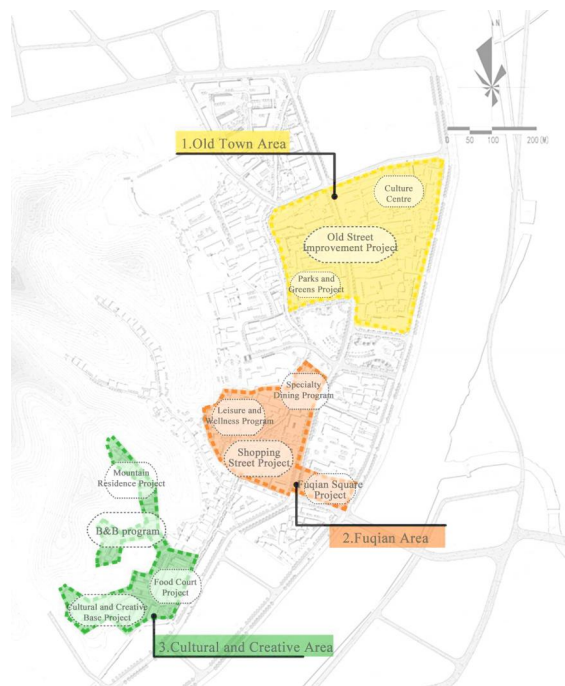


Figure 5-49 Distribution of key projects in Qinyang Area

Source：author

Distribution of key projects, the planning of Qinyang old city area, the east side of the government commercial plaza area, the south west of the West Drainage former stalls and the surrounding areas to guide the construction of key projects.

Among them, the northern part of the old city area to highlight the cultural heritage of historical neighborhoods as the core, spatial grooming and cultural remodeling, the construction of service facilities to highlight the theme of culture and leisure; the central government in front of the core to highlight the modern business, culture and entertainment, tourism and leisure, as well as administrative services, and rationally deal with the relationship between the mountains - water - the city, highlighting the theme of the development of modern service industry, the southern part of the area of culture and creativity to highlight the culture and creativity, leisure and experience, the flavor of the B&B The southern cultural and creative area is to highlight cultural creativity, leisure experience, and charming lodging as the core, shaping a functional area dominated by skills, cuisine, and lodging experience.

The eastern part repairs the water system along the river, the water-friendly platform and sponge city, and the western part introduces the green belt of Huashan into the city, interacting to form a green ecological belt to activate the urban public space together.

Different districts contain different subjects, different Restoration modes and subjects, so I want to use the theory of "Double Urban Repairs" to explore the different impacts of different restoration methods on the same district, and whether it is possible to utilize the same theory and unified model to create different directions of design.

## 5.4.3 Old town charm area

The overall positioning of cultural Qinyang, charm of the old city set Pu culture, tourism and leisure, commercial services, ecological residence in one, maintain the traditional appearance of the old city, very Kaihua cultural influence of the charm of the city. Development of Kaihua ideas - inheritance and remodeling of the old city space, enhance Qinyang old city's cultural identifiability, influence and publicity, the overall transformation of the intersection of Jiangbin North Road and Zhongshan Road Road block, functional implantation, the block into Kaihua's cultural landmarks of the cultural old city; - -Sorting out the internal space, reasonably guiding residents to demolish the original building, controlling the new building to Kaihua traditional

style as the theme, controlling the height of the building and the building volume, and realizing the overall coordination of the old city; - Functional replacement of the state-owned land and buildings inside the area, creating a community park, implanting cultural The state-owned land and buildings in the area should be replaced to become community parks, implanted with public functions such as cultural rooms, community activity rooms, senior culture centers, youth activity centers, etc., so as to improve the public service functions of the community in the old city.



Project Name

| | | | | | | |
|---|---|---|---|---|---|---|
| 01 Library | 04 Hall of fame | 07 Old Gate | 10 Community center | 13 Riverside Shops | 16 Xinhua Long | 19 Jiefang Commercial Street |
| 02 Cultural Centre | 05 Cultural Hall | 08 Wujia Long | 11 Jiangbin Hotel | 14 Chongzhen Long | 17 Xiqu Coffee | 20 Public Green |
| 03 Leisure Teahouse | 06 Cultural gallery | 09 Xingxian Long | 12 Kindergarten | 15 Featured Commercial Street | 18 Xiqu Teahouse | 21 Parking Lot |

Figure 5-50 Old town charm Master plan

Source：author

Traffic organization, combing the internal space of the old city, connecting the

urban road network, controlling the width of the main internal streets and alleys to be 4 meters, and the width of the secondary streets and alleys to be 3 meters, adding 3 small surface parking lots, and adding an underground parking lot in combination with the cultural park. At the same time, through the combing of streets and alleys, communication between the West Drainage Channel and Majin Creek, shaping the characteristics of the tour line, highlighting the charm of the old city.
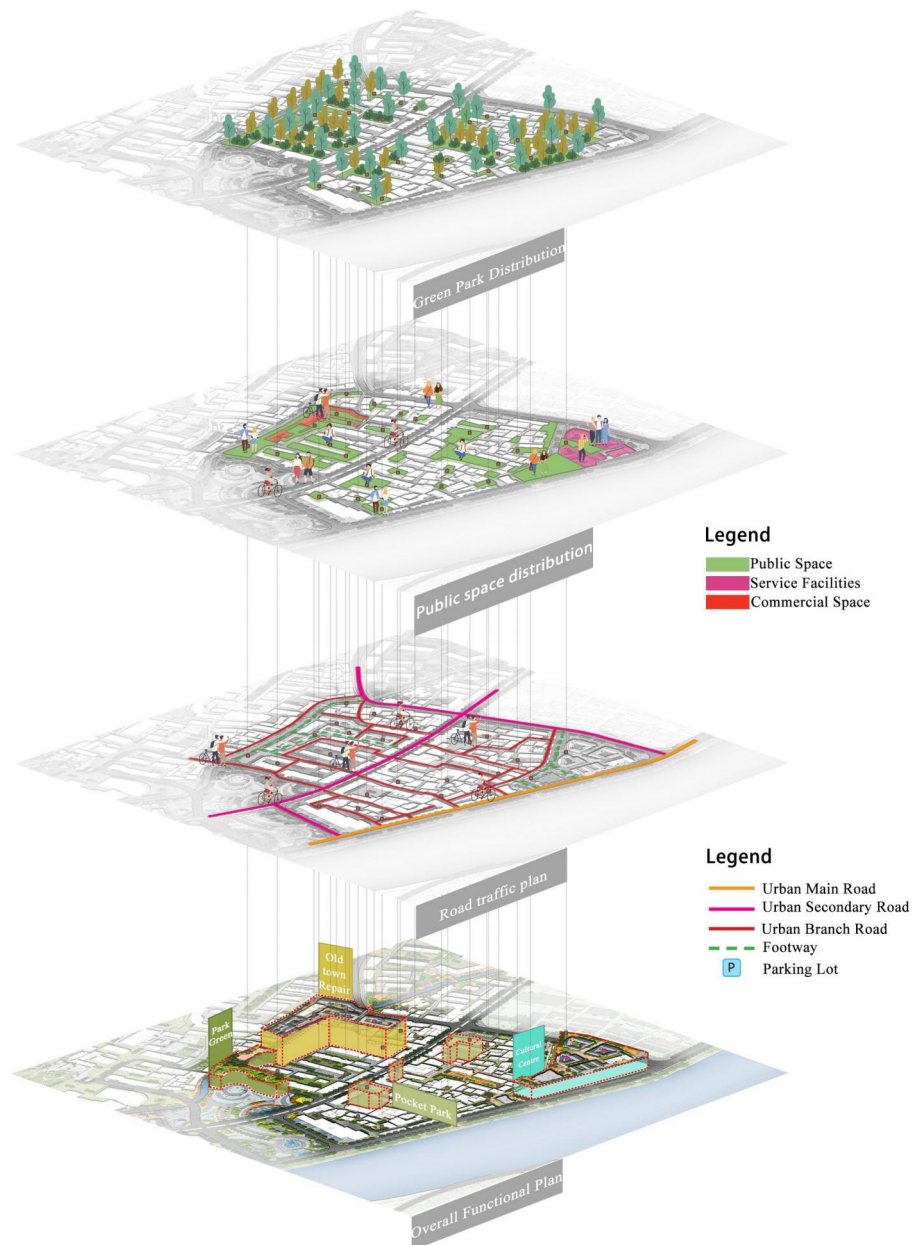


