Strategies and Design for Enhancing Walkability in Duobao Road Area under the Context of Population Aging

A Dissertation Submitted for the Degree of Master

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Abstract

With the deepening of population ageing in China, the needs of elderly populations are increasingly being considered in urban development, driving the construction of age-friendly cities nationwide. In daily urban life, elderly pedestrians are a visible presence among bustling crowds. However, current urban pedestrian environments often lack both quality improvements and sufficient attention to the needs of elderly pedestrians.

This study focuses on the Duobao Road area in Liwan District, Guangzhou, an area with a pronounced ageing population, and explores strategies to optimize walking spaces for elderly residents by emphasizing the concept of walkability. Through systematic research and design practices, the study aims to enhance the walking environment for elderly populations.

First, the study analyzes the physiological, psychological, and behavioral characteristics of elderly populations, as well as their specific pedestrian needs. It reviews theoretical foundations related to age-friendly cities and walkability, identifying three key dimensions for evaluating walkability in ageing areas. Building on literature analysis and case studies of advanced domestic and international practices, the study develops a checklist of elements for walkability in ageing areas. This checklist includes three major dimensions: urban street environments, community walking environments, and urban facility support. Key attributes covered in the checklist include pedestrian network quality, sidewalk conditions, accessibility facilities, and accessibility of services within daily living circles.

Through site surveys and data analysis, the study comprehensively evaluates the current pedestrian environment in the Duobao Road area using the checklist. Major issues identified include narrow sidewalks, severe obstructions on sidewalks, insufficient crosswalk facilities, and a lack of community public spaces. To address these challenges, the study proposes a series of design strategies, such as widening sidewalks, adding crosswalks, improving connectivity in community roads, creating age-friendly exemplary walking areas, and establishing functional clusters tailored to elderly needs. These strategies are further developed into specific implementation plans.

Ultimately, the study constructs a comprehensive framework for enhancing walkability in ageing urban areas. This framework provides a reference model for similar urban areas seeking to improve their walking environments. By enhancing the safety, comfort, and accessibility of pedestrian spaces, the study promotes greater social participation among elderly populations, improves their life satisfaction, and contributes practical solutions for the

development of age-friendly cities.

Keywords: Ageing; Walkability; Walking space; Duobao road; Guangzhou

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Chapter 1 Introduction

With the sustained decline in birth rates in recent years, the issue of population aging has gradually gained prominence, and Chinese society is now transitioning into a phase of profound aging[1]. Against this backdrop, driven by rapid economic development, evolving social values, and advancing urbanization, the interests of the elderly in urban contexts have garnered increasing attention. Moreover, their living needs are progressively being addressed within urban spaces. Simultaneously, urban renewal initiatives are currently being implemented vigorously across various cities. In this context, how to effectively align urban space improvement and renewal efforts with the challenges posed by an aging society, create more age-friendly environments, and thereby enhance the comfort and safety of elderly individuals' activities in urban areas, represents one of the critical issues requiring exploration and consideration today.

1.1 Research Background

1.1.1 Rising Aging Population in Guangzhou City

In recent years, the proportion of the elderly population in China has been steadily rising on an annual basis. According to data from the seventh national census conducted in 2020, the proportion of individuals aged 60 and above reached 18.7%, while those aged 65 and above accounted for 13.5%. This represents an increase of nearly 5% compared to the previous national census[2]. These statistics underscore that China is currently undergoing a significant degree of aging at a rapid pace.

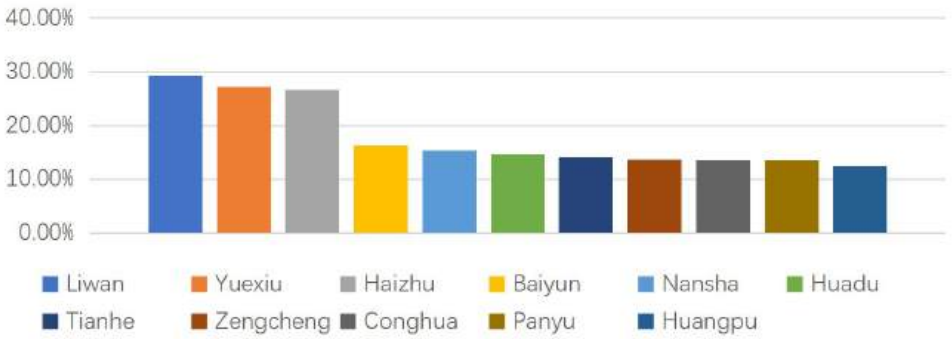


Figure 1-1 Aging Rates Across Different Districts in Guangzhou
Source: author

It is also noteworthy that, according to the findings of the fourth national survey on the living conditions of the elderly in urban and rural areas, the proportion of disabled and semi-disabled elderly individuals stood at 18.3% in 2015. Given the inevitable decline in physical functions associated with aging, the number of disabled and semi-disabled elderly individuals is expected to rise as the elderly population grows. Consequently, urban spatial planning

should incorporate greater consideration of the physical characteristics and practical needs of the elderly population[3].

Focusing on Guangzhou City, the degree of aging has been progressively increasing in recent years. According to the elderly population data released by the Guangzhou Municipal Bureau of Statistics and the Guangzhou Municipal Health Commission in 2021, the proportion of individuals aged 60 and above in Guangzhou City reached 18.27%, while the proportion of those aged 65 and above was 13.33%. Among the districts, Liwan, Yuexiu, and Haizhu exhibit the most pronounced aging challenges. Notably, in Liwan District—where Duobao Road is located—the proportion of individuals aged 60 and above reaches as high as 29.31%. Among the elderly in this district, 12.78% are in poor health but capable of self-care, while 5.79% require assistance for daily living[4].

As the core city within the Guangdong-Hong Kong-Macao Greater Bay Area (GBA) - an urban agglomeration with 86.3% urbanization rate in 2019 - Guangzhou's urban environments must accommodate its growing elderly population. Whilst providing vibrant urban amenities, the imperative for implementing and institutionalizing age-friendly city principles in urban development has become increasingly urgent, particularly given that over 85% of the region's elderly reside in urbanized areas.

1.1.2 Increasing Focus on Walkability in Policies and Concepts

The dual pressures of urbanization and population aging have elevated the accessibility and inclusivity of urban spaces for older adults as a critical agenda in urban planning and design. Older urban districts, burdened by aging infrastructure and protracted development histories, face amplified challenges in maintaining pedestrian environment quality.

The 13th Five-Year Plan period (2016-2020) witnessed substantive progress in China's elderly welfare system. Building upon enhanced social security frameworks, this phase prioritized senior care facilities and age-adaptive urban retrofitting through environmental quality enhancement initiatives aimed at improving seniors' living standards. The subsequent 14th Five-Year Plan (2021-2025) elevated active aging response to a national strategy, with dedicated provisions in the *Outline of the 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives Through 2035*[5].

Concurrently, China's evolving mobility paradigm recognizes walkability as both a policy priority and urban health indicator. Provincial and municipal governments have institutionalized pedestrian-friendly development through instruments like Guangdong's 2017 *Blue Book on Pedestrian and Cycling Transportation and Guangzhou's 2015 Slow Traffic*

System Plan, reflecting growing policy commitments to pedestrian-centric urbanism[6].

1.1.3 Lagging Development of Walking Spaces in Guangzhou

The *14th Five-Year Plan* explicitly mandates urban renewal initiatives encompassing historic conservation, urban form optimization, and regeneration of aging residential compounds. Notably, commencing in 2024, China will implement comprehensive urban physical examinations at prefecture-level cities and above, diagnosing systemic deficiencies affecting sustainable development and public welfare to formulate targeted *urban disease* remediation strategies.

Older urban districts suffer from outdated infrastructure and fragmented pedestrian networks compared with newer urban extensions featuring contemporary street design standards. The coexistence of neighborhoods developed across disjointed development phases has created discontinuous walking systems, particularly detrimental to elderly pedestrians' mobility experience. Persistent vernacular urban elements - narrow alleyways, uneven pavement transitions, and abrupt level changes - further exacerbate accessibility challenges in these districts.

The Liwan District, in which Duobao Road is situated, forms part of the core urban area of Guangzhou. With a long history of development and construction, it has successfully retained the distinctive characteristics of the old city area. Its retains intact vernacular urban fabric while accommodating intensive pedestrian flows - tourists, residents, and commuters intermingling in constrained spaces. Rapid urbanization over the past three decades has, however, manifested infrastructural deficiencies and planning lags within these older urban districts[7]. Their spatial configurations demonstrate acute functional diversity: historically designated conservation zones coexist with scattered tourist attractions, aging residential compounds, and diverse commercial precincts exhibiting heterogeneous morphological and functional characteristics.

In these old urban areas, the pedestrian facilities are backward, the roads were built early, the sidewalks are poorly constructed, the passageways are narrow, and some roads have mixed pedestrian and vehicle traffic. The building functions are mixed, there are irregular building clusters and outdated infrastructure. Some buildings are in poor condition, old buildings lack maintenance and repair, and the appearance is poor. The internal conditions of some old residential areas are poor[8]. These factors also limit the quality and safety of the walking space, so there is a need for improvement and construction in these areas.

1.2 Conceptual Definitions

1.2.1 Aging and the Elderly Population

Population aging refers to the phenomenon in which the proportion of elderly individuals within the total population is progressively increasing. Internationally, the proportion of the elderly population is commonly utilized as a standard for measuring population aging. Typically, when the proportion of individuals aged 60 and above reaches 10% of the total population, or when the proportion of those aged 65 and above reaches 7%, a country or region is considered to have entered an aging society[9].

In China, people aged 60 and above are generally considered to be in the elderly group. However, there is no universal definition of old age as it varies depending on specific circumstances. For instance, in most Western developed countries, 65 is regarded as the beginning of old age. At the same time, some gerontologists recognize that people experience different conditions at different stages of old age. Many people in their 60s and 70s are still relatively healthy and full of energy. Scholarly consensus categorizes aging populations into three distinct phases: young-old, middle-old, and oldest-old[10].

This article mainly discusses the walkability in the context of an aging population. On the one hand, the proportion of the elderly in the Duobao Road area is far above 10%, indicating that the research site is facing the issue of an aging population. On the other hand, for some very elderly individuals, their physical functions have deteriorated significantly, making it difficult for them to travel independently. Improving the quality of the walking environment has a relatively small impact on their quality of life. Therefore, the elderly group referred to in this article mainly consists of young-old and middle-old elderly people who can still travel and be active independently or with simple assistance.

1.2.2 Walkability

The concept of walkability was initially introduced by Jane Jacobs in her pioneering urban studies during the 1960s and subsequently gained broader attention in American transportation research in the late 1990s. This concept not only pertains to the extent to which an urban environment is pedestrian-friendly, reflecting the overall support for walking within a region, but also encompasses the degree to which the built environment facilitates and encourages walking. Additionally, it refers to individuals' experiences and perceptions of walking environments.

Simultaneously, relevant research highlights that walkability is a spatial attribute describing the capacity of space to guide pedestrian trips. Specifically, it involves spatial

proximity between origins and destinations, as well as the convenience and comfort of walking between these points. It also represents the extent to which facilities meet the demand for pedestrian travel and serves as a metric for evaluating the walkability of streets, communities, and cities[11].

Figure 1-2 The Importance of Walkability
Source: Reference [12]

In summary, walkability is a professional term used to describe the quality of walking spaces. In a narrow sense, walkability reflects the environmental quality of the physical built space related to walking traffic, only demonstrating the relationship between walking traffic and the built environment. In a broad sense, walkability represents the mutual relationship between the environment and the perception and experience of pedestrians. The concept of walkability in this article mainly covers the degree to which the urban built environment supports walking and the extent to which urban facilities meet the demand for walking trips.

1.2.3 Age-Friendliness

Figure 1-3 Framework of Active Aging
Source: Reference [9]

The concept of age-friendly cities was initially introduced by the World Health Organization (WHO) in its publication *Global Age-Friendly Cities: A Guide*. This concept is grounded in the WHO's framework of active ageing, which refers to the process of optimizing

opportunities for health, participation, and security to enhance the quality of life as individuals grow older. Active ageing is a lifelong process, and an age-friendly city extends beyond merely being elderly-friendly[13].

An age-friendly city fosters an inclusive urban environment for older adults by enhancing physical infrastructure, social environments, and support services. It emphasizes inclusiveness, respect, and meaningful social participation for older adults, effectively addressing their diverse needs through various facilities and services. This approach aims to strengthen their functional abilities and improve their overall quality of life.

1.3 Research Objectives

1.3.1 Integrating a Checklist for Walkability in Aging Urban Areas

In the context of an increasingly aging society, it has become a social consensus to consider the elderly more in urban construction and build an elderly-friendly city. However, the current related construction is still in its infancy and exploration stage. Moreover, in China, the focus of urban walking space construction mainly occurs in new urban areas, while old urban areas generally lack such construction. Additionally, research on walkability often targets the general healthy population, lacking specific considerations for the elderly.

In the process of specific actions, the improvement and transformation of old urban areas have insufficient responses to the aging context, making it difficult to effectively inspect and evaluate the existing environment, resulting in some elderly-friendly renovations being superficial. Against this background, this paper, starting from the perspective of an aging context and age-friendliness, attempts to analyze and summarize the corresponding frameworks and evaluation systems in existing literature and reports, and based on the Duobao Road area in Liwan District, Guangzhou, proposes a checklist of inspection elements for analyzing the walkability of urban spaces that is suitable for the research area. This will facilitate the analysis of the current situation and deficiencies of the pedestrian environment on the site, thereby facilitating the subsequent proposal of corresponding solutions.

1.3.2 Sorting out Strategies for Improving the Walkability in Aging Areas

Some existing renewal strategies are too broad and lack responses to the specific characteristics of the site. At the same time, they lack special attention to the elderly. Based on the clear understanding of the checklist of walkability in the context of an aging population, this study, through case analysis, summary of existing practices, and literature review, proposes relevant solutions to possible problems. During the research on related strategies, it focuses on the physiological, psychological, and behavioral characteristics and needs of the

elderly, combines the current situation of on-site investigation, and proposes strategies for improving the pedestrian environment from the aspects of construction goals, design principles, optimization elements, and implementation points, providing a basis and reference for subsequent optimization and renovation strategies for specific sites.

1.3.3 Proposing Improvement Dedign Strategies and Plan for Specific Sites

The Duobao Road area in Liwan District, Guangzhou, has a long development history, and the construction of the urban space pedestrian environment is inadequate. In this area, there are problems such as a lack of barrier-free facilities, low quality of the pedestrian system, a lack of activity spaces, and urban construction neglecting the needs of the elderly.

This study will target the relevant areas of Duobao Road, combine the checklist of elements for walkability, conduct detailed research, and at the same time, through questionnaire surveys, evaluate and identify problems related to indicators and spatial attributes. Then, based on relevant renewal strategies, it will conduct improvement research and design work from the dimensions of overall layout, node design, and detailed design of street spaces. Thus, it aims to enhance and optimize the elderly-friendly degree of the pedestrian environment in the selected research area under the framework of age-friendliness.

1.4 Literature Review

1.4.1 Current Status of Domestic Research

(1) Age-friendly cities

The concept of age-friendly has gained social consensus in China, frequently applied in urban design projects. Scholarly investigations employing keywords such as *age-friendly* and *aging-adaptive* reveal nascent yet evolving research focused on city scale and community scale. Key research themes encompass elderly housing needs, mobility requirements, age-friendly residential design, service facility optimization, and public space design.

At the city scale, scholars have adopted quantitative methods and GIS technologies to analyze age-friendly indicators. For instance, Sun Yi measured elderly accessibility in Hong Kong through residential density, road connectivity, and land-use diversity[14]. Others have explored city-wide aging-adaptive planning frameworks, such as Chen Zhe's elderly facility planning strategies for Xianyang City based on age-friendly principles. Comparative studies, including Dou Xiaolu et al., have examined international best practices to inform China's age-friendly city development[15].

Community-level research demonstrates greater diversity, with scholars investigating localized age-friendly interventions. Hu Xiaojing synthesized experiences from the United

States, Japan, and Canada to propose context-specific strategies for China[16]. Digital tools feature prominently in studies like Sun Wei's use of simulation software and ArcGIS to optimize community transportation networks, plaza layouts, and green spaces[17]. Evaluation frameworks have also emerged, exemplified by Yu Yifan's elderly-friendly community assessment system and Liang Qian's pocket park concept for enhancing neighborhood public spaces. Notable contributions include Tsinghua University Professor Zhou Yanmin's community design practices and Li Xiaoyun's doctoral research, which systematically developed an aging-in-place planning framework integrating service provision, environmental design, and policy coordination[18].

Some scholars have also increasingly integrated age-friendly principles with landscape architecture, investigating interconnections between green space design and elderly behavioral patterns. Li Teng established evidence-based design principles for elderly-responsive parks through systematic analysis of seniors' physiological thresholds, psychological preferences, and activity rhythms. Lang Leijie et al. advocated lifecycle-integrated application of age-friendly concepts in green infrastructure development, proposing context-sensitive evaluation frameworks optimized for Chinese urbanization contexts.

Simultaneously, extradisciplinary investigations from gerontology and sociology enrich the discourse. Chen Mingyu et al. examined the impacts of Beijing's aging residential environments on elderly active-living behaviors, deriving retrofit strategies that balance heritage preservation with accessibility upgrades[19]. Wang Yingying et al. quantified causal relationships between neighborhood environmental attributes and elderly life satisfaction indices, revealing mediation mechanisms through which spatial configurations influence psychosocial wellbeing[20].

Table 1-1 Domestic Research Literature on Age-friendly Cities
Source: Reference

Research Tier	Title	Key Contributions
City-level	Sun Yi & Ling Jiaqin. *Urban Spatial Walkability and Its Implications for Age-friendly Cities: A Hong Kong Case Study*	Assesses elderly-friendly walkability in Hong Kong through residential density, road connectivity, and land-use diversity metrics.
	Dou Xiaolu, John Pynoos & Feng Changchun. *Cities and Active Aging: International Experiences in Age-friendly City Development*	Analyzes global age-friendly city initiatives, identifying transferable strategies for Chinese urbanization.
Community-level	Yu Yifan et al. *Evaluation Framework for Age-friendly Communities*	Develops context-adapted community assessment system integrating international benchmarks with Chinese urbanization characteristics.

Research Tier	Title	Key Contributions
	Zhou Yanmin & Wang Chunyu. *Designing Socially Engaging Outdoor Environments for Age-friendly Communities: Longitudinal Study of a Beijing Neighborhood*	Proposes community space design strategies through longitudinal study of a Beijing community, emphasizing social interaction optimization.
	Li Xiaoyun. *Planning Strategies for Aging-in-place Oriented Urban Communities*	Systematizes elderly-oriented planning framework integrating service provision, environmental design, and policy coordination.
Landscape Design	Lang Leijie & Cheng Shi. *Global Perspectives on Age-friendly Green Space Research: Methodological Evolution and Implications*	Identifies key research trends and methodological innovations in elderly-centered green space design through bibliometric analysis.
Gerontology	Wang Yingying & Liu Lan. *Community Environments and Elderly Life Satisfaction: Examining Social Adaptation Mediators*	Quantifies environmental determinants of elderly wellbeing using national survey data (CLHLS 2018), revealing mediation effects of social adaptation.

(2) Walkability

As an intrinsic attribute of urban streets, walkability has attracted significant scholarly attention regarding its evaluation methodologies and quantitative measurement frameworks since gaining traction in Chinese academia.

① Elements and Evaluation System of Walkability

A comprehensive review of the current research status on environmental elements related to walkability is presented in Section 2-3 of Chapter Two. By integrating the research results of domestic literature in recent years, it is found that the current academic community in China generally recognizes that urban spatial elements such as the density of the walking network, the Walk Score of streets, the height-to-width ratio of street space, the detailed environment of streets, the walking environment of communities, accessible design, and the distribution of urban facilities are all closely related to walkability. For specific literature analysis, please refer to the next chapter.

Focusing on the factors influencing the walkability of space and streets, many domestic scholars have conducted research on walkability evaluation systems for various urban scenarios and target groups in recent years. The main keywords of related research focus on the elderly, children, living streets, and communities, reflecting the characteristics of these studies that pay attention to the walking behaviors of special groups and daily life.

For the elderly group, Huang Lidi et al. conducted a related walkability evaluation study on the community spaces frequently walked by the elderly in their work[55]. They selected

multiple aging communities with different facility layouts and road network forms in Daqing City as research objects to conduct walkability research. The relevant research established a comprehensive measurement model of community walkability at the macro and micro levels and applied the walking index at the meso level to analyze the distribution and accessibility of facilities. Their research found that the evaluation model and walking index they established could well reflect the walkability of the community; factors such as land use diversity, road network structure, facility distribution, and the quality of the walking environment all affect the walkability level of the community.

For the children group, Su Jianming et al. conducted a study on the evaluation system of walkability for children-friendly streets based on environmental behavior in their work[86]. The relevant research clarified the relationship between children's travel behavior and built environment elements through literature research, summarized the influencing factors of the built environment in terms of safety, accessibility, comfort, and pleasure, constructed the underlying framework of children's walking behavior needs, and established an evaluation framework for the walkability of children-friendly streets. Compared with other studies, their framework pays more attention to elements such as school accessibility, entertainment facilities, and the location of squares.

For the living streets, Yu Chenyang et al. conducted a study on the influence of street boundary space elements on walkability in their work[87]. They analyzed the composition and combination patterns of boundary elements of three living streets in Beijing's *Dayuan* communities and evaluated the walkability of the streets based on street view images. The study found that the number, type, and detailed design of street boundary elements have a significant impact on street walkability. In addition, the flexible use of green space elements can significantly enhance the walkability of the street.

Regarding the correlation between daily facilities and walkability, Lu Yintao conducted a study in which daily service facilities, the main destinations of walking trips, were taken as the research object. The study analyzed the characteristics of citizens' walking use of daily facilities in terms of frequency, diversity, and distance attenuation rules, and based on this, constructed a community walkability evaluation method based on the satisfaction of walking trip demands[88]. The study used the formed framework to analyze Jiangpu Road Street in Yangpu District, Shanghai, and accordingly proposed suggestions for improving the layout of facilities. The study found that walkability can to some extent reflect the service level of facilities, and the evaluation of walkability can provide a basis for the optimal layout of facilities.

The citizen groups mainly targeted by domestic research have many overlaps with the main body of this study. The above review of domestic related research can provide considerable assistance for the subsequent development of this study. Especially the research related to the elderly, living groups, and daily facilities can provide indicators and factor references for the subsequent checklist of this article.

② Quantitative and Measurable Analysis of Walkability

In addition to studying relevant evaluation systems, the academic community has also actively explored various quantitative methods for walkability. Through the construction of mathematical tools, they seek more rational and accurate methods for analyzing and comparing the walkability of urban spaces. Most of the related research is based on the localization of mature foreign tools.

Spatial morphology quantification predominantly employs GIS tools for two-dimensional analyses integrating road networks and building data. Jiang Yang et al. pioneered the maximum cross-section method to measure street interface continuity, revealing statistically significant correlations: positive with building density, floor area ratio, and road network density, negative with roadway width[21]. Three-dimensional analytical advancements emerge through Qu Bing et al.'s Rhino-Grasshopper modeling of Shanghai and Nanjing streets, complemented by streetscape image recognition and segmentation techniques for automated spatial diagnostics[22].

Walk Score adaptation represents another research trajectory. Wang De et al. localized this American methodology through facility categorization and weighting adjustments derived from Chinese pedestrian behavior surveys, replacing exponential decay functions with piecewise linear models. Subsequent innovations by Long Ying et al. applied optimized Walk Scores to evaluate Chinese cities, identifying positive correlations between walkability and intersection density/functional diversity[23].

Some scholarly investigations into street vitality quantification posit that vitality serves as a measurable proxy for assessing streets' socio-spatial performance. Contemporary research predominantly operationalizes vitality through population density metrics derived from heterogeneous data streams. Long Ying et al. constructed quantitative vitality indices using mobile signaling and LBS data, identifying causal relationships between urban centrality, functional intensity, mixed-use diversity, and pedestrian activity patterns[24]. Alternative methodologies emerge in Pei Yu et al.'s work, which harnessed Weibo check-in data to develop nighttime vitality indices. Their analysis revealed statistically significant positive correlations between nocturnal vitality and streetscape interface continuity and

functional density, contrasted by negative associations with morphological complexity.

Table 1-2 Domestic Research Literature on Walkability
Source: Reference

Research Tier	Title	Key Contributions
Streetscape Morphology	Jiang Yang et al. *GIS-Based Study on Streetscape Interface Continuity: A Jinan City Case*	Quantified streetscape interface continuity using maximum cross-section method, demonstrating significant positive correlations with building density, floor area ratio, and road network density.
	Qu Bing et al. *Quantitative Description and Evaluation Methods for Streetscape Morphology in Urban CBDs*	Developed Rhino-Grasshopper 3D modeling protocols for streetscape quantification in Shanghai and Nanjing.
Walkability Measurement	Wang De et al. *Development and Application of Walkability Evaluation Systems for Neighborhood Service Facilities*	Established localized facility classification and weighting system via pedestrian behavior surveys, replacing exponential decay with piecewise linear modeling.
	Long Ying et al. *Large-Scale Measurement of Street Walkability in Major Chinese Cities*	Applied optimized Walk Score methodology, identifying positive correlations between walkability and intersection density/mixed-use diversity.
Street Vitality Evaluation	Long Ying & Zhou Yin. *Quantitative Assessment of Street Vitality and Influencing Factors: A Chengdu Case*	Constructed LBS-derived vitality indices, revealing causal relationships between urban centrality, functional density, and pedestrian activity.
	Pei Yu et al. *Nighttime Street Vitality Analysis Within Beijing's Second Ring Road Using Spatial Big Data*	Leveraged Weibo check-in data to identify nocturnal vitality's positive correlation with interface continuity and functional density, negative with morphological complexity.

1.4.2 Current Status of Foreign Research

(1) Age-friendly Cities and Communities

The World Health Organization (WHO) pioneered the *Age-friendly City* concept in 2005, formalizing its implementation framework through the seminal 2007 publication *Global Age-friendly Cities: A Guide*. This foundational document introduced an evidence-based checklist of urban characteristics essential for elderly inclusivity, developed through consultative processes across 33 cities in 22 nations under the WHO Global Age-friendly Cities Project[13]. The guidelines catalyzed worldwide adoption of age-friendly urban development paradigms. Over two decades of iterative refinement, this framework has undergone multidimensional

evolution across policy, design, and technological domains, with its theoretical extensions and practical adaptations examined in subsequent chapters of this study.

Recent years have seen growing emphasis on technological integration in international age-friendly city development. In 2018, the WHO released a report titled *Looking back over the last decade, looking forward to the next*, explicitly highlighting technology as a critical enabler of age-friendly environments. Marston and Van Hoof critiqued the WHO's original *Age-friendly Cities and Communities model* for its lack of explicit consideration for technology, questioning: "In an increasingly digitized and intelligent world, has the age-friendly movement adequately integrated digital technologies and their potential?" They emphasized technology's evolution into an essential component of contemporary and future societies[25]. Podgórniak-Krzykacz et al. further advocated leveraging smart city technologies to address elderly citizens' needs[26].

At the city, community, and societal levels, researchers worldwide have conducted studies by integrating local social contexts through diverse methodologies. For instance, Versey et al. examined the role of communities in age-friendly cities in shaping older adults' daily lives, using New York City as a case study. Their work specifically investigated the impacts of gentrification on elderly populations and issues of indirect displacement caused by shifting social identities or socioeconomic status[27]. Concurrently, other studies have focused on elderly social participation and opinion expression. Von Faber et al. developed a participatory video design methodology as an empowerment tool to systematically collect older adults' perspectives on age-friendliness within their urban or community environments[29]. Additionally, numerous studies have explored methods for evaluating urban or community age-friendliness. Dikken et al. emphasized the need for robust assessment tools and developed a validated questionnaire to measure age-friendly characteristics. Furthermore, Marston and colleagues critically analyzed two major age-friendly assessment frameworks—the WHO model and the framework proposed by Marston and van Hoof—while identifying existing gaps in current evaluation systems[28].

Within transportation research, contemporary investigations extend beyond traditional foci on affordability, availability, and accessibility to encompass intelligent mobility systems tailored for aging populations. Klicnik and Dogr's study positions active transportation as an affordable and accessible mobility option enhancing elderly community engagement, while critiquing the insufficient prioritization of such modes in current age-friendly city frameworks[30]. Meanwhile, Loos et al. advance smart mobility paradigms through systematic literature analysis, particularly examining public transit systems' digital integration. Their

conceptual framework reimagines transportation as a core component of intelligent, age-friendly urban ecosystems[31].

Research on age-friendly housing and aging-in-place has evolved along two primary dimensions: housing typologies and residential performance optimization. Regarding housing typologies, Rusinovic et al. investigated Dutch senior co-housing communities that provide intermediate living solutions for older adults seeking peer companionship while avoiding institutional care environments. On the physical performance front, Bennetts et al.'s Australian case study advanced thermal comfort standards for elderly residences through empirical analysis of building envelopes and thermoregulatory perceptions among aging populations.

Beyond the aforementioned research themes, significant literature also addresses innovative practices in elderly care and urban inclusivity for aging populations.

Current international studies on age-friendly cities and communities primarily focus on two domains. One is built environment research within urban planning and architectural disciplines, emphasizing physical spaces such as buildings, public areas, and community infrastructure, alongside policy implementation and healthy city frameworks. Another is urban gerontological studies in sociology, exploring interactions between community environments and elderly populations. At the same time, recent years have seen growing academic attention to smart technologies within these fields, as reflected in emerging discussions on intelligent systems[32].

(2) Walkability

The concept of walkability originated in the United States and has a long-established research history internationally, resulting in an extensive body of scholarship encompassing diverse methodological approaches.

Regarding conceptual definitions, Forsyth systematically investigated walkability within urban design contexts, proposing a conceptual framework to differentiate its multidimensional interpretations[33]. As for the review of the current research status of environmental elements related to walkability abroad, a more comprehensive account is provided in Section 2-3 of Chapter Two of this paper.

Some studies have explored walkability based on the perception of the walking environment. The related methods have developed relatively maturely abroad, among which the recognized and widely used measurement tool is PERS (Pedestrian Environment Review System), or the Pedestrian Environment Evaluation System. This system can clearly identify

the adequacy of the supply of walking facilities and the deficiencies in service levels, systematically assess pedestrian needs, and make timely improvements. In recent years, planning scholars have also begun to use various methods to study the walking environment. The more commonly used ones include the SD method (Semantic Differential) and the PLPS (Public Life-Public Space) survey method. The SD method was proposed by Charles E in 1957. It was originally a psychological measurement method that measures psychological feelings through a verbal scale. By obtaining users' feelings about the use of walking spaces, qualitative judgments can be quantitatively analyzed through data statistics, usually identifying factors that influence the vitality of streets and proposing suggestions for enhancing street vitality. The PLPS method was created by Jan Gehl. It is a research method specifically for walking, cycling traffic and facility space environments. By investigating both public life and public space, it seeks to identify the characteristics of human activities and the characteristics of the spatial environment[56].

There are also studies that explore walkability based on the accessibility of walking spaces. At the community scale, Frank et al. developed a composite index operationalizing walkability through parcel-level data, and validated using travel surveys from the *Neighborhood Quality of Life Study*. Regarding existing quantification methods, Manaugh et al. corroborated walkability indices by analyzing household travel behaviors in Montreal, demonstrating significant correlations between walking frequency and index scores. Concurrently, Duncan et al. evaluated the commercial Walk Score metric as a valid measure of neighborhood walkability across four U.S. metropolitan areas, particularly within 1,600-meter buffer zones. Furthermore, Gebel et al. examined discrepancies between perceived and objectively measured walkability, underscoring the critical need to reconcile subjective experiences[34].

Additionally, scholarly explorations of walkability have expanded into interdisciplinary domains including public health, urban equity, individual mobility, and real estate economics. In health-related contexts, Berke et al. identified a protective association between neighborhood walkability and depression prevalence among elderly male populations. Regarding urban equity, Marshall et al. conducted comparative analyses of communities with divergent performance in walkability and air pollution exposure, thereby demonstrating the imperative for equitable urban planning frameworks. Pivo et al., utilizing data from the National Council of Real Estate Investment Fiduciaries (NCREIF), empirically examined walkability’s impacts on commercial property valuations and investment returns[35].

The scope of research on walkability abroad is broader and places more emphasis on

quantitative studies. The above review of foreign studies on walking environments and walkability can provide considerable assistance for the subsequent development of this research. In particular, it can serve as a reference for the framework construction and element design in the checklist to be presented later in this article.

1.5 Research Contents and Methodology

1.5.1 Research Contents

Based on the established research objectives and significance, this study focuses on elderly populations as the research subjects, integrating literature reviews and interviews to develop a walkability assessment toolkit for urban spaces in Guangzhou. The research selects the Duobao Road area in Liwan District—a area with high elderly population density—as the study site, applying the toolkit to investigate age-friendly walkability in pedestrian environments. Specific research contents include:

(1) Refinement of Existing Design Guidelines and Evaluation Criteria

Through the collection and synthesis of existing materials, the study consolidates foundational concepts of walkability and analyzes current domestic and international research trends. By reviewing characteristics of age-friendly cities and existing evaluation frameworks, it integrates the physiological, psychological, and behavioral needs of elderly populations with standards, codes, design manuals, and case studies. This process constructs a knowledge system for walkable cities, drawing insights from exemplary domestic and international cases to establish a theoretical foundation for subsequent optimization strategies.

(2) Analysis of Implementation Case Studies

The research adopts a dual approach: synthesizing successful retrofitting strategies from domestic and international cases, and conducting site investigations of pedestrian spaces in Guangzhou's age-friendly communities. These efforts summarize effective practices while cross-referencing findings with the study's theoretical framework, providing actionable references for design interventions in the selected study area.

(3) Development of a Checklist of Walkability in the Context of an Aging Society

In the formulation of design guidelines and evaluation standards, multiple existing and well-established age-friendly evaluation frameworks are comprehensively referenced, with items related to walkability extracted from these frameworks. Within this framework, aiming specifically at enhancing walkability, the walkability knowledge system outlined in the preceding sections is referred to, and the checklist of walkability related elements is further

supplemented and refined.

Simultaneously, based on existing regulatory requirements, the physiological needs of older adults, and other relevant information, the previously summarized effective strategies are integrated into the checklist as recommendations for renovation strategies for related projects.

(4) Analysis of the Needs of Older Adults and the Current Conditions of Walking Spaces in the Duobao Road Area

Employ methods such as questionnaires, interviews, and on-site observations to investigate the travel modes, destinations, walking experiences, and activity routes of older adult residents in the Duobao Road area. Simultaneously, based on the thematic framework derived from the previously obtained element checklist, conduct a dimensional on-site investigation of the current pedestrian environment in the Duobao Road area of Liwan District, Guangzhou. This aims to identify issues within the existing pedestrian environment that hinder the mobility of older adults and clarify the factors requiring optimization in the selected site's pedestrian environment.

(5) Proposing Targeted Design Strategies

Integrating theoretical research and practical analysis, under the context of regional aging, and aligned with the regional characteristics of Guangzhou's historical urban areas, with the goal of creating an age-friendly urban environment, propose specific optimization strategies grounded in the principles of systematicness, refinement, and intelligence. These strategies will address aspects such as overall layout, key nodes, detailed spatial design, pedestrian roads, public activity spaces, and pedestrian networks. Subsequently, develop a design plan tailored to the site conditions.

1.5.2 Methodology

(1) Literature Synthesis and Systematization

By reading theoretical works at home and abroad related to age-friendly cities and communities and walkability, and combining with journal articles, master's and doctoral theses published in databases such as the CNKI Resource Total Database and relevant foreign journal articles, understand the research achievements in related fields at home and abroad. Query and summarize domestic laws and regulations related to age-friendliness and urban walking systems, sort out the research system elements, and provide a foundation for subsequent research.

(2) Field Investigations

An on-site investigation was conducted on the current status of the pedestrian environment construction in Duobao Road area. The elements included in the checklist of walkability were observed on-site, photographed, and measured. The current construction status of the area was analyzed by region and function. The current problems in terms of walkability in the urban space of Duobao Road area were summarized to provide a basis for subsequent proposals of corresponding optimization design methods.

(3) Questionnaire Survey and Interviews

By distributing questionnaires specifically to elderly residents in the surrounding area of Duobao Road, we aim to understand their satisfaction with the current walking space, their walking needs, and other related aspects. The results of the questionnaires will be summarized and analyzed to gain insights into the views and demands of the elderly population in the study area regarding the current walkability. We will also conduct thematic interviews with relevant staff members of the Duobao Road Comprehensive Elderly Care Center, who have extensive and frequent contact with local elderly residents. Through these interviews, we will further understand the friendliness of the walking space in the study area for the elderly.

(4) Case study

By analyzing advanced cases of age-friendly environments and excellent designs of pedestrian systems both at home and abroad, and examining their advanced design experiences in corresponding projects, we can extract the corresponding design features and key points. By comparing them with the current situation of the surveyed areas in Liwan District, we can summarize the design concepts and methods that can be borrowed, and enrich the design methods for walkable environments.

1.6 Research Framework

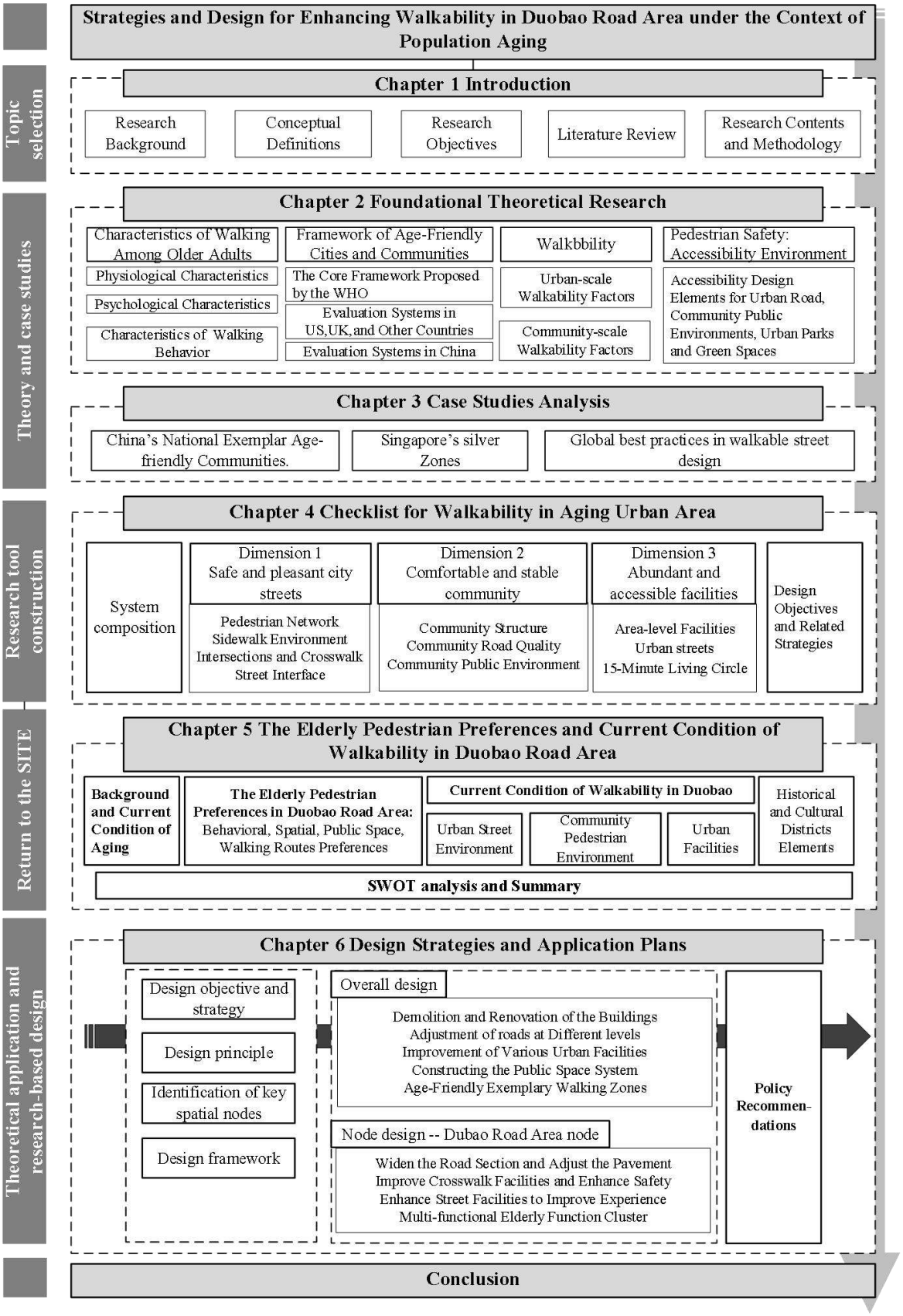


Figure 1-4 Research Framework
Source: Author

1.7 Summary

This chapter first introduces the research background, emphasizing the significance of enhancing the walkability of urban spaces in the context of an aging population and the necessity of environmental improvement in the old urban area where the Duobao Road area is located. It points out that relevant research can be carried out in combination with the framework of the age-friendly concept. Then, it reviews the current research status at home and abroad on this topic, clarifies the content and methods of the research, and paves the way for in-depth discussions in subsequent chapters. It is determined that the purpose of this study is to, in the context of an aging population, combine relevant literature to propose a set of checklists for analyzing the walkability of urban spaces, and to sort out spatial renovation strategies, and then conduct research and design on the study area based on this.

Chapter 2 Related Foundational Theoretical Study

2.1 Characteristics of Walking Among Older Adults

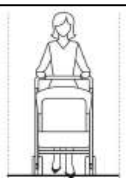
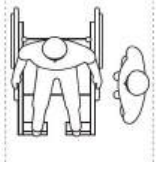
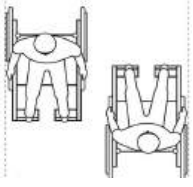
The interaction between the environment and individuals is bidirectional. When constructing urban environments for elderly populations, it is essential to comprehensively understand their physiological traits, psychological characteristics, and corresponding lifestyle behavioral patterns.

Age-related decline in physical functions significantly impacts elderly individuals' interaction with their surroundings. Beyond physiological changes, the transition from adulthood to post-retirement life brings objective socioeconomic shifts—such as reduced social status and economic capacity—which in turn alter psychological characteristics. Consequently, transformations occur in their living spaces, social interaction patterns, daily routines, and knowledge-skill utilization modes[38].

2.1.1 Physiological Characteristics and Corresponding Needs

(1) Body Dimensions of Elderly People's Walking

Table 2-1 Spatial Dimensions for Elderly Walking
Source: Author based on reference[36]

	Independent Walking	**Stroller Navigation**	**Crutch-Assisted Walking**	**Pet-Accompanied Walking**
	—			
Recommended Comfortable Width	800mm	1200mm(min.600mm)	1200mm(min.920mm)	1100mm
	Caregiver-Assisted Walking	**Wheelchair-Pedestrian Parallel Movement**	**Wheelchair-Pedestrian Lateral Passage**	**Dual Wheelchair Passage**
				
Recommended Comfortable Width	1200mm	1500mm	1200mm	1800mm

Due to the decline in physical functions and the presence of age-related diseases, older adults may find spaces designed based on the dimensions of healthy adults uncomfortable or unsuitable. Therefore, to enhance the walking experience of older adults, it is crucial to comprehensively consider their physical dimensions across various walking states and

reinforce the detailed design of walking spaces.

Among the elderly population, the proportion of those who are disabled or semi-disabled is relatively high. This group often requires assistive devices for mobility, and the diversity of the elderly's movement states also requires consideration of various scales. Therefore, when designing pedestrian spaces, the scale requirements for various travel states should be met. Through on-site observations and literature reviews, this paper summarizes the following common states of the elderly during outdoor walking: normal walking, traveling in a wheelchair, walking with a cane, walking with assistance from others, pushing a baby stroller or small cart, walking with a pet, etc[36].

By consulting the relevant standards and materials, it can be known that the corresponding width requirements for the above-mentioned actions are as shown in Table 2-1. From the data in the table, it can be seen that to meet the walking needs in various action states, a space of 1.8m wide should be reserved for pedestrians when designing sidewalks. Generally, a space of 2m or more in width should be reserved as much as possible, the wider the better, to ensure smooth and comfortable walking.