Figure 5-51 Analysis of the old town charm

Source：author

Around the old town style, three main projects are set up in the plot, namely: cultural center, old street renovation, and park green space. Cultural Center project:

Based on the original library, a new cultural center, Hall of Fame and other cultural infrastructure will be built around it; Old street renovation project: On the premise of not destroying the texture of streets, the existing buildings will be sorted out, and measures such as building facade renovation, maintenance and repair, demolition and reconstruction will be taken, and the street space will be sorted out to ensure fire protection requirements and revive the vitality of the community; Park Green project: Use the lost space in the block to create a public open space for the surrounding residents.



Project investment estimate sheet

| Number | Name | Area (ha) | Floor area (m²) | Construction cost (W) |
|---|---|---|---|---|
| | Old town Area | 2.31 | 19256 | 7160 |
| 1 | Cultural Centre | 1.28 | 9785 | 3900 |
| 2 | Old town Repair | 0.8 | 9471 | 2800 |
| 3 | Public Green | 0.23 | 0 | 460 |

Figure 5-52 Old area charm node renderings

Source：author

Focusing on the flavor of the old city, three major projects are set up within the site, namely: cultural center, old street improvement, park and green space. Cultural center project: based on the original library, the new cultural infrastructure such as culture center and hall of fame will be built in the surrounding area; Old street

improvement project: without destroying the street texture, the existing buildings will be sorted out, and measures such as building facade renovation, maintenance and repair, demolition and reconstruction will be taken, and the street space will be sorted out to ensure fire protection requirements and revitalization of the community; Park green space project: the lost space in the district will be used to create public open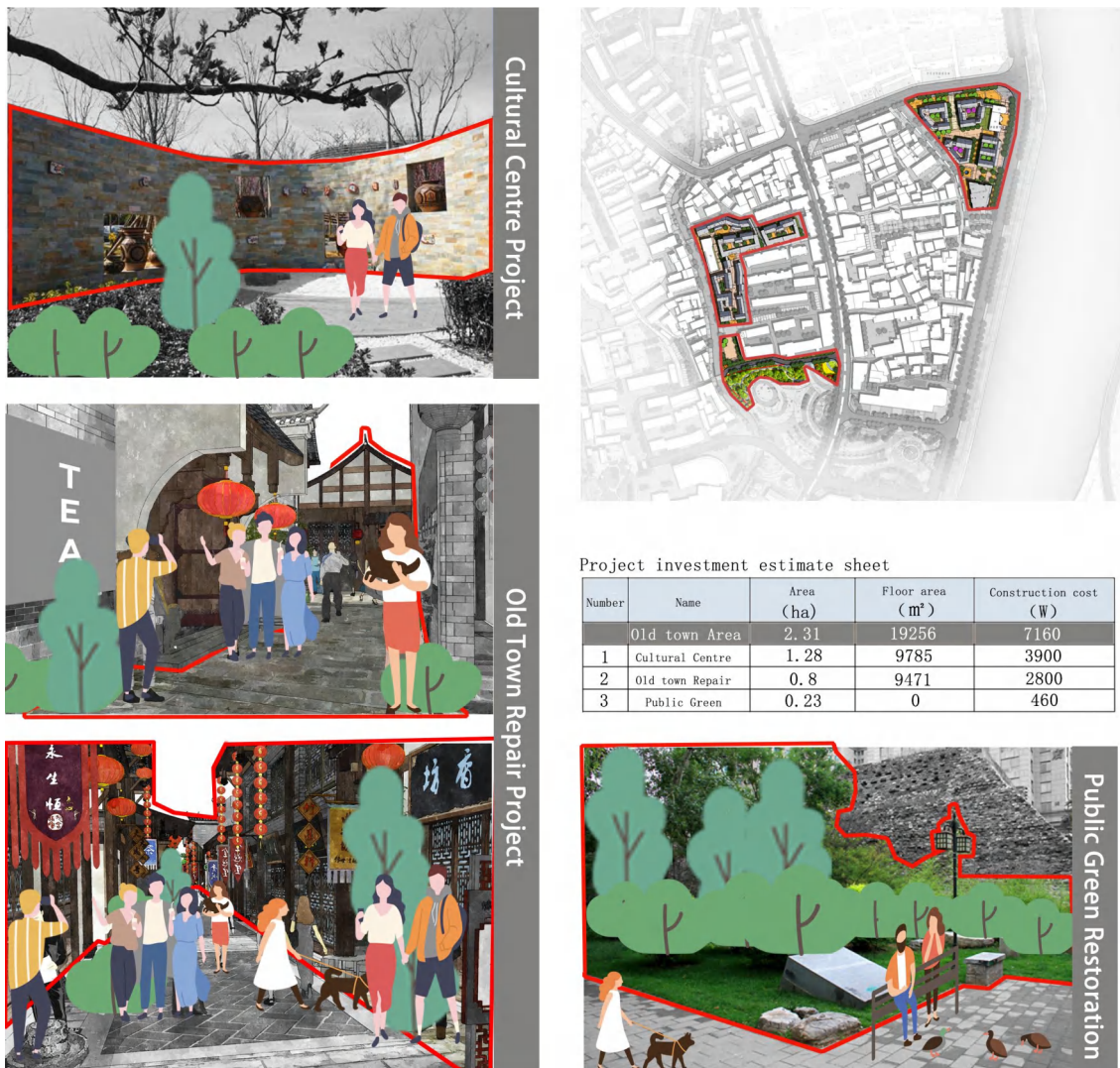 space that can be used by residents. Parks and Green Spaces Project: Utilizing the lost spaces in the district to create public open spaces that can be used by the residents in the surrounding areas.

The investment estimate of Qinyang Old area Style Area is about 71.6 million RMB. Under the premise of Double Urban Repairs connotation, small investment and micro-remodeling are used to meet the enhancement of urban function, ecology and urban outlook, and the inflow of different types of capitals has activated the public space of the Old area Area.

## 5.4.4 Fuqian Area

Overall positioning: Xiqu commercial district and cultural business district are adjacent to Xiqu, positioning regional consumer groups, building non-traditional shopping malls, and building a comprehensive commercial district integrating commercial entertainment, cultural landscape, leisure tourism, and conference and exhibition. The development idea is different from the underground commercial block of Lotus Square, and the plan combines the waterfront space of Xiqu to create high-end commercial leisure famous street and characteristic waterfront commercial street in Kaihua County. Taking the new Chinese style as the theme of the building, it adopts the facility method that integrates the building with the surrounding environment to create a leisure and commercial experience space that is suitable for static and dynamic; Dislocation of the surrounding community type of business, the introduction of high-end commercial sales brands, improve the overall level of commercial service and image of Kaihua. The traffic organization adopts the traffic planning concept of full walking and dynamic zoning, and the people flow organization strengthens the combination of walking and traveling, and creates a characteristic walking space through the landscape and fine design of the space.
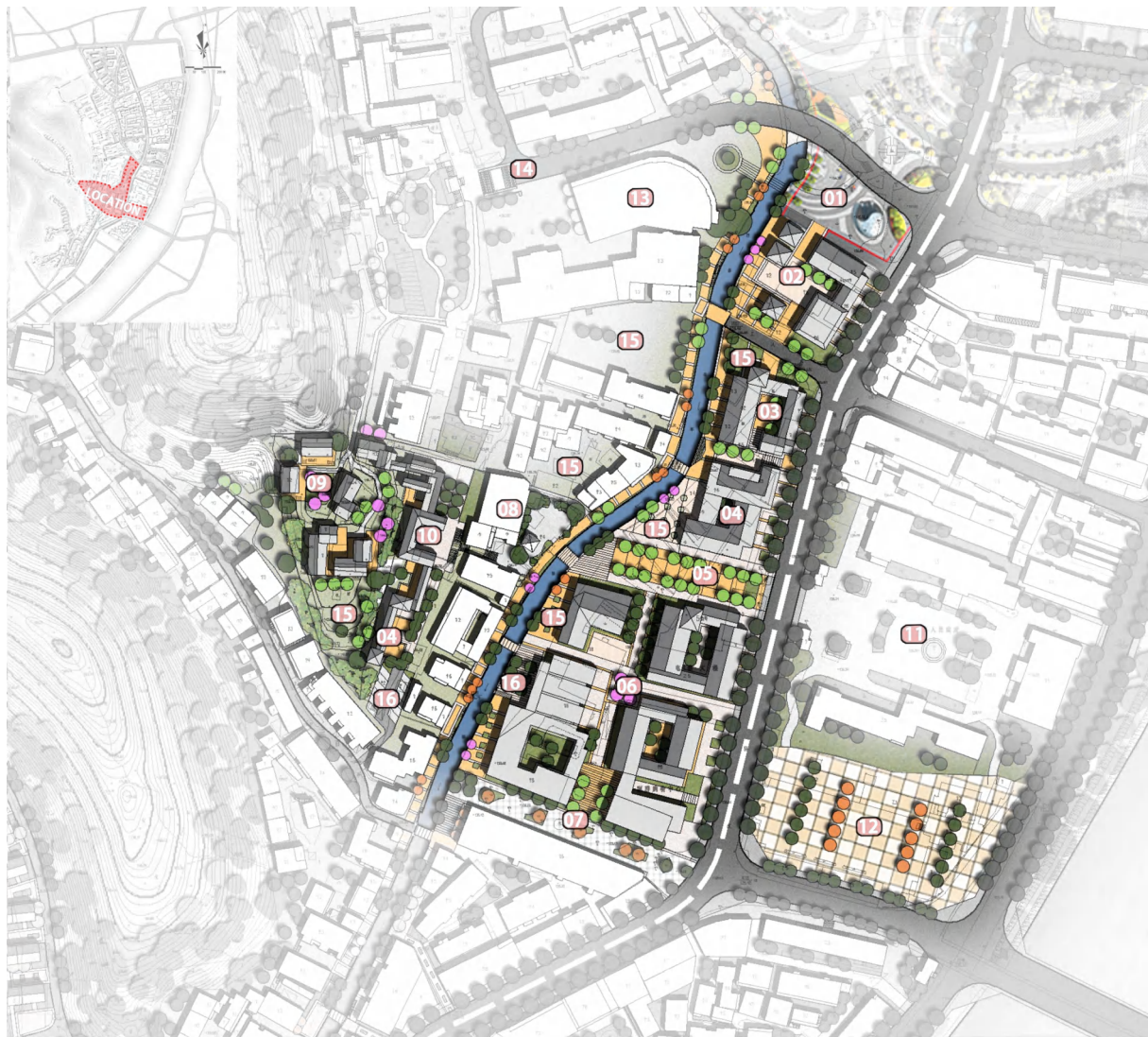
Project Name

| 01 Hehua Square | 04 Coffee Shop | 07 Comercial Pathway | 10 Teahouse | 13 Kaihua Hotel | 16 Parking Lot |
| 02 Tourist centre | 05 Commercial Square | 08 Xia compound | 11 Goverment | 14 Entrance of park | |
| 03 Fuqian food court | 06 Streets of shopping | 09 Leisure and health care | 12 Fuqian Square | 15 Public Green | |

Figure 5-53 Master Plan of Fuqian Area

Source：author

A large number of squares, environmental parks and pocket parks are placed in this area to build a good living environment experience. Among them, the new Fuqian Square connects the three landscape resources of Huashan, Xiqu and Majinxi with public space, forming the main landscape channel of the old urban area and strengthening the environmental construction of the area.
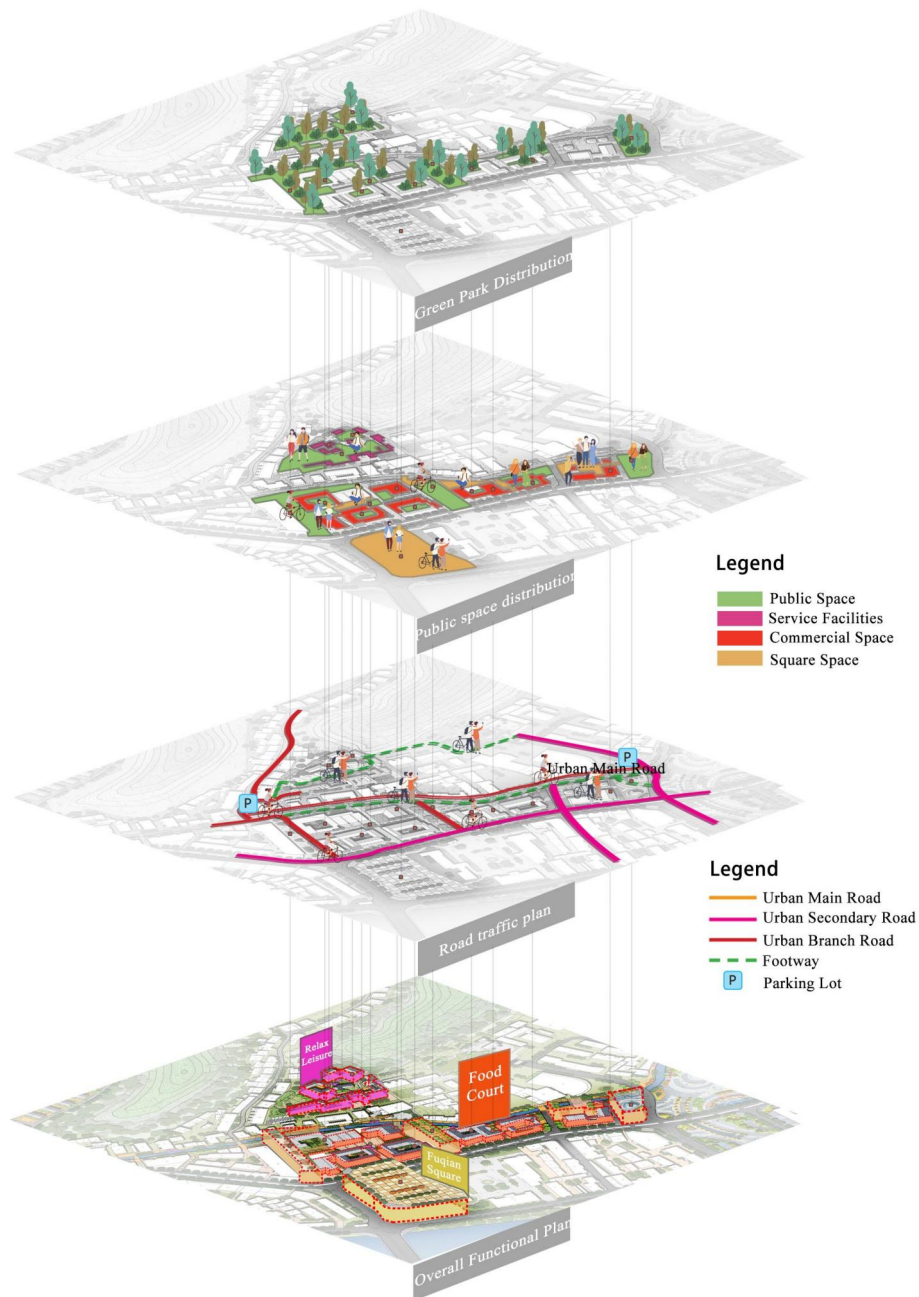
Figure 5-54 Analysis of Fuqian area