(2) Physiological Characteristics and Corresponding Needs

The physiological characteristics of elderly populations refer to age-related degenerative changes in bodily systems. The aging process primarily manifests through declines in physiological functions, immune competence, sensory systems, neurological responsiveness, and locomotor capabilities, leading to organ senescence, reduced disease resistance, and diminished environmental adaptability[37].

Regarding physiological functions and immunity, diminished physical constitution increases susceptibility to chronic conditions (e.g., hypertension, arthritis), which directly impede mobility and activity engagement. Notably, substandard environmental conditions exacerbate health risks through pathogenic feedback loops. Therefore, enhancing environmental comfort—such as optimizing outdoor ventilation efficacy and providing adequate supportive infrastructure—constitutes an essential intervention to mitigate these vulnerabilities.

In terms of sensory systems, the decline in organ function and nervous system during aging significantly impacts multiple sensory pathways including vision, hearing, touch, and smell. Visually, as the primary source of information acquisition, gradual deterioration of eyesight coupled with increased prevalence of ocular diseases leads to reduced color discrimination, diminished light sensitivity, and impaired visual imaging capacity. This results in daily inconveniences for older adults, such as difficulty recognizing small-sized or

low-contrast visual information and identifying ground elevation changes, thereby increasing fall risks. Auditory perception, which supplements visual information from the environment, becomes compromised through hearing loss, most notably manifesting as communication challenges where rapid speech or low-volume sounds become unintelligible. Regarding tactile and olfactory senses, the degradation of sensory cells during aging reduces sensitivity, necessitating prolonged tactile contact or olfactory exposure for environmental perception. [38].

Regarding the nervous system, the reduction of brain cells and slowed neural transmission in older adults result in delayed responsiveness and sluggish motor functions. Consequently, they struggle to rapidly process environmental stimuli when situational cues diminish. Elderly individuals predominantly rely on established cognitive schemas and environmental familiarity, exhibiting strong dependency on habitual living spaces. Exposure to novel environments exacerbates cognitive disorientation due to age-related declines in spatial cognition and wayfinding capacities, often triggering security anxiety.

In terms of the motor system, musculoskeletal degeneration significantly reduces muscular strength and agility compared to younger populations. Alterations in muscle fiber composition lead to compromised limb coordination and force generation, restricting strenuous activities or prolonged heavy lifting. Severe cases necessitate mobility aids like canes or wheelchairs.

These physiological aging processes profoundly impact daily living and mobility. Urban design must therefore implement targeted interventions addressing these vulnerabilities. Through systematic review of relevant literature and case studies, key design considerations and mitigation strategies have been synthesized[38] (see Table 2-2).

Table 2-2 Physiological Characteristics of Elderly and Design Strategies
Source: Based on literature review

Category		**Physiological characteristics**	**Design strategies**
Physiological function & immunity	Environmental Adaptation	Gradual decline in environmental adaptability, heightened sensitivity to environmental changes, reduced resilience to climatic variations	Ensure street space comfort and experiential quality
	Disease Resistance	Declining immunity, susceptibility to infectious diseases, prolonged recovery periods	Maintain high hygiene standards
	Chronic Conditions	High prevalence of chronic diseases requiring long-term medication	Provide comprehensive care services integrating medical, daily living, psychological, and safety support

Category		Physiological characteristics	Design strategies
Sensory systems	Vision	Prolonged dark adaptation, impaired color/brightness discrimination, blurred vision, poor night vision, high light dependency, presbyopia, ocular diseases, reduced sensitivity to green/blue/violet	-Provide optimal lighting (avoid glare, ensure nighttime illumination) -Enhance spatial legibility with high-contrast colors (prioritize red/yellow/orange) -Accommodate assistive tools (white canes, guide dogs)
	Hearing	Reduced sound discrimination, intermittent deafness, hearing loss, noise sensitivity	-Create acoustic buffers against noise pollution -Install audible signaling systems -Design soundscape guidance facilities
	Tactile Perception	Diminished pain sensitivity, increased burn/cut risks	-Eliminate sharp protrusions -Use textured paving materials
	Olfaction	Impaired odor discrimination, difficulty detecting hazardous gases	Ensure ventilation efficiency and odor control
Nervous system	Memory	Declining recall capacity, reduced memory efficacy, delayed responsiveness	-Install unambiguous wayfinding signage -Preserve familiar spatial layouts
	Cognitive Ability	Reduced cognitive flexibility, impaired novelty adaptation, heightened nostalgia	-Simplify spatial organization -Maintain historical neighborhood character
Motor system	Musculoskeletal System	Bone density loss, fracture susceptibility, muscle atrophy limiting strenuous movement	-Implement universal accessibility standards (ramps, elevators) -Ensure slip-resistant flat surfaces
	Limb Mobility	Joint stiffness, reduced flexibility, slowed motion	-Provide rest areas and emergency facilities
	Balance	Impaired equilibrium, increased fall/collision risks	-Optimize drainage systems

Based on the preceding analysis, subsequent site investigations should prioritize systematic observation of accessible infrastructure within the study area, coupled with empirical evaluations of spatial legibility and environmental quality along primary pedestrian circulation routes and their nodal spaces. This diagnostic approach enables identification of critical pain points to formulate targeted design responses in subsequent phases[39].

2.1.2 Psychological Characteristics and Corresponding Needs

Physiological aging often induces negative psychological states, compounded by maladaptation to post-retirement role transitions and lifestyle transformations. These cumulative stressors progressively engender adverse mental health outcomes in elderly populations, generating specific spatial requirements that demand enhanced environmental safety, convenience, and comfort.

Predominant negative psychological manifestations include sense of loss, loneliness, inferiority, anxiety, and depression. Mitigation strategies through public space optimization should prioritize the augmented spatial safety and comfort and the cultivation of community cohesion and belongingness[38].

Sense of Loss primarily stems from rapid functional decline (limiting activity articipation) and social network dissolution post-retirement. This psychological dissonance manifests as hypersensitivity, suspicion, and irritability. Age-friendly design must address needs for environmental stability, privacy preservation, and ergonomic comfort.

Loneliness and Depression emerge from identity discontinuity, increased leisure time, and contracted social circles. The transition from work-centric routines to aimless retirement exacerbates communicative atrophy and purposelessness. Design interventions should facilitate dignified social engagement and spiritual fulfillment.

Inferiority and Anxiety arise from diminished environmental adaptability and self-care capacities. Fear of burdening others and social stigmatization intensifies emotional vulnerability. Spatial solutions must prioritize safety assurance and cognitive reassurance.

Psychological transformations significantly impact elderly individuals' daily lives. To address these changes, multiple design strategies can be implemented: enhancing accessibility design to create a safe residential environment with walkable, accessible, and well-equipped infrastructure; improving environmental comfort through optimized urban landscapes, diverse activity spaces, and community interaction zones; fostering social engagement via learning platforms and culturally resonant public spaces that cultivate a sense of belonging. Based on elderly psychological characteristics, relevant literature and case studies have been systematically reviewed to synthesize corresponding design considerations and strategies, as detailed in the following Table 2-3.

Table 2-3 Psychological Characteristics of Elderly and Design Strategies
Source: Based on literature review

Category		Needs	Design Strategies
Sense of Loss	Sensitivity, Anxiety	Stability	Maintain consistent lifestyles and familiar environments
	Suspicion, Extremism	Privacy	Ensure residential privacy through spatial buffers and secluded design
	Impatience, Demandingness	Comfort	Reduce spatial partitions, optimize circulation efficiency, create open and tranquil public spaces with noise control
Loneliness	Isolation, Emptiness	Social Engagement	Organize community activities, enhance social participation, intersperse public and private spaces
	Boredom, Void	Spiritual Fulfillment	Provide diverse recreational facilities (reading rooms, gyms, game lounges, art studios)

Category		Needs	Design Strategies
Inferiority	Dejection, Low Self-Esteem	Respect	Eliminate stigmatizing decoration/signage, design inclusive public facilities with elderly-specific amenities
Fear	Worry, Unease	Safety	Apply human-scale spatial dimensions, install accessible pathways, use soft materials, and define territorial boundaries
Depression	Anxiety, Melancholy	Belongingness	Create age-appropriate activity spaces to foster social interaction, preserve local cultural identity

Quantitative analyses of elderly psychological characteristics have provided substantial empirical insights. Sun Juanjuan et al. leveraged data from the 2018 China Longitudinal Aging Social Survey (CLASS) and employed hierarchical linear modeling (HLM) to investigate the impacts of community environments on mental health across different age cohorts, as well as the moderating effects involved. Their results indicate that greater availability of age-specific facilities and services is associated with lower levels of depression among older adults. However, community-based elderly care services exhibit statistically insignificant effects on mental health. Additionally, infrastructure development, such as clinics, sports venues, parks, and senior housing, predominantly yields positive psychological effects for younger-old cohorts[10].

Based on the foregoing discussion, in the subsequent site research, at the street level, emphasis should be placed on investigating street experience and walkability, organizing pedestrian circulation, and conducting corresponding detailed studies; at the public space level, attention should focus on observing spatial comfort; at the community and supporting facilities level, it is essential to inventory key functional facilities and elderly-specific amenities while inquiring about the daily activities of the elderly[40]. Based on these observations, identify pain points and address them through subsequent research-informed design.

2.1.3 Characteristics of Elderly People's Walking Behavior

Based on the changes in the physiological and psychological aspects discussed above, elderly people also have corresponding changes in their walking behavior, which should be given special consideration.

(1) Walking Purposes

In terms of walking purposes, as the social status and roles of the elderly in the family change, their travel activities have gradually shifted from commuting to daily life. At the same time, the walking activities of the elderly are not only for daily travel needs but also include walking for the purpose of contact with nature and society, socializing, and physical fitness.

Jan Gehl pointed out in his *Life Between Buildings* that outdoor activities in public spaces can be divided into three types: necessary activities, spontaneous activities, and social activities[41]. According to a survey on the travel purposes of the elderly, the main purposes of the elderly's travel can be classified into three categories. The first is frequent daily travel, mainly for purchasing food, medicine, daily necessities, or handling affairs at banks, hospitals, and community centers. The second is social travel, mainly including participating in community activities, meeting friends, and other social activities, as well as sunbathing and outdoor rest. The third is physical activity for exercise, including walking, fitness, doing exercises, and walking the dog[42].

Table 2-4 Walking Purposes and Destinations for the Elderly
Source: Author based on reference[42]

Purpose	Destination
Daily Life	Living support facilities: commercial outlets such as markets, municipal service facilities, public transportation stops; Health care facilities: medical facilities, elderly care facilities;
Social Interaction	Public activity facilities: communities, urban public spaces, urban parks; Cultural and entertainment facilities: elderly cultural activity stations, community activity centers, etc.;
Exercise	Public activity facilities: communities, urban public spaces, urban parks; All Levels of Streets: sidewalks of urban roads, internal roads of communities

Based on the three purposes of elderly people's walking summarized above, the following considerations should be taken into account when designing urban walking systems: For the purpose of daily life, the convenience of urban facilities should be emphasized, ensuring that a wide variety of daily life facilities are fully equipped and conveniently located around the community, and medical facilities and elderly care facilities should be mixed to improve utilization efficiency. For the purpose of social interaction, the comfort of walking spaces should be enhanced, more comfortable walking space nodes should be designed, and rest facilities should be arranged. The quality of public activity spaces should also be improved to provide an environment for interaction that is suitable for staying, resting, and observing. For the purpose of exercise, more accessible public activity spaces should be provided for elderly residents, and the safety and comfort of walking paths should be enhanced.

(2) Walking Distance and Time

In terms of walking distance, the behavior of the elderly has a circular characteristic. Their daily life is mainly limited to a fixed living circle. Therefore, the walking distance of the elderly can be divided according to the 5-10-15 minute living circle (Figure 2-1). The 5-minute living circle mainly covers the residential community, the 10-minute living circle mainly covers the community and its surrounding areas, and the 15-minute living circle

extends to cover the local area of the city. As the distance increases, the outdoor activities of the elderly shift from daily basic activities to periodic activities, and the walking space expands from relatively closed and compact spaces within the community to more open and shared streets and public spaces at the city level. Considering that the elderly have poor endurance, the 5-10 minute living circle is their main walking range[43].

In terms of walking time, the behavior of the elderly has a regular characteristic. Due to their relatively fixed lives, the elderly often have regular schedules and daily activities. According to the pre-research in the Duobao Road area, it was found that the elderly in this area have the following general patterns of travel time: their main travel times are in the morning and after lunch, and the number of people traveling in the evening is relatively small. Dong Ren et al. conducted a study on the activity patterns of the elderly in Kunming and reached similar conclusions. They found that the elderly are mostly active in the morning, with a peak between 8 and 9 a.m. Additionally, during the pre-research, it was observed that the travel time of the elderly is significantly related to the season. In winter, the elderly mainly walk during the warmest part of the day, while in summer, they avoid the hottest periods[44].

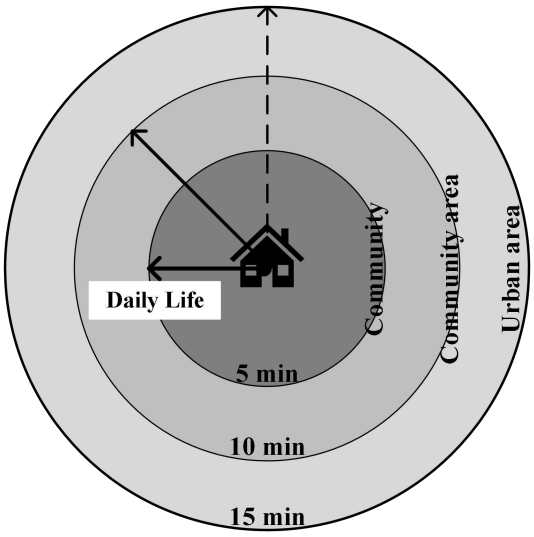


Figure 2-1 Elderly People's Travel Activity Circle
Source: Author

(3) Walking Speed and Stride Length

The walking speed and stride length of the elderly are significantly lower than those of the young. The main reasons are the decline in activity ability and cautious consideration of walking safety. Relevant studies have already statistically analyzed the characteristics of walking speed and stride length of the elderly group[45].

In terms of walking speed, some studies have statistically analyzed the walking speeds of the elderly, middle-aged, and young people, and pointed out that 47.5% of the elderly walk at

a speed lower than 1 meter per second. Moreover, the average walking speed of elderly men and women is significantly lower than that of young people of the same gender. Regarding stride length, some studies have found through statistics that the average stride length of elderly men and women is within the range of 53-57 cm, and both are 9 cm shorter than that of young people of the same gender[45].

From this, it can be known that the walking speed and stride length of the elderly group are significantly lower than those of the young group. Correspondingly, the living circle and walking range of the elderly group will be narrower. Daily living facilities for the elderly should be placed closer to the communities where the elderly live in concentration.

2.2 Framework of Age-Friendly Cities and Communities

2.2.1 The Core Framework Proposed by the WHO

The *Global Age-Friendly Cities: A Guide*, published by the World Health Organization (WHO), represents the first comprehensive and systematic framework for the development of age-friendly cities. Since its release, it has served as a foundational reference for numerous countries and organizations in their related work[46]. This guide provides a detailed checklist and structural framework to evaluate and guide the construction of age-friendly cities. It encompasses eight key dimensions, including outdoor spaces and buildings, transportation systems, and housing facilities. The specific content is presented in Table 2-4 below.

Table 2-5 Framework of the *Global Age-friendly Cities Guidelines*
Source: Author based on reference[13]

Framework	Key Domains	Technical Priorities
Global Age-friendly Cities: A Guide WHO, 2007 & 2014	Outdoor Spaces & Buildings	Environmental cleanliness; public green spaces; walkability; accessibility; public amenity availability; safety; adequate restroom provision
	Transportation	Affordability; reliability of public transit; safety and comfort; priority parking
	Housing	Cost-effective aging-in-place retrofits; service accessibility; family/community integration; housing diversity
	Social Participation	Inclusive activity programming; affordability; event visibility; intergenerational engagement
	Respect & Social Inclusion	Anti-ageism initiatives; cross-generational interaction; community mutual aid; economic equity advocacy
	Civic Engagement & Employment	Anti-ageism initiatives; cross-generational interaction; community mutual aid; economic equity advocacy
	Communication & Information	Age-adapted ICT access; real-time information dissemination; social connectivity infrastructure
	Community Support & Health Services	Accessible care networks; health promotion; home-based care coordination; integrated service hubs

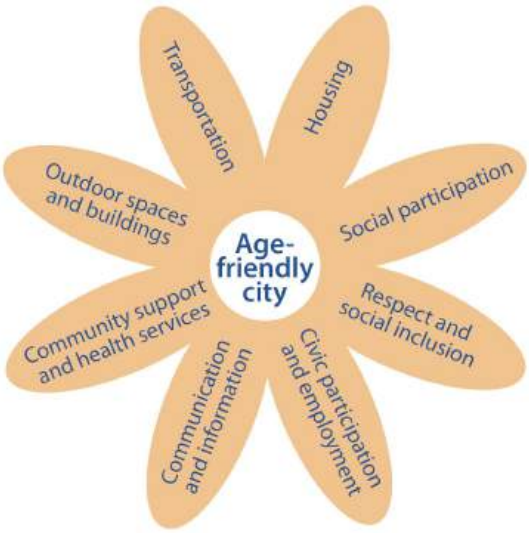


Figure 2-2 Framework of Age-friendly City
Source: Reference [13]

After years of practice and development, building upon the *Global Age-Friendly Cities: A Guide* and following a rigorous refinement process, the framework has evolved into *Measuring the Age-Friendliness of Cities: A Guide to Using Core Indicators*. This guide offers a comprehensive set of methodologies and core indicators designed to assist in developing a tailored set of metrics that are both meaningful and relevant to local contexts. Given its detailed content and high practical applicability, it has been widely adopted by European and American countries[47].

A review of this document indicates that it outlines the characteristics and definition methods of an age-friendly environment. The objective of an age-friendly environment comprises two key components: an accessible physical environment and an inclusive social environment. Among these, the information pertaining to the accessible physical environment is highly pertinent to this study.

The accessible physical environment primarily consists of the following core indicators: the walkability of residential areas, accessibility of public places and buildings, accessibility of public transportation vehicles, accessibility of bus stops, and affordability of housing[48]. Additionally, the guideline provides corresponding definition methods, as presented in the Table 2-6 below.

Table 2-6 Indicators from the *Measuring the Age-Friendliness of Cities*
Source: Reference

Indicator	Definition
Residential Area Walkability	Percentage of streets within residential zones featuring locally compliant sidewalks
Accessible Public Facilities	Proportion of new and existing wheelchair-accessible public spaces/buildings
Public Transport Accessibility	Percentage of transit vehicles equipped with priority seating for elderly/disabled passengers

Indicator	Definition
Proximity to Transit Stops	Percentage of housing units within pedestrian-shed (500m radius) of public transit nodes
Housing Affordability	Proportion of elderly residents in households spending ≤30% of disposable income on housing

The primary research focus of this study is the urban pedestrian environment. Therefore, the three indicators in the aforementioned table—residential area walkability, accessible public facilities and buildings, and proximity to transit stops—are of significant reference value.

The WHO Core Framework for Age-Friendly Cities and Communities exhibits advantages such as comprehensive coverage, a long development history, and broad applicability. These attributes provide valuable guidance for subsequent research in defining evaluation indicators and constructing assessment tools.

By reviewing the core framework of the World Health Organization on age-friendly cities and combining the definition of walkability, this section holds that in the context of an aging population, elements related to walkability such as the cleanliness of the outdoor environment, public green spaces, the degree of environmental accessibility, and the accessibility of public facilities deserve attention.

2.2.2 Relevant Evaluation Systems in the US, UK, and Other Countries

(1) The Age-Friendly Evaluation Framework in the US

As discussed in Section 2.1.3 of this article, the walking activities of the elderly have a circular characteristic, mainly taking place within the community and a 5-10 minute living circle. This can be seen from the fact that the elderly-friendly frameworks formulated by various countries mainly focus on the community level.

The United States has comparatively early established a series of research and evaluation frameworks for age-friendly communities. Among these, *Livable Communities: An Evaluation Guide*, developed under the leadership of the non-profit organization AARP, stands out as a representative example. This guide encompasses eight key domains: walkability, transportation, housing, shopping, safety and security, recreation and culture, health services, and community care. The detailed content is presented in Table 2-7. The primary objective of this guide is to encourage relevant organizations and stakeholders to evaluate the community and neighborhood environment from the perspective of older adults, thereby exploring whether community functions and services enhance the livability for all age groups[50].

Table 2-7 Framework of the *Livable Communities: An Evaluation Guide*
Source: Author based on reference

Framework	Key Domains	Technical Priorities
Livable Communities: An Evaluation Guide, AARP	Walkability	Sidewalk conditions and routine maintenance; pedestrian signalization; walkability amenities
	Transportation	Public transit accessibility; transit stop infrastructure quality; modal diversity; vehicle maintenance standards
	Housing	Available housing stock; property tax relief programs; aging-in-place retrofits; maintenance protocols
	Shopping	Accessible retail clusters; universal accessibility in commercial facilities
	Safety & Security	Lighting efficacy; security patrols; visual permeability; crime prevention strategies
	Recreation & Culture	Recreational programming; public library integration; senior center operations; cultural event sponsorship
	Health Services	Healthcare proximity metrics; in-home care coordination; mental health outreach
	Community Care	Meal delivery systems; housekeeping assistance; home repair services

Compared with the WHO's Age-Friendly City Framework, this framework also integrates transportation, housing, community support, and health services into its core structure. However, there are notable differences between the two frameworks. The *Livable Communities: An Evaluation Guide*, tailored to local characteristics, incorporates walkability, shopping, safety and security, as well as recreation and cultural activities into its primary framework. Given that this study primarily focuses on the urban walking environment, the walkability and transportation components in the aforementioned table hold greater reference value.

Additionally, through relevant data analysis, it has been observed that the United States features a variety of frameworks for age-friendly communities, such as the *Livable Community* framework developed by the National Association of Area Agencies on Aging. While the themes of these frameworks are largely similar, some discuss the physical environment of the community to a lesser extent.

(2) The Age-Friendly Evaluation Framework in the UK and Other Countries

In 2007, the Department for Communities and Local Government (DCLG) of the UK published *Towards Lifetime Neighborhoods*. This framework and its associated indicators were developed through collaboration and support from multiple stakeholders, with the aim of enhancing the quality of life and social participation of older adults by improving their daily living environments and neighborhood safety. The framework comprises seven domains and 24 indicators[48]. The specific content is presented Table 2-8.

Table 2-8 Framework of the Towards Lifetime Neighborhoods
Source: Author based on reference

Framework	Key Domains	Technical Priorities
Towards Lifetime Neighborhoods, DCLG	Built Environment	Enhance universal accessibility standards
	Housing	Develop high-quality housing markets with age-adaptive solutions
	Social Inclusion	Expand shared indoor/outdoor spaces; implement weather-resilient designs; promote volunteer programs
	Social Cohesion	Establish legible neighborhood hierarchies with distinct landmarks; foster aesthetically cohesive and secure communities
	Services & Facilities	Optimize accessibility triads: service proximity, public space connectivity, transit integration
	Innovative Planning	Implement participatory cross-sectoral planning frameworks
	Information Technology	Encourage smart-home security adoption; strengthen digital social networks for elderly engagement

Compared with the WHO's Age-Friendly Environments framework, this framework also integrates outdoor spaces, buildings, transportation, housing, respect and social inclusion, communication and information, as well as community support and health services into its core structure. The two frameworks exhibit significant similarities in their primary architecture. At the same time, there are notable differences. The " *Towards Lifetime Neighborhoods* " framework, tailored to the political system and community characteristics of the UK, incorporates cross-sectoral collaboration and social cohesion into its main framework. Given that the primary focus of this study is the urban walking environment, the corresponding indicators within the domains of the built environment, social inclusion, social cohesion, and services and facilities hold considerable reference value.

In addition to the aforementioned age-friendly frameworks from the UK and the US, various age-friendly community frameworks exist in Canada, Australia, and other countries. For instance, the Public Health Agency of Canada's Age-Friendly Community framework and the Australian Local Government Association's Age-Friendly Built Environments framework, among others. The core contents of these frameworks largely align with those discussed above[52].

By comparing and analyzing the technical systems of the UK, the US, and the WHO, it becomes evident that the "guidelines" of the WHO have been widely adopted as the foundational program. Although the technical systems of different countries primarily target the community level and exhibit some variations in detail, the "guidelines" of the WHO comprehensively encompass the substantive core elements of age-friendly cities, communities, and societies[53].

2.2.3 Relevant Evaluation Systems in China

In 2021, the National Aging Office formulated and issued the *National Exemplary age-friendly Community Assessment Guidelines* (Trial), which is divided into two sections: urban communities and rural communities. Based on the research objectives of this study, the focus is primarily on the urban community component.

The Assessment Guidelines encompass eight primary domains. Broadly speaking, the influence of the World Health Organization's guidelines remains evident, emphasizing key aspects such as living environment, daily transportation, community services, and social participation. However, it also highlights the unique characteristics of China and contemporary times, placing significant emphasis on the positive role of traditional filial-piety culture and the context of the intelligent information age in elderly-related work[54]. For detailed information, refer to Table 2-9.

Table 2-9 Framework of the *NEACAG* (Urban)
Source: Author based on reference

Framework	Key Domains	Technical Priorities
National Exemplary Age-friendly Community Assessment Guidelines (Urban), National Health Commission (National Aging Office)	Safe & Hygienic Living Environments	Eliminate safety hazards; community fire prevention and emergency response networks; aging-adaptive housing retrofits; eco-environmental development; daily waste management
	Accessible Mobility Infrastructure	Universal residential accessibility; elevator availability; community rest benches; pedestrian-vehicle separation; unobstructed walkways with even surfaces; street lighting; ambulance-accessible roads; public restroom installation
	Integrated Community Services	Family physician services; home-based medical/rehabilitation care; community elderly care institutions; elderly care facilities; support for disabled seniors; special-needs elderly visitation programs; meal assistance, psychosocial support, legal aid, and ancillary services
	Inclusive Social Participation	Elderly representation in resident councils and public affairs; senior social organizations and cultural/sports teams; dedicated activity spaces
	Filial Piety Cultivation	Publicize exemplary elder-respect practices; family caregiver training; intergenerational interaction programs; neighborhood mutual aid initiatives
	Smart Elderly Support	"Internet + elderly care" service platforms; digital literacy programs for smart device usage; retention of traditional service modalities
	Governance & Funding	Dedicated aging-affairs personnel; special budgetary allocations; implementation oversight mechanisms
	Distinctive Features (Bonus Criteria)	

The framework proposed by this assessment guidelines, compared with the age-friendly frameworks of various countries discussed earlier, undoubtedly better suits China's reality. This has significant reference value for this study's research on the pedestrian space of the

Duobao Road area. In line with the research objective of this study, the “Accessible Mobility Infrastructure” domain and related indicators of this scoring criterion are most worthy of reference and learning. At the same time, the related indicators of the “Integrated Community Services” domain clearly point out the necessary elderly facilities for the community, which provides an important reference for the subsequent investigation and analysis of the facility conditions in the relevant communities within the target site.

2.3 Attributes and Factors Related to Walkability

Walkability reflects the environmental quality of the physical built space related to pedestrian traffic and embodies the relationship between pedestrian traffic and the built environment. In a broad sense, walkability represents the interrelationship between the environment and the perception and experience of pedestrians’ behavior.

This study focuses on the area around Duobao Road in the context of an aging population. The walking spaces within this area include sidewalks along urban streets, walking paths within communities, and public activity spaces. Considering the different styles of walking in these types of spaces, from the perspective of the spatial hierarchy of the study area, this study will mainly explore walkability at the urban and community levels. At the urban level, walkability focuses on traffic efficiency and pedestrian safety, emphasizing its traffic nature. At the community level, walkability emphasizes comfort, highlighting its living nature.

The study area is located within the historical district of Guangzhou, which is rich in historical relics and has diverse walking behaviors. This section will examine and explore urban elements closely related to walkability from the perspectives of the region and specific streets, establish a checklist and evaluation framework, and thereby provide a methodological approach for on-site research to identify issues.

2.3.1 Urban-scale Walkability Factors

(1) Urban Road Network

When conducting research on walkability, it is often necessary to focus on specific urban areas. This study is carried out in a particular urban area. On the one hand, before studying specific streets, it is necessary to clarify the general attributes of the studied area. On the other hand, there are multiple communities within the research scope, so when studying the walkability of the community environment, it is also necessary to examine its 15-minute living circle. Therefore, it is necessary to conduct some research on the walking network from a meso-urban perspective.

Michael Ochs discovered that the attributes of the walking network are closely associated with walkability. Small-scale and high-density walking networks can enhance road connectivity[6]. For the corresponding indicators of the walking network layout, the "*Guidelines for the Planning and Design of Urban Pedestrian and Bicycle Transportation Systems*" provides clear recommended values, as presented in the Table 2-10 below.

Table 2-10 Recommended Pedestrian Metrics by Zone Classification
Source: Author based on reference[6]

Pedestrian Zone Classification	Pedestrian Road Density	Average Spacing
Class I Zone	14-20km/km^2	100-160m
Class II Zone	10-14km/km^2	160-200m
Class III Zone	6-10km/km^2	200-500m

In the central urban area of Guangzhou, areas where the elderly are active often coincide with zones where citizens and tourists frequently congregate, exhibiting a high density of pedestrian activity. Given that the elderly face challenges in walking, their pedestrian traffic should be prioritized to the highest degree. Therefore, based on the aforementioned table, the corresponding indicators for Class I zoning should be adopted.

The theory of space syntax also explains the relationship between the attributes of the road network and pedestrian behavior. In space syntax, Integration measures the ability of a space to attract arriving traffic as a destination; the higher the Integration of a space, the higher its accessibility and the easier it is to gather pedestrian flow. Choice reflects the possibility of a space being traversed; the higher the Choice of a space, the more likely it is to be traversed by pedestrian flow. These two attributes can be used as references for selecting the focus of urban pedestrian spaces in subsequent research designs[55].

(2) Urban Street Function and Environmental Quality

For the walkability of specific urban streets, it is necessary to examine two aspects. On the one hand, the accessibility of these streets to surrounding key facilities must be analyzed to assess their capacity to induce walking behavior. On the other hand, attention should be given to the quality of the street environment itself, evaluating how well its physical conditions support walking behavior.

In this regard, this study will focus on the elderly population and integrate the internationally recognized *Walk Score* method. Based on the spatial configuration of urban facilities and walking travel distances, the walkability of urban streets will be investigated from the perspective of the potential to induce walking[56].

At the same time, concerning the quality of the street walking environment, this study will develop a checklist based on relevant street elements. This will provide a relatively

objective qualitative evaluation approach, facilitating subsequent research by offering guidance and recommendations for improving and renovating related environments.

① Walk Score

In 2007, an American enterprise introduced the *Walk Score*, offering a tool for quantifying urban walkability. This method primarily evaluates the types and spatial distribution of daily service facilities while incorporating factors such as Distance Decay Functions, intersection density, and street length. The calculation of the single-point walk score involves classifying and weighting facilities, employing multiple curve calculations to determine the distance decay pattern, and subsequently adjusting it by integrating street length and intersection density to derive the final single-point walk score[56].

Through a review of relevant literature, it is evident that many domestic scholars have further developed this approach. This study builds upon the work of scholars such as Long Ying and integrates the characteristics of elderly lifestyles to construct a relevant age-friendly walk score.

Firstly, the weights of functional facilities are established. In designing the weight system, this paper draws on the original facility classification and weighting methodology of the Walk Score, localizes certain facilities, and selects pertinent facilities based on related literature and thematic interviews with professionals in the elderly care industry regarding the living habits of the elderly in Guangzhou. The weight system developed in this study encompasses nine types of facilities, and the weights of some related facilities have been studied, as presented in the Table 2-11 below[57].

Table 2-11 Facility Categories and Corresponding Weights
Source: Author based on reference

Facility Category	Weight	Facility Category	Weight	Facility Category	Weight
Fresh Markets & Neighborhood Groceries	3	Pharmacies	1	Transit Hubs (Bus, Metro)	2
Restaurants & Teahouses	2	Parks & Green Spaces	2	Elder-care Facilities (Activities, Meal Services)	1
Entertainment Venues	1	Preschools & Schools	1	Healthcare Institutions	2

Subsequently, a decay coefficient should be established for the walking speed of the elderly. Distance decay is a geographical phenomenon that reflects the diminishing interaction between objects as the distance increases. This study incorporates the distance decay principle and employs a piecewise function. Relevant literature indicates that the average walking speed of the elderly is approximately 60 meters per minute. Based on this calculation, the reachable range within 5 minutes is 300m, within 20 minutes is 1200m, and within 30 minutes is 1800m. Drawing upon existing research, it is determined that there is no decay in

facility service levels within a 300-meter radius, a decay coefficient of 0.9 within the 300–600 meter range, 0.6 within the 600–900m range, 0.25 within the 900–1200m range, 0.1 within the 1200–1800m range, and service levels are not considered for distances exceeding 1800m[55].

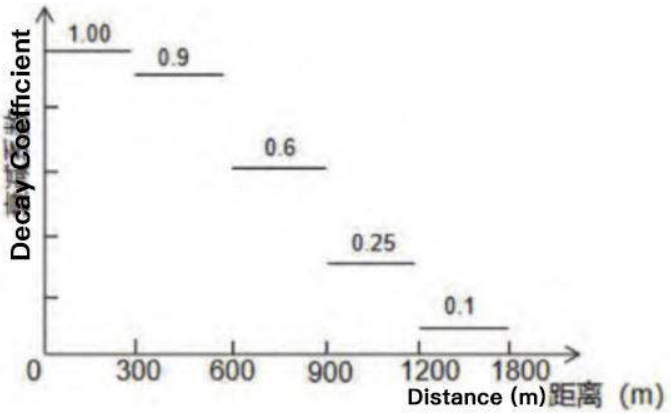


Figure 2-3 Distance Decay Coefficient
Source: Reference [55]

Then, based on the above data, the basic Walk Score can be calculated. The calculation formula is:

$$\text{Walk Score} = \sum_{i=1}^{n} (W_i \times f(s)) \times \frac{100}{15}$$

In this formula, W_i represents the weight corresponding to a specific type of facility; s is the walking distance from that type of facility to the street; $f(s)$ is the attenuation coefficient corresponding to s in the attenuation function. When calculating the Walk Score for a specific street segment, this study generally uses the key points of the road as the target points for calculation[58].

Relevant research suggests that the texture and form of urban blocks can influence the walkability of an area. In Guangzhou's older urban district, the block scale is relatively small, intersection density is high, and street accessibility is strong. Therefore, the basic Walk Score obtained above does not require further correction.

Table 2-12 Walk Score Classification
Source: Author based on reference

Walk Score	Description
90-100	Walker's Paradise: Daily errands fully achievable by walking
70-89	Very Walkable: Most daily services accessible on foot
50-69	Moderately Walkable
25-49	Limited Walkability: Few amenities within walking range
0-24	Car-Dependent: Most trips require motorized transport

By integrating existing research and the walking characteristics of the elderly, this study categorizes the Walk Score into five grades, as presented in the Table 2-12. For calculated

scores, the corresponding streets can be classified by referring to the table. This study posits that if the Walk Score exceeds 80 points, it can be concluded that the surrounding urban facilities adequately meet the walking needs of the elderly[59].

In the calculation of the Walk Score in this study, the primary focus is on quantifying the complexity of functions associated with key facilities surrounding the target point. This assessment aims to determine the extent to which urban functions support the daily lives of older adults and, consequently, evaluate how effectively urban streets encourage walking behavior.

② Factors related to the quality of urban street environment

Most existing studies on walkability have focused on the calculation of Walk Score, that is, they have concentrated on the facilities that may induce walking behavior, while less attention has been paid to the exploration of the street environment that affects the walking experience.

The environmental quality of the street is closely related to the walking experience of pedestrians. A high-quality street environment will greatly enhance the feelings of pedestrians when they walk. The perception and evaluation of this aspect are often formed based on the subjective feelings of users towards the spatial form of the street and the detailed environment of the street.

In related research, the NRDC and Tsinghua University's Long Ying, among others, proposed the "Street Environment Index" tool in their series of studies on *Evaluation of Pedestrian Friendliness in Chinese Cities*. They used crossing facilities, street greening, and the height-to-width ratio of buildings on both sides as main factors[58]. This provides an intuitive and simple approach to evaluating the walking environment, and the inspection items for the street environment hold significant reference value. This paper focuses on these aspects for reference.

Through further literature review, it was found that in more comprehensive and universal studies, Ewing developed an urban design quality evaluation system to attempt to quantify the intangible aspects of urban design[60]. In this evaluation system's research on the walking environment, he established an index system encompassing aspects such as enclosure, human scale, transparency, and imageability to evaluate street space[61]. This study, based on the characteristics of the elderly and historical urban areas, primarily referenced these four dimensions.

Enclosure refers to the provision of spatial definition through vertical elements such as

buildings that delineate outdoor spaces. Prior research on the elderly has indicated that their psychological traits often include feelings of insecurity and fear, which can be mitigated to some extent by enclosed spaces. Key indicators related to enclosure primarily include the street height-to-width ratio (hereinafter referred to as H/W ratio) and the continuity of the street interface.

Regarding the street H/W ratio, relevant literature provides relatively clear numerical guidelines for this value. For instance, Alexander et al. suggested that the total width of the street should not exceed the height of the buildings on either side, while Allan Jacobs recommended that the street H/W ratio should be at least 0.5. Furthermore, other studies propose varying ratios, typically ranging from 0.16 to 1.5[62]. This study adopts a standard range of 0.5 to 1 for the street H/W ratio. It is worth noting that in most historical urban areas, the street H/W ratio is maintained within this appropriate range. Therefore, in this study, the continuity of the street interface may hold greater reference significance for evaluating street enclosure.

In addition to the street H/W ratio, the continuity of the street interface also affects the spatial perception of the street space. Research indicates that the concept of street interface continuity mainly has two connotations: one is the density of the street interface, and the other is the alignment degree of the street interface. The density of the street interface reflects the completeness of the street interface, and its calculation method is as follows:

$$\rho_{sw} = \frac{L_{sw}}{2 \times L_s}$$

In this formula, ρ_{sw} represents the street interface density, L_{sw} is the length of the interface on both sides of the street (projected width), and L_s is the length of the street. The degree of alignment of the street interface describes the intensity of the concave and convex changes on both sides of the street. Excessive concave and convex changes can also weaken the continuity of the street interface. Here, this research borrows the concept of Standard Deviation and introduces the street interface alignment parameter to describe this attribute. The calculation method is as follows:

$$T_{sw} = \sqrt{\frac{\sum_{i=1}^{n} (D_i - \bar{D})^2}{n}}$$

In this formula, T_{sw} represents the street interface alignment parameter; n is the number of buildings along the street; D_i is the distance from the street-facing side of the building to the centerline of the street.

For the two parameters listed above that describe the continuity of the street interface,

Kang et al. analyzed and summarized multiple street samples and pointed out that the density of a walkable street interface should be above 75%, and the street interface alignment parameter should be controlled below 5.00[63]. This study will use this as a reference to evaluate the continuity of the street interface.

Transparency refers to the extent to which people can visually perceive or infer human activities beyond the street edge. This attribute enhances visual interest during the walking process. Closed walls and large buildings tend to reduce transparency. In addition to transparent storefronts, open doorways, and block entrances along the street, relevant literature also suggests that outdoor extensions of indoor activities, such as outdoor dining areas and street corner gardens, can effectively enhance street transparency.

Human-scale refers to the degree to which various street elements related to walking behavior align with the human body's dimensions. This attribute is directly linked to walking behavior itself. Appropriate sidewalk width, street greening, and other features all contribute to achieving a human-scale environment. Regarding appropriate street width, relevant conclusions were already drawn in the earlier discussion on the body scale of the elderly. It is also worth noting that for elderly individuals with mobility difficulties, street furniture for temporary rest is particularly important.

Safety is discussed separately due to considerations of the physical condition of the elderly. Smooth and well-maintained pavement, effective separation of non-motorized vehicle lanes, motor vehicle lanes, and sidewalks, as well as comprehensive accessible measures on sidewalks, all enhance the safety of the walking space. Regarding accessible measures, they will be specifically summarized later. Simultaneously, the installation of crosswalk facilities plays a significant role in ensuring the safety of elderly pedestrians and should also be included in this category.

Imageability was first introduced by Kevin Lynch and refers to the degree to which a place presents a distinctive and recognizable character. For this study, visible landmark buildings in the urban environment—such as *Qilou* arcade streets, old buildings, high-rise buildings in the old urban area—and distinctive public spaces can all enhance the imageability of the street.

Based on the above research, and by comprehensively referring to the "Street Environment Index" evaluation method proposed by Long Ying et al. for the street environment in China, this study has added and modified relevant items for the urban streets in Guangzhou[64].

Table 2-13 Factors related to the quality of the urban street environment
Source: Author based on reference[64]

Street Attribute	Factors	Criteria	Type
Enclosure	Appropriate street width-to-height ratio	Street space aspect ratio between 0.5-1	Quantitative
	Continuous street-side buildings	≥75% street interface density; building alignment deviation ≤5.00	Quantitative
Transparency	Non-enclosed ground-floor interfaces	At least one of: 1) Transparent shopfronts/open stores; 2) Accessible inner-block passages; 3) Outdoor seating/street corner gardens	Qualitative
Human Scale	Street furniture provision	At least one of: 1) Transparent shopfronts/open stores; 2) Accessible inner-block passages; 3) Outdoor seating/street corner gardens	Qualitative
	Adequate sidewalk width	Minimum clear width ≥1.8m (from curb) to accommodate wheelchair users and two pedestrians side-by-side	Quantitative
	Street greening	Continuous street tree canopy on ≥1 side (lawns/shrubs without shade provision excluded; shaded groundcover permitted)	Qualitative
	Unobstructed walkways	No vendor encroachment; limited bike/e-bike parking; maintenance of clear pedestrian corridors	Qualitative
Safety	Pavement maintenance	No widespread surface damage	Qualitative
	Dedicated bike lanes	Physically separated bicycle facilities with clear demarcation (e.g., colored paving, barriers)	Qualitative
	Vehicle-pedestrian separation	At least one of: 1) Protective barriers; 2) Continuous landscaping buffers	Qualitative
	Accessibility provisions	Compliance with ADA-equivalent standards (detailed in subsequent sections)	Qualitative
	Pedestrian crossing facilities	At least one of: 1) Signal-controlled crossings; 2) High-visibility crosswalks; 3) Refuge islands	Qualitative
Imageability	Distinctive landmarks	Visually prominent urban elements (architectural features, public art, bridges)	Qualitative

2.3.2 Community-scale Walkability Factors

The community represents the closest environment to the daily lives of the elderly, underscoring its significance. As residents, the elderly live and move within the community, with walking forming the foundation of various community activities. The requirements for walking spaces differ between urban and community levels. For urban streets, passage is the primary function, whereas in communities, walking is often accompanied by a wide range of daily activities.

Walking outside the community typically occurs on sidewalks along roads, while within

the community, walking activities are widely distributed across outdoor spaces[65]. Therefore, considering the differences in needs for walking environments at the urban and community levels, this section will focus on researching the quality inspection of community walking spaces.

The current the *National Exemplary age-friendly Community Assessment Guidelines* in China effectively summarize the characteristics that such communities should possess. This study primarily refers to these criteria. Dimensions related to walking and the community public environment are extracted as follows: safe & hygienic living environments, complete and convenient mobility facilities, and accessible & integrated community services. These three dimensions are developed from the perspectives of the overall community, mobility facilities, and living services. This study will also adopt these three perspectives in constructing the community walkability checklist.

At the overall community environment level, factors influencing the walking experience mainly include the quality of the community environment, such as greening, ecological conditions, and environmental cleanliness. Relevant literature also highlights that the development intensity of the community significantly impacts the walking experience. Communities with excessively high floor-area ratios severely compress outdoor spaces, thereby weakening various activities within the community. The degree of community greening also affects the walking experience, with relevant indicators including the green space ratio. However, it should be noted that for already-built old communities, guaranteeing the green space ratio may be challenging. Therefore, improving the green view ratio of activity areas can enhance the walking experience. Community cleanliness also influences walking within the community. Additionally, similar to urban streets, the road network structure of community roads may have varying degrees of impact on the walking experience, especially for the elderly with declining physical and mental strength. Relevant studies indicate that at the community level, attributes such as intersection density, the convenience of community entrances and exits, and road network density are related to the walkability of elderly communities. A reasonable number and placement of entrances and exits can reduce unnecessary detours for the elderly[66].