Source：author

Around the county government, four main projects are set up in the plot, which are: specialty catering, West Drainage Street of Fame, leisure and health care, and the square in front of the government. Characteristic catering project: including the visitor reception center, Kaihua flavor characteristic catering; West Drainage Street project: located in the government west of the former telecom building, positioned as a high-end commercial area of Kaihua; Leisure and health project: combined with the Xia family compound, in the west side of the mountainous area to set up high-end hotels and other recreational projects; Mansion Square project: located in the south

side of the government, as an administrative plaza, connecting the eastern part of the city with the old city area.



Figure 5-55 Nodal renderings of Fuqian area

Source：author

The total investment in this area is about 114.98 million yuan, of which the investment in projects such as specialty food and beverage business accounts for a relatively high proportion, and it is mainly necessary to adopt a model similar to the PPP, introduce more social capital, and at the same time encourage residents to start their own businesses, so as to form a better investment atmosphere and investment environment, in order to strengthen the spatial vitality of the city and the diversification of its functions. And tap the potential and advantages of old urban areas in health and leisure and other specialty industries.

## 5.4.5 Cultural and Creative Area



Project Name

01 Entrance Of Park  02 Food Court  03 Riverside Bar  04 Culture and Creative Base  05 Style homestay  06 Yuping plot  07 Public Green
08 Parking Lot

Figure 5-56 Master Plan of Cultural and Creative Area

Source：author

The overall positioning, the two creative landmark set creative research and development, display sales, cultural experience, tourism and leisure, style of homestay, business and entertainment in one of the innovative creative board. The development idea relies on the superior environmental advantages close to the west canal and backed by the valley, changes the development mode of the traditional service industry in the old city, and builds the leisure creative industry block of the civilized old city with innovation and creativity as the starting point; Excavate and refine

innovation, creativity and cultural resources within the scope of civilized county, build cultural and creative industry parks full of humanistic atmosphere and leisure experience content through industry integration and resource reorganization, and integrate with leisure tourism to create creative boards with the theme of leisure food and characteristic homestay. The traffic organization should reasonably deal with the relationship between road construction and terrain, and build public squares at the intersection of West Canal and road to enhance the identification of the area; The end road in the valley is provided with a return site; Set up a surface parking lot.
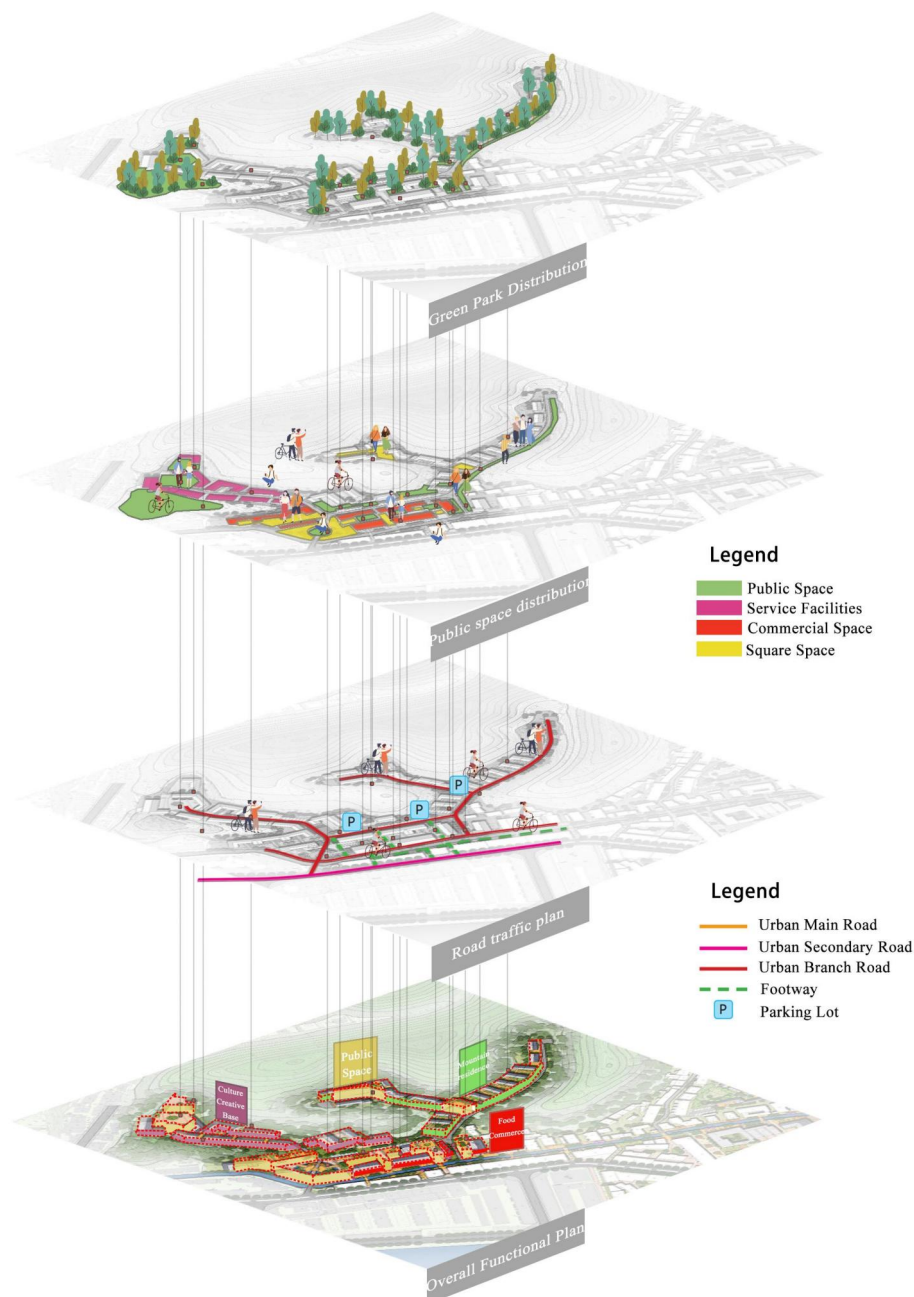


Figure 5-57 Analysis of the Cultural and Creative Area

Source：author

Green Park in this area according to local conditions, take advantage of the natural height difference of Huashan Mountain and the residual artery of Huashan mountain to build a large number of green parks and environmental squares, integrate the functions of this area into the environment, and use good environmental advantages to explore the good experience of living and service, use business and new industries to organize, and introduce different types of people groups.

This area is the new element injection area of Kaihua Old area, and 4 main projects are set up in the plot, namely: Gourmet City, Style B&B, Mountain Residence, and Cultural and Creative Base. Gourmet City Project: Restore the gourmet project in the original stall area, including teahouse, bar, special catering, local snacks, etc.; Style Lodging Project: Experience the local life and style of Kaihua's special lodging area; Mountain Residence Project: Dismantle the original factory buildings and rebuild the residential area; Cultural and Creative Base Project: Inject new power into Kaihua's old city and set up the Cultural and Creative Plaza.



Project investment estimate sheet

| Number | Name | Area (ha) | Floor area (m²) | Construction cost (W) |
|---|---|---|---|---|
| | Culture and creative | 2.86 | 28579 | 11300 |
| 1 | Gourmet commerce | 0.86 | 7154 | 2800 |
| 2 | Mountain residence | 0.75 | 8109 | 1300 |
| 3 | culture and creative base | 1.25 | 13316 | 5300 |

Figure 5-58 Cultural and creative artistes area node renderings

Source：author

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The total investment in this area is 113 million yuan, of which the cultural and creative base accounts for the largest proportion of investment. The main role of this project is to protect cultural heritage, including handicrafts and cultural inheritance and promotion of Kaihua city. The core investment of this area is to build the i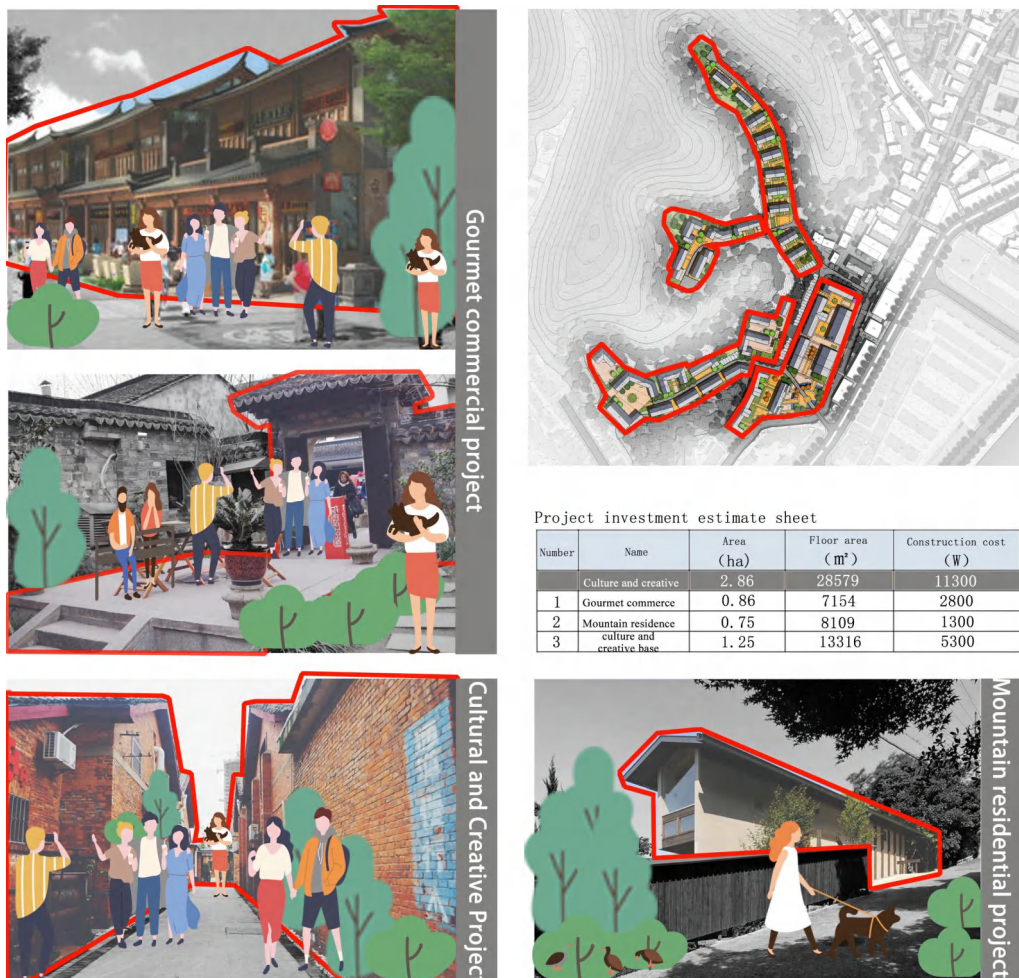nheritance and development of Kaihua's intangible cultural heritage, mainly undertaking the role of Kaihua's social and cultural direction to enhance.

## 5.5 Evaluation and analysis of "GRA" of restoration in Qinyang Area

### 5.5.1 Restoration program evaluation

After a series of public space enhancement and Restoration, the urban functional structure and ecological environment of Qinyang Area were reshaped, here the author reorganized the data and grey relational processing to get a new evaluation score.Because part of the evaluation scores cannot be collected and calculated before the implementation of the restoration program, such scores will be excluded from the program evaluation after the restoration.

| Sub-objective hierarchy | Hierarchy of elements | Indicator level | Segmentation indicators | Rating/ Before | Rating/ After | Subtotal Before/ After |
|---|---|---|---|---|---|---|
| Functional structure objectives | Location | Layout | Size | 0.2597 | 0.2597 | 0.8261/ 0.8460 |
| | | | Distribution | 0.0524 | 0.0678 | |
| | | | Land use | 0.0618 | 0.0663 | |
| | | Service radius | Gap | 0.1623 | 0.1623 | |
| | | | Time | 0.2899 | 0.2899 | |
| | Land use indicators | Site assessment | Percentage of public space | 0.0355 | 0.0682 | 0.4288/ 0.4635 |
| | | | Design capacity | 0.1435 | 0.1490 | |
| | | | Traffic area | 0.1032 | 0.0956 | |
| | | Functional satisfaction | Public Satisfaction | 0.0275 | / | |
| | | | Functional rationality | 0.0346 | 0.0355 | |
| | | | Frequency of use | 0.0809 | / | |
| | | Level of land use | Vacancy rate | 0.0929 | / | |
| | | | Construction area per capita | 0.1120 | 0.1152 | |
| | Service | Infrastructure | Illumination | 0.2767 | 0.2812 | 0.7681/ 0.8399 |
| | | | Electrical power | 0.0000 | 0.0000 | |
| | | | fire-fighting | 0.0534 | 0.0569 | |
| | | | Radiation area | 0.1339 | 0.1339 | |
| | | Service | Sanitation | 0.0860 | 0.0860 | |