Regarding mobility facilities, through comprehensive integration of relevant information, this study identifies that factors influencing the walking experience can be primarily categorized into those related to convenience and safety. Factors related to walking safety include the completeness of accessible walking environments, pedestrian-vehicle separation, road flatness, and the adequacy of night lighting. Factors related to walking convenience

mainly include the availability of residential elevators, the placement of rest benches within the community, and the provision of public toilets and other convenient facilities. These factors support the elderly's walking experience within the community through both facilities and the environment.

At the level of living services, it is crucial to ensure the completeness of key facilities within the community, enabling the elderly to handle various necessary matters without leaving the community. Simultaneously, it is necessary to consider whether important urban facilities such as hospitals, bus stops, and parks are accessible within a 15-minute walk from the community. Corresponding factors may include whether the community has medical service points, public activity areas, elderly care service facilities, convenient markets, and other essential amenities, as well as the accessibility of key urban functions surrounding the community[67].

Combining the above discussion and existing relevant materials, the preliminary checklist for the walkability of age-friendly communities can be formulated as follows:

Table 2-14 Factors related to walkability at the community level
Source: Author based on reference

Primary Category	Secondary Category	Factors	Criteria	
Overall Environment	Outdoor Environment	Floor Area Ratio	≤4 for high-rise residential areas; ≤5 for low-rise areas. Higher ratios reduce comfort.	Quantitative
		Green Space Coverage	Minimum green space ratio: 0.25; continuous greening along main walkways and leisure zones; green view index of 0.15-0.25 where feasible	Quantitative /Qualitative
		Architectural Aesthetics	Neat building facades; distinctive architectural styles to enhance pedestrian experience.	Qualitative
		Sanitation	No exposed garbage or debris along primary walkways and activity areas.	Qualitative
	Community Road Network	Intersection Density	≥700 intersections/km² (exempt for historic communities).	Quantitative
		Road Network Density	Road length-to-area ratio ≥8 km/km² (exempt for historic communities).	Quantitative
		Community Access Points	≥2-3 access points adjacent to urban roads; nearest bus stop within 300m.	Quantitative
Mobility Infrastructure	Safety Assurance	Accessibility Compliance	Accessible design compliance (detailed in subsequent sections).	Quantitative /Qualitative
		Pedestrian-Vehicle Separation	Dedicated pedestrian/vehicle lanes; non-motorized lanes where feasible. Exempt for narrow historic roads but require enhanced management.	Qualitative
		Pavement Quality	Smooth, non-slippery surfaces; no encroachment	Qualitative

Primary Category	Secondary Category	Factors	Criteria	
			by parking or vendors.	
		Night Lighting	Streetlights installed along walkways, staircases, and activity zones.	Qualitative
		Emergency Vehicle Access	Continuous internal roads connecting to residential building entrances.	Qualitative
	Comfort & Accessibility	Walkway Width	Minimum clear width: 2m (1.5m allowed for historic communities with spatial constraints).	Quantitative
		Elevators	Elevators required for buildings ⩾7 floors.	Qualitative
		Rest Seating	Benches in activity zones/main walkways; seatable planter edges or tree pits.	Qualitative
		Public Toilets	Toilets near elderly activity hubs.	Qualitative
		Activity Zones	Dedicated dynamic/static activity areas with noise control.	Qualitative
		Shading Facilities	Tree canopies or shelters in activity zones/main walkways.	Qualitative
		Wayfinding System	Clear signage with high legibility.	Qualitative
Living Services	Internal Community	Healthcare Services	On-site clinics providing basic medical care and home nursing.	Qualitative
		Senior Activity Centers	Indoor spaces for recreation (e.g., game rooms, libraries).	Qualitative
		Elderly Care Facilities	Services including meal assistance, daily care, and emergency response.	Qualitative
	15-Minute Living Circle	Amenity Completeness	Full-service coverage (prioritizing hospitals and markets).	Qualitative
		Facility Accessibility	Measured via Walk Score (calculation methods as previously defined).	Quantitative
		Park Proximity	Direct pedestrian access to urban parks/green spaces.	Qualitative

The above systematically outlines the key characteristics of a age-friendly walkable community. The corresponding evaluation criteria are derived from existing literature and the relevant research findings discussed earlier.

2.4 Pedestrian Safety: Accessibility Environment

The accessibility feature of the walking environment is an important part of walkability, which may seem dispensable to able-bodied people but is a necessary prerequisite for the safe travel of the elderly and people with disabilities. In the previous series of studies, the safety of walking has been mentioned many times. In the research on the characteristics of the elderly, the increasingly weak physical functions and the psychological trait of being prone to fear of

the elderly all point to their demand for the safety of urban spaces. This section will further supplement the previous content from the perspective of accessible environment design.

Through information retrieval, many provinces in China have successively introduced accessibility urban design guidelines in recent years. Among these, the "*Beijing Accessibility Urban Design Guidelines*" stands out as particularly representative. Based on an in-depth analysis of Beijing's urban conditions, this guideline proposes primary target strategies and elaborates on the key aspects of accessibility design for seven design elements, including roads and squares, public transportation stations, parks and green spaces, public building sites, and community public environments[68]. Similarly, the "*Quzhou City Urban Environment Accessibility Design Guidelines*" is divided into six volumes covering urban blocks, parks and green spaces, medical rehabilitation, education and culture, etc., detailing the key points of accessibility urban environments for different scenarios[69]. Generally, the contents are similar, all demonstrating systematic and detailed characteristics.

Figure 2-4 Accessible Journey from Home to Frequently Visited Places
Source: Reference [36]

In 2024, Guangzhou also released the *Guangzhou Accessibility Environment Design Guidelines*, which is more tailored to the local characteristics of Guangzhou. It discusses the design elements of accessible cities from five major perspectives: urban public spaces, residential areas, public buildings, etc.[70].

This guideline proposes the core concept of all-age-friendly and shared-by-all, with the vision of "zero height difference in blocks, zero obstacles in venues, and zero barriers in information". It proposes four transformations to lead the innovation of urban design. The four transformations are as follows: 1. Object Transformation: shifting from focusing solely on the needs of people with disabilities to the needs of all age groups, emphasizing the concept of universal design; 2. Concept Transformation: upgrading from isolated facility

placement to systematic closed-loop design, achieving the integration of urban space, buildings, and services; 3. Facility Transformation: integrating Internet and AI technologies to upgrade traditional facilities to smart and interconnected ones; 4. Experience Transformation: shifting from physical environment optimization to the all-round improvement of safety, comfort, and dignity.

The key design areas related to elderly walking in the *Guangzhou Accessibility Environment Design Guidelines* include: 1. Urban Public Spaces: continuous blind paths, curb ramps, vehicle barriers, tactile paving guidance in metro stations, and priority waiting areas for public transportation. 2. Residential Areas and Buildings: anti-slip paving in activity areas, and handrails on seats. 3. Innovative Smart Facilities: digital tactile paving, assistance and guidance systems at bus stops, and accessible digital map navigation.

It is also noted that the Guangzhou Planning and Natural Resources Bureau compiled and released the *Guangzhou City Urban Design Guidelines* in 2019, which contains a considerable amount of regulations related to age-friendly and accessible streets[89].

At the level of age-friendliness and accessible environments, this guideline points out that it is necessary to create livable and enjoyable parks and squares, provide sufficient rest facilities, barrier-free access, and age-friendly activity areas to meet the daily activity needs of the elderly. At the same time, it is necessary to build convenient and open small green spaces to provide nearby social and activity spaces for the elderly in the community.

At the block and community level, this guideline advocates a small blocks and dense road network model to shorten walking distances and enhance street accessibility. The recommended distance between new street roads should not exceed 200 m to improve the convenience of elderly walking. The guideline also requires the improvement of the walking network within 500 m of public transportation hubs, adding covered walkways, sunshades, and guiding signs to optimize the travel experience of the elderly.

The *Guangzhou City Urban Design Guidelines* effectively integrates age friendliness, and street accessibility into urban construction through multi-level spatial control. This design guideline focuses on age-friendly public spaces, continuous walking networks, and refined accessible facilities.

This study mainly refers to the "Guangzhou Design Guidelines for *Guangzhou Accessibility Environment Design Guidelines* and the *Guangzhou City Urban Design Guidelines*, screening and extracting projects related to the research and integrating them into the research system.

2.4.1 Accessibility Design Elements for Urban Road

In this study, the accessibility environment at the urban road level is primarily examined from the following four aspects: sidewalks, flat and vertical crosswalks, non-motorized vehicle lanes, and facility strips. Given that this research focuses on the walking environment for the elderly, the elements of sidewalks, flat crosswalks, and facility strips are more directly relevant to walking behavior. The key accessibility design elements are outlined as follows:

Table 2-15 Accessibility Design Elements for Urban Road
Source: Author based on reference

Category	Design Elements
Sidewalks	Pavement materials, anti-vehicle bollards, utility covers, curb ramps, staircases, signage, tactile guidance paths (directional and warning)
At-grade Crossings	Pedestrian signal actuators, audible crossing alerts, marked crosswalks, refuge islands, wayfinding signage
Amenity Zones	Tree wells and hedges with shade provision

For the accessibility elements of sidewalks, the following specific information is provided. Sidewalks should feature continuous and uninterrupted anti-slip tactile paving that contrasts in color or material with the adjacent pavement, and no obstacles or facilities should be placed on either side. Curb ramps are used to address height differences at intersections and crosswalks, featuring appropriate slopes and widths. Where steps are set on streets and consist of three or more levels, handrails should be installed. For detailed regulations regarding various design elements, such as dimensions and tactile paving, relevant standards can be consulted. Generally speaking, accessible sidewalks should be smooth, free of height differences, and highly recognizable.

The key design elements for accessible pedestrian crossings are outlined as follows. When a sidewalk with tactile paving is interrupted by a road, a crosswalk should be provided, ensuring its width accommodates wheelchair passage. Crosswalks with safety islands should be anti-slip and level with the road surface. If conditions allow, 3D painted crosswalks may be utilized. For commercial and residential roads where the crosswalk length exceeds 9 meters, pedestrian safety islands should be installed wherever possible. Regarding tree pits, if they are included, care should be taken to ensure they do not create height differences with the pedestrian walkway.

2.4.2 Accessibility Design Elements for Community Public Environments

The accessibility environment at the community public environment level primarily addresses the following four aspects: community roads, community green spaces, public activity areas, and supporting facilities[71]. The relevant accessibility design elements are summarized as follows:

Table 2-16 Accessibility Design Elements for Community Public Environments
Source: Author based on reference

Category	Design Elements
Community Roads	Sidewalks, community access points, tactile warning strips, night guidance lighting, wheelchair ramps, accessibility signage
Community Green Spaces	Woodland understory spaces, residential inter-block green areas, pocket parks, community parks
Community Green Spaces	Senior outdoor fitness areas (steps, accessible ramps, seating benches, non-slip paving), emergency call buttons
Supporting Facilities	Age-adaptive activity centers, community service hubs, retail amenities

In terms of community roads, similar to urban roads, significant height differences should be avoided or mitigated through the use of ramps. Additionally, the entrances and exits of the community should ensure seamless connectivity with surrounding urban roads and bus stops, as previously discussed in earlier studies. At the same time, attention should be paid to the continuity of community public green spaces, activity areas, and supporting facilities. Pedestrian and vehicle traffic lines should be separated as much as possible; when they must run parallel, they should be distinguished by variations in color or material. Where there is green space along the road, elderly rest seats can be integrated, with a configuration interval not exceeding 50 meters. In community green spaces and public activity areas, in addition to ensuring the elimination of height differences and site accessibility, prompt lighting should be installed, and rest seats and entertainment facilities should be provided to expand the range of elderly fitness and social activities.

2.4.3 Accessibility Design Elements for Urban Parks and Green Spaces

Rich walking behaviors also occur within urban park green spaces. As important destinations for the daily outings of the elderly, urban park green spaces fulfill critical needs such as exercise, entertainment, and social interaction for this demographic. The research area nearby includes urban parks such as the banks of Lizhi Wan Stream and Liwan Lake Park, which serve as vital activity venues for the elderly in surrounding communities. The safety of walking in these areas warrants particular attention. Therefore, the corresponding accessibility design elements are summarized as follows:

Table 2-17 Accessibility Design Elements for Urban Parks and Green Spaces
Source: Author based on reference

Category	Design Elements
General Parks & Green Spaces	Accessible pathways, slope-compliant surfaces, rest seating, viewing platforms and activity zones, tactile plant selection
Waterfront Parks	Accessible waterfront boardwalks with non-slip surfaces and guardrails
Public Squares	Accessible circulation routes, graded terrain transitions, Relax seating, ADA-compliant parking

For park and green spaces, accessible paths are typically designed in conjunction with slow-moving routes, effectively linking major viewing areas and optimal photo spots. Where landscape plants are required, priority should be given to selecting species with distinct textures and fragrant scents, which can provide olfactory guidance and create memorable landmarks. For riverside areas, accessible pathways along the water should be established, ensuring adequate passage width and incorporating effective anti-fall safety measures. In public squares, in addition to meeting general accessible requirements, emphasis should also be placed on ensuring efficient connectivity between activity zones, cultural and sports facilities, and external roads.

2.5 Summary

This chapter conducts fundamental research on the walking characteristics of the elderly, age-friendly theories and frameworks, elements of walkability at the urban and community levels, and accessible walking environments, summarizing the current research status of relevant subjects and available tools.

Under the theme of the walking characteristics of the elderly, this chapter first explores the physiological, psychological, and walking behavior characteristics of the elderly, thereby summarizing their possible needs at the walking level; then, by summarizing the mature age-friendly frameworks of various countries, it summarizes the key research dimensions related to walking in the context of aging. Under the theme of walkability at the urban level, this chapter discusses some factors affecting walkability at the urban level from the perspectives of urban regional walking networks and urban street functions and environments. Under the theme of walkability at the community level, considering the differences between urban public spaces and internal spaces of residential communities, this chapter separately explores the factors that may affect the walking environment in communities. Finally, in response to the safety needs of the elderly when walking, this chapter also separately sorts out the knowledge related to barrier-free environments, starting from the existing barrier-free urban design guidelines, and discusses the factors of barrier-free design in several different types of spaces.

The research on the above-mentioned basic theories and tools provides a theoretical basis for the subsequent chapters to integrate the relevant elements of walkability and establish a checklist.

Chapter 3 Case Study Analysis

The basic theoretical research presented in Chapter 2, through the systematic integration and adjustment of literature and materials, developed research tools and preliminarily established the research direction. This chapter will, at the empirical level, analyze and investigate relevant case studies to understand how existing mature cases shape age-friendly walking spaces, thereby providing valuable guidance for subsequent design work.

3.1 The National Exemplary Age-friendly Community

National Health Commission (National Aging Office) has initiated a nationwide program to establish demonstration age-friendly communities. Over the past two years, this program has identified more than a thousand such communities. Recognition as a national exemplary age-friendly community signifies that the community has achieved a high level of adaptability for the elderly and serves as an exemplary reference. Therefore, for this study, two communities were selected from the 999 approved in early 2024 based on their relevance and similarity to the research subject for on-site visits and analysis. The objective is to examine and incorporate their successful practices in developing age-friendly pedestrian environments, thereby further enriching the earlier-discussed research content on the pedestrian environment of age-friendly communities.

3.1.1 Dufu Community, Beijing Subdistrict, Yuexiu District

Figure 3-1 Plan of Dufu Community
Source: Author

Dufu Community is situated within Guangzhou's political, economic, and cultural

nucleus in Yuexiu District, spanning 66,500 square meters. This multi-arterial neighborhood interconnects four major thoroughfares—Yuehua Road, Cangbian Road, Dongfeng Road, and Zhengnan Road—and experiences significant pedestrian and vehicular traffic flows.

The overall layout of this community exhibits distinct characteristics of an older urban area: new and old buildings coexist, with narrow and densely packed old structures in the southern part of the plot, 6-7 floors residential buildings in the central area, and newly constructed office buildings in the northern section. The functions within the community are mixed, encompassing various types of residential buildings, cultural landmarks such as the Uprising Memorial Hall, religious facilities like a mosque, and essential infrastructure including primary schools, kindergartens, and hospitals. The juxtaposition of new and old buildings results in significant variations in living conditions across the community, while the mixed-use nature facilitates residents' easy access to diverse urban services.

Firstly, concerning the community's road network (as indicated by the dark red-brown lines in Figure 3-1), the author's on-site investigation revealed that the road network is relatively irregular. Although this may cause some navigational challenges for pedestrians, the irregularity also makes the walking space more memorable. For elderly residents who have lived in the community for extended periods, this irregular road network aids in their spatial orientation, thereby enhancing their confidence when navigating the area. Additionally, the road network contains few dead-end roads and maintains good connectivity, improving the accessibility of walking spaces for the elderly within the community.

From the perspective of green spaces and public areas, despite being an old and spatially congested community, Dufu Community still features a notable amount of public space. In the southern part of the plot, there is a public space known as "Xiaodongying Cultural Square" (highlighted in bright red in Figure 3-1). This square is adorned with high-quality shade trees and surrounded by buildings, creating a well-defined sense of space and providing a venue for elderly residents to engage in physical activities. Adjacent to the cultural square and in the northern part of the plot, there are two concentrated green spaces (indicated in green in Figure 3-1), which also serve as outdoor activity areas for the elderly. Furthermore, the community boasts a relatively dense tree canopy along its main internal roads, which not only enhances the visual appeal of these routes but also provides ample shade, thereby improving the overall walking experience for residents.

From the perspective of the 15-minute living circle and urban functional facilities, the Dufu Community and its surrounding area are well-equipped with diverse amenities. Regarding elderly care facilities, the community's service station provides certain services to

meet residents' needs. Additionally, within a 10-minute walk from the community, there is a senior day care center and a senior canteen that offer care and meal services for elderly residents. In terms of medical facilities, two medium-sized hospitals are located within the community boundaries: the Yuexiu District Maternal and Child Health Hospital and the Yuexiu District Hospital of Traditional Chinese Medicine, which can fully address the daily healthcare requirements of elderly residents. Concerning fitness infrastructure, the community features the "Xiaodongying Cultural Square" as an exercise venue, and within a 5-10 minute walk, there are two dedicated fitness paths designed specifically for elderly residents to engage in walking and physical activities. Furthermore, considering the needs of elderly residents who may need to pick up or drop off their grandchildren, a primary school and a preschool are conveniently located within the community premises, enhancing accessibility for such tasks.

Figure 3-2 15-minute Facility Circle of Dufu Community
Source: Author

From the perspective of the internal public environment of the community, in addition to the favorable age-friendly environmental factors mentioned in the preceding analysis, the on-site investigation identified several noteworthy environmental management practices. Firstly, the streets and alleys within the community have undergone renovation and regular maintenance, ensuring smoothness and cleanliness. This enhances both the sense of security and the overall walking experience for residents, while the stone pavement provides a distinctive tactile and visual experience. Secondly, external elevators have been retrofitted into 6-7 floors residential buildings, facilitating vertical mobility for elderly residents and

encouraging them to venture outdoors more frequently. Thirdly, the community features relatively centralized and designated parking areas for E-bikes, which not only prevents disorderly parking and the obstruction of internal roads but also minimizes the risk of E-bikes traversing core residential zones, thereby mitigating potential safety hazards. Moreover, the community boasts a comprehensive signage guidance system, with directional signs strategically placed at intersections and corners of internal roads to indicate key facilities such as the community service station and other elderly-care services.

Figure 3-3 Good Pedestrian Support in the Dufu Community
Source: Author

During the case study and on-site observation, the author identified a distinctive strategy employed by the Dufu Community in fostering an age-friendly environment: the provision of various types of shelter facilities, as illustrated in Figure 3-4. These facilities offer appropriate activity spaces for elderly residents during the intense summer heat or the extended drizzle characteristic of the spring rainy season. Once the bamboo sunshades and plant-covered pergolas are fully overgrown with vegetation, they not only provide effective shade but also serve as significant community landscapes. Additionally, the community features extensive covered corridors that protect against wind and rain, enabling elderly residents to engage in leisure activities such as playing cards and chatting during their free time.

Figure 3-4 Shelter Facilities in Dufu Community
Source: Author

This case study provides the following insights for this research: While the community road network may adopt an irregular layout, it must ensure connectivity through well-maintained connections to guarantee accessibility. Community roads can retain a historical aesthetic, but they must be regularly maintained to ensure smoothness and safety. The functional mix within the community should be maximized, as diverse urban functions, including healthcare and education, significantly enhance convenience for the elderly. Green spaces and public areas should be strategically located at key points within the community to meet the exercise and social needs of elderly residents. Emphasis should be placed on the 15-minute living circle concept, ensuring that essential services for the elderly, such as medical facilities, elderly care centers, and exercise areas, are included within this radius. Dedicated parking areas for electric bikes and other vehicles can mitigate the issue of on-street parking along primary pedestrian routes, thereby enhancing the quality of the walking environment.

3.1.2 Fanghe Garden Community, Dongjiao Subdistrict, Liwan District

Fanghe Garden Community is situated in the Fangcun region of Liwan District and represents a government-developed affordable housing community in Guangzhou. The community comprises 21 residential buildings, each ranging from 28 to 29 floors, covering a total area of approximately 79,600 square meters.

The overall layout of the community exhibits distinct characteristics of a resettlement community, featuring tall residential buildings, relatively comprehensive supporting facilities, and a spacious public area at its center. In comparison with the previously analyzed Dufu Community, the internal planning of Fanghe Garden Community is more systematic and regular. Beyond the commercial complex designed for public use, the internal functional layout primarily caters to the needs of the community's residents. Regarding residential functions, all buildings within the community are high-rise residential towers. Despite both communities being located in Guangzhou's older urban area, one reflects an older style while the other embodies a newer design, showcasing contrasting architectural aesthetics.

Consequently, the manifestation of age-friendly environments also varies between the two.

The primary road network of the community is depicted by the black lines in Figure 3-5. It is evident that the road network is highly logical and has undergone modern planning, organized around a loop encircling the community's central landscape square. Although the road network is regular and well-defined, it avoids monotony through the strategic placement of various landscape features throughout the community. These features serve as reference points for elderly residents during their walks, reducing the likelihood of disorientation. Additionally, the community's road network connects to six exits along the three major urban roads surrounding it, ensuring no dead ends and providing excellent accessibility.

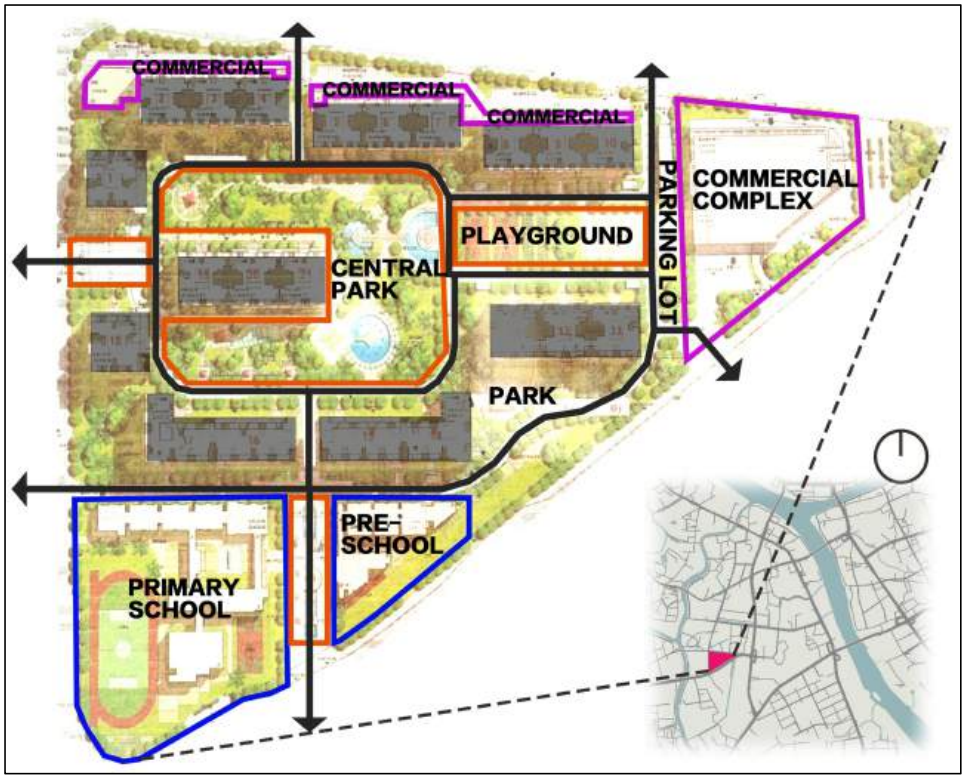


Figure 3-5 Plan of Fanghe Garden Community
Source: Author

From the perspective of green spaces and public areas, Fanghe Garden Community boasts a relatively high green coverage rate. As depicted in Figure 3-5 above, the community's public spaces are well-landscaped. Furthermore, the community features a dense tree canopy, with trees along the main internal roads providing ample shade for residents during their walks, thereby enhancing their walking experience. Regarding public activity spaces, the community includes a large sports field, as indicated by the rectangular orange box on the eastern side of the site in Figure 3-5. This area comprises basketball courts, tennis courts, and activity zones suitable for multiple age groups. Such intergenerational shared public spaces contribute to fostering a stronger sense of belonging among elderly residents.

Additionally, the parks located in the central and surrounding areas of the community provide tranquil rest areas for the elderly. The public spaces cater to both dynamic and static activities, offering diverse options for outdoor engagement among the elderly population.

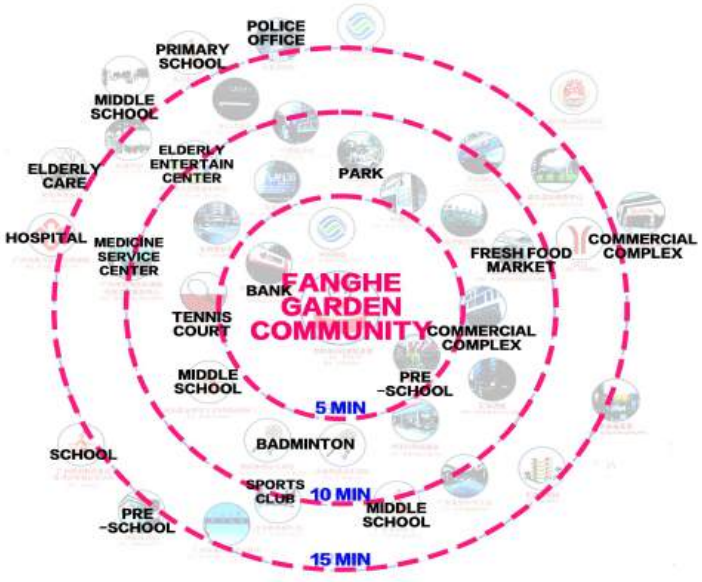


Figure 3-6 15-minute Facility Circle of Fanghe Garden Community
Source: Author

From the perspective of the 15-minute living circle and urban functional facilities, Fanghe Garden Community and its surrounding amenities are also highly diverse. In comparison with Dufu Community, this community boasts superior commercial conditions and a broader range of sports facilities. Within a 5-minute living radius, there are commercial complexes and markets that can fulfill the varied shopping requirements of elderly residents. Additionally, the community and its vicinity feature various sports amenities such as courts and fitness clubs, as well as urban parks that cater to the needs of elderly individuals for gentle exercise. Regarding elderly assistance facilities, an elderly entertainment and activity center is located within a 10-minute walk, enriching the cultural life of elderly residents. Within a 15-minute walking distance, there is a nursing home that addresses some of the daily care needs of the elderly population. In terms of healthcare, a community medical service center is situated adjacent to the community, and within a 15-minute walk, there are medium and large hospitals available to meet more extensive medical needs of elderly residents. The presence of numerous schools in the surrounding area ensures convenience for elderly residents who need to pick up or drop off their grandchildren.

From the perspective of the internal environment of the community, in analyzing Fanghe Garden Community, beyond the elderly-friendly environmental factors such as community public spaces mentioned earlier, the on-site investigation identified additional noteworthy environmental management practices. Firstly, similar to Dufu Community, this community

has established centralized parking areas for electric vehicles, effectively addressing issues of random parking and uncontrolled movement of electric vehicles. Additionally, the internal roads are notably wide, providing an excellent walking experience. Furthermore, numerous rest benches are strategically placed around public activity areas and landscape walking paths, enhancing the comfort of elderly residents during their walks.

Figure 3-7 Good Pedestrian Support in the Fanghe Garden Community
Source: Author

This case offers the following insights for this study: It is essential to provide diverse activity spaces for the elderly, encompassing both dynamic and static options, enabling them to engage in exercise and rest. These spaces can be designed as intergenerational shared areas, accommodating both the elderly and children. Environmental greening should be prioritized, as abundant green spaces contribute significantly to environmental health and well-being. In addition to essential services for the elderly, such as hospitals and elderly assistance facilities, cultural and recreational amenities can also be incorporated within the living circle to enrich the spiritual lives of elderly residents. In areas frequented by the elderly, additional rest benches can be installed to accommodate their physical limitations.

3.2 International Cases of Age-friendly Street Construction

The preceding section primarily analyzed and drew lessons from two exemplary age-friendly communities in Guangzhou, focusing on community environments and urban facility support. The following section will explore current renovation strategies and methods aimed at enhancing the quality of the urban walking environment for age-friendly streets globally by examining international cases of walkable street and block design. We will analyze and incorporate replicable successful experiences to further refine the research content on the age-friendly urban walking environment presented in the previous section.

3.2.1 Singapore's Silver Zone

The Singaporean government observed that traffic accidents involving the elderly remained consistently high, with most incidents occurring within or around residential areas.

In response, relevant authorities launched the Silver Zone renovation project in multiple residential districts across Singapore. Drawing on the experiences of the UK, Australia, and New Zealand, the implementing agencies systematically identified and analyzed key indicators such as the aging population rate, accident occurrence rate, and the degree of mixed pedestrian and vehicle traffic in targeted areas, thereby pinpointing several urban "black spots" for renovation[73].

For the street-level adaptation measures implemented in Singapore's Silver Zone, the following strategies and methods were primarily adopted:

(1) Strategy 1: Adjust Land Use

Through research, the implementing agencies discovered that single-function plots often necessitated the elderly to travel long distances for daily activities. To address this, in collaboration with the urban planning department, the land use function was adjusted from a purely residential attribute to a multi-functional one. Commercial, catering, and other community living service facilities were expanded and renovated accordingly. This not only mitigated the need for the elderly to cross motor vehicle roads over long distances but also enhanced the vibrancy and livability of the community.

(2) Strategy 2: Limit Vehicle Speed

High-speed motor vehicles pose significant safety risks and jeopardize the travel safety of the elderly. Therefore, it is imperative to impose speed restrictions on vehicles. The Silver Zone initiative in Singapore has undertaken comprehensive renovations to road surfaces, cross-sections, and ancillary facilities to effectively reduce vehicle speeds. Specific renovation methods can be categorized into the following types:[73]

The first measure involves installing roundabouts at road intersections, as illustrated in Figure 3-8, ①. Transforming crossroads into roundabouts not only reduces the speed of motor vehicles but also decreases the number of traffic conflict points, thereby enhancing the safety of both pedestrians and vehicles.

The second measure entails establishing safety islands. Two-stage crossings are considered safer. By installing pinch points, which partially narrow the lane width, in the middle of the road for pedestrian crossings (as shown in Figure 3-8, ②), or wider eye-lands that slightly bend the road (as shown in Figure 3-8, ③), this approach not only prompts vehicles to slow down but also provides a rest and shelter area for elderly pedestrians crossing the road.

The third measure consists of converting straight roads into Chicanes to reduce vehicle speeds, as depicted in Figure 3-8, ④. S-shaped chicanes modifications have been

implemented in sections with higher vehicle speeds, aiming to decelerate vehicles without altering the carriageway width, similar to the “eye-land” measure.

The fourth measure involves narrowing the road width through the use of low-height central dividers, as shown in Figure 3-8, ⑤. These dividers occupy a portion of the road’s width, reducing lane width and prompting drivers to slow down while preventing random U-turns. Additionally, their low design allows emergency vehicles such as ambulances to pass safely during emergencies.

Figure 3-8 Deceleration Measures in the Silver Zone
Source: Author based on references[73]

(3) Strategy 3: Enhancing the Pedestrian System

In addition to limiting vehicle speeds, the Silver Zone has also made strategic adjustments to the pedestrian system and related facilities[73]. The specific adjustment methods primarily include the following categories:

1) Extending, widening, and connecting pedestrian paths to achieve maximum separation between pedestrians and vehicles;

2) Linking pedestrian paths to parks and urban green spaces to provide a comfortable walking environment for the elderly;

3) Constructing additional bus stops and transfer facilities, and systematically renovating and managing bicycle paths and parking lots to encourage walking and public transportation use;

4) Installing prominent signage at intersections, pedestrian crossings, and other key nodes, as well as improving nighttime pedestrian lighting, to make pedestrian paths more suitable for the elderly.

Among these measures, the diverse and visually striking pavement markings, as shown in Figure 3-9, are particularly noteworthy.

Figure 3-9 Prominent Road Markings
Source: Reference[73]

3.2.2 Safer and Pedestrian-Friendly Streets

The case of the Silver Zone offers valuable insights for the design of age-friendly streets. This section will draw on practices from various countries to explore diverse design strategies related to street walking and pedestrian safety crossing.

(1) Singapore: Safer Crosswalk Facilities

Singapore employs a range of methods to improve pedestrian crossing safety, which is particularly crucial for elderly individuals with limited mobility.

In crosswalk design, Singapore implements multiple strategies to encourage passing vehicles to slow down and ensure pedestrian safety. Firstly, zig-zag line markings are used along crosswalks, as shown in the left image of Figure 3-10, to alert drivers in advance of an upcoming crosswalk and prompt them to reduce speed. These zig-zag lines on both sides of the road also visually narrow the road width, encouraging drivers to drive more cautiously. Additionally, yellow flashing signal lights can be installed at crosswalks to enhance nighttime visibility and alert drivers.

In Singapore's crosswalk design practice, some sections have adopted raised crosswalks, as illustrated in the right image of Figure 3-10. By elevating the crosswalk to the level of the sidewalks on either side of the road, this design not only facilitates crossing for individuals with mobility challenges and wheelchair users but also functions as a speed bump, compelling all types of vehicles to slow down. Other road markings in Singapore, such as "LOOK" signs

near crosswalk facilities, advance warning signs for drivers, and yield signs, provide valuable references for enhancing pedestrian safety and deserve attention in this study.

Some of the practices in this case, such as zig-zag line markings before crosswalks and raised crosswalks, offer significant inspiration for creating an age-friendly street environment. These measures, by restricting vehicle speeds, provide greater convenience for elderly residents and enhance crossing safety, which holds substantial significance for the frequent street-crossing behavior of the elderly in urban settings.

Figure 3-10 Specialized Pedestrian Crossing Facilities
Source: Reference

(2) Heart of Budapest Program: Reclaiming Space for Pedestrians

The historical center of Budapest is a renowned historical district in Europe. This program aims to reverse the trend of traffic-oriented development by reallocating more space to pedestrians and cyclists, enhancing public spaces, and re-establishing the prominence of the old town. The following measures related to the pedestrian experience within this project are particularly noteworthy and offer valuable lessons.

First, enhance the pedestrian experience. Clearly define road zones, separate sidewalks and lanes with curb posts, reduce the radius of the curb, provide more safe space for pedestrians, and in some street-side open-air restaurants or rest areas, do not set curbs but only use bollards for separation; widen sidewalks, improve paving, add street furniture such as seats and pedestrian guidance systems.

Second, improve public activity spaces. Install recreational and entertainment facilities in urban public spaces, including interactive fountains, touch maps, playgrounds, rest seats, etc., to enhance the interest of public spaces.

Third, restrict car traffic. Limit car traffic in the historical center, encourage only buses to use the roads in the area, and allow only local residents' vehicles in some areas. At the same time, strictly regulate parking in the area; modify lanes, reduce the number of lanes, narrow the distance for pedestrians to cross the street, and add two rows of trees and green spaces between the lanes. This green belt can also serve as a safety island at the crossing.

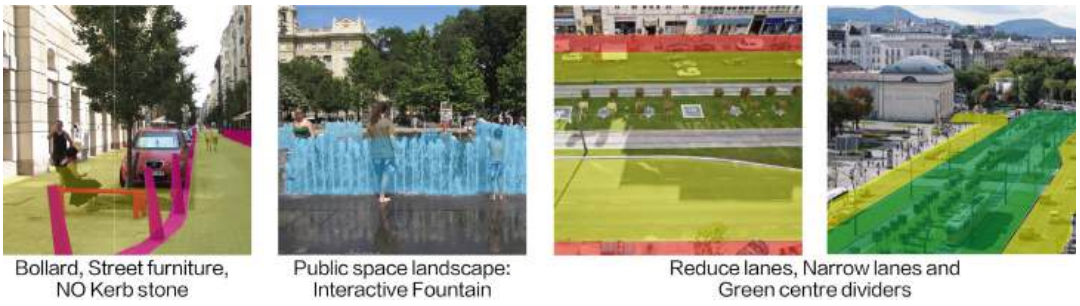


Figure 3-11 Budapest's More Walkable Renovation
Source: Reference

3.3 Summary

This chapter starts from existing successful cases and mature practices to explore what features an age-friendly walking space might have and what renovation methods can make urban spaces more conducive to seniors' walking. Firstly, this study selected two communities in Guangzhou that were awarded the title of The National Exemplary Age-friendly Community to investigate what measures can be taken at the community level to enable seniors to enjoy the community public environment more safely and comfortably. From these two cases, this study found that a good internal community environment and rich urban public facilities play a significant role in promoting seniors' going out. Secondly, this chapter also selected two on-site cases in Singapore and Budapest to study the supportive role of urban street environment improvement for seniors' travel. The various renovation strategies for urban roads in Singapore's Silver Zones are worth referring to, while the renovation project of Budapest's historical center provides an important reference for improving the street environment in historical urban areas.

The practices and strategies worth referring to in the cases mentioned in this chapter are listed in the following Table 3-1.

Table 3-1 Design Strategies from Case Studies
Source: Author

Dimension	Focus Area	Specific Strategies
City Level	Sidewalks	Install bollards to separate sidewalks from vehicle lanes; reduce curb radii; remove curbs in specific zones. (Budapest)
		Widen sidewalks, improve paving materials, add street furniture and tactile guidance systems. (Budapest)
		Install high-visibility signage at pedestrian nodes; upgrade nighttime lighting. (Singapore)
	Public Spaces	Equip public spaces with recreational amenities to enhance engagement. (Budapest)
	Crossing Facilities	Use zigzag line markings along crosswalks; install flashing pedestrian signals. (Singapore)
		Elevate crosswalks to sidewalk level. (Singapore)
		Install central refuge islands, eye-land, or pedestrian safety islands for two-stage

Dimension	Focus Area	Specific Strategies
		crossings. (Singapore, Budapest)
	Roadways	Restrict private vehicles in historic districts (bus-only access permitted). (Budapest)
		Reduce lane counts; add green buffers between lanes. (Budapest)
		Implement roundabouts at intersections. (Singapore)
		Install low-height central dividers; design chicanes to reduce speeds. (Singapore)
	Public Space Network	Connect sidewalks to parks and urban green spaces for elderly-friendly walking routes. (Singapore)
Community Level	Land Use	Transition single-use residential zones to mixed-use zoning; retrofit community service facilities. (Singapore, Dufu Community)
	Road Network	Eliminate cul-de-sacs; ensure interconnected road networks with enhanced accessibility. (Dufu Community)
		Maintain logical road hierarchy. (Fanghe Garden Community)
		Provide multiple access points to adjacent major roads. (Dufu/Fanghe Garden Community)
	Public Spaces	Locate activity hubs at community nodes to meet elderly exercise needs. (Dufu/Fanghe Garden Community)
		Prioritize shade provision via tree canopies or sun shelters in key areas. (Dufu/Fanghe Garden Community)
		Increase green space coverage. (Fanghe Garden Community)
		Designate dedicated parking zones for motorized/non-motorized vehicles. (Dufu/Fanghe Garden Community)
	Community Roads	Repave historic alleys with even, non-slip surfaces. (Dufu Community)
		Create dedicated fitness trails. (Dufu Community)
		Ensure wide, clean internal roads with ample seating along walkways. (Fanghe Garden Community)
	Other	Retrofit aging residential buildings with external elevators. (Dufu Community)
Urban Facilities	15-Minute Living Circle	Elderly care facilities (day care centers, meal hubs, activity stations, nursing homes)
		Healthcare facilities (hospitals, community clinics)
		Public activity spaces (plazas, fitness trails, sports courts, indoor gyms)
		Commercial amenities (markets, shopping complexes)
		Schools and preschool

Chapter 4 Checklist for Walkability in Aging Urban Area

4.1 Key Dimensions Influencing Elderly Pedestrian Experience

The relevant research presented in this thesis is based on the context of an aging society, so the walking needs of the elderly should be given particular attention. Therefore, the content related to walking in the theory of age-friendly cities is worth focusing on. In Chapter 2 of the previous text, a comprehensive analysis of the frameworks of age-friendly cities and communities in various countries has been conducted. This article finds that in terms of the physical environment closely related to walking, these frameworks mostly divide dimensions according to the urban spatial hierarchy. For instance, the core framework released by the WHO divides the indicators related to the physical environment into three levels: outdoor spaces and buildings, transportation, and housing.

This study focuses on the walking environment of the Duobao Road area, aiming to promote the improvement of walkability for the elderly in this area. Walking behaviors occur in different levels of space within this region and are accompanied by various activities. Therefore, when studying walkability, referring to the age-friendly framework, this research also mainly divides dimensions according to the urban spatial hierarchy, studying the corresponding walkability elements at two levels: the urban street environment and the community walking environment.

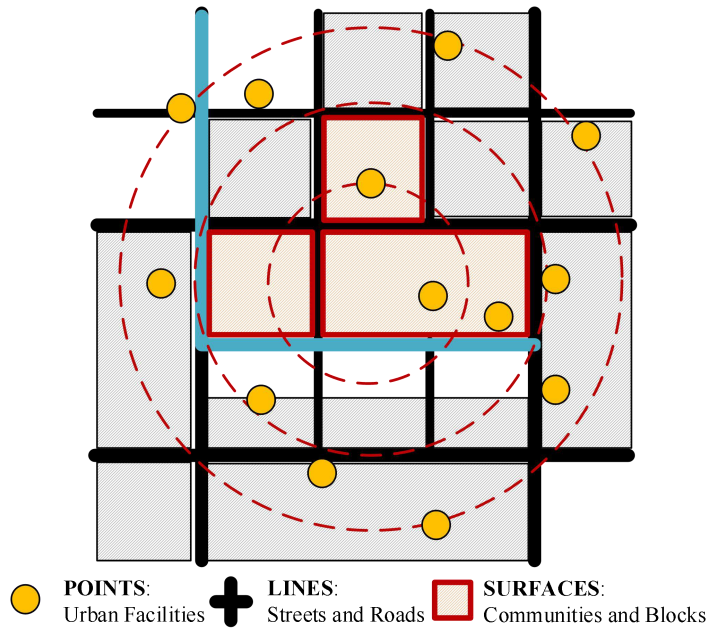


Figure 4-1 Major Dimensions of the Checklist
Source: Author

Meanwhile, medical and commercial facilities within the urban area, as destinations for walking, provide crucial support for the elderly's daily life. Therefore, the richness and

accessibility of these facilities significantly influence the current status of regional walkability and are important factors. Thus, urban facilities should also be listed as a separate research dimension as a functional support factor.

Based on this, the main structure of the walking space system in the Duobao Road area has been initially determined, which is divided into three levels: urban streets, community spaces, and urban facilities.

Based on this structure and informed by insights from numerous urban design experts and professionals in the elderly care sector, the check system is developed through a three-dimensional framework of point, line, and surface. The checklist for walkability in aging urban area is accordingly categorized into three dimensions as Table 4-1.

Table 4-1 Key Dimensions of the Checklist for Walkability
Source: Author

Primary Dimensions	Check Object	
	Urban-level	Community/Block-level
Safe and Pleasant Urban Streets	√	
comfortable and stable community Environments		√
Abundant and accessible urban facilities	√	√

Among the three dimensions—linear "street environment", planar "community environment", and point-like "urban functional facilities" dispersed throughout urban space—the distinction between "street environment" and "community environment" is based on the differing pedestrian environments for the elderly. The "urban facilities" are categorized separately due to their dual roles: not only do they provide physical environmental support for elderly walking, but they also significantly promote elderly mobility. Furthermore, urban facilities must be considered at multiple levels, including urban streets, communities, and blocks.

After defining the three major dimensions, relevant guidelines, government documents, and the foundational research content from Chapter 2 were consulted to further decompose these subsystems and identify their specific attributes, as illustrated in the Table 4-2 below. The detailed content will be elaborated upon in the subsequent research.

Table 4-2 Framework of Checklist for Walkability in Aging Urban Area
Source: Author

Dimension/Vision	Primary Factors	Associated Attributes
Safe & Pleasant Urban Streets	District Pedestrian Network	Pedestrian road density (km/km²); Space Syntax Integration Index, Choice Index
	Sidewalk Environment	Maintenance status (width, encroachment rate, paving integrity, tactile guidance systems, accessible ramp gradient…
		Elderly-supportive interventions (Street furniture density, green space,

Dimension/Vision	Primary Factors	Associated Attributes
		cultural identity elements)
		Effective Pedestrian-vehicle segregation
	Crossing Facilities	Signal, Refuge Island, zebra crossing, …
		Mid-block crossing intervals
	Street Interface	Enclosure (H/W Ratio, continuity)
		Ground-floor transparency, Cityscape
Comfortable & Stable Community environment	Community Structure	FAR, Green space ratio
		Community inner road network, Internal intersection density
		Number and position of community's access points to urban roads
	Community Road Quality	Community Road maintenance status (width, occupation problem, paving quality, accessible ramp, nighttime lighting…)
		Pedestrian-vehicle separation, emergency vehicle access
	Public Environment	Comprehensive outdoor activity space and green space
		Measures that can improve the quality of activities for the elderly (support facilities such as residential elevators, rest benchs, shelter devices, sign systems, cultural elements…)
		Rich and sufficient community elderly service facilities
Abundant and accessible urban facilities	15-Minute Living Circle	A variety of facilities within the 5-10-15-minute range to meet daily needs
		The walk accessibility of urban public activity areas, and transit stops
	Public Activity Hubs	A variety of facilities and public activity spaces
	Street-level Accessibility	The walk accessibility of important living facilities

4.2 Dimension 1: Safe and Pleasant Urban Streets

"Safe and Pleasant Urban Streets" constitutes the first dimension of the checklist developed in this study, designed to analyze the physical environment of urban roads, particularly sidewalk sections, in terms of their support for elderly walking behavior. The four primary factors of this dimension are structured in a logical sequence, progressing from macro to micro levels. Initially, the attributes of the walking network within the area under examination are analyzed from a broader perspective, followed by an in-depth focus on the micro-environment of streets, including sidewalk conditions, crosswalks, intersections, and street facades along roadways. Based on this framework, and drawing upon prior relevant research, the following specific checklists have been formulated.

Table 4-3 The factors influencing the walkability of urban streets
Source: Author

Category	Specific Factors	Standards and Criteria	Checkbox
Pedestrian Network	Pedestrian Road Density	Class I pedestrian zones: 14-20 km/km²; intersection spacing: 100-160 m. Density may increase within 300 m of transit stations.	☐

Category	Specific Factors	Standards and Criteria	Checkbox
	Network Continuity	Prioritize connectivity between key urban facilities; establish jogging corridors linking public landscape nodes.	-
	Integration Index	*(Measures spatial capacity to attract pedestrian flows)*	-
	Choice Index	*(Reflects spatial permeability for through-movement)*	-
Sidewalk Environment	Sidewalk Width	The wider, the better. Narrow historic roads may retain reduced widths but ⩾1.8 m from curb.	☐
	Encroachment Control	No vendor occupation; limited bike/e-bike parking; no debris; with vegetation/public fixtures must maintain enough clear path.	☐
	Paving Quality	Slip-resistant surfaces; No cracks, warping, gaps.	☐
	Accessibility	Continuous tactile paving; zero-step transitions via ramps.	☐
	Street Furniture	At least one of: 1) Street benches (excluding temporary shop displays); 2) Seatable planter edges or tree pits; 3) Bus station shelter seating.	☐
	Street Greening & Landscaping	Continuous street trees on ⩾1 side; low grass plants count only in *Qilou* arcaded streets with enough shade.	☐
	Dedicated Bike Lanes	Physically segregated bike lanes (via markings/texture) with reasonable separation from pedestrians.	☐
	Vehicle-Bicycle Separation	Separation by: 1) Barriers; 2) Continuous planters (height ⩾0.3 m).	-
Crossing Facilities	Mid-block Crossings	Install pedestrian crossings every 150-200 m along urban roads.	☐
	Crosswalk Safety Facilities	Mandatory in crosswalk: 1) Signalized control; 2) Zebra markings; 3) Refuge islands (for roads >15 m width).	☐
Street Interface	Height-to-Width Ratio	Optimal H/W range: 0.5-1.0.	☐
	Building Continuity	Continuous street walls ⩾75% of block length; façade alignment variation ⩽5.0 m (see Section 2.2.2 for calculation).	☐
	Ground-floor Transparency	At least one of: 1) Retail display windows; 2) Public access openings to blocks inside; 3) Outdoor seating/street gardens.	☐
	Urban Identity	Incorporate landmark architecture or Cantonese cultural elements in streetscape design.	-

4.2.1 Pedestrian Network and Sidewalk Environment

The pedestrian network comprises diverse walking paths, including sidewalks on urban

roads, slow walking lanes, alleyways, public passages within blocks, walking paths in public green spaces, overpasses, and underpasses. A high-density road network with smaller blocks significantly enhances pedestrian accessibility and improves the overall walking experience. Furthermore, the continuity of the pedestrian network must be emphasized. By effectively connecting parks, squares, public activity centers at various levels, public transportation stations, and areas with concentrated public service facilities, pedestrian behavior can be encouraged from an alternative perspective.

Check items related to the sidewalk environment are primarily based on the relevant indicators of the street environment index established in Section 2.3.1. On one hand, these items provide guidance for evaluating the current quality and maintenance status of sidewalks, ensuring they are sufficiently wide, unobstructed, and accessible. On the other hand, they establish corresponding regulations for supporting facilities that sidewalks should provide, such as street greening and street furniture. Additionally, separating pedestrians from vehicles is crucial for enhancing pedestrian safety. This involves effectively segregating sidewalks from vehicle lanes and addressing the “chaos of E-bikes” by establishing dedicated non-motorized vehicle lanes.

4.2.2 Intersections and Crossing Facilities

Crossing facilities, including pedestrian zebra crossings, traffic lights, and refuge islands, are designed to facilitate safe pedestrian crossing of vehicle lanes. These facilities should be strategically placed at road intersections to assist pedestrian movement. Moreover, crossing facilities should also be installed along longer continuous roads to ensure pedestrian safety. The previously mentioned high-density pedestrian network objectively breaks up roads, preventing excessively long continuous stretches. However, in old urban areas where the road network is relatively fixed, longer continuous roads may still exist. Therefore, it is essential to consider installing crossing facilities mid-road.

The check items related to intersections and crossing facilities are mainly based on the relevant factors affecting the quality of the street environment as sorted out in Section 2.3.1. It mainly stipulates the recommended distance between crossing facilities and the types of planar crossing facilities. It should be noted that there are various types of crossing facilities, including 3D crossing facilities and underground crosswalk facilities, etc. This study is based on the Duobao Road area in the old urban area. To ensure the overall style, only planar crossing facilities are discussed.

4.2.3 Street Interface

"Street Interface" define certain attributes of the building's facades lining urban streets. Street space is delineated by the buildings on either side, making the street building facade the "wall" of the street. Thus, the street building interface should exhibit a degree of enclosure, and continuous, orderly buildings on both sides contribute to this effect. A reasonable height-to-width ratio of street space also enhances the comfort of the street environment. Additionally, the visual experience during walking should be considered. Transparent first floors of buildings can provide visual penetration, adding interest to the walking process.

Check items related to street interface are also based on the relevant indicators of the street environment index presented in Section 2.3.1. These items specify quantitative factors for the height-to-width ratio of street space and the continuity of buildings on both sides of the road. Furthermore, qualitative regulations regarding the transparency of the first floor are established based on the current conditions of the study area. Given the focus on Duobao Road area located in older urban districts, the well-preserved original integrity of the buildings on both sides can enhance the walking experience.

4.3 Dimension 2: Comfortable and Stable Community Environment

"Comfortable and stable community environment" is the second dimension of the checklist constructed in this study, used to analyze the support degree of the public environment in the residential community for outdoor activities and walking behaviors of the elderly. The residential community is an important component of the city and also an important activity area for the elderly. When evaluating the walking environment of a certain community in the selected research urban area, this dimension can be used for analysis.

The expansion of the element categories under this dimension is carried out in a logical sequence from the macro attributes of the community to the quality of community roads and then to the quality of the community's public environment. Under this structure, combined with the relevant research in the previous text, the specific checklist is as follows.

Table 4-4 The factors influencing the walkability of community space
Source: Author

Category	Specific Factors	Standards and Criteria	Checkbox
Community Structure	Comfortable FAR	-High-rise residential: ≤4.0 -Mid-rise residential: ≤5.0	□
	Green Space Ratio	-Existing communities: ≥25% -Continuous greening along primary walkways and leisure areas	-
	Community inner	Recommended: ≥700 intersections/km² (Older	-

Category	Specific Factors	Standards and Criteria	Checkbox
	Intersection Density	communities exempt)	
	Community Road Network Density	Recommended road length-to-area ratio: ⩾8 km/km² (Older communities exempt)	-
	Access Point Position's Rationality	-⩾2-3 access points connecting to urban roads -⩽300 m from access points to nearest transit stops	☐
Community Road Quality	Good-quality Road Paving	Even, non-slip surfaces; no cracks/potholes	☐
	Walkway Width	-Minimum clear width: 2.0 m -For some existing older historic communities: ⩾1.5 m	☐
	Nighttime Lighting	Uniform lighting (⩾10 lux) on primary paths; no unlit zones	☐
	Sanitation & Encroachment	No exposed garbage, debris, or illegal parking	☐
	Accessible Walkways	Zero-step transitions with ramp gradients	☐
	Pedestrian-Vehicle Separation	-Dedicated lanes for vehicles/bicycles where feasible (Historic narrow roads exempt but require traffic management)	-
	Emergency Vehicle Access	Continuous internal roads connecting residential entries and activity spaces	-
Public Environment	Integrated Green & Activity Spaces	-Equipped with dedicated squares/parks -Abundant Green area -Coherent spatial connectivity	☐
	Safe & Comfortable Activity Zones	Enough lighting in main activity area, Sloped transitions with ramps, set active/quiet area, set Amenities: relax seating, recreational facilities	☐
	Relax Seating Provision	Benches/seatable garden edges along primary routes (Maximum spacing: 50 m)	☐
	Residential Elevators	Mandatory for buildings ⩾7 floors	☐
	Community Aesthetics	Facade maintenance prioritized where feasible	-
	Elderly Service Facilities	Basic medical stations, Indoor activity centers, Elderly-care institutions	☐
	Wayfinding System	Clear signage at key intersection points	☐

4.3.1 Overall Community Structure

When evaluating the walking environment of a community, it is essential to first define its overall attributes from a macroscopic perspective. Key attributes closely associated with the walking environment include floor area ratio (FAR) and green space ratio. A lower FAR and a higher green space ratio can significantly enhance the quality of walking spaces. Similar to urban roads, the density of the community road network and intersection density may also

influence the walking experience, albeit to a lesser extent. Given that the elderly predominantly rely on walking and public transportation, the placement of community entrances, as well as their proximity to transit stops, substantially impacts the elderly's walking experience.

Therefore, when formulating inspection items related to the community's overall structure, based on prior foundational research and relevant literature reviews, FAR and Access points to community are established as key check items. Considering the challenges in strictly regulating the green space ratio for older historical urban areas' older communities, this item is treated as a reference rather than a mandatory requirement. Additionally, since items such as network density and intersection density have less prominent impacts, they are categorized as reference items and not prioritized during site surveys.

4.3.2 Community Road Quality

This section focuses on assessing the quality of internal community roads. Unlike urban roads, which typically feature clear lane divisions and wider pathways, community roads often lack distinct demarcations and are narrower. Due to differing needs and standards between these two types of roads, this section separately evaluates the quality of internal community roads. While some check items overlap with those for urban roads, this study tailors requirements according to community-specific characteristics. Furthermore, items often overlooked in older communities, such as lighting, are included to enhance safety and comfort.

The formulation of check items for community road quality draws upon prior foundational research and relevant literature reviews. In addition to shared items with urban roads—such as walking road width, pavement quality, and road occupation—at the community level, emphasis is placed on separating pedestrian and vehicular traffic to ensure safe walking conditions. Beyond walking-related items, this checklist also incorporates accessibility for emergency vehicles, aligning with the overarching goal of creating an age-friendly environment.

4.3.3 Community Public Environment

Walking behavior within a community extends beyond roads and frequently occurs in public environments such as activity areas and green parks. On one hand, the physical environment of community public spaces must fully support walking, ensuring both comfort and safety. On the other hand, the community should provide sufficient functional facilities to enable the elderly to access basic services conveniently within the community. For older

communities located in older historical urban areas, if relevant historical building resources exist, they should be preserved and respected as integral components of the public environment.

When developing check items for the community public environment, it is necessary to evaluate whether the community provides adequate public activity areas and whether the micro-environment supports elderly walking, such as the presence of rest seats and accessibility design features to enhance spatial safety and comfort. Additionally, the convenience of leaving home for the elderly should be considered, including the proper installation of residential elevators. At the functional level, the completeness and accessibility of elderly facilities within the community must also be assessed.

4.4 Dimension 3: Abundant and Accessible Urban Facilities

"Abundant and accessible urban facilities" constitutes the third dimension of the checklist developed in this study. This dimension evaluates the extent to which urban functions promote elderly walking. Urban facilities play a critical role by providing essential services such as shopping, entertainment, and dining. Greater accessibility of urban facilities encourages the elderly to venture out and actively participate in urban life. This dimension encompasses inspection items at the urban area, street, and community levels. After defining the research area, an analysis of urban facility distribution within that area should be conducted initially. When examining a specific urban street, the walk score can serve as a tool to assess its ability to promote walking. When evaluating a community, while Dimension 2 includes basic regulations, more detailed assessments are made in Dimension 3 from the perspective of the living circle.

Based on this framework, combined with earlier referenced studies, the following specific sub-checklist is formulated.

Table 4-5 The factors influencing urban facilities to promote walking
Source: Author

Category	Specific Factors	Standards and Criteria	Checkbox
Area-level Facilities	Comprehensive Facility Types	Ensure elderly-critical facilities (hospitals, markets, senior centers, parks) within designated urban zones.	-
Urban streets	Walking accessibility to important living facilities	For a certain section of urban roads, Walk Score≥80	☐
Communities' 15-Minute Living	5-minute living circle (200-300 m)	-Senior activity halls≥200 m² -Indoor/outdoor fitness areas≥300 m²	☐

Category	Specific Factors	Standards and Criteria	Checkbox
Circle	10-minute living circle (500 m)	-Cultural stations≥200 m² -Community clinics 150-200 m² -Day-care centers≥200 m² -Fresh Food Markets≥1500 m² -Convenience Service hubs≥200 m²	☐
	15-minute living circle (800-1000 m)	-Community activity centers≥4500 m² -Community Healthcare centers≥3000 m²	☐
	Other elderly-related facilities	Consider the construction of facilities such as elderly schools to improve conditions; the paths to preschools and primary schools should also be taken into account.	-
	Public Space Distribution	Small public spaces: service radius≤300 m (≤150 m in Public activities center and High-density communities)	☐

4.4.1 Key Living Facilities from a Urban Perspective

When studying the walkability of a selected urban area, the first step is to conduct a census of the functional facilities in the area. This can be done through on-site surveys or online information collection to identify and screen out urban facilities such as markets, hospitals, and parks that are highly relevant to the elderly's daily life and to understand their distribution. Generally, a richer and denser urban facility network promotes walking. Through this process, a more comprehensive understanding of the urban functions of the study area can be achieved, facilitating more detailed subsequent research.

When conducting a walkability study of a specific urban street, in addition to inspecting the street environment as mentioned in 2.3.1, the accessibility of the street space to surrounding functional facilities should also be inspected. To check this attribute, the walk score method discussed in Chapter 2 can be used. A higher walk score indicates that a greater variety of facilities can be reached on foot through this street, and the walkability is better. In this toolkit, the items related to urban living facilities from a urban perspective mainly aim to conduct a qualitative study of the study area, providing preliminary information for subsequent community-centered life circle research.

4.4.2 The 15-Minute Life Circle of a Community

The 15-minute life circle of a community can be divided into three layers: 5, 10, and 15 minutes, corresponding to different groups of people and walking distances. From the perspective of the elderly, important facilities should be arranged within the 5-minute life circle, which will greatly facilitate their daily life[74]. For this, this study mainly refers to the

relatively mature *15-Minute Community Life Circle Design Guidelines* issued by Shanghai [75].

The 5-minute life circle corresponds to a walking distance of approximately 200-300 meters. This level is closest to community life, and the facilities distributed within this range have the strongest walking accessibility. Facilities within the 5-minute life circle are generally located inside the community or on the periphery of the community. Within this range, there should be outdoor fitness areas of sufficient size, which can often be combined with community public activity areas or corner parks. In addition, there should be elderly activity rooms to provide a place for the elderly's daily social activities. These facilities can often be combined with community service rooms[75].

The 10-minute life circle corresponds to a walking distance of approximately 500 meters, expanding to the surrounding area of the community. The walking accessibility of facilities within this range is reduced. In this range, the balance between accessibility and facility service efficiency is relatively good, so some facilities that are closely related to daily life and have a larger service range can be arranged within this range, such as service health points, day-care centers, and indoor fresh food markets. These facilities are often located on the ground floor of buildings or in single buildings[75].

The 15-minute life circle corresponds to a walking distance of approximately 800-1000 meters, expanding to the urban-street level. The walking accessibility of facilities within this range for the elderly is already very low. Therefore, facilities within this range have a larger service range. Hence, some comprehensive and large-scale facilities suitable for all age groups can be arranged within this range[75].

To better reflect the age-friendly aspect, on the basis of the above description, facilities with a higher correlation to the elderly can be more frequently arranged within the 5-minute life circle, or even within the community.

Picking up and dropping off grandchildren at school is also an important part of the daily life of some elderly people. Therefore, in addition to the facilities mentioned above, the location of preschools and primary schools within the 15-minute life circle also needs to be considered.

4.4.3 Urban Public Activity Spaces

Urban public activity spaces represent a specialized category of urban facilities. Although they do not provide direct services, they publicly offer physical spaces for citizens to engage in various outdoor activities. Urban public spaces come in diverse forms, including centralized green spaces, squares, linear greenways, waterfront promenades, and pedestrian

streets. They also vary in function, encompassing cultural, sports, and commercial attributes.

While general functional facilities typically only require sufficient space and personnel to meet usage requirements, public activity spaces demand larger areas and are preferably continuous and systematically organized. Thus, relying solely on scattered activity areas within the community is insufficient to meet the needs of community life in terms of both area and quality. Thus, on one hand, it is essential to ensure an adequate number of small public spaces to enable the elderly to exercise nearby, as reflected in the corresponding indicators in this checklist; on the other hand, it is necessary to evaluate the accessibility from the community to nearby medium and large public spaces, as well as the quality of the connecting routes[76].

4.5 Design Objectives and Related Strategies

This chapter has thus far constructed a checklist for walkability in aging urban areas. During actual research, one can conduct investigations by comparing the environmental elements and corresponding requirements in this checklist with the specific environment, identifying problems, and thereby having a clear direction for subsequent improvement designs. Moreover, the specific regulations in the checklist constructed in this paper not only reflect the possible issues in the walking space of severely aging urban areas like the Duobao Road area but also provide corresponding design strategy guidance.

Under the urban street dimension of this checklist, the main factors affecting walkability are related to the pedestrian network and street environment. This also indicates that improving the walkability of urban streets should focus on building a more connected and comfortable pedestrian network and creating a more vibrant street environment. Besides enhancing the walking environment of streets, it is also necessary to improve their functional support. Some literature suggests that by strengthening the development around subway stations and creating functional centers, the attractiveness of surrounding streets can be enhanced. Through these measures, urban streets can become safer and more pleasant.

Under the community environment dimension of this checklist, the main factors affecting walkability are related to community activity spaces and internal roads. This tells us that to enhance the walkability of the community environment, we should focus on improving the quality of community activity spaces and internal roads, thereby creating a more comfortable and stable community walking environment.

Under the urban facilities dimension of this list, the main factors affecting walkability are related to service facilities and public spaces within the elderly's living circle. This

indicates that to further improve the walkability of the area, we should also focus on enhancing the quality and quantity of various living facilities and activity spaces within the elderly's living circle.

Combining the checklist proposed in this chapter, this thesis has put forward a series of design objectives and visions for improving walkability from different dimensions. Based on the relevant regulations in the list of elements and related design documents, the following strategy package in Table 4-6 is proposed, thereby providing corresponding guidelines to facilitate subsequent research-based designs[77].

Table 4-6 Packages of possible strategies for some key issues
Source: Author

Dimension	Design Goals	Strategy Packages
Urban Street	1. Establishing Connected and Comfortable Pedestrian Networks	1. **Optimize micro-circulation of road networks**: In commercial/public facility blocks with road spacing >250 m, retrofit/activate public passages to improve connectivity. 2. **Build a complete pedestrian system**: Integrate diverse pedestrian pathways into a cohesive system linking parks, plazas, transit stations, and public facilities.
	2. Developing Transit-Oriented Functional center	1. **Enhance the Coverage of Public Transport Stations**: In the central urban area, all types of public transport stops should ensure full coverage within a 300-meter service radius. Priority should be given to key facilities such as hospitals and schools, as well as roads with high connectivity for strategic placement. 2. **Strengthen Development Around Metro Stations**: Develop comprehensive infrastructure around metro stations, including parking lots, bus stops, and bicycle parking areas, to facilitate seamless transfers. The core area surrounding metro stations should adopt mixed land use, integrating commercial, residential, public green spaces, and public service facilities to enhance the vitality of pedestrian activity in the vicinity.
	3. Creating Vibrant and Inclusive Street Environments	1. **Improve the Quality of Sidewalks**: Ensure that sidewalks on urban roads have adequate width, are clean, and remain free of obstructions. Encourage integrated design of sidewalks and setback spaces adjacent to buildings to provide rest areas or street landscapes. Construct accessible walkways to accommodate all users.
Community Environment	1. Developing Accessible and Safe Community Roads	1. **Mitigate the Impact of Vehicles**: Optimize Road section designs by separating pedestrian and vehicle lanes and utilizing differentiated pavement materials. Introduce moderate road curvature, reduce curb radii at intersections, and lower vehicle speeds to enhance pedestrian safety. 2. **Enhance the Walking Experience on Roads**: Adopt a high-density road network with intersection spacing of 100-200 meters

Dimension	Design Goals	Strategy Packages
		and add passageways where appropriate. Provide reasonable road widths ranging from 9 to 24 meters. Design accessible walkways and ensure sufficient nighttime lighting to improve the walking experience.
	2. Building Multifunctional and Accessible Community Spaces	1. **Enhance the Connectivity of Community Walkways**: Ensure that important internal facilities within communities are connected by walkways, linking community activity spaces to create a vibrant walking environment. Smoothly integrate the community walking system into the urban walking network for seamless connectivity.
Urban Facilities	1. Delivering Age-friendly and Convenient Community Services	1. **Create a 15-Minute Living Circle**: Provide diverse urban functional services according to different life circles (5, 10, and 15 minutes). Facilities frequently used by the elderly should be located close to communities, preferably within the 5-minute living circle, to maximize accessibility. 2. **Enrich Age-Friendly Services in Communities**: Within communities and the 5-minute living circle, incorporate various services frequently used by the elderly. Provide rich activity spaces and integrate facilities such as elderly-care centers and indoor fresh food markets into the community to enhance convenience. 3. **Develop Shared and Multi-Functional Service Facilities**: Encourage the integrated development of public service facilities and promote shared functional spaces that can serve multiple user groups, enhancing efficiency and inclusivity.
	2. Creating Comfortable and Accessible Public Space System	1. **Build a Multi-Level Public Space Network**: Integrate various urban spaces, including green spaces, squares, *Qilou* arcade streets, and waterfront walkways, to establish a comprehensive public space network. Connect public spaces of different levels and scales, providing diverse functions at various spatial nodes as needed. 2. **Smoothly Connect Communities with Public Space Systems**: Highlight the accessibility between communities and urban public spaces, ensuring that internal community areas are seamlessly integrated into the urban public space system. 3. **Unlock the Potential of Public Spaces**: Open up ancillary spaces in commercial, residential, and cultural land uses for public access. Improve fragmented spaces through micro-renovations to enhance their usability and functionality.

The above design strategies mainly unfold from three dimensions: urban streets, community walking environment, and urban facilities, which are consistent with the structure of the checklist. In subsequent design, corresponding design strategies can be found based on

the problems discovered in the research site for reference.

4.6 Summary

Based on the fundamental theory research in Chapter 2 and the case study analysis in Chapter 3, this chapter constructs a checklist for the walkability in aging urban areas. The checklist is divided into three main dimensions, which can be used to analyze specific urban environments from different research perspectives. The three dimensions are respectively developed from the perspectives of urban streets, community environments, and urban facilities. The urban street dimension mainly focuses on the sidewalk environment of roads at the urban level, organizing check items from the macroscopic to the microscopic level, from the pedestrian network to the sidewalks and their adjacent interfaces. The community walking dimension mainly targets communities with residential functions distributed throughout the city. Similar to the urban street dimension, this part starts with the overall structure of the community and then describes the community roads and public spaces. The urban facilities dimension mainly examines the sufficiency and accessibility of important urban functional facilities. It provides a detailed discussion on the 15-minute living circle of communities and conducts a separate study on urban public spaces.

Based on the formed checklist, this chapter also proposes corresponding design strategies and target visions, and presents the corresponding design strategy package, thereby laying the foundation for subsequent site analysis and specific design.

Chapter 5 The Elderly Pedestrian Preferences and Current Condition of Walkability in Duobao Road Area

5.1 Site Background and Current Condition of Aging

5.1.1 Location

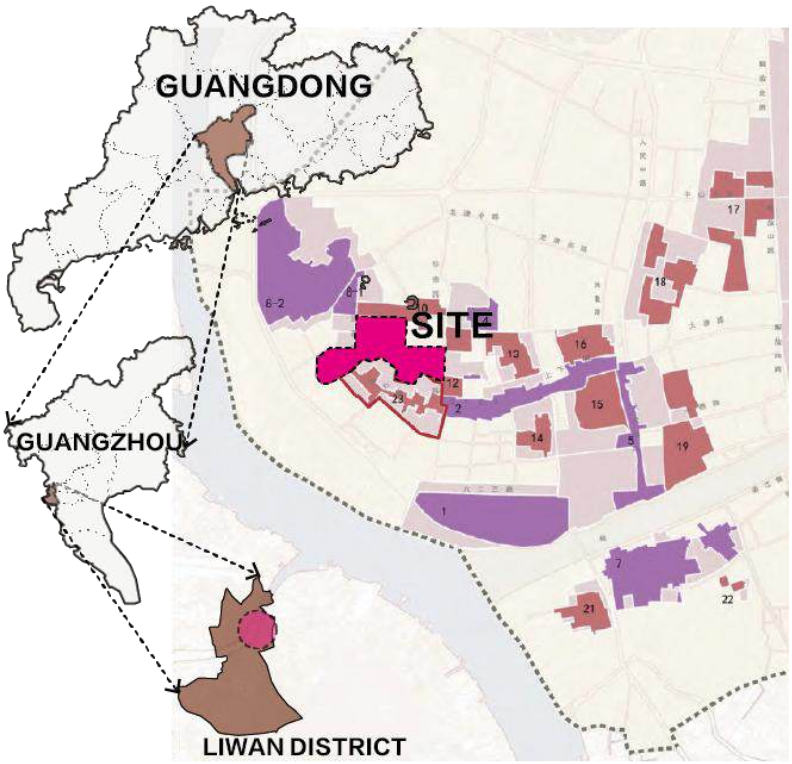


Figure 5-1 Location of Research Site
Source: Author

Guangzhou is a national historical and cultural city with a history of over 2,200 years of urban construction, and it has a total of 26 historical and cultural blocks. The research site, Duobao Road area, is located in the core area of the Xiguan region in Liwan District, at the junction of Duobao Subdistrict and Changhua Subdistrict. The site is roughly bounded by Lizhiwan Stream to the west and south, Baoyuan Road to the north, and Baohua Road to the east, covering an area of approximately 19 hectares. This area is close to the well-known tourist destination “Yongqingfang”, and it is home to multiple communities with a large number of residents and tourists. The Xiguan region is home to several historical and cultural blocks, and the research site encompasses parts of the Duobao Road, Changhua Street, and Baoyuan Road historical and cultural districts.

At the same time, the research site and its surrounding areas have strong appeal. On the one hand, it stems from the rich memory spaces brought by the dense historical and cultural districts, making it one of the regions with the most distinctive Guangzhou characteristics. The related Lingnan-style pedestrian elements include *Qilou* arcade streets and slabstone

roads. On the other hand, it is due to the clear urban spatial guidance. The *Qilou* arcade road of Longjinxi Road - Enning Road - Dishifu Road connects the Liwan Lake Park, Yongqingfang, and the Shangxiajiu Pedestrian Street, which are key urban areas, gathering both tourists and residents. This route precisely passes through the site[78].

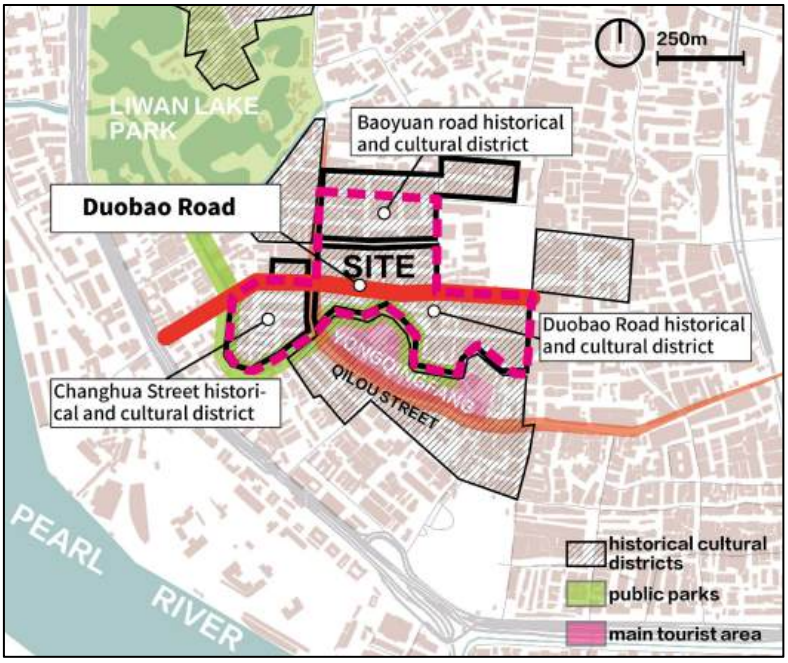


Figure 5-2 Surrounding Key Urban Elements
Source: Author

5.1.2 The Current Condition of Population Aging in the Site

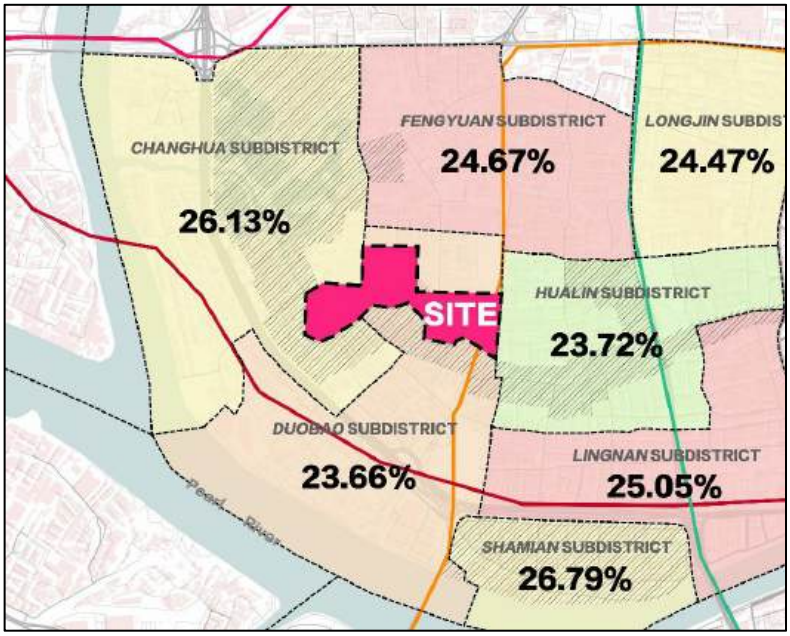


Figure 5-3 The Aging Rate of the Research Site
Source: Author

The Duobao Road area has a relatively high proportion of elderly residents and a high demand for walking among its residents. The aging rate in Liwan District, where the Duobao

Road area is located, ranks among the top in Guangzhou, with the proportion of residents aged 60 and above reaching 29.31%.

The Duobao Road area studied in this thesis is located at the junction of Duobao Subdistrict and Changhua Subdistrict in Liwan District. Based on the relevant data released by the Guangzhou Elderly Affairs Office, this article has calculated the elderly population ratio of these two subdistricts to reflect the degree of aging in the research area. The relevant data shows that the proportion of residents aged 60 and above in Changhua Subdistrict and Duobao Subdistrict is 26.13% and 23.66% respectively. The elderly population ratio of the Duobao Road area between them should also be within this range, which indicates that the Duobao Road area studied in this article has entered the aging stage.

Meanwhile, this study mainly focuses on walkability. The health and self-care ability of the elderly affect their willingness to go out for a walk. Based on the data from the 7th national census and the Guangzhou Elderly Affairs Office, this paper has statistically analyzed the health status of the elderly population in Liwan District. The relevant data show that among the elderly over 60 years old in Liwan District, 63% of them maintain a healthy physical condition. Among the remaining 37% of the elderly with suboptimal health, 81% are basically healthy, and 13% are not healthy but still have self-care ability. From the health data of the elderly population in Liwan District, it can be seen that the proportion of the elderly who are healthy and have self-care ability is relatively high, which means that the elderly in this district may have a relatively strong demand for going out for a walk.

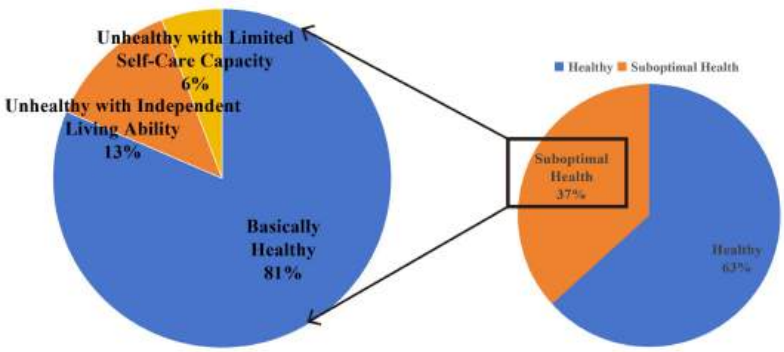


Figure 5-4 The health conditions of the elderly in Liwan
Source: Author

Overall, the research site is facing a relatively pronounced aging issue. Simultaneously, the majority of these elderly residents are in relatively good health and possess substantial potential for outdoor activities. Consequently, under this context, it is both meaningful and essential to investigate the walkability of the Duobao Road area for the elderly population.

5.2 The Elderly Pedestrian Preferences in Duobao Road Area

This thesis uses on-site questionnaire surveys to study the pedestrian environment preferences of the elderly in the Duobao Road area, clarifying the spatial environmental factors that influence the walking activities of the elderly and their spatial needs for walking. This paper also uses interview methods to interview Ms. Liang, who has been engaged in elderly care services at the Duobao Street Comprehensive Elderly Care Service Center for many years, further enhancing the understanding of the walking habits of local elderly residents. At the same time, during the on-site investigation of the Duobao Road area, several elderly pedestrians were randomly selected for tracking, and the high-frequency walking routes of the elderly in the Duobao Road area were sorted out.

This study conducted three rounds of questionnaire distribution to elderly people walking outside in the research area and its surrounding areas in September 2024 and January 2025 (Appendix 1). Based on the United Nations' classification standards for age groups, this study mainly focused on the elderly aged 60 and above, distributing a total of 98 questionnaires. After age screening, 63 valid questionnaires were collected, and all respondents were over 60 years old.

From the perspective of age structure, approximately 36.5% of the respondents were aged between 60 and 65, and 25.4% were between 65 and 70. This indicates that the majority of the elderly who filled out the questionnaires were between 60 and 70 years old, which are the low and middle-aged elderly. Elderly people in this age group are generally in good health and have a higher frequency of outdoor walking. Respondents aged 71 to 75 accounted for about 19%, and those over 76 accounted for about 19%. This shows that as age increases, the number of people who go out for walks decreases. The distribution of age structure is consistent with the pre-assumption that the research subjects mainly focus on low and middle-aged elderly people.

5.2.1 Basic Condition of Questionnaire Survey

This study conducted three rounds of questionnaire distribution (Appendix 1) to elderly people walking outside in the research area and its surrounding areas in September 2024 and January 2025. Based on the UNs' classification standards for age groups, this study mainly focused on the elderly aged 60 and above, distributing a total of 98 questionnaires. After age screening, 63 valid questionnaires were collected, and all respondents were over 60 years old.

From the perspective of age structure, approximately 36.5% of the respondents were aged between 60 and 65, and 25.4% were between 65 and 70. This indicates that the majority

of the elderly who filled out the questionnaires were between 60 and 70 years old, which are the low and middle-aged elderly. Elderly people in this age group are generally in good health and have a higher frequency of outdoor walking. Respondents aged 71 to 75 accounted for about 19%, and those over 76 accounted for about 19%. This shows that as age increases, the number of people who go out for walks decreases. The distribution of age structure is consistent with the pre-assumption that the research subjects mainly focus on low and middle-aged elderly people.

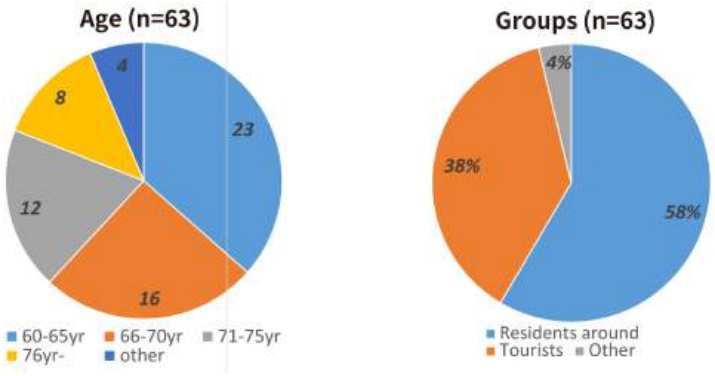


Figure 5-5 The age and identity of the respondents
Source: Author

From the perspective of the respondents' identities, 58% of them indicated that they were local residents and were quite familiar with the area. 38% said they were tourists visiting from other places, and 4% stated that although they were not local residents, they frequently took the bus to the area for exercise, grocery shopping or business, and were also familiar with it. The diversity of the respondents' identities reflects the characteristics of the Duobao Road area, which is densely populated with residential communities and has tourism resources. All these respondents have experience walking in the research site, which can reflect the problems existing in the area's walkability.

5.2.2 Behavioral Preferences of Elderly Pedestrians

Through the analysis of the questionnaires, the characteristics of the elderly pedestrians' walking behavior in the Duobao Road area were analyzed and summarized, covering aspects such as walking frequency, duration, and destination analysis.

Regarding the walking frequency of the elderly, among the surveyed elderly group, only 4.76% almost never went out. The majority of the elderly had relatively regular habits of going out. Among those with the habit of going out, approximately 36.67% went out 3 to 5 times a week, and about 63.33% went out every day. The vast majority of the elderly who went out daily did so 1 to 2 times a day. Overall, the elderly in the Duobao Road area maintained frequent daily walking activities.

Regarding the walking duration of the elderly, this study investigated the single walking duration of the elderly. Among the respondents, 20.63%, or 13 people, had a single walking duration of less than 10 minutes; 39.68%, or 25 people, had a single walking duration of 10 to 20 minutes; 26.98%, or 17 people, had a single walking duration of 20 to 30 minutes; and a small number of elderly people had a single walking duration of more than 30 minutes. These people indicated that they regarded walking as a form of exercise and thus preferred longer walking durations. Overall, the majority of the surveyed elderly had a single walking duration of less than 15 minutes. Considering both the walking duration and the walking radius, it can be inferred that the walking range of the elderly is basically within a 15-minute living circle.

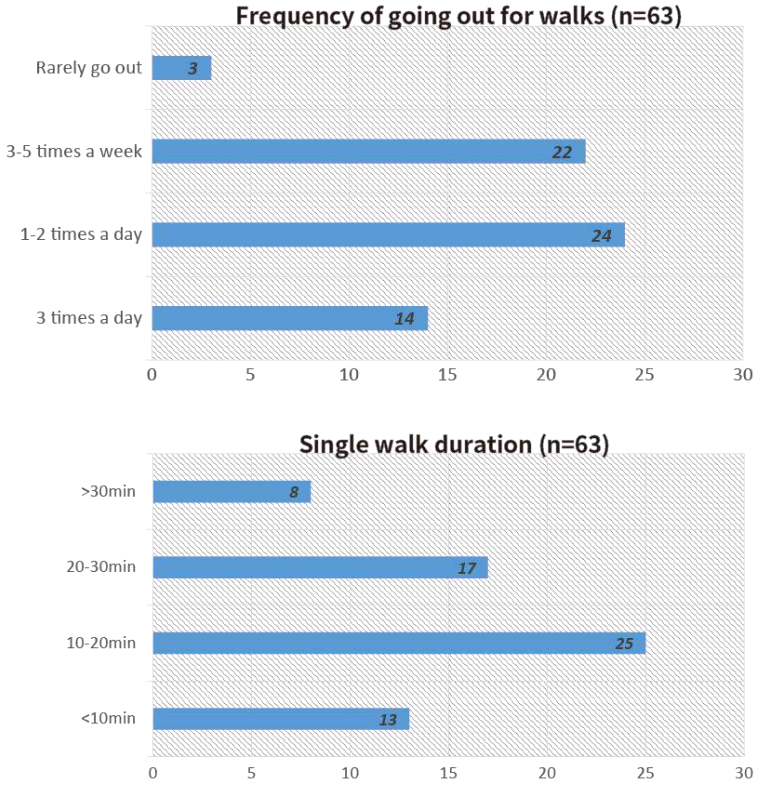


Figure 5-6 The frequency and duration of walking
Source: Author

Regarding the factor of walking destinations, it was found that metro and bus stations, supermarkets, fresh food markets, parks, etc. are important facilities for the elderly to go out. The vast majority of respondents in the questionnaire chose these facilities as their main destinations for walking outside. Some respondents also pointed out that elderly-care facilities, schools, tea houses, restaurants and medical institutions are also important destinations for them to walk outside. This indicates that for the elderly residents in the Duobao Road community, various service facilities around the community are important supports for walking behavior. Complete supporting services can provide more diverse choices of walking destinations, thereby enhancing the convenience of the elderly's walking activities and

supporting the occurrence of walking activities.