| Sub-objective hierarchy | Hierarchy of elements | Indicator level | Segmentation indicators | Rating/ Before | Rating/ After | Subtotal Before/ After |
|---|---|---|---|---|---|---|
| | | Facilities | Guide sign | 0.0159 | 0.0165 | |
| | | | Cultural facility | 0.1452 | 0.1452 | |
| | | | Open space | 0.0570 | 0.0655 | |
| | | Utility | Service structures | 0.0769 | 0.0547 | |
| | Space structure | Traffic organization | Parking space | 0.1726 | 0.1776 | 0.8793/ 0.8799 |
| | | | Pedestrian space | 0.2234 | 0.2162 | |
| | | | Visualization system | 0.0068 | 0.0069 | |
| | | | Accessibility | 0.0638 | 0.0647 | |
| | | Scale of spatial interface | Landscape coordination | 0.0059 | 0.0062 | |
| | | | Spatial logic | 0.0094 | 0.0097 | |
| | | | Street Aspect Ratio | 0.1217 | 0.1217 | |
| | | | Plaza scale | 0.2569 | 0.2569 | |
| | | Structure | Spatial integration | 0.0188 | 0.0200 | |
| Ecological objective | Geographical environment | Flexibility | Score | 0.0021 | 0.0023 | 0.7132/ 0.7661 |
| | | Continuity | Local Characteristics | 0.0057 | 0.0058 | |
| | Environmental protection | Construction materials | Bio-materials | 0.0000 | 0.0000 | |
| | | | Economize on resources | 0.0200 | 0.0200 | |
| | | | Construction cost | 0.3410 | 0.3770 | |
| | | Energy use | Clean energy | 0.0000 | 0.0000 | |
| | | Operating cost | Dynamic update | 0.0075 | 0.0081 | |
| | | | Manpower inputs | 0.3969 | 0.3529 | |
| | Green landscape | Green space quality | Geen area ratio | 0.0242 | 0.0248 | 0.4201/ 0.5006 |
| | | | Green space per capita | 0.0588 | 0.0667 | |
| | | | Number of natural parks | 0.0907 | 0.0907 | |
| | | | Green area | 0.0533 | 0.0538 | |
| | | | Visual weighting | 0.0389 | 0.0574 | |
| | | Plant condition | Protection of vegetation | 0.0540 | 0.0631 | |
| | | | Vegetation ratio | 0.0518 | 0.0714 | |
| | | Scenic beauty | Essentials | 0.0197 | 0.0304 | |
| | | | Public Satisfaction | 0.0506 | / | |
| | | | Aesthetic resolution | 0.0287 | 0.0423 | |
| | | Environment quality | Clean and tidy environment | 0.0710 | 0.1237 | 0.8172/ 0.8699 |
| | | Air quality | AQI | 0.1195 | 0.1195 | |
| | | Water quality | Hierarchy | 0.3114 | 0.3114 | |
| | | Noise condition | Public space noise | 0.3153 | 0.3153 | |
| Sio-culture | publicity | Accessibility | Pedestrian system | 0.1424 | 0.1595 | 0.5018/ 0.6337 |
| | | | Mass transit | 0.1435 | 0.1721 | |
| | | | Indication system | 0.0614 | 0.0968 | |

| Sub-objective hierarchy | Hierarchy of elements | Indicator level | Segmentation indicators | Rating/ Before | Rating/ After | Subtotal Before/ After |
|---|---|---|---|---|---|---|
| | | | Structural clarity | 0.0880 | 0.1219 | |
| | | Activities | Variegation | 0.0665 | 0.0834 | |
| | Comfortableness | Vigor | Retention time | 0.3153 | / | 0.2859/ 0.2882 |
| | | | Frequency of use | 0.2172 | / | |
| | | Quality | Environmental Behavioral Linkages | 0.1424 | 0.1274 | |
| | | Intimacy | Willingness | 0.1435 | 0.1608 | |
| | Cultural attraction | Geographical characteristic | score | 0.2957 | 0.3381 | 0.6001/ 0.7489 |
| | | Cultural activity | Frequency | 0.1612 | 0.1492 | |
| | | Place of cultural interest | Densities | 0.0989 | 0.1638 | |
| | | | Values | 0.0443 | 0.0978 | |
| | Cultural heritage | Material heritage | Historical relic | 0.2628 | 0.2628 | 0.5772/ 0.5903 |
| | | | Historical building | 0.0677 | 0.0677 | |
| | | | Historic relics | 0.0638 | 0.0638 | |
| | | Intangible heritage | Quantities | 0.1243 | 0.1243 | |
| | | | Historical relevance | 0.0586 | 0.0717 | |
| Economic efficiency targets | Building development | Construction funds | Land price | 0.0664 | / | 0.5365/ 0.3676 |
| | | | Engineering costs | 0.0980 | 0.0837 | |
| | | | Management costs | 0.2776 | 0.1616 | |
| | | | Revenue | 0.0792 | / | |
| | | | GDP | 0.1318 | / | |
| | | construction cycle | Cycle time | 0.1609 | 0.1223 | |
| | Economic benefit | Land benefits | Utilization factor | 0.0146 | 0.0164 | 0.1453/ 0.1928 |
| | | | Proceeds | 0.0878 | / | |
| | | | Value-added level | 0.0883 | / | |
| | | | Value added of land | 0.0876 | / | |
| | | | Peripheral Development | 0.0780 | 0.0931 | |
| | | | Industrial Enhancement | 0.0527 | 0.0833 | |

Table 5-4 Area Restoration Scores

Source：author

## 5.5.2 Restoration program analysis

From this, it can be known that the new planning scheme has made significant improvements in the four target items of urban environment repair, functional repair, social culture and economic benefits.

However, the score of the construction and development item of economic benefits has only slightly increased. In the Study of the detailed items, it can be found that there is a slight decline in one small item: management cost. However, the author needs to point out that in the process of urban restoration construction and development, a greater increase in management costs is bound to be required than under normal circumstances. This is an inevitable particularity during the construction period. This does not lead to the conclusion that the economic benefits of the plan have not improved significantly within the design cycle. In contrast, it has optimized the management costs and engineering investment of this area during the construction period. The optimization of these detailed items can be compared with other cases, and it can be known that the construction of this project has good investment value. Better investment expectations can cover up the deficiency of increased management costs. It should be pointed out that this grey model is dynamic and can evaluate the correlation degree of economic benefits of the design scheme during the planning period. Therefore, this scheme should be compared horizontally with other design schemes in the design stage to achieve a better solution for planning and design. Moreover, due to the particularity of this item, after the completion of the urban restoration project and during its actual operation, a vertical comparison can be made with the economic benefits before the restoration to assess whether the improvement in economic benefits is effective or not. Therefore, the grey relation model in the planning and design stage makes more value judgments for future predictions.