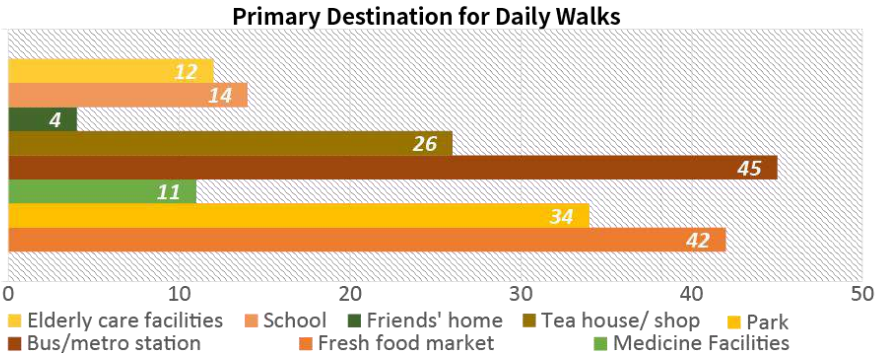


Figure 5-7 The main destinations for walking
Source: Author

5.2.3 Spatial Preferences of Elderly Pedestrians

Based on the questionnaire statistics, the spatial preferences of the elderly residents in the Duobao Road area for their pedestrian activities were analyzed and summarized, covering their satisfaction with the current pedestrian environment, demands for pedestrian facilities, and the elements that need to be improved urgently. It can be found that the demands of the elderly residents in Duobao Road for walking space mainly come from several aspects such as accessible environment, street environment, and service facilities.

(1) Satisfaction with the Current Pedestrian Environment

The questionnaire surveyed the satisfaction of the elderly with elements that affect the quality of the pedestrian environment, including the accessibility condition of the pedestrian path, the width of the sidewalk, slip resistance measures on the pedestrian path, nighttime lighting, and the occupation of the sidewalk. The relevant data show that the local elderly residents have a relatively low satisfaction with the width of the sidewalk and the mixed use of the sidewalk by pedestrians and electric vehicles. Their satisfaction with the evenness, accessibility condition, and slip resistance performance of the pedestrian path is acceptable.

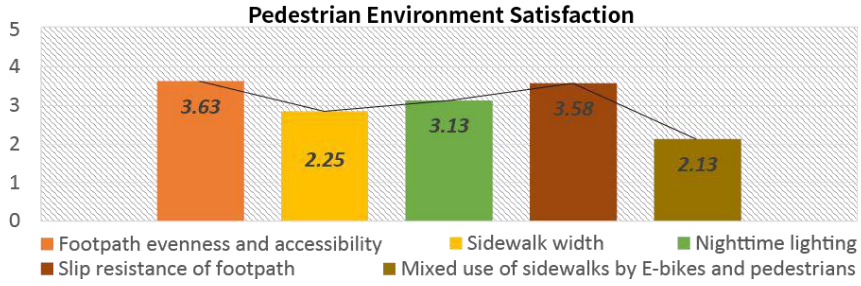


Figure 5-8 Pedestrian environment satisfaction
Source: Author

The relevant data from the questionnaire shows that local residents are not satisfied with the width of the sidewalks and the mixed use of sidewalks by pedestrians and E-bikes. However, their satisfaction with the evenness, accessibility and slip resistance properties of the sidewalks is acceptable. This indicates that there is considerable room for improvement in

the quality of sidewalks in the Duobao Road area, and management of E-bike traffic should also be strengthened.

(2) Views on Different Sidewalk Obstacles

The questionnaire surveyed the views of local elderly residents on some of the obstacles currently existing on the sidewalks, in order to understand their opinions on the sidewalk environment.

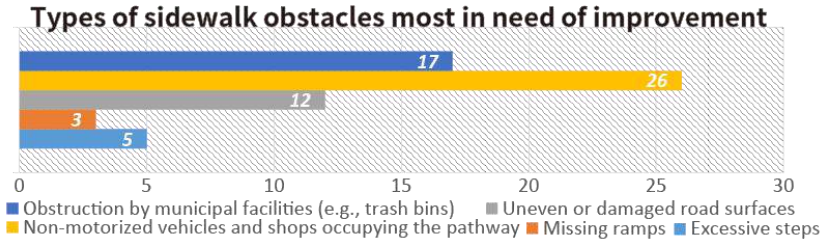


Figure 5-9 Views on Sidewalk Obstacles
Source: Author

The questionnaire data shows that 41.27% of the respondents believe that the occupation of sidewalks by non-motorized vehicles and street vendors has the greatest impact on pedestrians and needs to be addressed most urgently; 26.98% of the respondents think that municipal facilities such as trash bins cause relatively serious obstruction to sidewalks; about 17% of the respondents consider the problem of damaged road surfaces to be the most in need of improvement. A small number of people also believe that the lack of accessible ramps and steps on sidewalks have a significant impact on the walking experience.

From this, it can be analyzed that the problems of non-motorized vehicles occupying sidewalks and street vendors and merchants occupying sidewalks should be given top priority in subsequent designs.

(3) Preferences of Pedestrian Facilities

The questionnaire also investigated the preferences of elderly pedestrians in the study area for the pedestrian facilities.

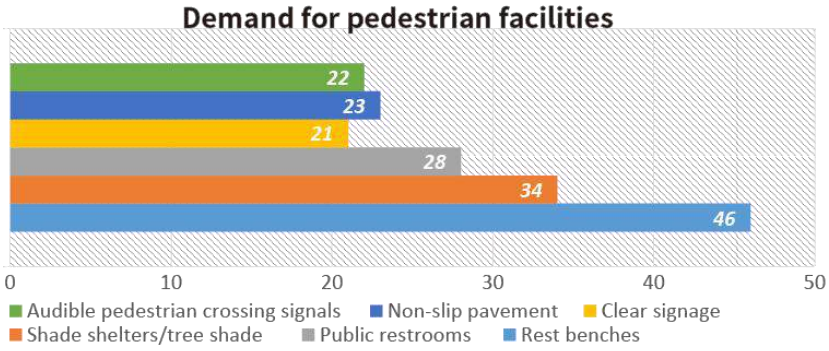


Figure 5-10 Demands of pedestrian facilities
Source: Author

The questionnaire data on the walking environment and facilities show that approximately 73% of the respondents hope that more rest seats can be added to the walking

space; about 54% of the respondents think that the shading facilities or tree shade in the walking environment is quite important and needs to be further increased; meanwhile, 44.44% of the respondents hope that more public toilets can be added. Besides these, clear signs and slip resistance walkways and other environmental elements should also be taken into consideration. Therefore, it can be concluded that in the subsequent design for improving the walkability, in order to enhance the quality of the walking environment, more attention should be paid to improving its rest function and providing more rest facilities.

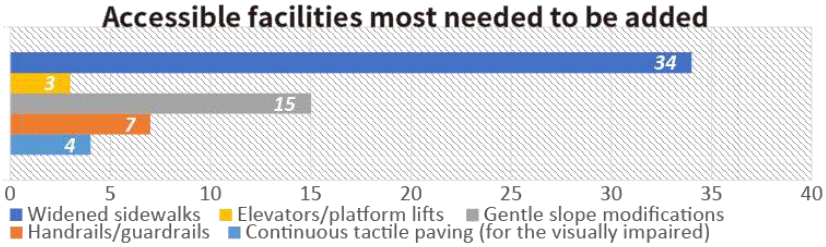


Figure 5-11 Needs of accessible facilities
Source: Author

Considering the elderly's demands for the safety and convenience of walking, the questionnaire also included relevant questions about the need for accessible facilities. The data from the questionnaire shows that the majority of people believe that to enhance the accessibility nature of the walking space, the most important thing at present is to widen the sidewalks; while fewer people think that the current elevators, continuous tactile paths and handrails are relatively scarce and need to be increased. Thus, we can conclude that compared with other elements of the walking space, the elderly residents of Duobao Road place more emphasis on a spacious walking space.

5.2.4 Public Space Preferences of the Elderly Pedestrians

On January 16, 2025, the author visited the Duobao Street Comprehensive Elderly Care Service Center and conducted an approximately one-hour interview with Ms. Liang, a staff member who has worked there for many years and has established deep connections with the local elderly residents, thus having a profound understanding of their lives.

During the interview, the respondent pointed out the close relationship between the walking behavior of local elderly residents and public spaces. She then shared the activities of the elderly in various public spaces within the Duobao Road area and its surroundings. The elderly in the Duobao Road area prefer to go to Liwan Lake Park and Lizhiwan Stream for their daily activities. They are accustomed to engaging in various sports and entertainment activities in the spacious Liwan Lake Park, while in the linear Lizhiwan Stream area, they prefer to take walks. However, the utilization rate of public spaces within the community is relatively low. The respondent explained that this is partly due to insufficient area and partly

because the functions of some public spaces are not clearly defined. Besides sports, many other people pass through or do other things there, which makes the elderly feel embarrassed.

The respondent also mentioned the activities of the elderly in the spaces around the fresh food market. Local residents have agreed to conduct some morning exercises and other activities there during the idle time from 6:30 to 7:30 in the morning.

5.2.5 Walking Routes Preferences of the Elderly Pedestrians

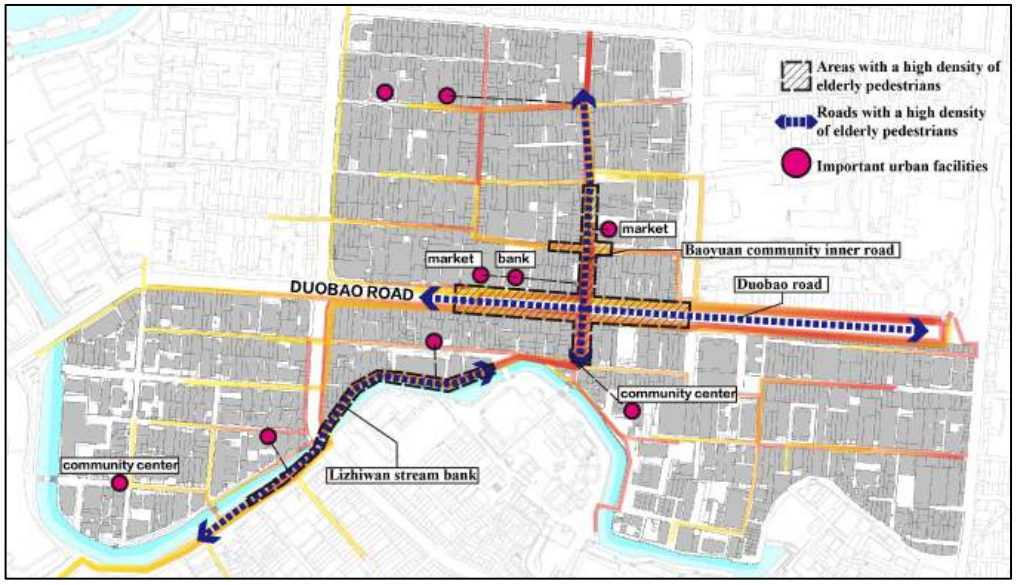


Figure 5-12 Walking Routes Preferences of the Elderly
Source: Author

In the interview with Ms. Liang, a staff member of the Duobao Street Comprehensive Elderly Care Service Center, she shared with us the main routes taken by local elderly residents for their activities. Among them, Duobao Road is a must-pass route for elderly residents in the surrounding area due to the dense distribution of various living facilities on both sides, including metro stations, markets, and various shops. Meanwhile, the internal road on the west side of Fengyuan fresh food market within Baoyuan Community is also frequently visited by elderly residents for purchasing food and sundries, as various convenient commercial facilities are located on both sides of the road. The elderly walk on this road quite frequently.

In addition, several elderly pedestrians were randomly selected in the Duobao Road area and followed. Their walking routes were recorded and statistically analyzed. The tracking records of their walking routes were marked on the site map, as shown by the orange and yellow lines in Figure 5-9. The thicker the line, the higher the frequency of the tracked individuals passing through that location. From this figure, it can be seen that Duobao Road and the internal road on the west side of Fengyuan fresh food market are more frequently passed by the tracked individuals, which is consistent with the information gathered from the

interview. It can also be observed that the elderly have a higher preference for walking along the footpaths along the Lizhiwan Stream.

In conclusion, for the walking route preferences of the elderly in the Duobao Road area, their walking routes mostly pass through various living facilities within the area. Duobao Road, the internal road on the west side of Fengyuan fresh food market, and the footpaths along the Lizhiwan Stream are frequently walked by the elderly.

5.3 Current Status of Land Use and Transportation

5.3.1 Current Land Use and Building Functions

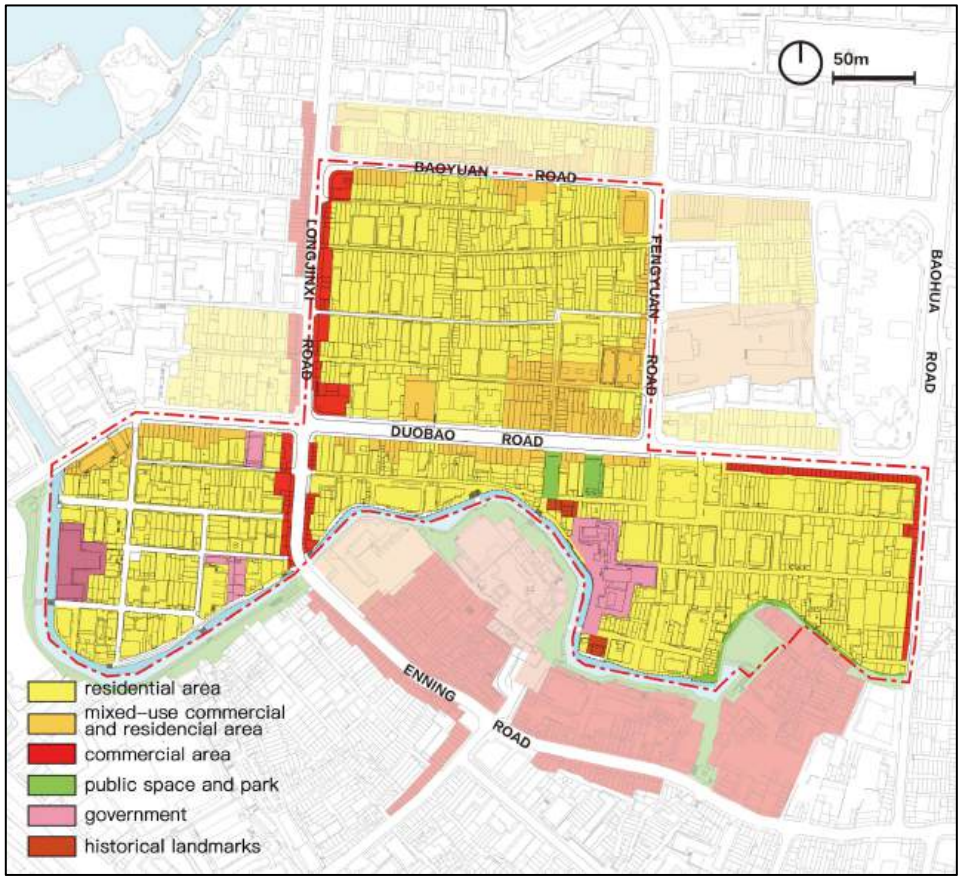


Figure 5-13 Current Status of Land Use
Source: Author

From 2021 to 2023, the Guangzhou Municipal People's Government issued protection plans for multiple historical and cultural Blocks, including Duobao Road, Changhua Street, and Baoyuan Road, providing more detailed regulations for the preservation of Guangzhou's historical and cultural heritage. The research area is included in these plans, and the design of this study will be based on them. The current planning emphasizes cultural protection and tourism development. For example, in the Duobao Road historical street area, a Xiguan-style experience zone, a Cantonese opera culture experience zone, co-working spaces, and characteristic commercial-residential areas have been established under the theme of

"integration of culture, business, and tourism". While this has significantly enhanced the commercial value of the area, it has, to some extent, overlooked the needs of local residents, particularly the elderly population[85].

Based on existing planning documents and on-site investigations, this study conducted a statistical analysis of building functions within the research area. Currently, residential functions dominate the area. The study area is divided into three parts by Duobao Road and Enning Road, roughly corresponding to three residential communities. Meanwhile, along streets such as Baohua Road, Enning Road, and Longjinxi Road, where tourists are concentrated, dense tourism and commercial functions exist. Along Duobao Road and Fengyuan Road, where local residents constitute a higher proportion, various convenient commercial facilities are integrated with adjacent residential buildings.

The above information provides the following guidance for designing age-friendly walking spaces: The design of street interfaces and the arrangement of commercial functions should target both tourists and elderly residents, adopting differentiated strategies for different streets. Within communities and blocks, the construction of resident activity spaces should be strengthened, independent of tourist walking routes, and an age-friendly resident walking space system should be designed.

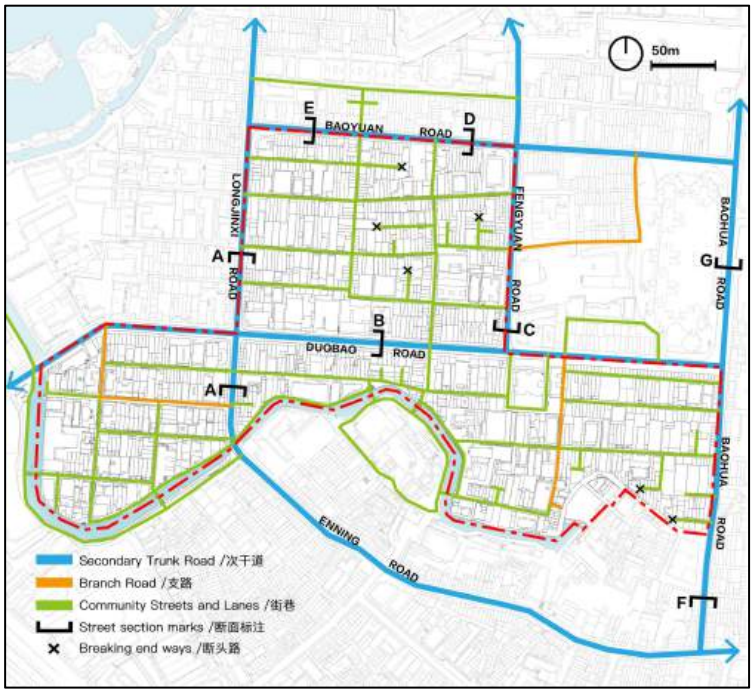


Figure 5-14 Road network situation
Source: Author

5.3.2 Current conditions of roads and traffic flow statistics

The road classification in the study site is relatively clear, consisting of secondary trunk roads and branch roads accessible to motor vehicles, non-motorized vehicles, and pedestrians,

as well as internal streets and alleys within communities and blocks accessible only to non-motorized vehicles and pedestrians. At the level of urban secondary trunk roads, Longjinxi Road, Enning Road, Duobao Road, and Fengyuan Road within the area are two-way double-lane roads, while Baoyuan Road and Baohua Road are one-way roads. Additionally, the southern section of Baohua Road has only one lane.

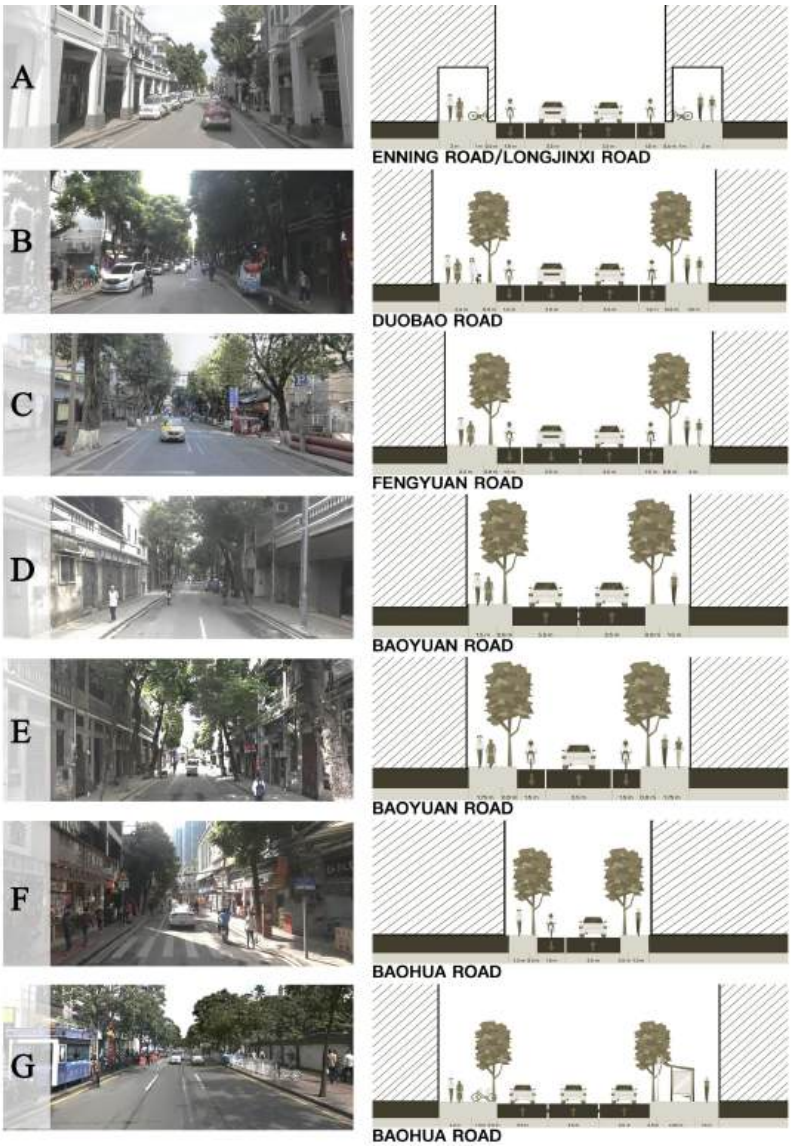


Figure 5-15 Road cross-section
Source: Author

For internal streets and alleys within communities, most are relatively narrow with poor road quality. Moreover, within the historical and cultural districts of Baoyuan Road and Duobao Road, many dead-end roads exist, reducing the accessibility of these internal streets and alleys.

Combined with the cross-sections of the main roads within the area in Figure 5-15, the traffic characteristics of relevant urban streets can be observed more intuitively. Among them, the cross-section designs of Duobao Road (B) and Fengyuan Road (C) are similar but suffer

from relatively narrow sidewalks. Enning Road and Longjinxi Road (A) are *Qilou* arcade streets with strong *Lingnan* characteristics, reflected in the modern historical buildings on both sides and the unique experience of walking under the arcades. The sidewalks in this section are in good condition. Baoyuan Road and Baohua Road are one-way streets with relatively narrow roads. Especially Baohua Road (F), which is narrow and experiences high pedestrian flow, often causes traffic congestion.

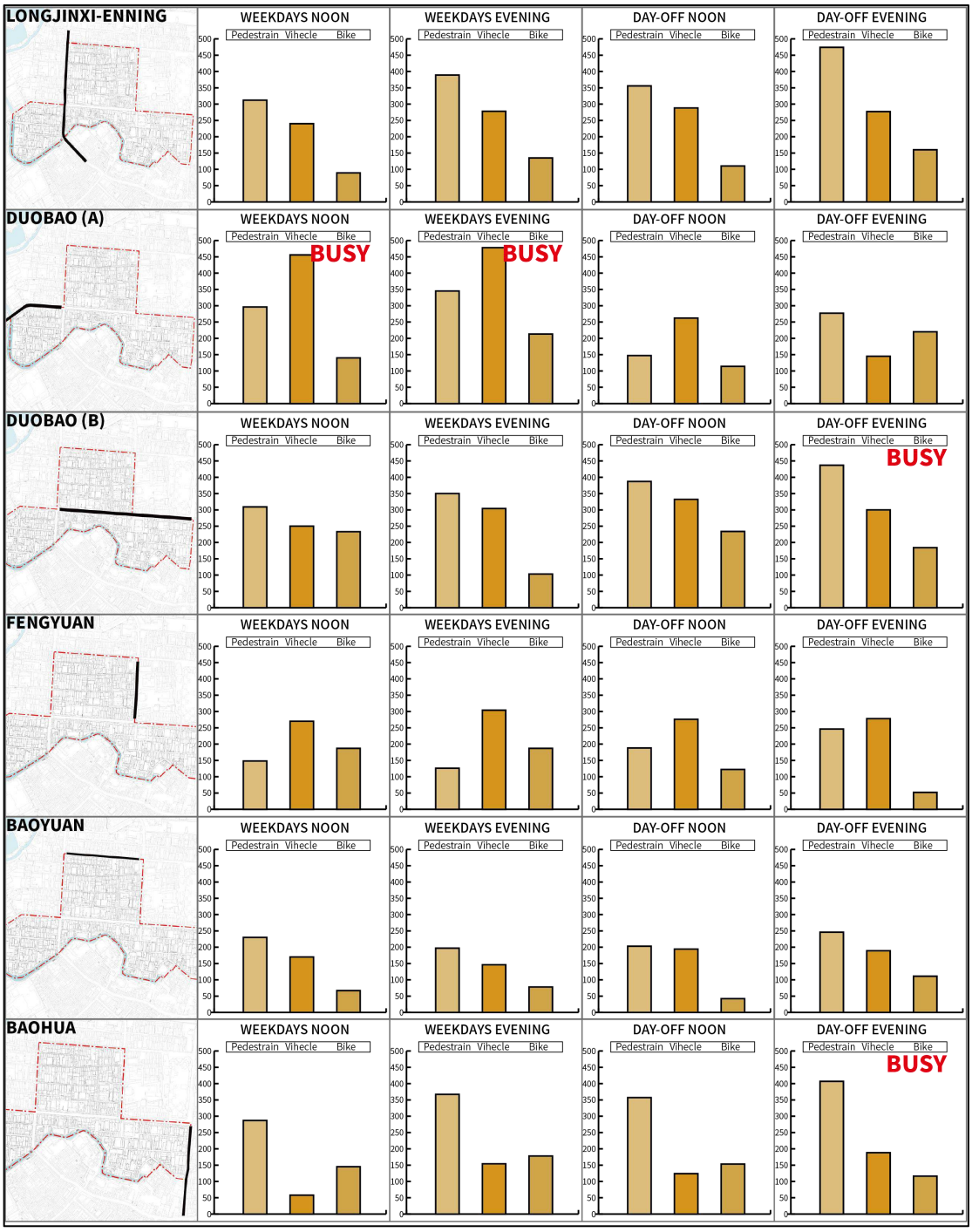
To better understand the current traffic conditions and pedestrian flow on the main roads in the study area, this research conducted statistics on foot traffic, vehicle traffic, and non-motorized vehicle traffic at 12:00 and 18:00 on working days and holidays in July and December 2024, as shown in Table 5-1.

Based on traffic flow statistics and on-site observations, the following patterns were identified: In most roads within the study area, walking is the most common mode of transportation, with higher traffic flow in the evening than at noon and higher on holidays than on weekdays. Analyzing each road separately, Longjinxi - Enning Road has a high volume of tourists due to its connection to multiple tourist attractions, resulting in the highest overall traffic flow. However, due to its wide road and effective separation of pedestrians and vehicles via *Qilou* arcades, congestion is not severe. The section of Duobao Road from Lizhiwan Stream to Longjinxi has high traffic flow on weekdays with significant congestion, mainly because this section includes a middle school and a large hospital. Just one intersection further east, the section of Duobao Road from Longjinxi to Baohua has lower traffic flow, with most pedestrians being local residents. Fengyuan Road has relatively low traffic flow, with most pedestrians being local residents. As for the one-way streets of Baoyuan Road and Baohua Road, Baoyuan Road has the lowest traffic flow, while Baohua Road, connecting to Changshou Road metro station and Yongqingfang, has a large number of tourists. Coupled with extremely narrow sidewalks and only one lane, there is a significant conflict between pedestrians and vehicles, leading to severe congestion.

The above research on road conditions in the study area and traffic flow statistics on major roads provides the following guidance for designing age-friendly pedestrian spaces: The ratio of vehicle and pedestrian traffic on some roads conflicts with the ratio of vehicle lanes to sidewalks, especially on Baohua Road, where the proportion of pedestrians is high but the proportion of sidewalks is too small. During the design process, it is necessary to consider readjusting this ratio. Pedestrians on Enning Road and Longjinxi Road are mainly tourists, and the current road conditions are the best. During the design process, improvements can focus on details. Duobao Road has a large volume of pedestrians, primarily

elderly residents from the surrounding area, and the pedestrian space is relatively narrow. This section can be the focus of the design for age-friendly streets. Fengyuan Road and Baoyuan Road are also important pedestrian roads for local residents, with moderate traffic flow. During the design process, minor adjustments to the road section can be considered.

Table 5-1 10-minute Traffic Flow Statistics
Source: Author



5.3.3 Public Transportation

The site is located in the core of the older urban district, with very convenient public transportation. Metro Lines 1 and 6 pass through the east and southwest sides of the site,

respectively. “Changshou Road Station” and “Ruyi Fang Station” are the nearest metro stations to the study area, with Changshou Road Station having a higher passenger flow density. Additionally, multiple bus stops exist within and around the area, further enhancing accessibility and meeting the travel needs of local residents and tourists.

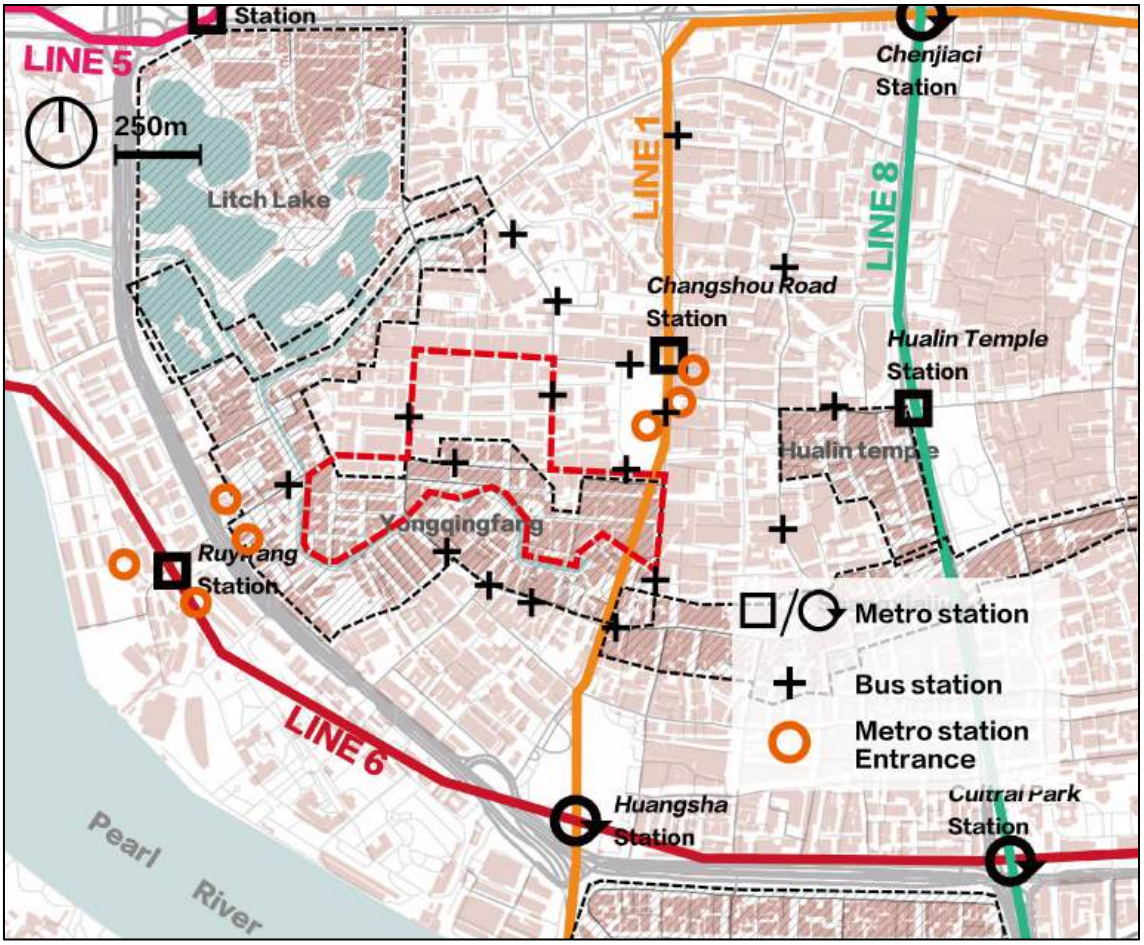


Figure 5-16 Public transport situation
Source: Author

Public transport serves as an important extension of walking behavior, especially for the elderly. To analyze the area’s public transport situation in greater detail and quantitatively, this research used road network data to analyze the 500-meter walking range of bus stops. This range only partially covers the research site. However, as shown in Figure 5-17, the bus system effectively supplements uncovered gaps. Except for Baohua Road, all surrounding roads of the research area are covered by bus routes.

The above analysis of public transportation provides the following inspirations for designing age-friendly walking spaces: Attention should be paid to exploring accessibility from residential community entrances to the nearest metro entrances and bus stops. Furthermore, when designing road sections, dedicated bus lanes should be considered to improve bus operation efficiency.

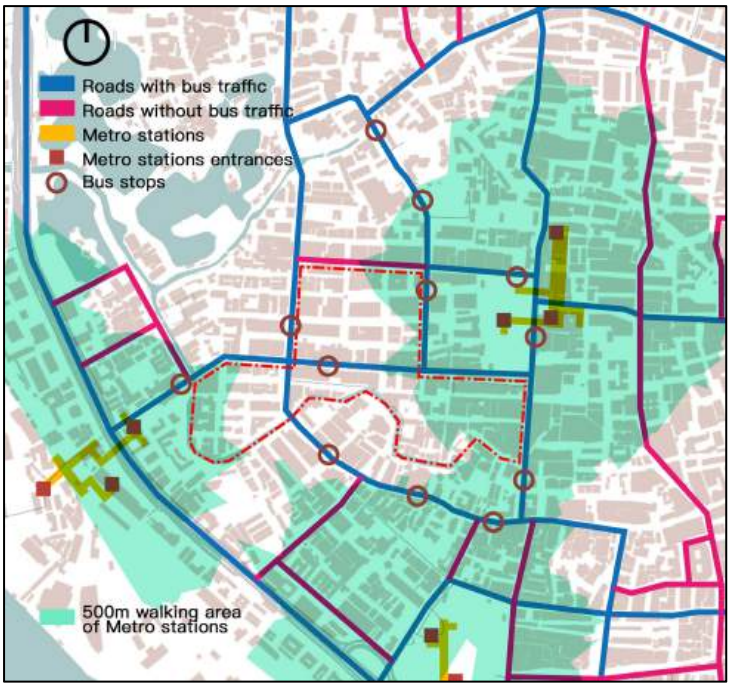


Figure 5-17 Service Range of Metro Stations and Bus Routes
Source: Author

5.4 Dimension 1: Urban Street Environment

5.4.1 Pedestrian Network and Sidewalk Environment

First, the research area was evaluated against the check items related to the regional pedestrian network in “Dimension 1” of the checklist. The total length of pedestrian roads within the research area was approximately 3.94 kilometers, with a pedestrian road density of about 20.7 kilometers per square kilometer, slightly exceeding the recommended range of 14-20 kilometers per square kilometer. Therefore, overall, the pedestrian road density in the research area is pleasant. Moreover, the distance between most intersections within the area is around 100 meters, with a relatively high density, which enhances accessibility for the elderly. However, a section of Duobao Road has an intersection distance of 225 meters, which is excessively large.

This study also utilized the Depthmap platform to conduct a spatial syntax analysis of the pedestrian road network in the research area and its surrounding urban areas. The integration analysis measures the ability of a space to attract arriving traffic as a destination. Roads with higher integration exhibit greater accessibility and are more likely to gather people. The Integration analysis reveals that Longjinxi Road, Enning Road, and Duobao Road have relatively high integration, indicating their spatial capacity to attract pedestrians, consistent with the results of the previous road condition analysis and traffic flow statistics. The Choice degree reflects the likelihood of a space being traversed. Roads with higher Choice degrees are more frequently used by people. The Choice degree analysis further highlights the

importance of Longjinxi Road, Enning Road, and Duobao Road.

Figure 5-18 Integration and Choice of the Road Network
Source: Author

The above research on the regional pedestrian network provides the following possible design directions: Add openings at appropriate locations on the section of Duobao Road east of Longjinxi Road to connect with adjacent communities, enhancing internal accessibility; when designing, pay attention to the pedestrian space environment of Longjinxi Road, Enning Road, and Duobao Road.

Subsequently, this study conducted a survey on the quality of the sidewalk environment of each urban road in the research area by referring to the inspection items related to sidewalks in “Dimension 1” of the checklist.

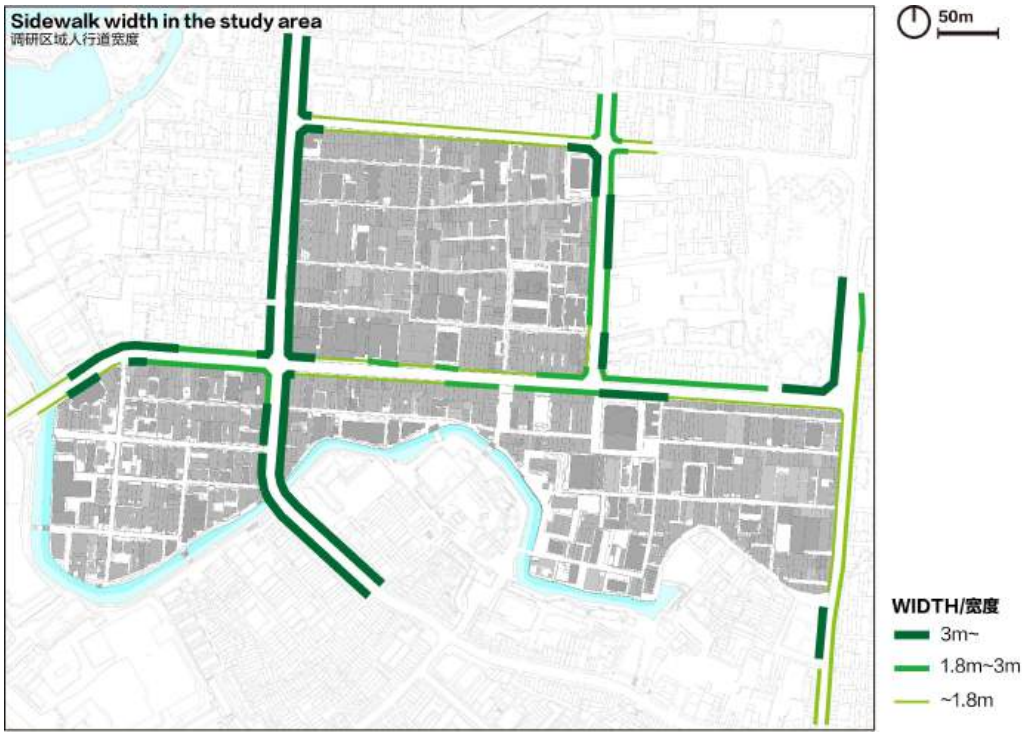


Figure 5-19 Sidewalk Width in the Site
Source: Author

Regarding the width of sidewalks on both sides of the road, main roads generally meet

the standards, but significant sections of Baoyuan Road and Baohua Road fail to meet the requirements. Additionally, some sections of Duobao Road have insufficient sidewalk widths due to street trees obstructing the pathways. For specific details on sidewalk widths, refer to Figure 5-19.

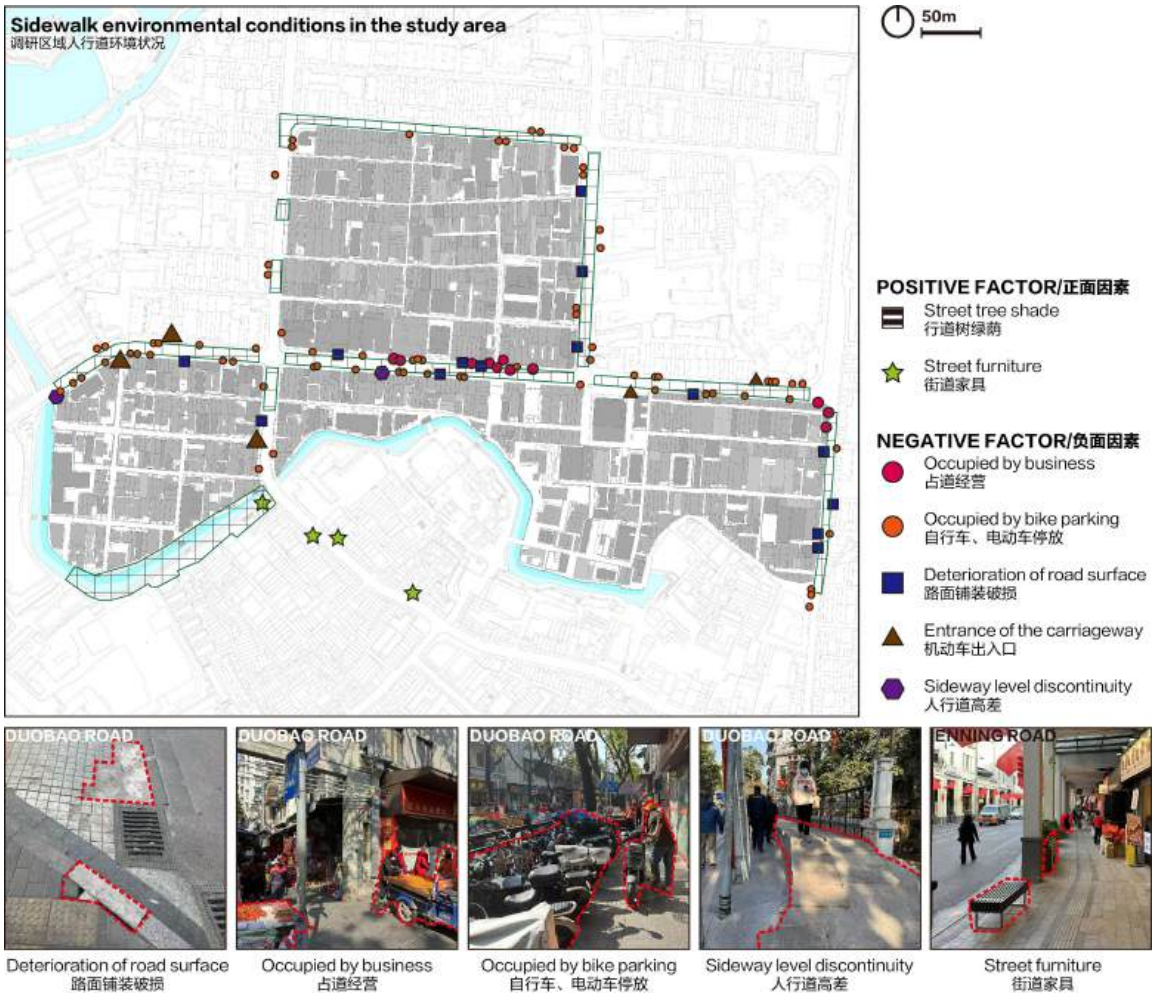


Figure 5-20 Sidewalk Environment of the Site
Source: Author

For other sidewalk-related projects, on-site surveys revealed prominent issues of bicycles occupying sidewalks and vendors operating on sidewalks, significantly reducing the effective width of pedestrian walkways and creating obstacles for elderly individuals with mobility challenges. Specific inspection results of sidewalk conditions are shown in Figure 5-20.

From the research on sidewalk environments, it is evident that sidewalks along Duobao Road face numerous problems, primarily due to sidewalk occupation. Possible solutions include two approaches: strengthening management and widening sidewalks.

5.4.2 Intersections and Crosswalk Facilities

The research area was evaluated against the inspection items related to intersections and crosswalk facilities in “Dimension 1” of the checklist. Crosswalk facilities within the research

area mainly consist of pedestrian crossings located at intersections and mid-blocks. The distribution of pedestrian crossings and accessible ramps in the research area is shown in Figure 5-21.

Figure 5-21 Pedestrian Crossing Facilities in the Site
Source: Author

Through detailed organization of the pedestrian crossing facilities in the study area (as shown in Figure 5-21), the following issues were identified at intersections and pedestrian crossing facilities within the research area: Some roads lack mid-block pedestrian crossing facilities. For instance, on Longjinxi Road and Fengyuan Road, where residential and commercial functions are densely distributed, there are no pedestrian crossing facilities for nearly 250 meters. Some pedestrian crossings have unreasonable accessibility facilities, such as accessible ramps not connecting to one side of the zebra crossing. The intersection of Duobao Road and Baohua Road is large and crowded but lacks pedestrian crossing channelization islands.

Based on the above research and findings related to crosswalk facilities, this study suggests considering the following measures in subsequent designs to enhance the safety of elderly pedestrians: Adding mid-block crosswalks at appropriate locations on Longjinxi Road and Fengyuan Road; improving accessibility facilities at crosswalks, such as adding and widening wheelchair ramps; and enhancing intersection design through methods like partially expanding sidewalks, raising intersections, and adding safety islands to increase pedestrian

priority.

Figure 5-22 Problems with Crosswalk Facilities
Source: Author

5.4.3 Street Building Interface

The research area was evaluated against the check items related to street building facades in “Dimension 1” of the checklist.

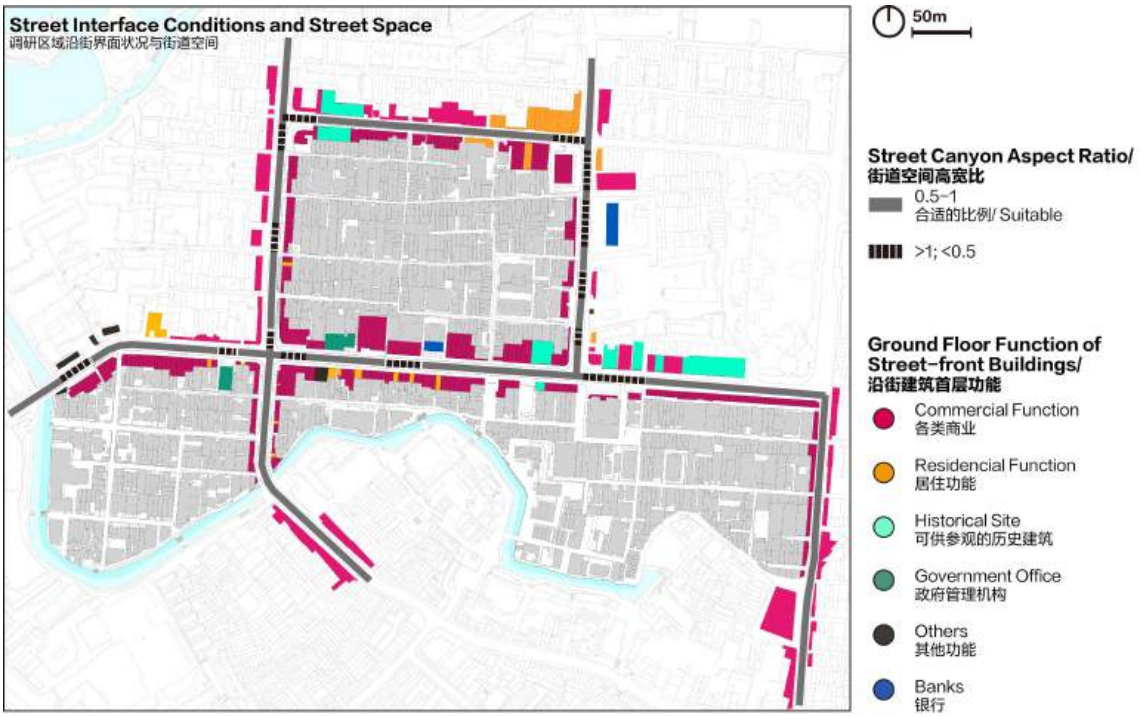


Figure 5-23 Street Ground-floor Interface and Street H/W Ratio
Source: Author

Regarding the height-to-width ratio of the major street spaces within the research site, on-site measurements and observations revealed that due to the dense low-rise buildings in the old urban area, the height-to-width ratio of street spaces is generally within the reasonable range of 0.5 to 1. However, at some modern mid-to-high-rise buildings, low buildings, or where the street interface is broken (e.g., parts of Duobao Road and Fengyuan Road), the height-to-width ratio is unreasonable. For specific details, see Figure 5-23, where black dotted lines indicate areas with an unreasonable height-to-width ratio.

Regarding the continuity of buildings on both sides of the road, verification of the street interface density and alignment parameters of several main roads within the research area shows that they are generally within the appropriate range, except for the east side of Fengyuan Road, which is too sparse and uneven.

Regarding the transparency of ground floors along the street, this study conducted a statistical analysis of the ground floor functions of buildings along the main roads within the research area. Ground floor functions in this area are predominantly commercial, interspersed with government institutions such as police stations and sub-district offices, banks, and historical buildings open for visits or preservation. These provide rich visual stimuli for elderly pedestrians. In addition to the vibrant ground floor functions, common outdoor shop arrangements, although partially obstructing sidewalks, offer visual interest points for elderly walkers. Furthermore, as a historical and cultural district, the distinctive architectural facade styles and historical buildings carry local and era-specific characteristics, providing memory points for elderly pedestrians.

Based on the above research on street interface, it is evident that the street building interfaces in the site offer a rich array of urban functions and a prominent sense of memory in terms of facade appearance, bringing vitality to the walking environment. To further enhance the vitality of the street space, the following strategies can be considered in subsequent designs: Designing roadside and street corner gardens along Duobao Road and Fengyuan Road; considering the renovation of historical building facades along Longjinxi Road and Enning Road to improve facade quality.

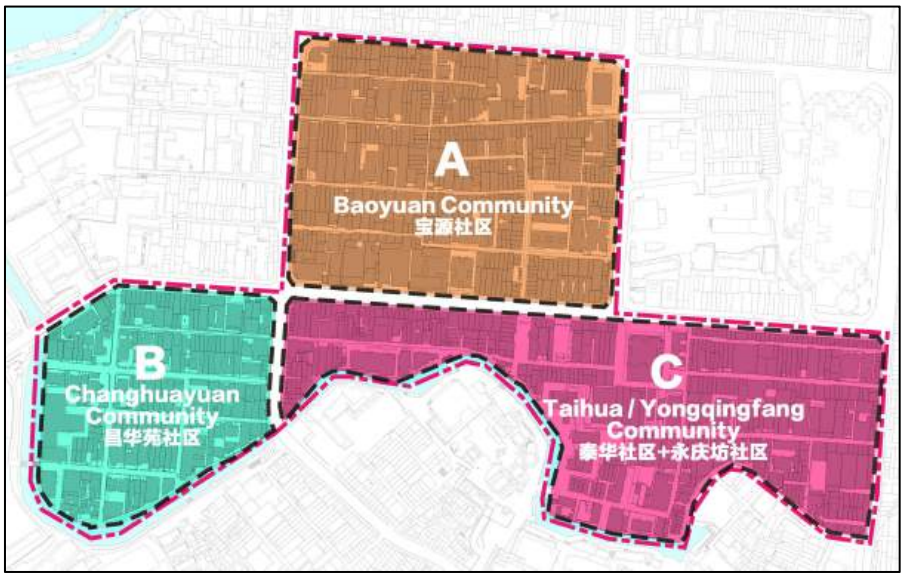


Figure 5-24 Distribution of Communities in the Site
Source: Author

5.5 Dimension 2: Community Pedestrian Environment

As shown in Figure 5-24, the study site is primarily composed of three plots, encompassing four communities: Taihua Community, Baoyuan Community, Changhuayuan Community, and Yongqingfang Community. Among these, Baoyuan Community has the largest resident population.

Since Plot C includes parts of Taihua Community and Yongqingfang Community, which are interconnected as a whole, this study combines these two communities for inspection when assess the community environment. Therefore, the following check of the community walking environment will summarize the overall research area while focusing specifically on Plots A, B, and C, as shown in Figure 5-24.

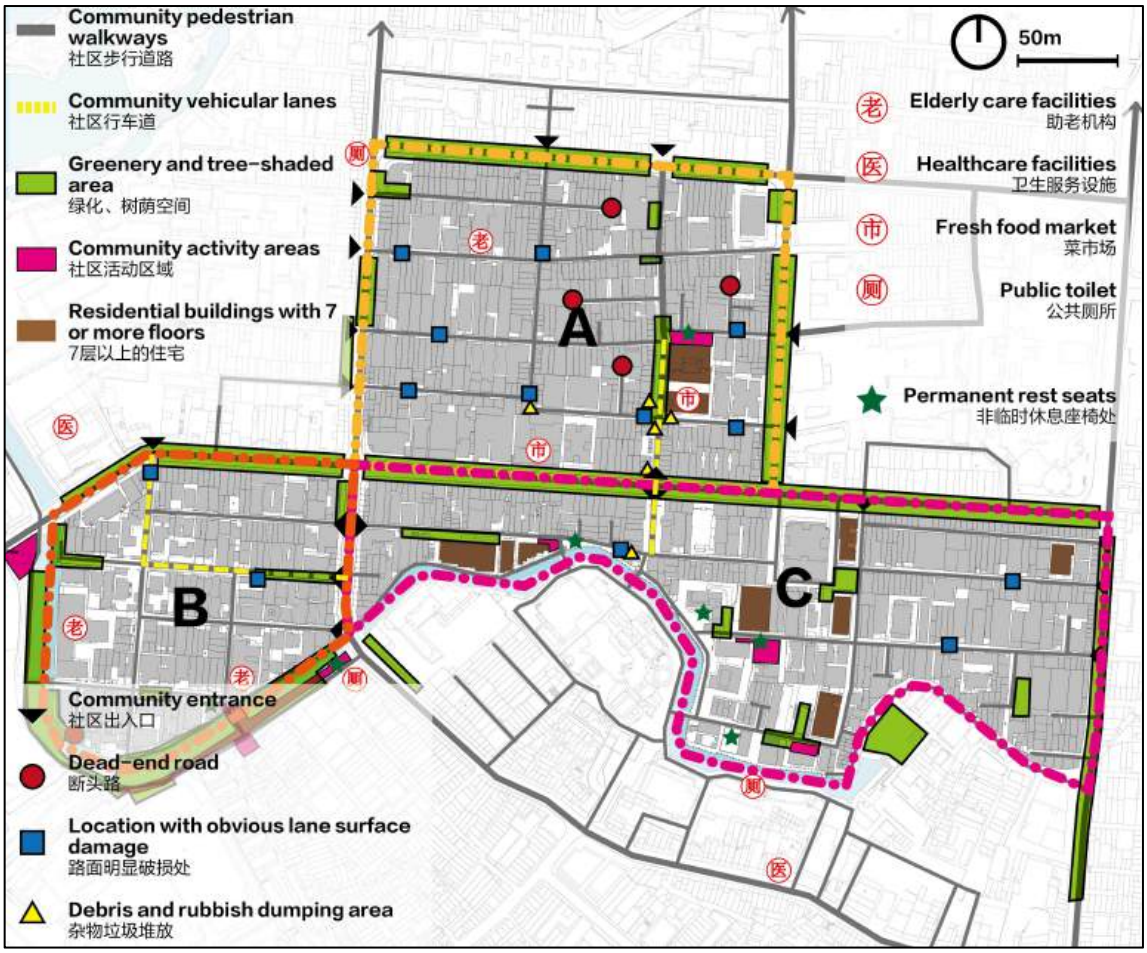


Figure 5-25 Status of the Pedestrian Environment in Communities
Source: Author

5.5.1 Overall Community Structure

The overall structure and pedestrian network of the three plots within the study area are clearly depicted in Figure 5-25. By comparing the inspection items related to the overall structure of the community in “Dimension 2” of the checklist, it was found that the number of intersections in the overall pedestrian network of the three plots within the study area is

relatively appropriate. Moreover, the entrances of each plot are reasonably distributed, with multiple access points connected to surrounding urban roads. Coupled with the rich public transportation resources in the surrounding area, elderly residents' accessibility to nearby bus stops via the community is relatively good. The inspection results that do not meet the checklist requirements are summarized below.

Table 5-2 Issues Found in the Overall Community Structure
Source: Author

Plot	Factors	Result	Details Finding
A	Comfortable Community FAR	×	Plot A is predominantly composed of multi-story residences, with a floor area ratio >5, which is excessively high.
A,B,C	Green Space Ratio	×	The green space ratio of Plots A, B, and C is all <0.25, and the green coverage of main pedestrian paths and leisure areas is insufficient.
	Network Density	-	The road length-to-area ratio in Plots A, B, and C is all <8 (not mandatory).

Through the assessment, it was found that Plot A has a high building density, scarce public spaces, and an elevated floor area ratio, which compresses outdoor pedestrian space and negatively impacts the pedestrian experience within the community. Additionally, all three plots—A, B, and C—face the issue of insufficient green spaces. On one hand, the green space ratio is low; on the other hand, some pedestrian paths and activity areas within the plots lack greenery or tree cover, further affecting the pedestrian experience.

In terms of road network structure, it was observed that the road network density of each plot is relatively low. Although this indicator is not mandatory for older communities, a low road network density indirectly reflects the problem of overly narrow internal roads within the community. Furthermore, as shown in Figure 5-25, Plot A contains numerous dead-end roads, which may hinder the accessibility of community roads.

Based on the above inspection of the overall pedestrian structure of each community within the study area, the primary issues identified include: excessively high floor area ratios in certain areas, insufficient public activity spaces and greenery within the community, narrow community roads, and the presence of dead-end roads. To further enhance the pedestrian experience in outdoor community spaces, the following strategies can be considered in subsequent designs: clearing dead-end roads and connecting local road networks to improve accessibility; appropriately demolishing some buildings to release community public space and enhance community greening.

5.5.2 Community Roads Quality

By comparing the inspection items related to the quality of community roads in "Dimension 2" of the checklist, the inspection results that do not meet the checklist

requirements are summarized below. For specific distributions of road quality problems, refer to Figure 5-25.

Table 5-3 Issues Found in the Community Roads Quality
Source: Author

Plot	Factor	Result	Details Finding
A	Walkway Width	○	The width of the internal roads is all above 1.5m to 2m. However, in addition to pedestrians, the alleys also need to accommodate various non-motorized vehicles, thus encroaching on the pedestrian space.
	Emergency Vehicle Access	×	The internal roads of the plot are narrow and vehicles cannot pass through.
B	Pedestrian-Vehicle Separation	×	Some roads inside can be driven, with pedestrians and vehicles sharing the same space, and the management is relatively lacking.
A,B	Encroachment-Free Walkways	×	Around the Fengyuan Fresh Food Market and the entrance of Duobao Road in Plot A, due to the dense business activities, there are problems of occupying the road for business. In Plot B, there are problems of occupying the road for parking, which encroaches on the pedestrian space.
	Paving Integrity	×	Some ground pavements have problems of damage and unevenness.
A,B,C	Nighttime lighting	×	There are areas without light at night in Plots A, B and C.

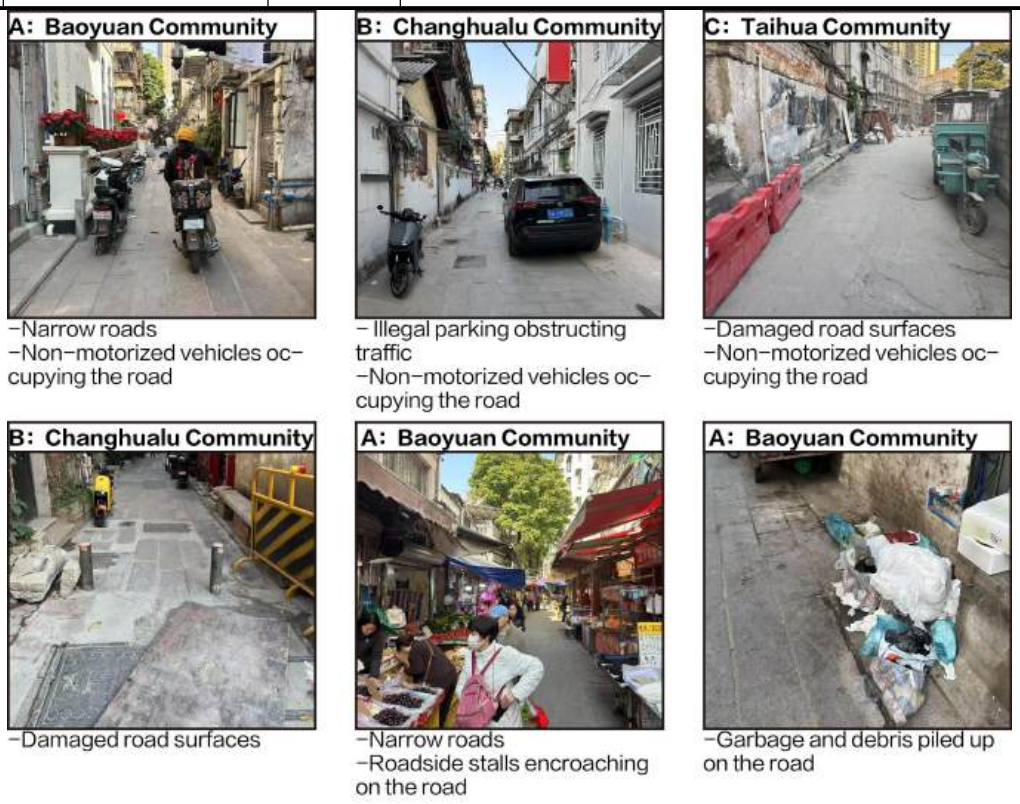


Figure 5-26 Pictures of Road Quality Issues in the Communities
Source: Author

Through the assessment of the quality of community roads, this study found that although the pedestrian paths in Plot A are wide enough for walking, the 2-meter-wide internal alleys are very narrow due to the presence of only pedestrian paths, with E-bikes,

freight tricycles and pedestrians all competing for the same space. The internal alleys that are too narrow for vehicles to pass through also make it difficult for ambulances to reach. However, considering that these are old alleys in a historical block with limited space for expansion, the issue of ambulance access is not considered for the time being. At the same time, there is an indoor fresh food market in Plot A, and around the market, there are many retail businesses and street vendors, which have led to problems such as occupying the road for business and piling up of debris, hindering pedestrian traffic. In Plot B, some roads are accessible to vehicles, but there are serious problems of mixed pedestrian and vehicle traffic and roadside parking occupying the road. There are also some problems with the ground paving. In Plot A and B, some of the ground is in disrepair, with damage and unevenness. For specific locations, please refer to Figure 5-25. When visiting the study site at night, it was found that there are areas without light at night in Plots A, B and C, which poses a risk to the nighttime travel of the elderly.

For this, the following strategies can be considered in the subsequent design: improving the quality of night lighting; for Plot A, while strengthening the management of non-motorized vehicles, it is possible to consider widening some alleys and internal roads; arranging public spaces around the fresh food market to provide business areas for some small vendors; for Plot B, strengthening management, properly separating the vehicle and pedestrian sections of the internal roads, and considering setting up small dedicated parking lots to alleviate the problem of street parking.

5.5.3 Community Public Environment

Table 5-4 Issues Found in the Community Public Environment
Source: Author

Plot	Factors	Result	Details Finding
A	Rest Bench	×	Lack of rest seats and flower beds/tree pits in the main activity areas and main passageways for the elderly
C	Elderly Service Facilities in the Community	×	Lack of basic medical facilities such as medical stations, indoor places for the elderly to engage in activities and entertainment, and elderly-care institutions
A,B	Elderly Service Facilities in the Community	×	Lack of basic medical facilities such as medical stations
A,B,C	Outdoor Activity Spaces and Community Green Spaces	×	Lack of outdoor activity spaces and community green spaces, and they are scattered and not well-organized
	Clear Signage System	×	Lack of signage systems for the elderly

The research site was inspected against the assessment items related to the community road public environment in “Dimension 2” of the checklist. The inspection results that do not

meet the requirements of the checklist are as above.

Through the inspection of the quality of the community public environment, this study found that the main problems are mainly concentrated in the quantity and corresponding supporting facilities of the community public spaces. As can be seen from Figure 5-25, all three plots in the research area lack sufficient and well-connected green spaces and public spaces. At the same time, the public activity spaces in Plot A lack rest seats. In terms of community facilities, all three plots A, B, and C lack medical stations for the elderly to inquire about daily matters nearby. Additionally, Plot C also lacks elderly assistance institutions and indoor elderly entertainment venues. Moreover, there is a widespread problem of lacking clear signage for the elderly or having unclear signage in all areas of the research area.

Figure 5-27 Status of Some Community Public Spaces
Source: Author

For this, the following strategies can be considered in the subsequent design: Add public activity areas for the elderly and increase green spaces within the community; enhance community service supply, and consider adding a comprehensive elderly service center in Plot A to provide assistance for the elderly and simple medical services; set clear signs pointing to commonly used facilities for the elderly at the main road intersections within the community.

5.6 Dimension 3: Urban Facilities

5.6.1 Facilities in the Site and Surroundings

First, this study statistically analyzed the urban facilities within the research area at the urban level. Using map platform POI data, relevant facilities were counted within a 1-km radius around the center of the study area.

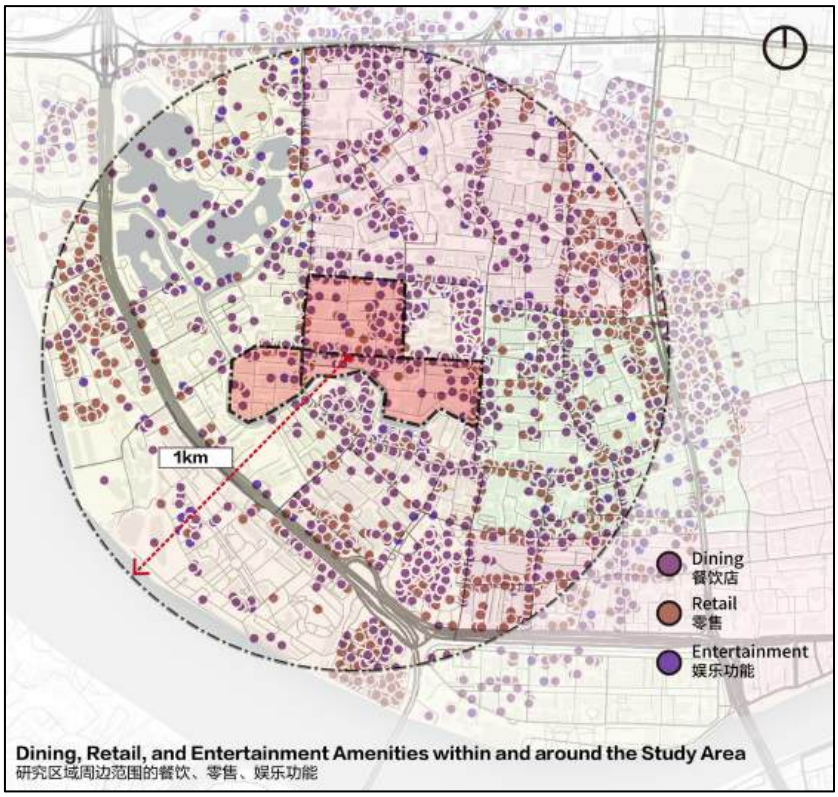


Figure 5-28 Commercial Functions Surrounding the Site
Source: Author

The number of various urban facilities types within a 1-kilometer radius of the study area is as follows:

Table 5-5 Number of Facilities Types within 1 km of the Site
Source: Author

Catering	Retail	Preschool/School	Entertainment	Medical Institutions
1240	2962	46	1698	31

From the above data, it can be observed that the urban facilities types surrounding the study area are abundant and diverse, likely due to the long-term development of the older urban district. This indicates that elderly residents living in this area will enjoy a highly convenient lifestyle.

This study also paid special attention to the distribution of urban facilities closely related to the elderly's daily lives, such as catering stores, retail stores, hospitals, markets, elderly-care institutions, and parks. The distribution of catering stores, retail stores, and entertainment businesses is shown in Figure 5-28. These functions are primarily concentrated along main roads, with areas along Duobao Road, Baoyuan Road, and Enning Road being key zones for these activities. This reflects that the commercial vitality in the study area is high, providing strong shopping convenience for the elderly. For other urban facilities closely related to the elderly's lives, such as hospitals, markets, elderly-care institutions, and parks, their distributions will be further explored in Sections 5.6.2 and 5.6.3.

Regarding the accessibility of urban streets to important elderly facilities, this study used the walk score described in Section 2.3.1 to verify five urban roads and eight road sections within the study area. The scores of the eight road sections involved in the calculation all fall within the range of 90-100, which can be referred to as “pedestrian paradises”.

5.6.2 15-Minute Living Circle and Distribution of Elderly Facilities

This study first calculated the 5-10-15-minute walking isochrones of the four communities in the study area based on the urban road network from the OpenStreetMap platform. Specific results are shown in Figure 5-30. Based on this, the elderly-related facilities within the 15-minute living circle were analyzed in combination with POI data.

By comparing the assessment items related to the 15-minute living circle for the elderly in “Dimension 3” of the checklist and combining them with relevant data, the 15-minute living circles of the three plots in the study area were inspected. The assessment results are as follows:

Table 5-6 Elderly-related Facilities within the 15-Minute Living Circle
Source: Author

Plot	Living Circle	Existing Facilities	Lacking Facilities
A	5min	Elder activity room (integrated into Duobao Street Elderly Care Service Center)	Outdoor fitness area with sufficient area
	10min	Hospitals (Guangzhou Medical University Affiliated Third Hospital), Day care center (integrated into Duobao Street Elderly Care Service Center), Indoor markets (Duobao Street Market, Fengyuan Fresh Food Market)	Cultural activity station with sufficient area, Convenience point including home services, repair, and express delivery services
	15min	Hospitals (Guangzhou Liwan District Traditional Chinese Medicine Hospital, Guangzhou Medical University Affiliated Traditional Chinese Medicine Hospital), Duobao Street, Changhua Street, and Fengyuan Street Community Health Service Centers	Community activity center
B	5min	Outdoor fitness area (total area meets the standard of 300 ㎡), Elder activity room (integrated into Changhua Street Elderly Care Service Center)	None
	10min	Hospitals (Guangzhou Medical University Affiliated Third Hospital), Day care center (Changhua Street and Duobao Street Elderly Care Service Centers, Jinghui Elderly Care Home), Indoor markets	Cultural activity station with sufficient area, Convenience point including home services, repair, and express delivery services

Plot	Living Circle	Existing Facilities	Lacking Facilities
		(Duobao Street Market, Fengyuan Fresh Food Market)	
	15min	Hospitals (Guangzhou Medical University Affiliated Hospital of Traditional Chinese Medicine), Community health service centers in Duobao Street, Changhua Street, and Fengyuan Street	Community activity center
C	5min	Outdoor fitness area (total area meets the standard of 300 ㎡), Elderly activity room (integrated into Duobao Street Elderly Care Service Center)	None
	10min	Hospitals (Guangzhou Medical University Affiliated Third Hospital), Day care center (integrated into Duobao Street Elderly Care Service Center), Indoor markets (Duobao Street Market, Fengyuan Fresh Food Market)	Cultural activity station with sufficient area, Convenience point including home services, repair, and express delivery services
	15min	Hospitals (Guangzhou Liwan District Hospital of Traditional Chinese Medicine, Guangzhou Medical University Affiliated Hospital of Traditional Chinese Medicine), Community health service centers in Duobao Street, Changhua Street, and Fengyuan Street	Community activity center

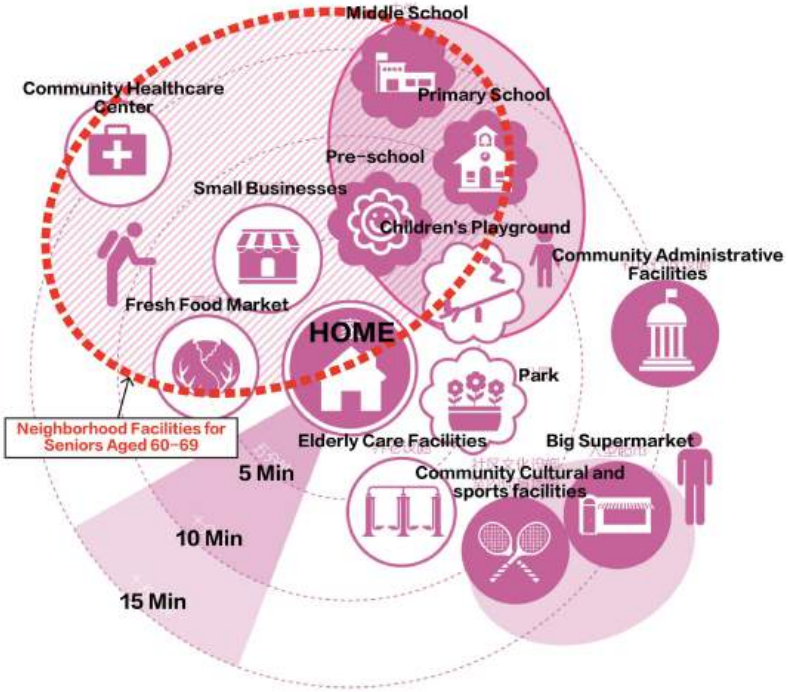


Figure 5-29 Facilities Life Circle for the Elderly
Source: Reference [72]

The above assessment results indicate that the facilities closely related to the elderly's lives within the 15-minute living circle of the three plots in the study area are relatively complete. The study area has abundant medical resources within the 15-minute living circle, ensuring adequate health support for elderly residents living in this area. Additionally, accessible markets and subdistrict-level elderly care centers provide significant convenience for the elderly's daily lives.

In addition, the "*Shanghai 15-Minute Community Living Circle Planning Guidelines*" emphasize that for the middle-aged elderly group aged 60-69 studied in this paper, common facilities within their 15-minute living circle mainly include markets, small-scale commercial facilities, community health service centers, preschools, and primary/secondary schools. These guidelines also suggest functional layouts centered around markets, integrating green spaces, small-scale commercial facilities, schools, and training institutions nearby.

Therefore, the next step of this research will involve further investigations into the distribution of important facilities such as convenient commercial facilities, hospitals, elderly care facilities, and schools within the 15-minute living circle.

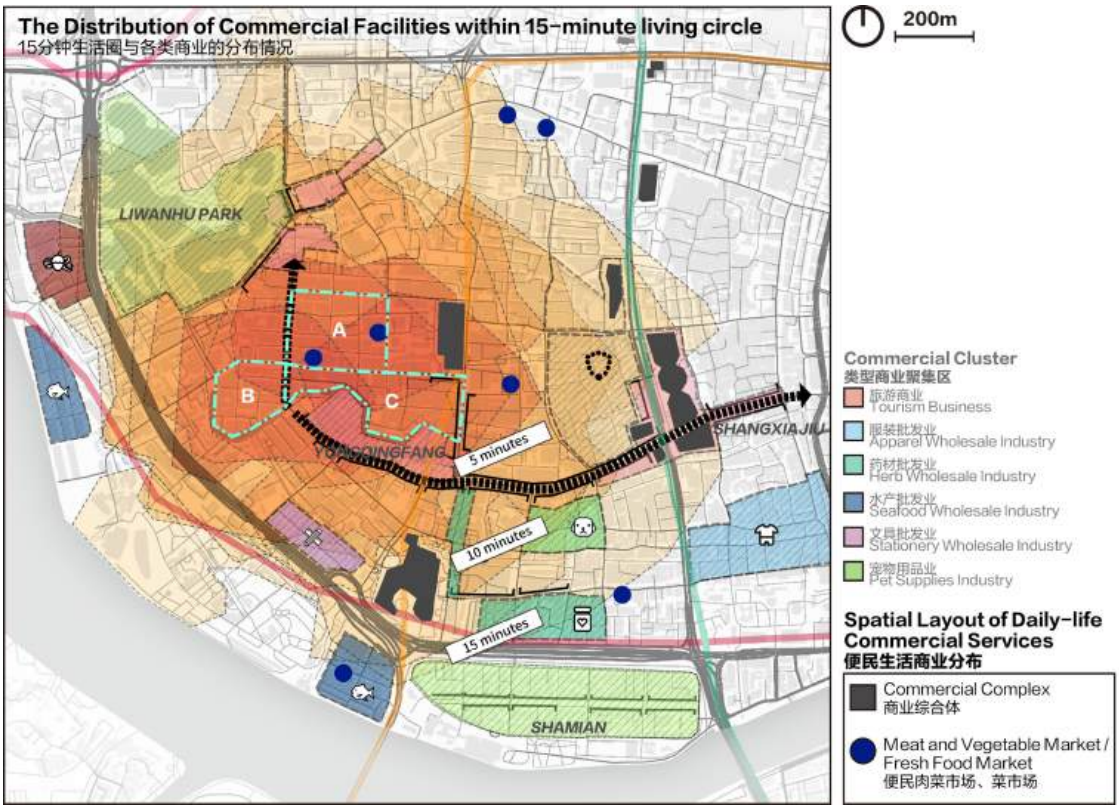


Figure 5-30 Distribution of commerce within the 15-Minute Living Circle
Source: Author

Firstly, regarding the distribution of commercial facilities, please refer to Figure 5-30 for details. This area is densely populated with commercial establishments. On the one hand, it was the earliest commercial center in Guangzhou, thus featuring a concentration of wholesale

businesses such as clothing, aquatic products, and medicinal herbs. On the other hand, it has several well-known tourist destinations, which led to the development of tourism-related commercial activities along Enning Road and Longjinxi Road. These commercial types are not closely related to the lives of the elderly. However, convenience markets and fresh food markets, which are more convenient for daily life, are closely integrated with the lives of elderly residents. As can be observed from Figure 5-30, there are two fresh food markets within the study area, providing significant convenience for the elderly residents. Additionally, within a 5-10 minute walking distance from the study area, there is a large commercial complex, “Hengbao Plaza”, which offers the elderly a wider range of commercial choices.

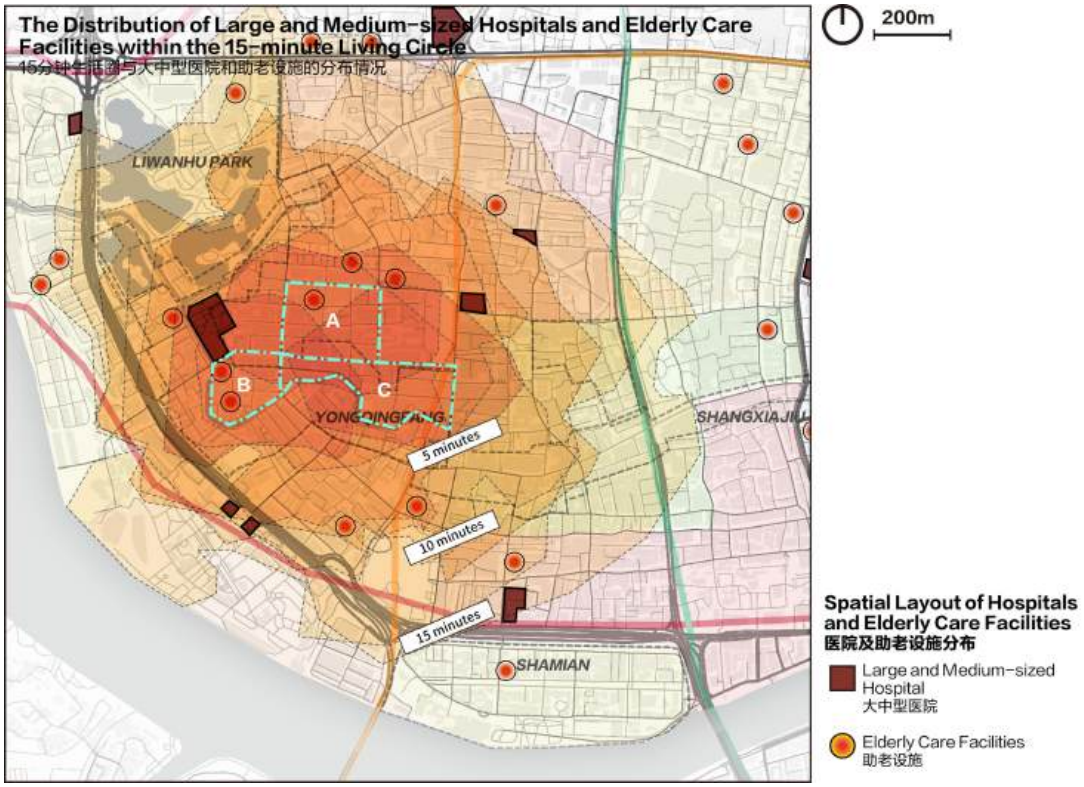


Figure 5-31 Distribution of Health Care Function within the 15-Minute Living Circle
Source: Author

Secondly, the distribution of large and medium-sized hospitals and elderly care facilities is shown in detail in the above Figure 5-31. Due to the relatively dense distribution of community health service centers and health stations, which are primary medical facilities, in this area, they are not detailed in this figure. Only large and medium-sized hospitals are indicated, as these hospitals can comprehensively address various medical needs of the elderly. From this, it can be seen that the medical resources in the study area are relatively abundant, with sufficient primary medical facilities to meet daily health inquiries and large and medium-sized hospitals to handle various diseases. The accessibility of health services for the elderly is relatively high.

Regarding elderly care facilities, it is found that there is a considerable density of various elderly care facilities within a 5-15 minute walking range in the study area. In plot A of the study area, there is the Duobao Street Comprehensive Elderly Care Service Center, which can provide multiple functions such as meal delivery, care, and activities. In plot B of the study area, there are Fushouyuan and Jinghui Nursing Home, which can offer full-time care and other services. Meanwhile, multiple elderly care facilities are also distributed within the 15-minute living circle of the study area. Thus, it can be concluded that the elderly care resources in the study area are relatively abundant. While providing full-time care, they also offer meal delivery, organizing activities, and other functions, meeting the living needs of the elderly group targeted in this study, namely those who live at home and are relatively healthy and able to travel.

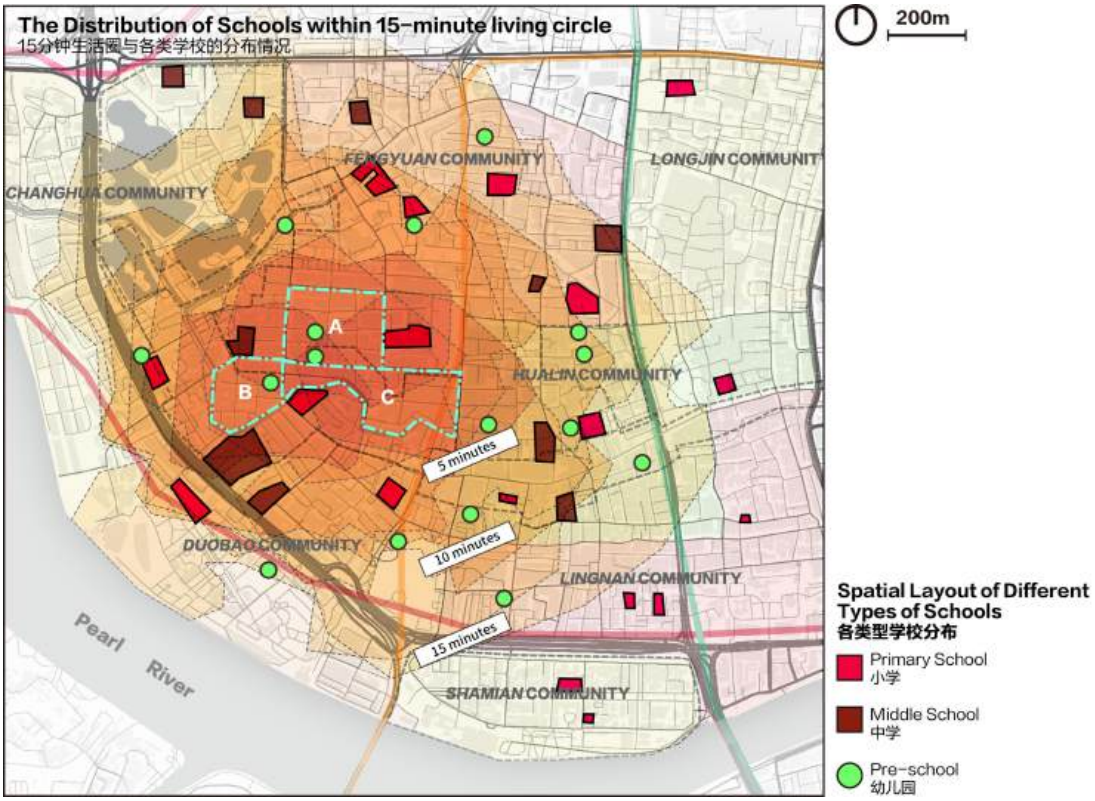


Figure 5-32 Distribution of Schools within the 15-Minute Living Circle
Source: Author

This study also noticed the social phenomenon of elderly people taking care of their grandchildren and picking them up from school. Therefore, the distribution of various types of schools within the 15-minute living circle was also statistically analyzed, and the results are shown in Figure 5-32. We can see that there are many primary and secondary schools and preschools around the study area. This not only reflects the abundance of educational resources in the study area but also indicates that elderly residents living here can easily walk to the corresponding schools if they need to pick up their grandchildren.

Based on the above research on the 15-minute living circle and related urban facilities in the community, we found that the various urban functional facilities within the 15-minute living circle of the study area can better meet the living needs of the elderly. However, there are still some points that can be improved: functions such as markets, elderly activities, and elderly assistance facilities are relatively scattered and have not formed a cluster effect. Therefore, the elderly may need to go to multiple places to complete multiple tasks, which is not very convenient. There is a lack of outdoor activity spaces for residents and elderly cultural stations, and the elderly lack nearby dedicated activity areas.

Therefore, to further enhance the support of urban facilities for the elderly's lives, the following strategies can be considered in the subsequent design: At the intersection of the 5-minute walking isochrones of the three plots in the middle section of Duobao Road, with Duobao Street Market and Fengyuan Fresh Food Market as the core, design surrounding public activity spaces, combining functions such as elderly activities, cultural leisure, day care, and elderly canteens, to provide an elderly urban service cluster.

5.6.3 Urban Public Activity Space System

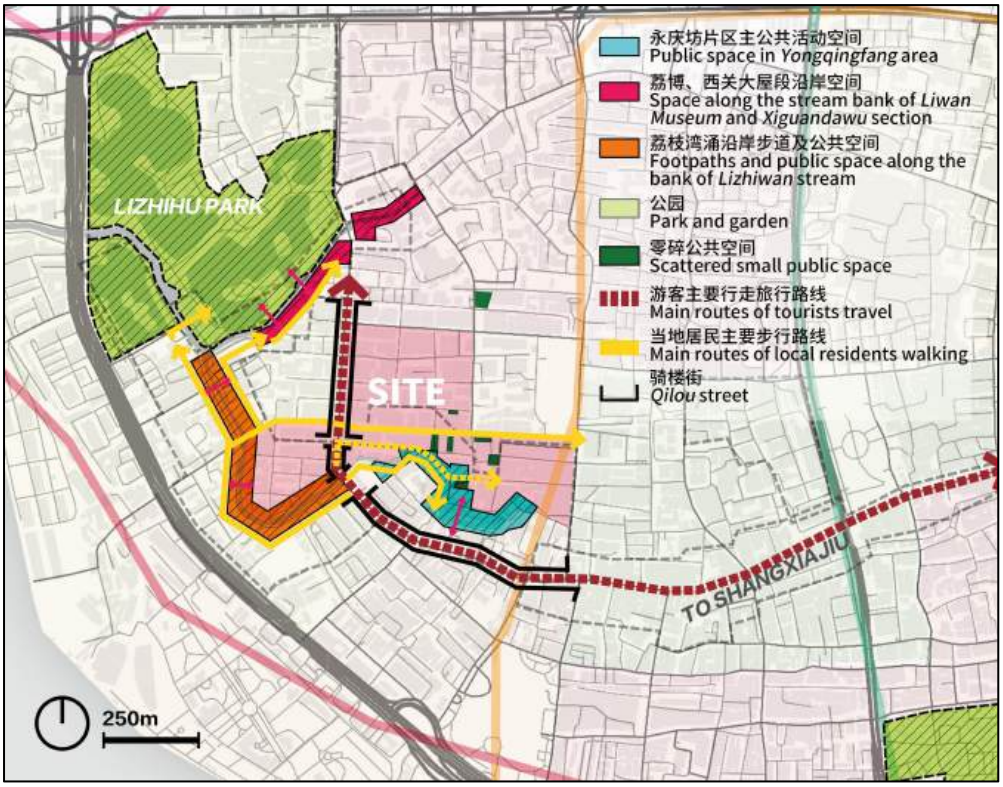


Figure 5-33 Surrounding Public Activity Spaces
Source: Author

Urban public spaces can provide areas for the elderly to exercise, rest, and entertain. Urban public spaces are both the starting and ending points of the elderly's walking behavior. Therefore, this study statistically analyzed the distribution of urban public spaces within and

around the study area, as shown in detail in Figure 5-33.