During the restoration process of old areas in medium and small cities, there are still certain problems regarding the shortage of funds and the stability of supply. However, at the same time, it is also closely related to the low capital turnover rate and small investment funds before the restoration. Based on the expert opinions, the overall optimization and adjustment can be briefly described as follows: The utilization and introduction of the environmental system can be improved, and the environmental repair of Majinxi, Xiqu and Huashan should be given more attention, and their connection and integration should be strengthened. Deepen the treatment of the layout form of the square, enrich the spatial layout form, and interact with the public space through the treatment of the street interface along Jiefang Street; Strengthen the planting of local tree species, enhance the environmental repair of the sponge city park along the Majin Stream, add waterfront platforms, and optimize the height difference of the water within the city. Strengthen the organic connection

between the Spaces in the old urban area, and enhance the flow line treatment of the entrances and exits in the pedestrian rest and activity Spaces to increase their accessibility and interaction. Greater efforts should be made to protect and integrate the ancient buildings in the Qinyang Area, creating an interactive space with local characteristic spatial landscapes and the surrounding environment. Intensify the discussion on the PPP Zhejiang model to solve the funding problem for the restoration of old urban area and propose more possibilities.

According to the final score obtained from the grey relation system, compared with that before the restoration, the overall score of the Qinyang Area has seen significant improvements in 12 indicators. The project score has increased from the previous 7.4996 to 7.9874. The overall goal has been basically achieved. Among them, the scores of green landscape, supporting facilities, public nature, cultural attraction and land benefits have all increased by more than 10%. As the influence of weights on this project was considered during the implementation of the plan, it is easy to grasp the main core contradictions and problems of the site during the design and restoration process. As a result, a large number of urban green Spaces, parks and public service Spaces have been added. The ultimate outcome is not only an optimization in the functional structure, but also a significant improvement in residents' closeness to the environment in the environmental field. At the same time, it has also generated considerable economic benefits and activated the commercial space and communication of the venue. During the restoration work in different periods, the value transformation of the urban restoration of the site has gradually been reflected in the increase of land prices and the frequency of economic activities, and this process has achieved sustainable economic development.

Based on the final comprehensive analysis, there are still some indicators with individual scores below 0.6, such as cultural heritage, land efficiency and green landscape. Due to the inherent deficiencies of the Qinyang Area and the commonality of high-density construction in the old urban areas of Zhejiang, it can be attempted to carry out subsequent improvements by supporting new cultural heritage and recreating the intangible cultural activities of Kaihua. At the same time, it can provide guidance and direction for the next round of urban restoration.

## 5.6 Summary of the chapter

This chapter takes the Qinyang Area as an example and elaborates in detail how to utilize the "grey relation Model for restoration of Old areas in small and medium-sized cities in Zhejiang" established above to guide the restoration strategies and practical processes.Firstly, the location conditions and selection reasons of the Qinyang Area were introduced, providing a specific Study object for the Study. The interpretation of the project background and the current situation of the base provides background information for the formulation of the restoration strategy. Through questionnaires and interviews, the demands and opinions of residents regarding the restoration of the Qinyang Area were collected, enhancing the pertinence and practicality of the Study. The current situation of the Qinyang Area was evaluated based on the "grey relation Model Established for the restoration of Old areas in small and medium-sized cities in Zhejiang Province", and the problems and difficulties of the area were integrated. Subsequently, for the parts with lower scores in the detailed items, the possible problems and their causes were analyzed. Based on the total of the restoration methods for old areas in small and medium-sized cities in Zhejiang extracted above, the implementation process and results of the restoration strategy in line with the Qinyang Area were proposed, including design principles, design framework, formulation of restoration strategies, generation of design plans, guidance of key projects, and guarantee of phased project implementation.The proposal of these strategies and practices aims to revitalize the diverse Spaces in the Qinyang Area, enhance their quality, and organically integrate them into the urban system. Finally, this chapter evaluated the design scheme based on the "grey relation" mathematical model, providing a scientific basis and practical guidance for the restoration of the Qinyang Area. The Study of this chapter not only demonstrates the effect of applying theory to actual urban restoration projects, but also provides a reference template for urban restoration in other regions. At the same time, it reduces the route cost of urban restoration and offers new solutions.

# Conclusion and prospect

Small and medium-sized cities are important strategic nodes in the administrative system of our country, and play an extremely important position and role in the reform and opening up. Its scale is huge, gathering a huge population and social resources, industry, environment and other development factors; The pace of development is much faster. old urban area embodies the development level of urban regulation, economy, society and culture, and the urban needs of residents at that time, and is the key node of urban sustainable development. The restoration of old districts in small and medium-sized cities is one of the needs for the development of new urbanization, which is of great value and significance for improving the quality of spatial environment, increasing the supply of basic services, enhancing the ability to support population gathering and services, strengthening the inheritance and innovation of urban culture, and implementing the new people-oriented urbanization.

The level of urban economic development in Zhejiang is relatively prominent, while the types and diversity of urban space are extremely rich, and the construction level is a leading position in the same type of cities in the country, which has high demonstration value and research significance.

Based on the above considerations, this paper focuses on the restoration method of old districts of small and medium-sized cities in Zhejiang province. Through literature, research and learning of outstanding urban renewal cases, the author constructs a restoration model of old districts of small and medium-sized cities in Zhejiang province based on the gray correlation cell to adapt to the urban renewal strategy under the current era. Taking Qinyang Area of Quzhou city as an empirical study of urban restoration, the research results of this paper are applied in practice.

## Main conclusion

① Established the "grey correlation" index system of restoration of old areas in small and medium-sized cities in Zhejiang: Based on the case data collected by basic research, this paper analyzes, synthesizes, compares, summarizes, interprets and analyzes the current situation of old districts of small and medium-sized cities in Zhejiang Province. It not only studies the urban material space, but also analyzes the social, economic, cultural and other factors of the city, summarizes the influencing

factors of restoration of old urban area, and explores the problems and contradictions summarized in the construction of restoration. It deepens the rational research of the research object and provides basic information for urban restoration. Firstly, at the theoretical research level, the aspects involved in old urban area are extremely complicated; secondly, at the practical level, there are many cases of urban restoration in Zhejiang. Therefore, through relevant literature review and summary of the elements of different research levels and the types of old urban area space, four general research categories and target elements are obtained, which are problem-oriented. The construction of "grey association" is carried out by establishing four hierarchical item objective levels, namely, functional repair, environmental repair, social culture and economic benefit. In this process, a variety of analysis methods are comprehensively applied to obtain a reasonable and relatively complete repair evaluation system. The whole model is divided into four layers, including one objective layer factor and four sub-item objective layer factors. There are 13 criteria layer factors and 83 index factor layer factors.

② Put forward the analysis method of restoration in old areas of small and medium-sized cities in Zhejiang: With the help of the combing model "grey relation" and the construction of an index system of "grey relation", this paper proposes a old urban area renewal evaluation system with Zhejiang characteristics. The paper studies the overall coordinated operation of the old urban area renewal system at each stage, and emphasizes the correlation between different grey relation objective levels and impact factors and their impact on the overall objective. Based on the interrelation among various factors and starting from the objective level, the grey relation is used to give weight and connection to different impact factors, and target control is carried out on each stage of the project process, so as to make the restoration plan objective and improve the operability of the implementation of the plan under the market environment with the participation of different entities.

③ It provides the methods and basis for the implementation of restoration in the old areas of small and medium-sized cities in Zhejiang province, which makes this study practicable in practice: First, the author makes use of the restoration of the "grey association" index system and the optimal selection results of the weight values of the mathematical model in the old areas of small and medium-sized Zhejiang cities to conduct exploratory case practice. The author uses the grey association evaluation

index to assign different impact factors to cases and quantify the impact scores of different factors, which can quantify the advantages and disadvantages, characteristics and defects of different cases in the construction of old urban area. This will provide relevant basis and guidance for urban restoration strategy, and provide restoration strategy guidance and guidance through different levels of evaluation criteria. Second, in the urban restoration scheme design, the case design scheme can be evaluated and scored through the data layer that can be directly calculated and assigned, so as to improve and enhance the advantages and disadvantages of the case in real time. The third is to evaluate and analyze the completed results data, so as to establish the future direction of optimization and improvement. This link lasted for a long time. In the practical application of the case, it provides non-professional technical support and an operable data platform for the stakeholders of using the theme and urban restoration in the old urban areas, promotes the rationality of public participation and reduces the subjective judgment of decision makers, which is more in line with the characteristics of renewal of small and medium-sized old urban area at the present stage.

## Innovation point

The innovative achievements of the thesis on the restoration methods of old areas in small and medium-sized cities in Zhejiang Province are reflected in the following aspects:

① For the first time, the "grey relation Model" was applied to the analysis of the correlation and restoration methods of old urban area space, and a restoration system and evaluation criteria for small and medium-sized old urban area in Zhejiang were constructed. During the establishment of this system, the four aspects of function, environment, social culture and economic benefits of restoration in small and medium-sized old urban area were deeply bound. Based on the establishment of the index system of "grey relation" in the old areas of small and medium-sized old urban area, a standardized Study on the expression of factor elements in the "target system" is conducted to establish a unified factor model platform.

② A systematic methodology for the restoration implementation of old urban areas in small and medium-sized cities in Zhejiang has been established, which has effectively promoted the development of restoration and transformation work in old urban areas of small and medium-sized cities in Zhejiang. Based on the practical

operation of the project as the basic example, from the initial stage of the project to the selection and evaluation in the project, and then to the evaluation and analysis of the results after the project is completed and providing guidance for the next round of restoration, an operational platform for equal communication among relevant stakeholders has been established in this process, and the basis for selection in each process has been provided. It can enable various departments and stakeholders to formulate specific restoration operation methods more objectively and quickly, and has been well applied in the restoration of the Qinyang Area in this article.

## Study prospect

This paper builds a grey relation system for old areas of small and medium-sized cities in Zhejiang, puts forward an restoration analysis method for small and medium-sized cities in Zhejiang, and validates and applies the old area restoration method based on this in Quzhou and qinyang district. However, there are still some specific problems that can be discussed and improved in the future work of urban renewal.

As a student with an architecture background, the author has incomplete theoretical knowledge in the construction of the two index factors of economic benefit and social impact, so he has referred to a lot of literature reviews and the integration of expert opinions, and the demonstration and practice are incomplete, which needs to be further improved in the future research.

In the process of discussion, although the grey relation data model is used to build a relatively objective operation platform, this platform is based on the analysis of the research results of many small and medium-sized cities in Zhejiang, and also invites relevant experts and scholars to conduct in-depth research and reflection. However, even in Zhejiang province, different cities have different social, economic, cultural and other influencing factors in their generation background, climate conditions, history and culture, and the gap is very large, so the types of public space generated by them are numerous. The grey relation model can be optimized by using the development of different regions and studies, so that the development of relevant elements of the model can better meet the objective requirements of dynamic development.

In the process of weight calculation, the coefficient of variation is selected to

deal with the relevant importance of different impact factors. Although the calculation process can be objective, the original data of the survey and the opinions of experts will artificially affect the final weight and result. However, with the continuous revision of expert opinions and the dynamic adjustment of urban restoration needs in the future, many subjective and human-influenced data will be constantly restoration and re-corrected, making the evaluation system more objective, comprehensive and accurate.

The author will conduct in-depth research on different kinds of old urban area in the future, so as to ensure that the system is suitable for the restoration and development of small and medium-sized urban old areas under different backgrounds, and provide more powerful support and research for the objectivity and accuracy of the research.

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# Appendix

## Questionnaire of restoration demand in Qianyang Area

**The purpose of the survey: To understand people's views and needs for old area (such as squares, parks, streets) in Qianyang Area, so as to help us better plan and improve these places.**

**1.How old are you? [Single choice] \***

○ Under 18 years old

○ 18-30 years old

○ 31-50 years old

○ Age 51-65

○ Age 65 or older

**2.What is your occupation? [Single choice] \***

○ Students

○ Office Workers

○ Self-employed

○ Retirees

○ Other: _____

**3.How long have you lived in Qianyang Area? [Single choice] \***

○ Less than a year

○ 1-5 years

○ 5-10 years

○ More than 10 years

**4.What is your identity? [Single choice] \***

○ Local residents

○ Tourists

○ Migrant workers

○ Relatives of migrant workers

○ Others (please specify) _____

**5.Are you satisfied with the public Spaces (such as squares, parks, streets) in Qianyang District? [Single choice] ***

○ Very satisfied

○ Satisfied

○ Normal

○ Dissatisfaction

○ Very dissatisfied

**6.Which of the following issues do you think need the most improvement?   [Multiple choice] ***

☐ Old facilities (such as seats, street lights)

☐ Too little greenery

☐ Poor environmental hygiene

☐ Traffic congestion

☐ Lack of cultural characteristics

☐ Insufficient activity space

☐ Others: _____*

**7.What space do you visit most often? [Multiple choice] ***

☐ Plaza

☐ Community Park

☐ Street pedestrian area

☐ River Walk

☐ Others: _____*

**8.What would you most like to improve? [Multiple choice] ***

☐ Increase greenery and parks

☐ Increase leisure facilities (such as fitness equipment, pavilions)

☐ Display local culture (e.g. historic buildings, traditional activities)

☐ Increase convenience services (such as small booths)

☐ Improve transportation

☐ Increase children's/senior citizens' activity venues

**9.How do you think the cultural characteristics of Qianyang area (such as the west canal, old buildings) should be integrated into the transformation? [Single choice] ***

○ Restoring old buildings

○ Add cultural identity

○ Holding traditional activities

○ Preservation of status quo -

○ Others: _____ *

**10.Which of the following improvements do you support? [Multiple choice] ***

☐ Old building facade repair

☐ Increase small parks/green Spaces

☐ Improve drainage facilities

☐ Restore the ecological landscape of the West Canal

☐ Increase commerce

☐ Others: _____*

**11.Are you willing to participate in the discussion and decision-making of restoration? (e.g. community meeting, questionnaire survey) [multiple choice]***

○ Very willing

○ Yes

○ Normal

○ Reluctant

○ Very reluctant

**12.Do you think the urban restoration will help the local economy? [Single choice] ***

○ Great help

○ Some help

○ No impact

○ Possible negative effects

○ Uncertainty

**13.Do you support the "government + enterprise cooperation" approach to promote the transformation? [Single choice] ***

○ Full support

○ Support

○ Neutrality

○ Objection

○ Strong opposition

**14.What other suggestions do you have for the renovation of Qianyang Area? [Fill in the blank] ***

_____

**15.What are your expectations for the future development of Qianyang Area? [Fill in the blank] ***

_____

**Closing remarks**

**Thank you for your participation! Your comments will help us to better improve the living environment in Qianyang Area**.

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