There are some scattered small public spaces within the study area, mainly concentrated in the communities on both sides of Duobao Road. The “dimension 3” in the checklist has the following requirements: the service radius of small public spaces should not exceed 300 meters, and in public activity centers and high-density communities, it should not exceed 150 meters. This study considers the study area to be a public activity center, so 150 meters should be used as the service radius of small public spaces. From this perspective, the number of small public spaces is insufficient, which is consistent with the inspection results of the community public environment quality in 5.5.3. At the same time, even considering the large and medium-sized public spaces in the surrounding city, some elderly residents in the A plot within the study area cannot find suitable public activity spaces within a 150m radius.

There are various types of urban public activity spaces around the research area. While they serve as tourist attractions, they also provide ample social and recreational venues for the elderly residents within the research area. The following will provide a detailed description of each major urban public space.

The public activity space in the Yongqingfang area, located at the center of the tourist attraction Yongqingfang, mainly attracts tourists. Local residents only come here in the early morning or late afternoon when there are fewer tourists. As for the walkways along the Lizhiwan Stream and the spaces along the Liwan Museum and Xiguan Maisons, these are linear public spaces along the Lizhiwan Stream, with multiple communities and important urban facilities on both sides. The main users are local residents who walk, rest, or fish along the canal. Liwan Lake Park is a large park with beautiful natural scenery, attracting both tourists and local residents. Elderly residents in the research area often come here for various cultural, sports, social, and recreational activities.

At the same time, this study has observed that the walkways along the Lizhiwan Stream not only function as urban activity spaces but also connect two important public space nodes in the area, namely Yongqingfang and Liwan Lake Park. Moreover, this walkway links multiple communities, including the Changhuayuan Community within the research area. Through the linear connection provided by the Lizhiwan Stream, multiple public spaces in the area are linked to form a continuous spatial system.

To better understand the activities of elderly residents in the aforementioned urban public spaces within the research area, this study also conducted research and statistics on the activity times and types of two groups: elderly residents and tourists, in the several public spaces mentioned above. The specific results can be seen in the Figure 5-34. We found that

the activities of elderly residents in the above-mentioned urban public spaces have the following characteristics: In terms of activity time, they are out of phase with the peak times of tourists, mainly visiting in the morning and afternoon. In terms of activity types, they are diverse and related to the types of public spaces. For example, in linear waterfront spaces like the Lizhiwan Stream, they mostly engage in activities such as walking, resting, and fishing. In large parks like Liwan Lake Park, they participate in more free and diverse activities, such as sports, singing, and playing cards. In terms of the activity population and influence range, landmark parks like Liwan Lake Park attract elderly people from a larger urban area to engage in activities, while in contrast, public spaces in the Yongqingfang area and along the Lizhiwan Stream mainly attract elderly people from the surrounding communities.

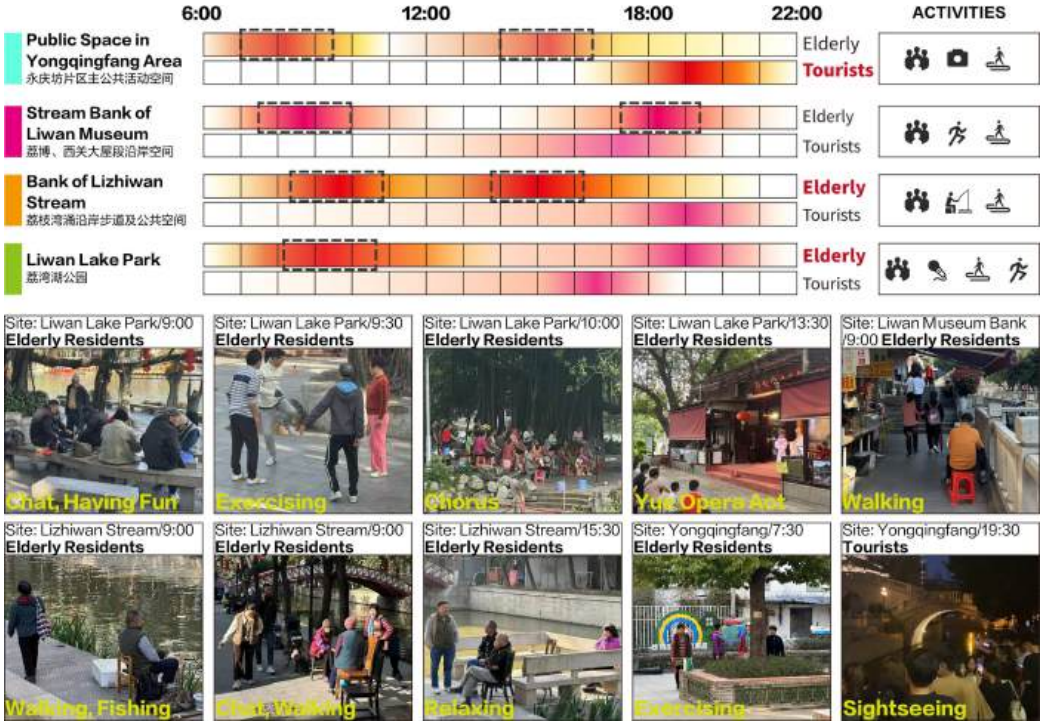


Figure 5-34 Usage of Public Activity Spaces Near the Study Area
Source: Author

Based on the problems and regional characteristics identified in the above research on urban public activity space systems and the activities of people in them, to further enhance the support of urban public spaces for the outdoor activities of the elderly, the following strategies can be considered in the subsequent design: increase scattered small public spaces. Figure 5-35 presents some methods for arranging small spaces, which can be added along the roadside, at street corners, and in areas with concentrated public functions within communities to facilitate the elderly's access to them nearby; pay attention to the development and improvement of public spaces along the Lizhiwan Stream, clear and release the space along the Lizhiwan Stream in Plot B; sort out the relationship between the urban and community

walking network and the regional public space system, and design a dedicated walking path for the elderly to connect various important functions and public spaces within the area.

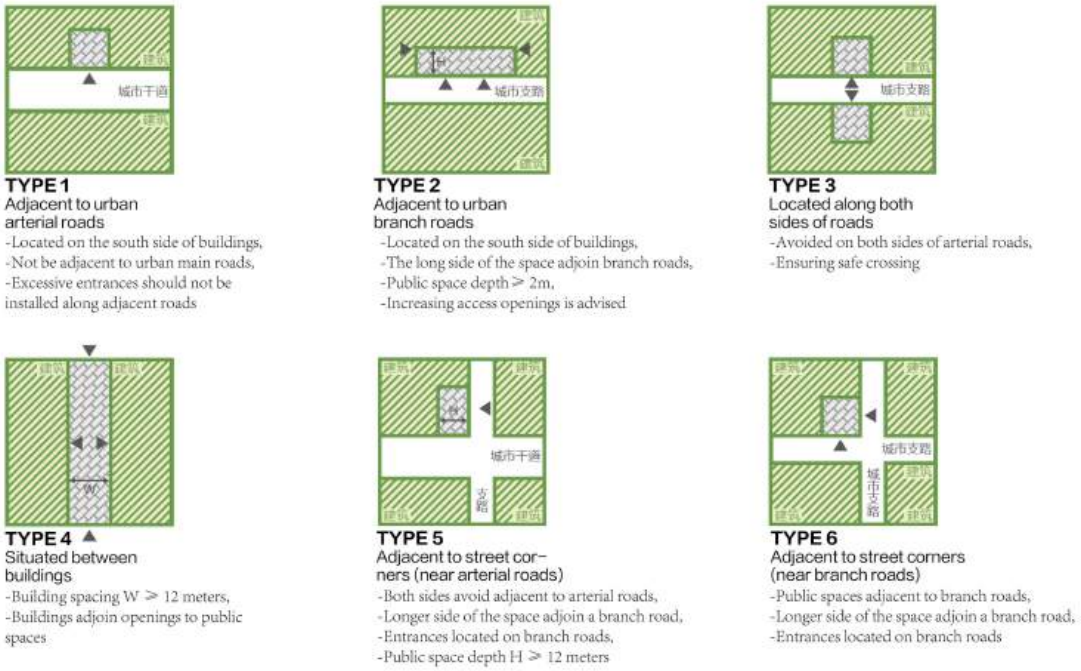


Figure 5-35 Some Layout Methods of Small Public Spaces
Source: Reference [75]

5.7 Key Clue: Historical and Cultural Districts

5.7.1 Historical Evolution

The Duobao Road area is located in the Xiguan region of Guangzhou. This area is roughly west of Renmin Road in today's Liwan District. It gradually developed as a mixed-use area integrating residence, handicrafts, and trade from the late Qing Dynasty to the Republic of China period due to commercial expansion that broke through the limits of the old city[79].

Since the Tang and Song Dynasties, the Xiguan region has been a cluster hub for domestic and foreign merchants. During the Ming and Qing Dynasties, when Guangzhou became the core of the “single-port trade”, the prosperity of the Thirteen Factories trade fueled commercial and residential demands in Xiguan. Wealthy merchants and tycoons constructed mansions here, forming traditional residential clusters characterized by bamboo tube houses and *Xiguan-style* mansions[80]. As illustrated in the following figure, the historical expansion process of the main urban area into the Xiguan region can be observed. During the Ming and Qing Dynasties, the location of the research site was still a field and marshland on the outskirts of the main city. By the late Qing Dynasty, with the expansion of Guangzhou's industry and commerce, the urban area had extended to this region. By the mid-Republic of

China period, the urban fabric of this area was largely established and has been preserved to the present day.

It is also worth noting that the water system in this area has undergone significant changes. With urban development, the water system has gradually contracted. By the early days of the People's Republic of China, only a small section of the Enning Stream (now the Lizhiwan Stream) remained in the southwest corner of the research area. In the 21st century, with the implementation of protection projects for the Enning Road area and the development of Yongqingfang, the government undertook river cover removal and water restoration initiatives. As a result, the water system in the area was revived and restored as an important landscape feature[82].

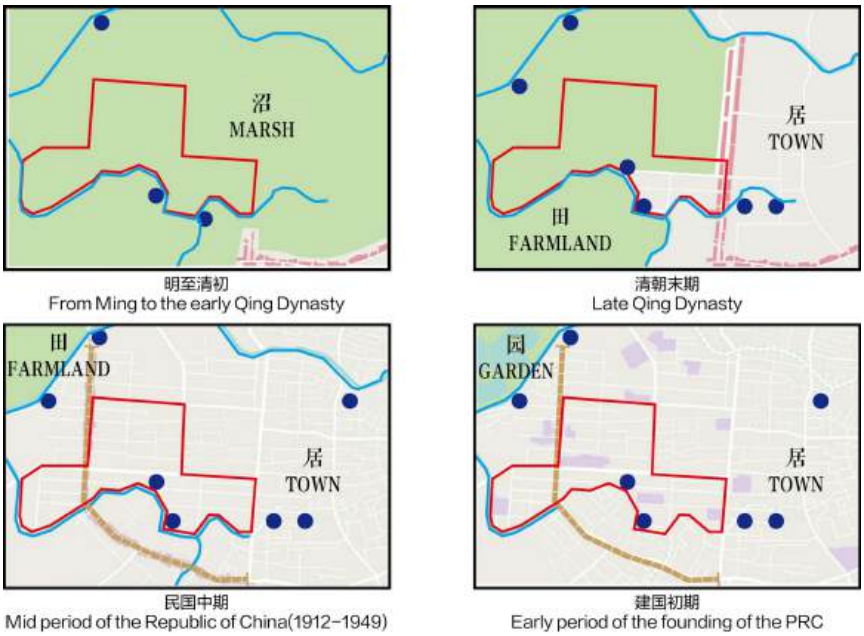


Figure 5-36 Historical Evolution of the Site
Source: Author

A detailed analysis of the various historical and cultural blocks within the study area reveals that the Duobao Road Historical and Cultural District, established in the late Qing Dynasty, is currently the most commercially developed area within the study scope. Notable historical architectural landmarks in this district include Taihua Building and Baoqing Pawnshop[83]. The Changhua Street Historical and Cultural District serves as a “living museum” showcasing Guangzhou's modern residential development, featuring diverse buildings from different periods, such as late Qing Dynasty bamboo tube houses, Republican-era Xiguan Western-style structures, and garden-style independent residences[82]. The Baoyuan Road Historical and Cultural District stands out as the most intact and vibrant area in terms of resident life within the study area, retaining a grid-like road network with a dense distribution of bamboo tube houses and terraced houses[81].

Through an in-depth analysis of the historical evolution of the study area, the following design inspirations can be derived: First, emphasis should be placed on exploring the value of historical buildings, traditional streets, and the Lizhiwan Stream as landscape resources and walking nodes, which could significantly enhance the spatial identity of local elderly residents. Second, efforts should be made to balance commercial activities with residential life in the Duobao Road area and develop an age-friendly pedestrian system tailored to residents' needs. Third, the grid-like road network in the Baoyuan Road area should be further strengthened by opening up dead-end roads to improve connectivity. Finally, public activity spaces should be designed in conjunction with historical buildings and characteristic residences to activate the internal community space and foster social interaction among residents.

5.7.2 Exploration of Historical and Cultural Elements of the Site

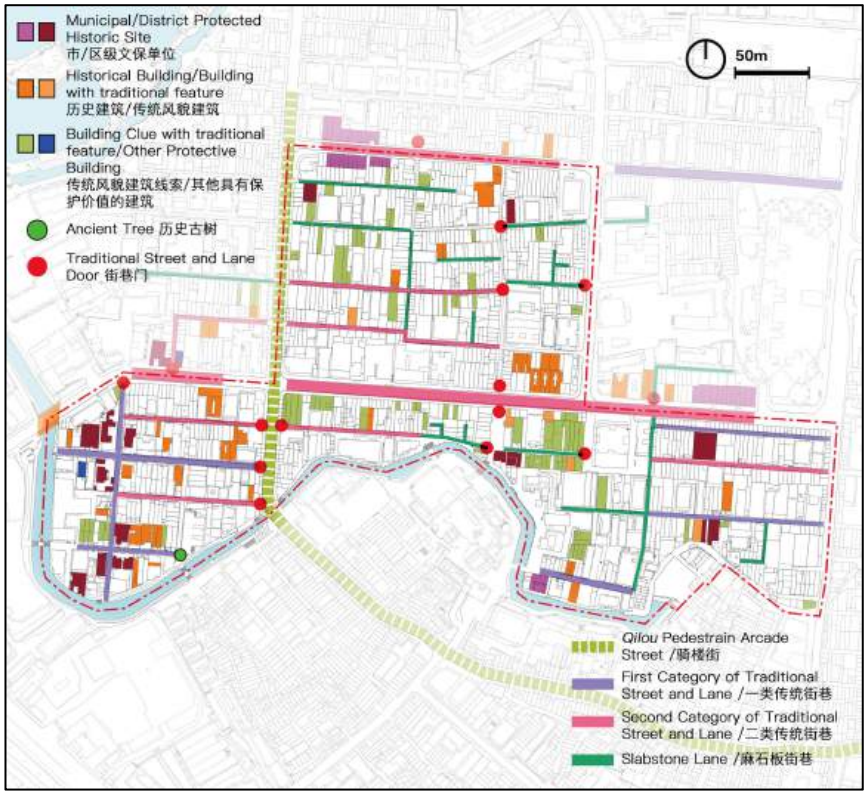


Figure 5-37 Historical and Cultural District Elements in the Site
Source: Author

The study site encompasses three historical and cultural blocks, so during the research and design process, the corresponding historical and cultural elements should also be taken into consideration. On the one hand, when designing within protected historical and cultural districts, efforts should be made to preserve the original urban appearance and comply with the relevant protection planning regulations. On the other hand, some important historical and cultural buildings and nodes will become key clues for subsequent designs and form part of the pedestrian landscape, creating a sense of place.

Based on on-site research and corresponding planning documents, the historical and cultural elements within the study area have been sorted and organized. For specific distribution, please refer to the above Figure 5-31. These elements are mainly divided into two categories: traditional streets and alleys, and historical and cultural buildings. Additionally, there are traditional street gates at the entrances of some communities and districts, which are also important memory points. This study also noted that there is an ancient tree along the Lizhiwan Stream on plot B within the site, which may become an important node in subsequent designs[79].

For the various historical and traditional style buildings within the site, demolition should be avoided in subsequent designs. For some historical building clusters, public spaces can be designed in combination with them to fully utilize their historical landscape features.

For the various historical streets and alleys within the site, the original appearance should be protected in subsequent designs. It is possible to consider designing characteristic pedestrian streets around some of these streets and alleys. For *Qilou* arcade streets and First-category traditional streets and lanes, no changes should be made during subsequent designs, and they should be completely preserved in their original state. For second-category traditional streets and lanes paved with granite slabs, while building characteristic pedestrian paths around them, some roads can be appropriately widened and renovated to enhance the comfort of walking.

5.8 SWOT Analysis and Issues Regarding Walkability of the Site

Based on the research conducted in the previous sections of this chapter, including the overall site conditions, urban street environment, community walking environment, urban facilities, historical and cultural elements, and interviews and questionnaires with activists and stakeholders, the strengths, opportunities, weaknesses, and threats of the current walking space in the study area have been identified. These pieces of information will serve as the starting point for the subsequent design strategy proposal and the design of the elderly walking system. According to the above information, this study has conducted a SWOT analysis as shown in Table 5-7.

Table 5-7 SWOT Analysis
Source: Author

	Strength	Weak	Opportunity	Threat
City streets	1. The density of the pedestrian network is appropriate. 2. Most roads have separate non-motorized vehicle	1. Some roads are one-way, narrow, with heavy pedestrian traffic, and there is competition	1. The pedestrian and vehicle traffic on some roads do not match, and the tidal effect is obvious.	1. The phenomenon of sidewalk parking and business operations is prominent.

	Strength	Weak	Opportunity	Threat
	lanes. 3. The covered walkways on Longjinxi Road and Enning Road offer a relatively comfortable walking experience. 4. The streets have good tree shade and building coverage. 5. The building interfaces on both sides of the streets are generally continuous and even. 6. The street height-to-width ratio is generally appropriate. 7. The street interface has a lively atmosphere and strong commercial vitality.	between pedestrians and vehicles. 2. Some sections of Duobao Road have too few entrances to the blocks on both sides. 3. Some sections of the sidewalks are too narrow. 4. Longjinxi Road and Fengyuan Road lack mid-street crossing facilities. 5. Some crossing points lack barrier-free facilities. 6. Some buildings along the street are too tall, affecting the sense of space on the street.	2. Spatial syntax analysis shows that Longjinxi Road, Enning Road and Duobao Road are prone to gathering crowds.	2. Some sections of the sidewalks lack rest seats. 3. Some sidewalks have height differences and pavement damage problems. 4. The intersection of Duobao Road and Baohua Road is large and lacks crossing channelization islands. 5. E-bikes travel chaotically, posing safety hazards.
Community environment	1. The internal road network of the community is well connected. 2. There are elderly assistance services within the community. 3. The community has a rich variety of convenient commercial facilities. 4. The community entrances are reasonably set up.	1. The FAR of Baoyuan Community is too high. 2. The green coverage rate within each community is low, lacking green spaces and tree shade. 3. The community roads are too narrow. 4. There are problems of street vending and parking, as well as garbage and debris accumulation within the community roads. 5. Some community alleys have damaged and uneven pavement. 6. There is a lack of public activity spaces within the community, and they are scattered. 7. Public spaces lack rest seats. 8. There are areas without light at night.	1. Some communities have historical protection buildings within them.	1. Baoyuan Community has many dead-end roads. 2. Some community roads are not accessible to ambulances. 3. There is a mixture of pedestrians and vehicles on some community roads. 4. There is a lack of signage systems. 5. The community lacks basic sanitation facilities and elderly entertainment venues.

	Strength	Weak	Opportunity	Threat
Urban facilities	1. Public transportation is convenient, with strong accessibility to bus and metro stations. 2. Within a 15-minute living circle, there are various commercial formats and public facilities. 3. The walk score of the main roads in the research area is high. 4. There are abundant elderly care homes and medical resources. 5. Within a 15-minute living circle, there are numerous primary and secondary schools and preschools with good accessibility. 6. There is a large park within a 15-minute living circle.	1. There is a lack of outdoor fitness areas, cultural activity stations, convenience service points, and community activity centers in the research area. 2. There are insufficient and scattered small public activity spaces within a 15-minute living circle.	1. Elderly-related functions such as markets, elderly activity areas, and elderly-care facilities are scattered in the research area and have not formed clusters. 2. Liwan Lake Park and LiZhiwan Stream attract a large number of elderly residents to engage in various activities. 3. LiZhiwan Stream connects multiple urban elements to form a spatial system.	1. Some areas near Yongqingfang are overly commercialized with a mixed crowd.
Historic district	1. The streets have a distinctive regional historical style.	1. The quality of buildings and alleys varies, and some alleys lack maintenance.	1. Historical alleys, historical buildings, and ancient trees, among other elements of the historical and cultural district, can serve as design clues.	1. The historic district and scenic spots attract a large number of tourists.
Elderly residents	1. Elderly residents are moderately satisfied with the flatness, accessibility, and anti-slip properties of the walking paths. 2. Elderly residents have a high recognition of the spaces along Liwan Lake Park and LiZhiwan Stream.	1. Elderly residents have significant concerns about various street occupation issues. 2. The passage of people in public areas with unclear functions makes elderly residents who are active there feel embarrassed.	1. Elderly residents mainly walk to public transportation, markets, and parks. 2. Elderly residents value shaded walking environments and hope for more rest seats and public toilets. 3. Elderly residents hope to widen some narrow walking paths. 4. Social workers mentioned that the space around the market could be developed and utilized.	1. The safety of walking spaces needs attention, as the passage of various vehicles and E-bikes poses a threat to the elderly.

Based on the above SWOT analysis and the in-depth research on the study area in the previous text, this study summarizes the main problems faced by the elderly walking

environment in the site as follows.

(1) Urban Streets: The walking environment needs improvement, the status of pedestrians and vehicles is unequal, and crossing safety needs to be considered

The quality of the sidewalk environment on urban streets has room for improvement. The most prominent problem is that some sections of the sidewalks on Duobao Road, Baoyuan Road, and Baohua Road are too narrow, and some sections of Duobao Road have street vendors and non-motorized vehicles occupying the walking space. Secondly, some sections of the sidewalks lack rest seats, have damaged pavement, and have height differences, which also affect the walking experience of elderly residents. In addition, some sections have buildings that are too tall on both sides, making the street space feel oppressive.

On some sections, the status of pedestrians and vehicles is unequal, with pedestrians and vehicles competing for the road, resulting in low traffic efficiency. Baoyuan Road and Baohua Road are one-way streets. Especially on the section of Baohua Road south of Duobao Road, the road is narrow, the pedestrian flow is huge and has obvious tidal characteristics, while the vehicle flow is not large, resulting in competition between pedestrians and vehicles and a poor walking experience and safety. Baoyuan Road has a similar problem, but not as prominent as Baohua Road.

In terms of crossing safety, some sections lack proper crossing facilities, reducing the safety of crossing the road. On Fengyuan Road and Longjinxi Road, there is a 250-meter-long section without a mid-street crossing facility. Elderly residents will inevitably cross the road at unmarked locations, which poses a significant safety hazard. There are also issues with the standardization of crosswalk facilities. For instance, some crosswalks on Duobao Road lack accessible ramps on both sides. Another concern is the problem of E-bikes crossing the road. Elderly residents often need to cross the road on Duobao Road, but E-bikes rarely slow down or give way at crosswalks.

(2) Community environment: The community road network needs to be improved, the public environment needs to be enhanced, and elderly-care services need to be strengthened.

The internal road network of the community needs to be further organized to improve connectivity. On one hand, there are problems with dead-end roads, which are particularly prominent in Baoyuan Community. On the other hand, the number of communities entrances to the outside is relatively small, especially in Baoyuan and Taihua Communities, where there are too few entrances and exits connecting to Duobao Road, which is a key pedestrian area in this region. This reduces the convenience for elderly residents to go out.

The public environment of the community also has room for improvement. In terms of

the walking experience on internal roads, the old alleys are too narrow and often have to share the space with non-motorized vehicles. Additionally, some historical alleys lack maintenance and have damage issues. The problem of road occupation within the community is also prominent. Near the community fresh food market, there are issues of street vendors and the debris. Non-motorized vehicles park on the community roads. And in Changhuayuan Community, there are also problems of motor vehicles occupying the roads. Regarding the community's public activity spaces, the green coverage rate is low, and the lack of green spaces and shade is a common problem. At the same time, issues such as insufficient night lighting and a lack of rest seats are also quite obvious.

In terms of elderly care services within the community, the current conditions are relatively sufficient, but there is still room for improvement. The community lacks basic health stations and indoor activity and entertainment venues for the elderly. These service facilities can enhance the quality of life for elderly residents in the community. Moreover，Taihua Community and Yongqingfang Community lack elderly care facilities. Although they can obtain services from nearby communities, adding such facilities would improve the quality of life for the elderly in these communities.

(3) Urban facilities: Elderly-care facilities need to be added, and elderly-related functions are scattered.

In terms of the supply of urban functional facilities, the study area has a rich variety of businesses and good basic conditions, and its service efficiency can be further improved. Within the 15-minute living circle, there is a lack of outdoor fitness areas, cultural activity stations, convenience service points, and community activity centers.

At the same time, it is observed that the study area's fresh food markets, elderly activity venues, and elderly-care facilities, which are closely related to the lives of the elderly, are scattered and have not formed clusters. This means that elderly people may have to travel to multiple places in one outing, which is not very convenient.

(4) Public spaces: More activity spaces are needed, functional definitions should be clear, and public spaces should form a system.

The majority of elderly residents' outdoor activities are absorbed by the Liwan Lake Park and the banks of the Lizhiwan Stream around the study area. However, there are few small public activity spaces within the community or along the streets for elderly residents to choose from nearby. The existing few small public activity spaces, such as the “Duobao Gufang” area beside Duobao Road, often become urban wastelands due to unclear functional definitions and lack of appeal.

The public activity spaces in the study area and its surroundings also have the problem of

being scattered and not forming a system. This results in the small public spaces having a limited radiation range and reduced appeal. If they can be combined with walking loops, key facilities such as fresh food markets, or linear public spaces like the Lizhiwan Stream, their appeal may be enhanced.

5.9 Summary

This chapter conducts a thorough investigation and exploration of the walking preferences of the elderly and the current status of walkability in the Duobao Road area. Firstly, through questionnaires, the behavioral and spatial preferences of elderly residents in the Duobao Road area for outdoor walking were surveyed. Through interviews combined with on-site observations, the preferences of local elderly residents for public spaces and walking routes were understood.

Secondly, this paper uses the checklist constructed in Chapter 4 to investigate the built environment's walkability in the Duobao Road area. The investigation of urban streets analyzed the existing unfriendly factors in the walking network, sidewalk environment, crossing, intersections, and street interface; the investigation of the community environment analyzed the existing unfriendly factors in the overall structure, internal road quality, and public environment of several communities within the study area; the investigation of urban facilities analyzed the insufficiencies in promoting and supporting the walking of the elderly group by various urban facilities and surrounding public activity spaces within the 15-minute living circle. This section also statistically analyzed the elements related to walking in the historical and cultural districts within the Duobao Road area.

Combining the above research results, through SWOT analysis, this chapter summarizes the existing deficiencies in walkability in the Duobao Road area, facilitating the proposal of targeted strategies in subsequent designs.

Chapter 6 Design Strategies and Application Plans

6.1 Design Strategies and Intentions

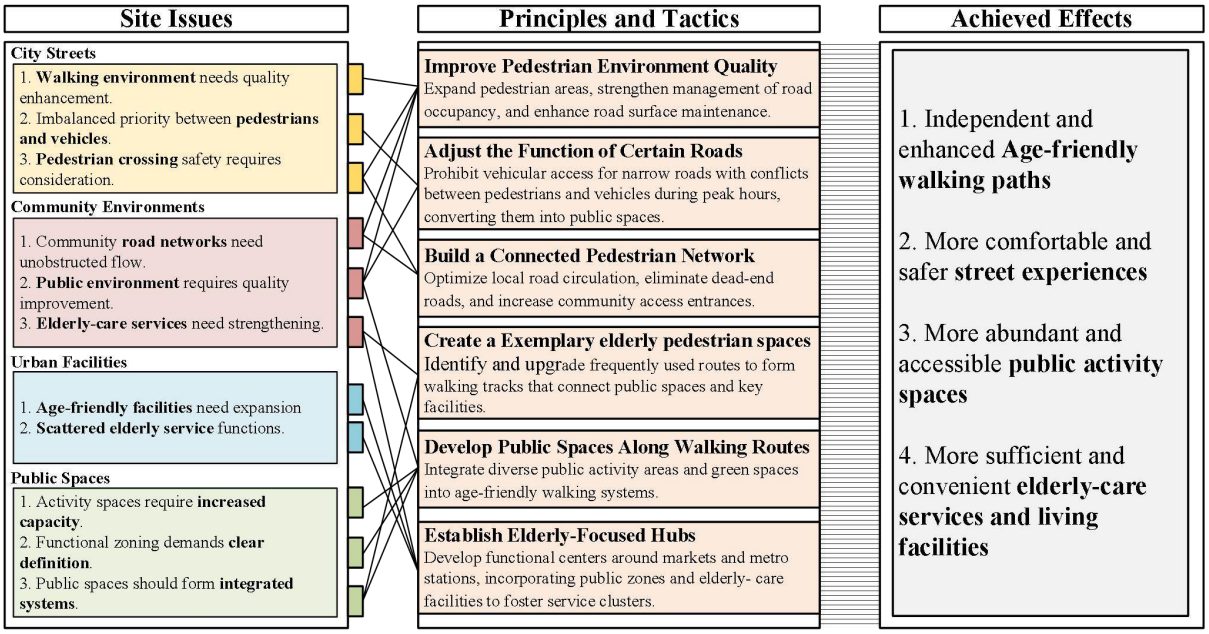


Figure 6-1 Design Principles and Strategies
Source: Author

Based on the detailed investigation of the research site in accordance with the checklist for walkability in aging urban area constructed in Chapter 4, Chapter 5 of this thesis comprehensively analyzed the current walkability status of the Duobao Road area in Liwan District, Guangzhou City.

According to the content of Chapter 5, the main problems related to walkability currently existing in the site are summarized as follows:

Firstly, at the urban street level, there are notable challenges such as narrow sidewalks, sidewalk occupation, and insufficient rest seating, requiring improvements in environmental quality. On some roads, pedestrians and vehicles experience unequal status due to narrow road widths, leading to competition for space and a suboptimal walking experience. Additionally, there is either a lack of crosswalk facilities or inadequately standardized facilities, which compromise the safety of elderly pedestrians when crossing streets.

Secondly, at the community environment level, the current community road network exhibits issues such as dead-end roads and insufficient external exits in certain areas, negatively impacting the connectivity of the community road network. The community public environment requires enhancement, with narrow internal roads, unauthorized occupation, and inadequate maintenance. Furthermore, each community lacks sufficient public spaces and greenery, and the existing public spaces are of low quality. The provision of community

services is also insufficient, lacking essential facilities such as health service stations, elderly activity stations, and elderly-care facilities.

Thirdly, at the urban facility level, services within the 15-minute living circle can be further optimized. Currently, there is a shortage of several types of facilities critical to elderly residents' lives, including outdoor fitness areas, cultural activity stations, and community activity centers. Moreover, functions related to elderly life within the 15-minute living circle are scattered and have not formed cohesive clusters, reducing convenience.

Finally, at the urban public space system level, there is a current deficiency in elderly-specific activity spaces, necessitating their addition. Additionally, some existing open spaces lack clear functional definitions, exhibit poor attractiveness, and operate independently without forming a systematic network among various public spaces within the area.

In response to these challenges, drawing upon the renovation strategies summarized in Sections 3.3 and 4.5 based on real-world cases and corresponding standards, this study proposes the following design strategies to address the aforementioned issues:

(1) Enhance the Quality of the Pedestrian Environment: At the spatial level, widen sidewalks, add pedestrian crossing facilities at necessary mid-block locations, and elevate certain road sections where appropriate. At the management level, strengthen regulation of road occupation and ensure regular maintenance of road surfaces.

(2) Adjust Road Functions: For narrow sections experiencing conflicts between pedestrians and vehicles, consider redefining their functions. During peak pedestrian hours, prohibit vehicle access on these sections and repurpose them as temporary public spaces to facilitate pedestrian movement.

(3) Build a Connected Pedestrian Network: Improve the micro-circulation of the road network by adjusting the local road network within communities and connecting dead-end roads. On select sections, introduce additional entrances to adjacent blocks to enhance connectivity.

(4) Create Age-Friendly Exemplary Walking spaces: Select roads and areas where elderly residents are highly active, widen and specially renovate them, and pay attention to the layout of surrounding elderly living facilities and public activity spaces.

(5) Arrange public spaces around the pedestrian system: Along the main roads of the pedestrian network, set up various public activity spaces and green spaces with distinct themes and appropriate functions to form a public space system.

(6) Establish Elderly Function Centers: Surround key facilities such as fresh food markets and metro stations to create integrated elderly function centers, incorporating public activity

areas, elderly-care facilities, and other supportive amenities to form functional clusters.

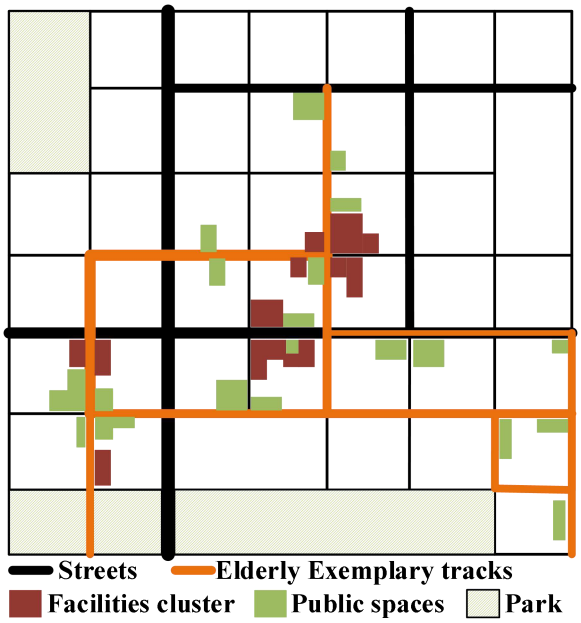


Figure 6-2 Schematic Diagram of Design Strategies
Source: Author

Through these comprehensive measures, this study aims to construct an independent and more enjoyable elderly pedestrian system for the elderly residents around Duobao Road, create more diverse and accessible public activity spaces, provide a more comfortable and safer street experience, and offer more abundant and convenient elderly assistance services and living facilities.

6.2 Design Principles

(1) Holistic design from multiple dimensions of the Duobao Road area

The factors influencing walkability are multi-dimensional, covering not only the physical space elements of the street that affect the quality of the walking space, but also the urban functional facility elements that affect the satisfaction of walking travel demands. Correspondingly, the existing walkability problems in the Duobao Road area discovered in this thesis are also multi-dimensional.

Therefore, this design should start from the overall site and be carried out from multiple perspectives to enhance the walkability of the Duobao Road area. It is necessary to design the overall pedestrian network, renovate the street space and community public space, and strengthen the services of various urban facilities in the area, enhancing the walkability of Duobao Road from multiple perspectives.

(2) Protection as the Premise, Minimizing Damage to Historical Status Quo

The study area falls within the scope of Guangzhou's historical and cultural city. Preservation remains the primary premise. When renovating walking spaces, this design

should avoid altering first-category traditional streets and lanes and maintain their current state. For the renovation of other traditional alleys, irreversible damage to the original pavement must be avoided. When demolishing or renovating certain buildings within the study site, destructive operations such as the demolition or structural modification of historical buildings must be avoided. This can primarily be achieved through functional replacement and quality enhancement to improve their usability.

While designing age-friendly pedestrian spaces, it is also essential to protect and preserve the cultural value of the site. Ensuring that the original site context and clues remain intact, the design should flexibly accommodate the travel needs of the elderly.

(3) Enhancing Walkability Based on the Needs of Elderly Residents and Site Issues

This thesis, in the context of an aging society, focuses on the severely aging population in the Duobao Road area. The design should start from the specific needs and preferences of local elderly residents to create a more age-friendly walking space. When enhancing walkability, the design should, on the one hand, respond to the walking preferences of elderly residents in the Duobao Road area and meet their needs, and on the other hand, conduct specialized and detailed designs for areas where the elderly frequently walk. At the same time, it should strive to solve the current walking space problems identified in the Duobao Road area through the research in Chapter 5.

6.3 Identification of Key Spatial Nodes

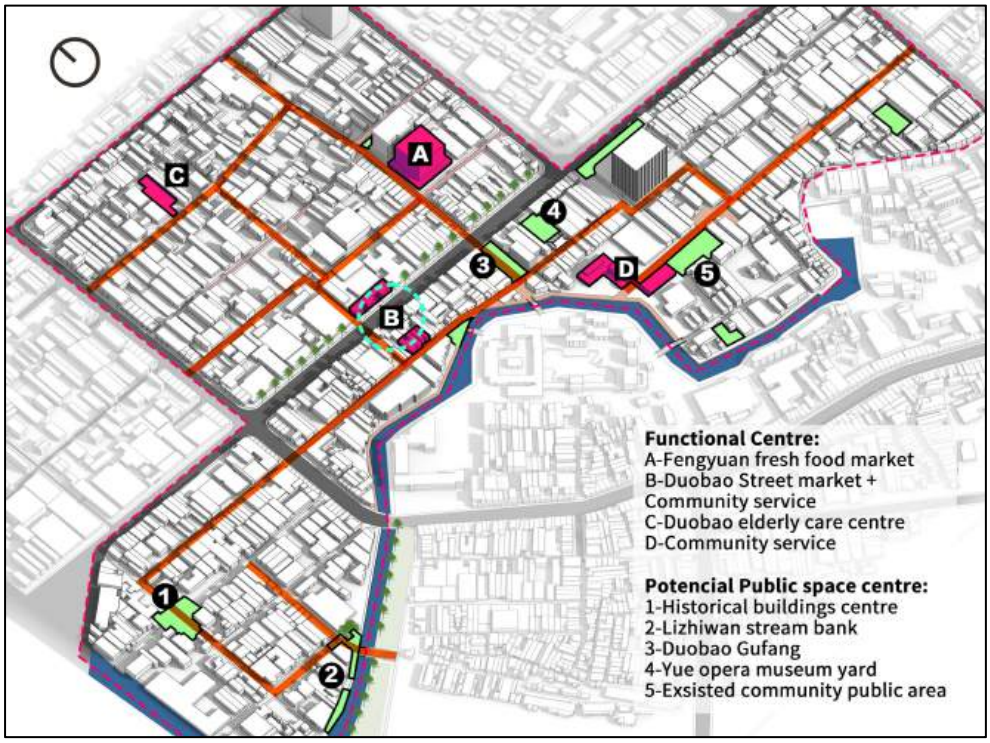


Figure 6-3 Potential Spatial nodes in the Site
Source: Author

Based on the above discussion, the construction of the elderly functional center and the public space system requires the identification of some existing functional elements within the study site. Through an analysis of the site's functions, this study has identified the following areas as important functional centers and potential public spaces:

Table 6-1 Key Spatial Nodes
Source: Author

Type		Location	Spatial and Functional Characteristics	Considered Design Directions
Functional Center	A	Plot A (Baoyuan Community) Fengyuan Fresh Food Market	The ground floor is a market, surrounded by shops and small vendors, with a narrow space where residents often gather.	Consider adding public spaces around for elderly activities and vendors to set up stalls, and install some elderly facilities.
	B	Duobao Street Market + Duobao Street Community Cultural Center	Located on both sides of Duobao Road, surrounded by street vendors, close to urban roads, with a narrow space where residents and pedestrians gather.	Consider adding entrances leading to the community interior, installing elderly facilities, and elevating some surrounding buildings to create a stall area that can also be used for activities.
	C	Duobao Street Elderly Care Service Center	Located inside the community, near community alleys, with a narrow space, providing full-time care and meal services, and with relatively low foot traffic.	Release the surrounding space, add green public spaces, and add elderly entertainment functions around.
	D	Plot C (Taihua Community) Community office center	Near Yongqingfang, with a relatively spacious surrounding space, conducting various community management tasks, and the attached buildings also have some cultural functions, with tourists gathering around.	Release the public space on the side of the building facing the community, and combine it with the Yongqingfang Anti-Drug Theme Park to build an elderly activity area.
Public Space	1	Changhuayuan Cluster of Nationalist Era Residences	At the intersection of community walking paths, relatively spacious, surrounded by protected buildings.	Combine with the community walking system and utilize the surrounding historical building landscapes to build a community square.
	2	Lizhiwan stream Bank	Along the Lizhiwan stream, a narrow linear waterfront space with good landscape conditions, and also featuring ancient trees and small bridges.	Release the space along the stream and build a linear waterfront park; build landscape squares around the ancient trees and bridges.
	3	"Duobao Gufang" Open Space	Adjacent to Duobao Road, the northern exit of the Yongqingfang Tourist Area, spacious, with dense historical buildings around, and pedestrians passing through.	Clarify the function and make a good functional division, and set aside part of the open space for public activities.
	4	Baoqing Cantonese	Adjacent to Duobao Road, spacious,	Strengthen the renovation and add

Type		Location	Spatial and Functional Characteristics	Considered Design Directions
		Opera Cultural museum Open Space	not fully developed yet, and in a state of disuse.	activity functions.
	5	Yongqingfang Anti-Drug Theme Park	Near the Taihua Community Office center, relatively spacious, with not many people, and mainly local elderly residents.	Combine with the surrounding space to expand the area, change the park theme, and strengthen the support for elderly activity facilities.

6.4 Design Framework

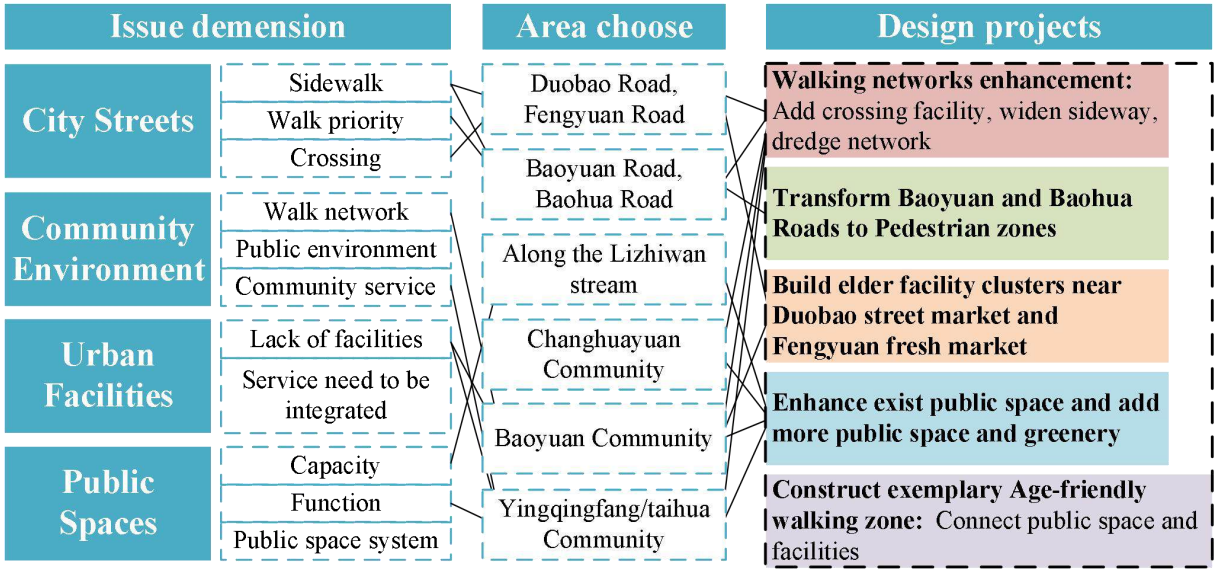


Figure 6-4 Design Framework and Key Projects
Source: Author

Based on the site issues identified in the previous sections and the summarized design strategies, the following design will focus on the following sub-projects:

Firstly, the pedestrian network quality improvement project, targeting urban roads and internal community roads. This project primarily involves widening sidewalks on Duobao Road and certain internal roads in Baoyuan Community, enhancing the walking experience through the addition of rest seats, roadside landscapes, and improved pavement quality. Additionally, pedestrian crossing facilities will be added on Duobao Road, Longjinxi Road, and other key roads. The speed of passing vehicles and E-bikes will be controlled by partially raising road elevation, partially narrowing road widths, and adding indication signs to ensure safety. Some dead-end roads within Baoyuan Community will be opened up, and additional community entrances will be added along both sides of Duobao Road in Yongqingfang Community and Baoyuan Community to enhance connectivity.

Secondly, it is proposed to convert certain sections of Baoyuan Road and Baohua Road into pedestrian streets during peak pedestrian hours. During this period, vehicle traffic will be

prohibited, and creative markets or fitness walking areas can be established along these roads, leveraging their commercial functions and historical buildings.

Thirdly, a cluster of elderly facilities will be constructed. It is proposed to establish an elderly comprehensive service center near Fengyuan Fresh Food Market and Duobao Street Market, providing medical, entertainment, and cultural services to elderly residents in surrounding areas. Simultaneously, some public areas can be appropriately arranged to effectively guide street vendors and provide activity spaces for residents.

Fourthly, the quality of existing public spaces will be improved, and more public spaces and green areas will be added. On one hand, the quality of certain existing urban vacant lots and public activity areas will be enhanced, with their functions re-planned to improve usability. On the other hand, micro-public spaces and greenery will be added within communities, at key nodes, and along elderly walking routes.

Finally, exemplary age-friendly walking zones will be constructed. Based on the research conducted earlier, the areas frequently walked by the elderly should be specially designed, with the addition of elderly living facilities, elderly-care institutions, public activity spaces, green spaces and other elements around these areas.

6.5 Overall Design

Based on the site issues and design framework identified in the previous sections, this study proposes the following design. The master plan is as Figure 6-5.

This design can be divided into four main levels: site environment and facility buildings, regional pedestrian network, public activity spaces and green systems, and the exemplary age-friendly walking area. The specific relationships are illustrated in the following exploded analysis diagram Figure 6-6.

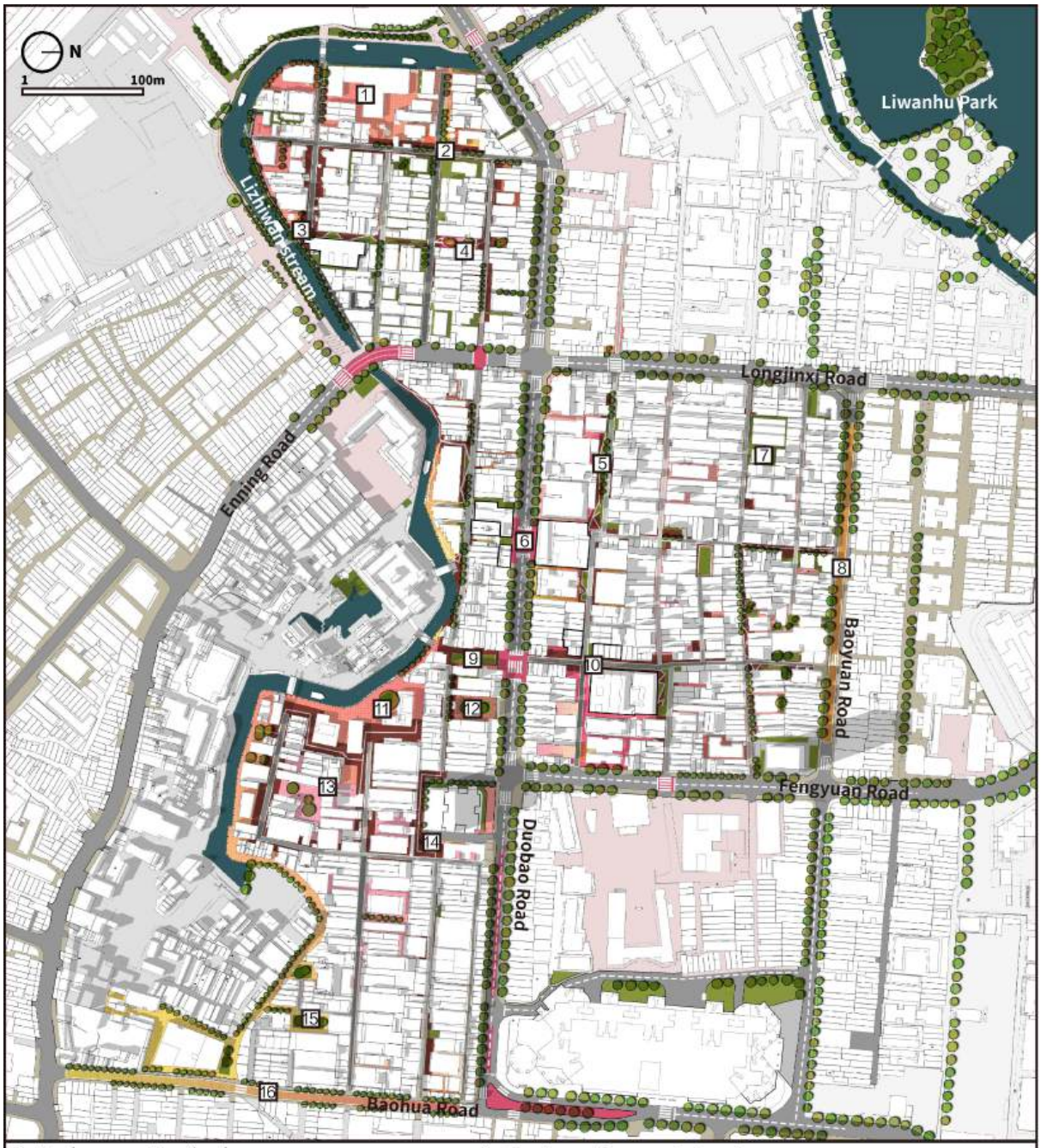


Figure 6-5 Master Plan
Source: Author

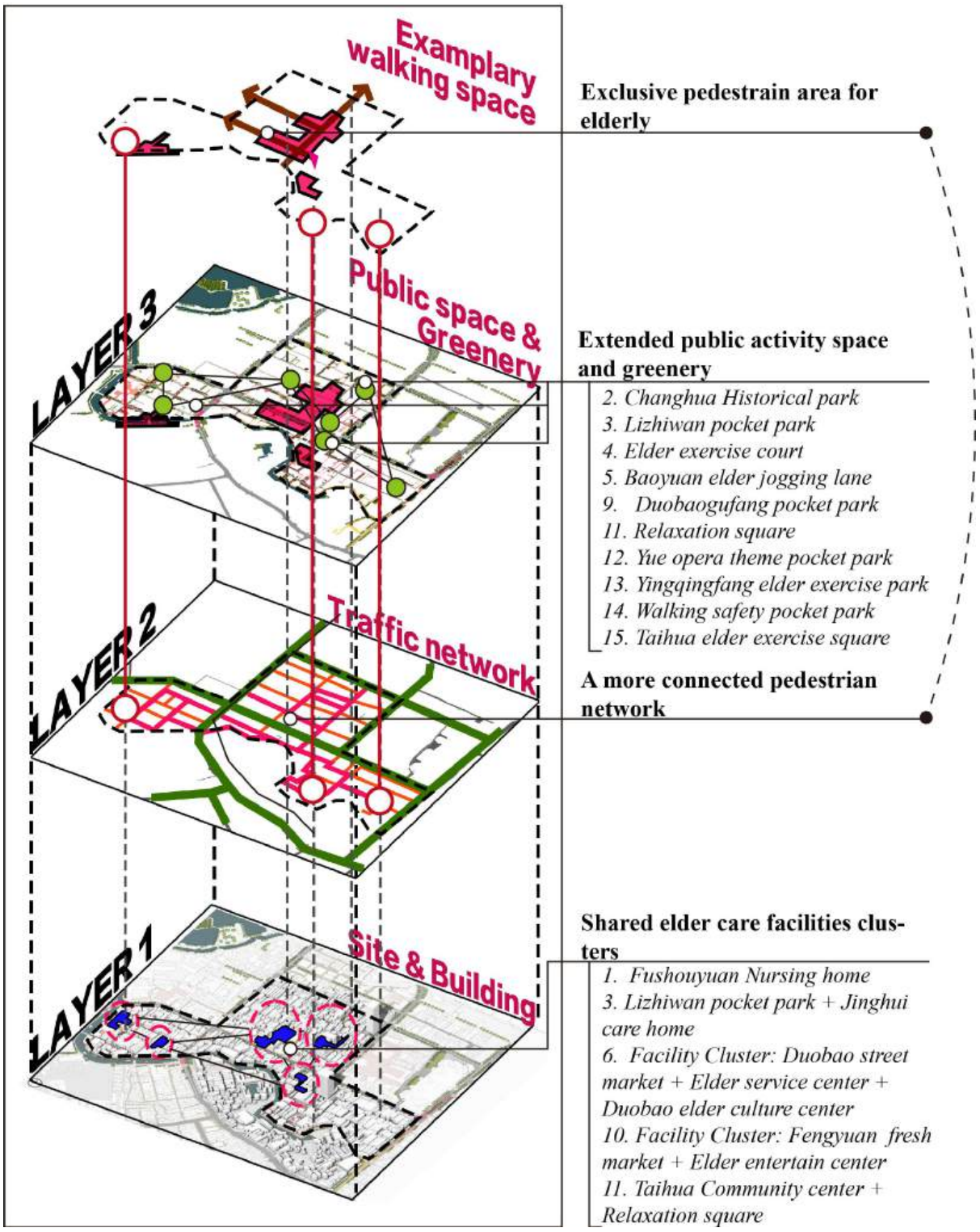


Figure 6-6 Explosion Schematic Diagram
Source: Author

Figure 6-7 Axonometric Drawing of the Design
Source: Author

6.5.1 Demolition and Renovation of the Buildings

This design involves the demolition of certain buildings within the study area. These buildings are primarily of poor quality and low preservation value. When selecting buildings for demolition, the design team exercised restraint, minimized the scope and volume of demolition, and preserved existing structures to the greatest extent possible.

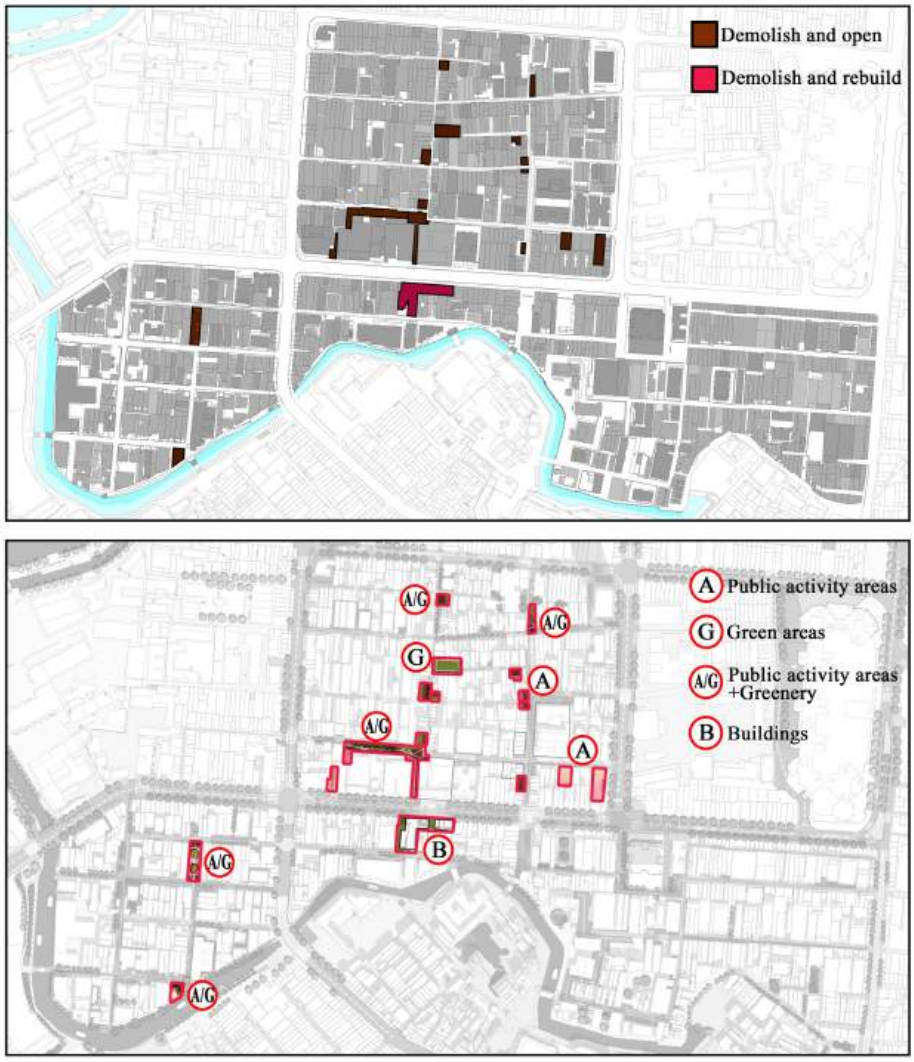


Figure 6-8 Demolition of Existing Buildings
Source: Author

For the space released by demolishing existing buildings, this design primarily implemented the following treatments: adding public activity areas or green spaces, expanding the area of existing public spaces and the width of internal pedestrian paths within the community, and constructing new public facilities to supplement missing urban elderly support facilities.

Through the measure of demolishing certain buildings to release space, this design addressed some of the site issues identified in Chapter 5, as detailed in the following Table 6-2.

Table 6-2 Issues Addressed by Demolishing Some Buildings
Source: Author

Dimension	Before Design	After Design
Urban Streets	There were too few pedestrian entrances on both sides of some sections of Duobao Road.	By demolishing buildings, three new pedestrian entrances were opened on both sides of the relevant sections of Duobao Road.
	Pedestrian sidewalks were frequently occupied by vendors.	By demolishing buildings, public spaces were added around the market, which could be used by vendors during specified hours.
Community Environment	The FAR of Baoyuan Community was too high.	After demolishing some low-quality buildings, the floor area ratio of Baoyuan Community dropped below 5.
	The roads in Baoyuan Community were too narrow.	By demolishing some buildings, the space of some roads within Baoyuan Community was widened.
	There was a lack of green spaces within each community. There was a lack of public activity spaces within each community.	After demolishing some buildings, the released space was partly transformed into activity areas with greenery, and partly, along Duobao Road, a new elderly function center was built, including medical care, cultural entertainment and other functions.
	There was a lack of medical facilities and elderly entertainment venues within each community.	
Urban Facilities	There was a lack of outdoor fitness areas, cultural activity stations, convenience service points and community activity centers.	
	There was a shortage of small public activity spaces within the living circle.	

In addition to demolishing some buildings, this study also renovated some existing buildings in the community and introduced new functions, which partially addressed the issue of the community's lack of living services. This part will be discussed in more depth in 6.5.3 below.

6.5.2 Adjustment of roads at Different levels

This design has connected some dead-end roads within the study area and added some community entrances. This has increased the connectivity and accessibility of the pedestrian network within the study area and enhanced the circulation of the road network. The design has also added more pedestrian crossing facilities and upgraded some existing ones. This not only improves the safety of elderly residents when crossing urban roads but also enhances the connectivity of the pedestrian system within the study area.

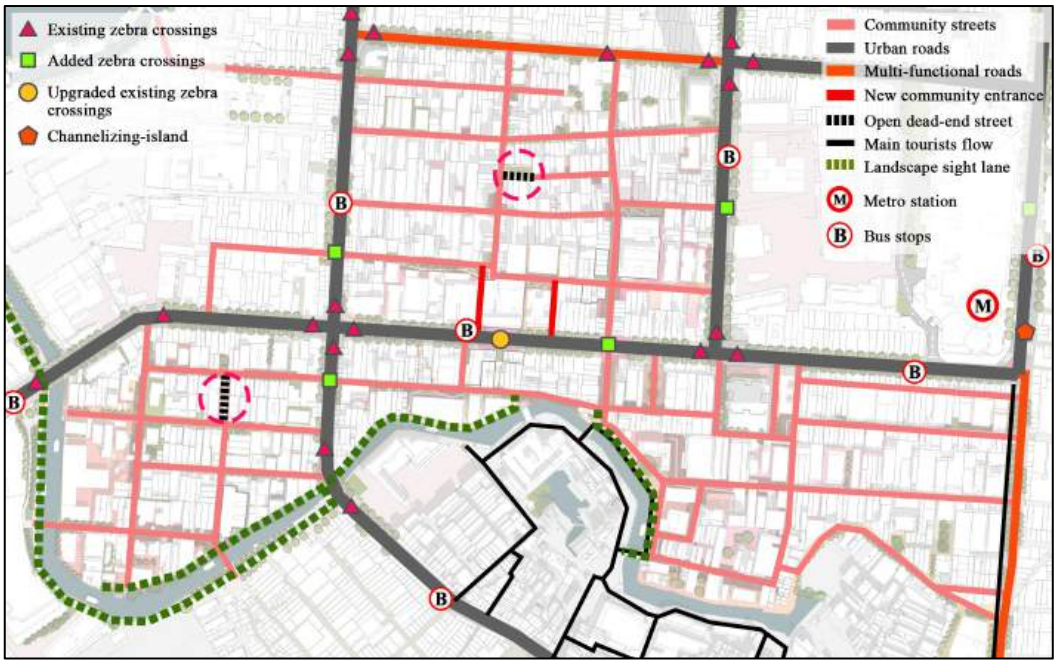


Figure 6-9 The Pedestrian System Constructed by the Design
Source: Author

As shown in the above figure, this design has made adjustments to the structure of the pedestrian system. Through these adjustments, this design has solved some of the site problems identified in Chapter 5, as detailed in the following Table 6-3.

Table 6-3 Issues Solved by Adjusting the Pedestrian Network
Source: Author

Dimension	Before Design	After Design
Urban Streets	Some sections of Duobao Road have too few entrances on both sides of the streets.	Add three pedestrian entrances on both sides of the relevant sections of Duobao Road to connect the internal road network of the community to Duobao Road.
	Longjinxi Road and Fengyuan Road lack mid-street crossing facilities.	Add pedestrian crosswalks on the relevant roads to ensure that there is a crossing facility every 150-200 meters.
	Some crossing points lack accessibility measures.	Add ramps at locations lacking barrier-free facilities or make local modifications to raise the road surface to the same height as the sidewalks on both sides.
	The passage of various types of cars and e-bikes poses a threat to the elderly	
	Some sections of the sidewalks on Duobao Road are too narrow.	Widen the sidewalks on Duobao Road.
	The intersection of Duobao Road and Baohua Road is large and lacks pedestrian channelization islands.	Add a channelization island here to separate the traffic flow and reduce the width of the crossing.
Community Environment	There are many dead-end roads within Baoyuan Community.	Remove buildings and add public spaces to clear some of the dead-end roads.
	Some sections of the driving lanes in Changhuayuan Community have mixed traffic of pedestrians and vehicles.	Modify the road function and change it to only allow pedestrians and special vehicles to pass.

For issues related to the quality of the pedestrian environment, such as illegal parking on

sidewalks and the accumulation of garbage and debris on community roads, solutions should be sought through enhanced management and the addition of garbage disposal stations. For problems like the lack of rest seats and damaged pavement on some sidewalks, deficiencies should be addressed by installing rest seats in major pedestrian areas and repairing damaged road surfaces.

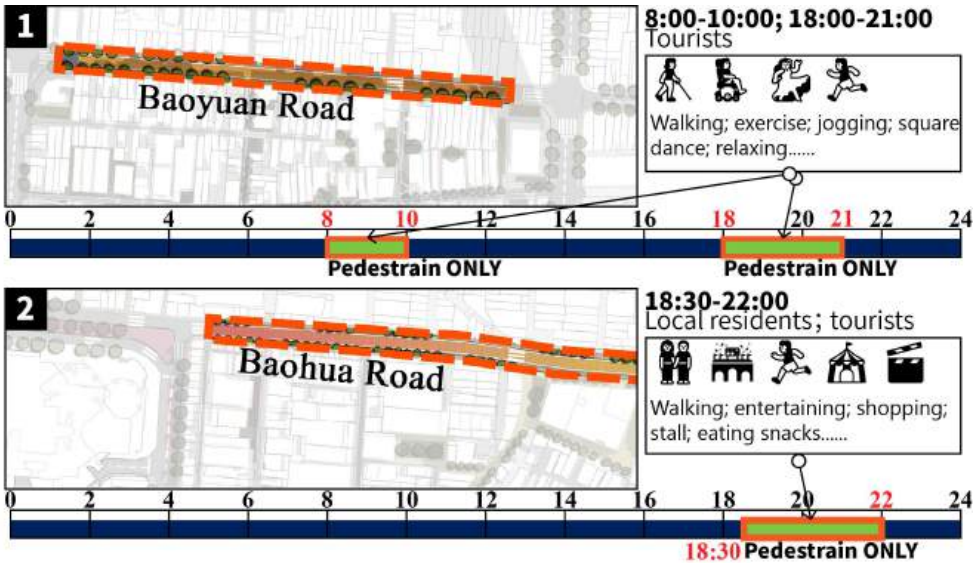


Figure 6-10 Time-based Vehicle Restrictions
Source: Author

Regarding the issue of Baoyuan Road and Baohua Road being one-way streets with narrow roads and conflicts between pedestrians and vehicles, this design also restricts vehicle traffic on these roads during specific times to open up this part of the urban road space for public use. Based on on-site observations and the traffic flow research in Chapter 5, this design has set the no-vehicle times for relevant sections of Baoyuan Road and Baohua Road. The specific details of the setting are shown in the figure 6-10.

6.5.3 Improvement of Various Urban Facilities

This design has added and improved the living facilities closely related to the lives of elderly residents within the 15-minute living circle of the study area and related communities by constructing new buildings and introducing new functions into existing buildings. Two elderly function clusters have been placed in the center of the design site located on both sides of Duobao Road, integrating functions such as a fresh food market, retail commerce, an elderly health service center, and a cultural activity center, providing one-stop service experiences for the elderly residents in the surrounding areas. Meanwhile, within each community, multiple elderly activity and entertainment stations have been added by replacing the functions of some existing buildings, offering convenient access for the elderly to socialize and entertain nearby. For the distribution of facilities in the study area after the

design, refer to the following Figure 6-11.

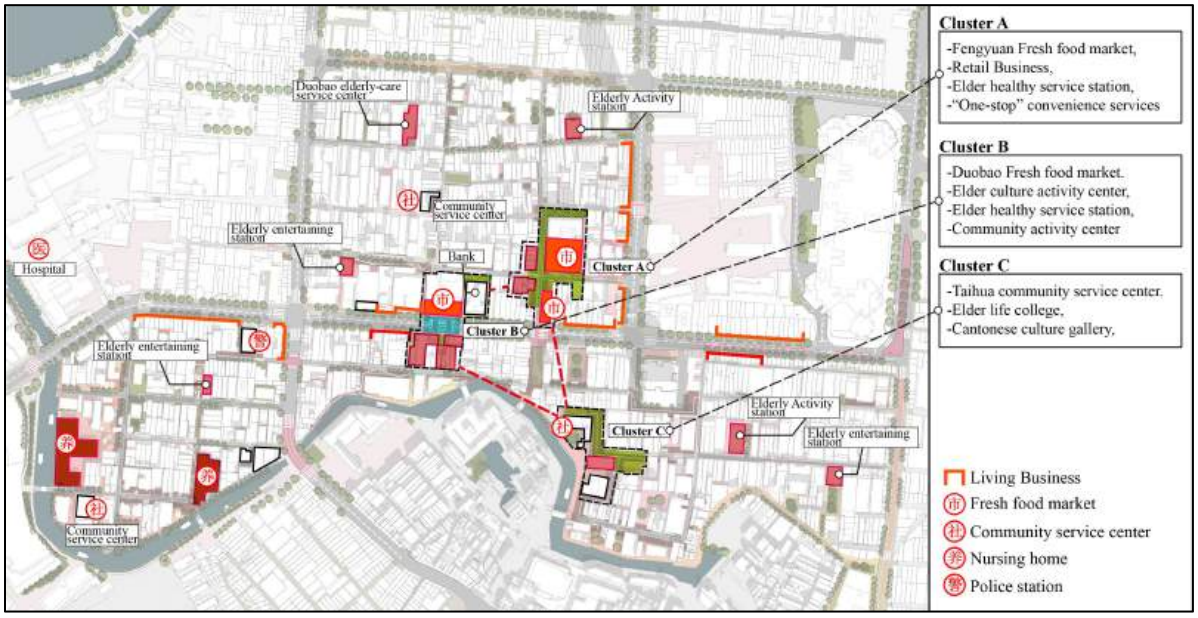


Figure 6-11 Distribution of Urban Facilities
Source: Author

Through the above figure, this design has improved the various facilities and services within the study site. As a result, this design has solved some of the problems identified in Chapter 5, as detailed in the following Table 6-4.

Table 6-4 Issues Solved by Improving Various Facilities
Source: Author

Dimension	Before Design	After Design
Community Environment	The community lacks basic medical facilities and elderly entertainment venues	In the elderly functional clusters within Duobao Road and Baoyuan communities, the function of elderly health service stations has been added; multiple elderly entertainment activity stations have been added in each community within the study area.
Urban facilities	Each community lacks cultural activity stations, convenience service points, and community activity centers.	In the elderly functional cluster of Duobao Road, functions such as community activity centers and cultural activity stations have been added; in the elderly functional cluster of Baoyuan Community, a one-stop convenience service point has been added.
	In the study area, elderly-related functions such as vegetable markets, elderly activity venues, and elderly assistance facilities are scattered and have not formed clusters.	Both the elderly functional clusters of Duobao Road and Baoyuan Community are organized around Duobao Street Market and Fengyuan Fresh Food Market, and various elderly assistance facilities and elderly activity venues have been added.

6.5.4 Constructing the Public Space System

Given that the study site is located in a historical district with narrow spaces, on the one hand, this design renovates the fragmented spaces released by the demolition of some existing buildings. On the other hand, it improves the quality of some corner and public spaces on the

site. Thus, a public space system organized around the pedestrian network has been established, which can provide nearby activity and rest places for elderly residents. For the distribution of public spaces in the study site after the design, please refer to the following figure.

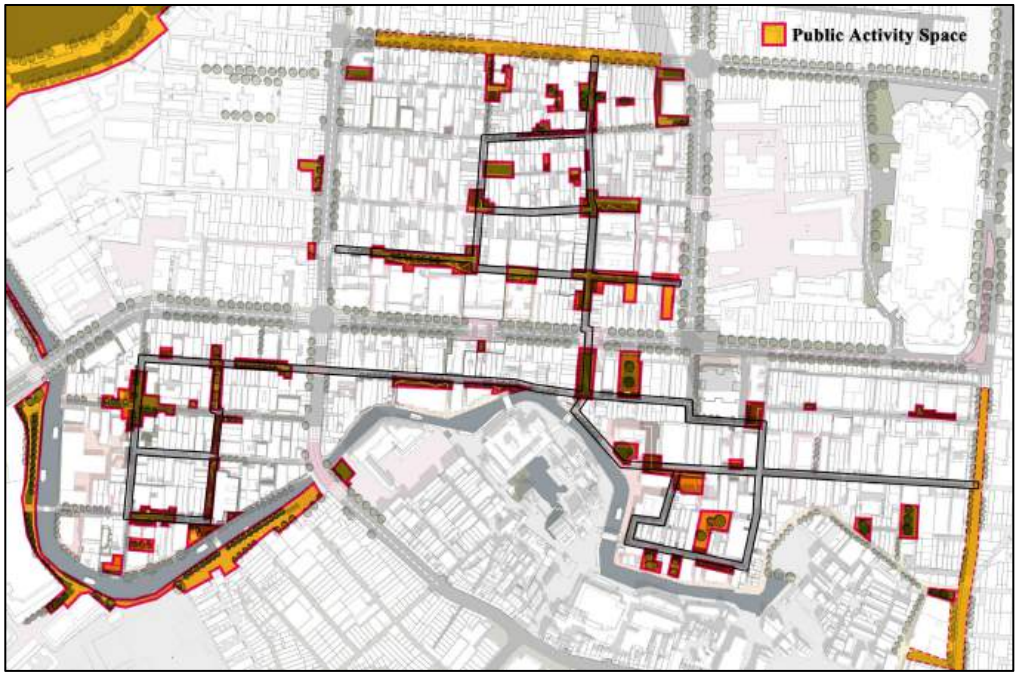


Figure 6-12 Distribution of Public Space
Source: Author

Through the above figure, this design addresses the design of the public space system for the research site. This design thereby resolves some of the issues identified in Chapter 5, as detailed in the following table.

Table 6-5 Issues Solved by Constructing the Public Space System
Source: Author

Dimension	Before Design	After Design
Community Environment	The public activity spaces within each community in the research area are scarce and scattered.	Many small public spaces have been added along the walking paths within the communities.
	The green coverage rate within each community is low, with a lack of green spaces and tree shade.	Street trees have been supplemented along the main walking paths in the communities where there is sufficient space; green spaces have been added in the public areas within the communities.
Urban facilities	There is a lack of outdoor fitness areas within the research area.	Activity areas or sports fields have been set up in the larger public spaces within the research area for elderly residents to exercise and dance square dancing; fitness equipment has been placed in the fragmented small spaces; fitness trails have been specially designed in communities such as Baoyuan and Changhuayuan.
	The small public activity spaces within the 15-minute living circle are insufficient and	Public activity spaces have been concentrated within the 5-minute walking range of residents to make them

Dimension	Before Design	After Design
	scattered.	conveniently accessible to elderly residents.
	The unclearly defined public areas are frequently crossed by people, making elderly residents who are active there feel embarrassed.	When arranging public spaces, they should be placed on one side of the walking paths or in the community center as much as possible to avoid people and vehicles crossing the public spaces.

This study improved and enhanced the vast majority of the existing pedestrian space issues in the research site by demolish and renovate some buildings, adjusting some roads, perfecting the age-friendly facilities, and creating a public space system, as discovered through the Checklist for Walkability in Aging Urban Area in Chapter 5.

6.5.5 Age-Friendly Exemplary Walking Zones

Figure 6-13 Exemplary walking zone with various functions.
Source: Author

In order to better respond to the background of an aging population, this design, in Chapter 5, visited and identified areas with a high concentration of elderly residents walking and key areas such as community residents' committees. Specifically, it designed a age-friendly exemplary walking zone for the local elderly residents. For these areas, on the one hand, through design, it will enhance the walking environment design based on the needs of elderly residents, creating a more comfortable and leisurely walking activity space. On the other hand, it will strengthen various facilities and services in these areas, concentrating the commonly used facilities for the elderly in these areas or their surroundings, and adding public activity spaces in these areas. This will enable the elderly to “enjoy while walking”, allowing them to easily access various services while walking in these areas.

6.6 Key Design Zones

Duobao Road Renovation & Elderly-care Cluster
多宝路改造与老年功能组团

Duobao Road Renovation
1. Widen sidewalks 2. Enhance sidewalk quality
3. Expand roadside public spaces
4. Add street furniture, lighting, and shade structures
5. Increase pedestrian crossing areas
6. Implement traffic calming measures (e.g., raised crosswalks)

Elderly-care Cluster
1. Organize functions around the fresh food market area
2. Incorporate diverse services (health, recreation, culture)
3. Centralize facilities to improve service efficiency

Changhuayuan Central Senior Leisure Landscape Belt
昌华苑中央乐龄景观带

Senior Leisure Landscape Belt
1. Release partial space for public activity areas.
2. Historic streets and alleys interconnect multiple nodal spaces.
3. Design plazas around spatial nodes such as historic buildings, waterways, and bridges.
4. Age-friendly renovation of walkways.

Yongqing Fang Senior Fitness Area
永庆坊老年健身区

Senior Fitness Area
1. Improve the quality of existing senior activity squares.
2. Utilize existing streets and alleys to create age-friendly fitness trails.
3. Arrange activity zones along waterfront areas to leverage scenic advantages.
4. Design fitness trails that wind through residential neighborhoods.

Figure 6-14 Key Design Zones Plan
Source: Author

In response to the key spatial nodes identified in Section 6.3 above, this design has made

corresponding responses. By setting up a series of public functions at these spatial nodes, this design connects these public spaces into the regional pedestrian system through point-to-line integration. In this design, the key design areas mainly focus on the middle section of Duobao Road and its two sides, the central area of Changhuayuan Community, and the area around the Taifa Community Residents' Committee. The relevant area plans are as Figure 6-14.

For the middle section of Duobao Road and its surrounding areas, this design has carried out the Duobao Road renovation project and the elderly function group planning. On the one hand, it has improved the walkability of the section through measures such as widening sidewalks, enhancing the quality of sidewalks, increasing roadside public spaces, adding street furniture, creating more pedestrian crossings, and implementing traffic calming measures. On the other hand, it has created an elderly function group, arranging various functions including health, entertainment, and culture around the market, and improving the efficiency of elderly services by concentrating them. The specific details of this part will be described in more detail in Section 6.7.

For the central area of Changhuayuan Community, this design, on the one hand, has released some space for public activities by removing fences and other measures, and on the other hand, has connected landscape nodes through the historically traditional streets and alleys that have been adapted for the elderly. Considering that this community has many historical buildings and is close to Lizhiwan Stream, important elements such as key historical buildings, stream, and bridges have been incorporated into the layout of the landscape nodes.

For the area around the Taihua Community Residents' Committee, this design has strengthened the construction of elderly fitness facilities. On the one hand, it has improved the quality of the existing elderly activity square, and on the other hand, it has utilized the existing streets and alleys to create age-friendly fitness trails that run through the residential area. Considering the landscape advantages of Lizhiwan Stream and Yongqingfang area, some activity areas have been arranged in the waterside area of this region.

6.7 Duobao Road Renovation and Elderly Facilities Cluster Planning

Figure 6-15 Axonometric Drawing of Duobao Road Node
Source: Author

This design selects a section of Duobao Road within the study site as a node and makes a more detailed design to further demonstrate how this design can more comprehensively respond to the problems existing in the study area as discovered in the previous chapter.

The design scope of the node is located in the middle section of Duobao Road between Longjinxi Road and Fengyuan Road, including the road and the community areas on both sides of the road. The ground floor plan of the node area is shown in the Figure 6-15, which clearly presents the relationship between the pedestrian system and key urban facilities.

Figure 6-16 Ground Floor Plan of the Duobao Road Node
Source: Author

6.7.1 Widen the Road Section and Adjust the Pavement

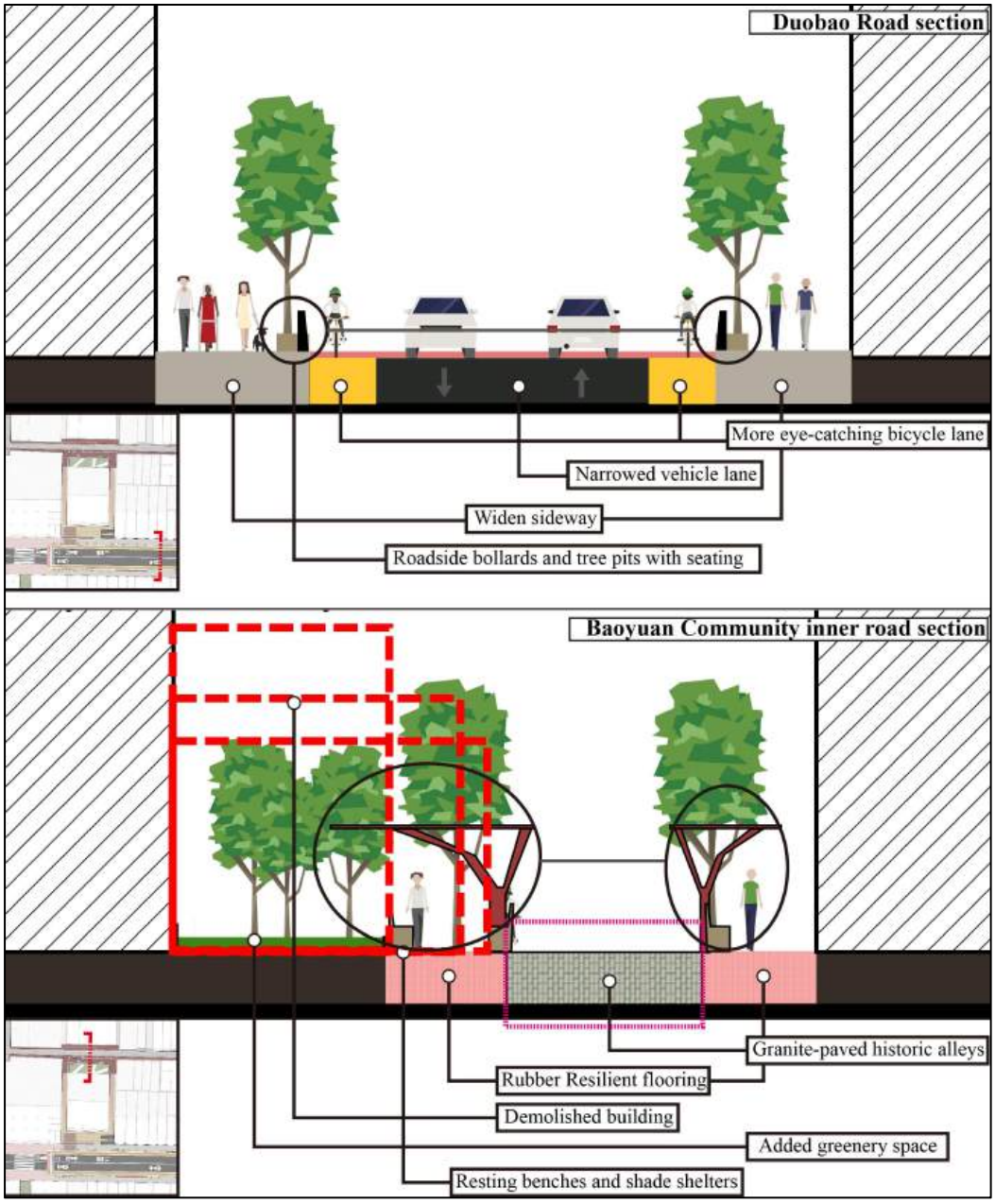


Figure 6-17 Road Cross-Section Adjustment
Source: Author

The study site has a relatively prominent problem of narrow roads, and the limited width for pedestrians has significantly affected the walking experience. In response, this design has made renovations to some of the roads.

Table 6-6 Node Design - Widening Pedestrian Roads
Source: Author

Dimension	Before Design	After Design
Urban Streets	The sidewalks on some sections of Duobao Road are too narrow.	The design proposes to narrow the vehicle lanes and widen the sidewalks on both sides. Environmental improvements will be made to the sidewalks, including reducing bicycle parking areas that occupy the sidewalks and removing

Dimension	Before Design	After Design
		municipal facilities such as transformer boxes located on the sidewalks.
Community Environment	The internal roads within the community are too narrow.	For some internal roads, demolishing some buildings on both sides to widen the road.

For urban roads like Duobao Road, this design has reduced the lane width to widen the sidewalks on both sides. At the same time, the design has replaced the pavement of the non-motorized vehicle lanes with brighter and more eye-catching materials. To enhance the utilization rate of the sidewalks, this design has also carried out a series of comprehensive management measures for the sidewalks, such as clearing the distribution boxes and other municipal facilities on the sidewalks and using bollards instead of fences to separate the sidewalks from the lanes.

As for some community roads, such as the road in Baoyuan Community shown in Figure 6-15, this design has widened some narrow community roads by demolishing some buildings on both sides of the original road to release road space. Since the internal roads of this community are historical traditional alleys, this design has retained the traditional stone pavement and chosen to add plastic elastic material walkways on both sides of the original historical road to provide a more comfortable walking environment for the elderly residents in the community. In addition, this design has also added some green spaces in the released idle spaces, further improving the walking experience in the community.

6.7.2 Improve Crosswalk Facilities and Enhance Crossing Safety

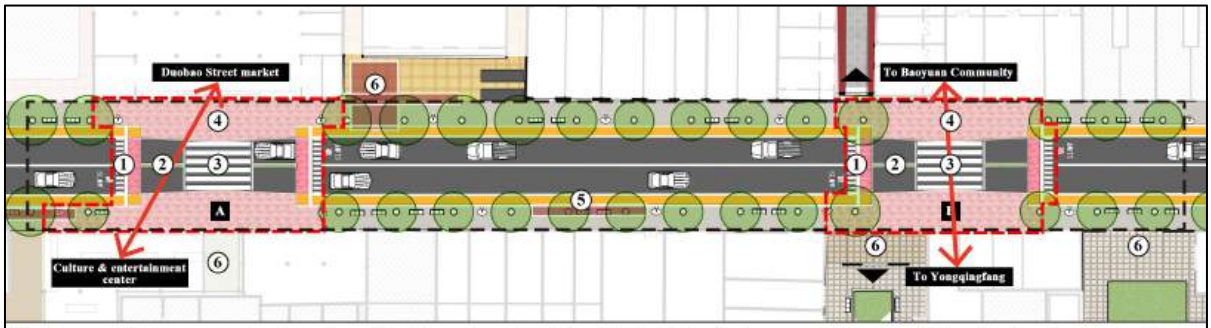


Figure 6-18 Design of Crosswalk Area
Source: Author

There is a high volume of traffic on Duobao Road, and both sides of the road are lined with various commercial functions. Pedestrians often need to cross the road, but within the design scope of this node, there is only one crosswalk. To address this, this design has added an additional crosswalk and redesigned the crosswalk area in multiple ways to enhance traffic tranquility and improve pedestrian safety.

Table 6-7 Node Design - Improvements to Crosswalk Area
Source: Author

Dimension	Before Design	After Design
Urban Streets	Some sections of Duobao Road lack mid-street crossing facilities.	Add a crossing at the entrance of Baoyuan Community to facilitate the passage of elderly residents.
	Some crossings lack accessibility measures.	Raise the height of the lanes at the zebra crossings to the level of the sidewalks on both sides.
	There is chaos in the passage of cars and E-bikes, posing safety hazards.	Raise the height of the lanes and non-motorized vehicle lanes at the zebra crossings, and narrow the lanes locally at the zebra crossings to prompt passing vehicles and E-bikes to slow down.

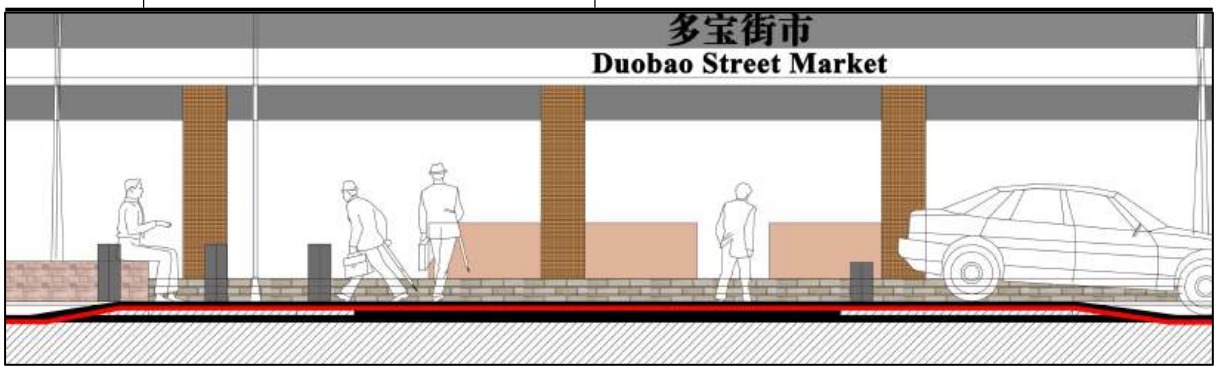


Figure 6-19 Elevated Crosswalk
Source: Author

This design has taken the following measures for the crossing area: Before the crosswalk, conspicuous warning signs are painted on the road surface to prompt passing vehicles to slow down; at the crosswalk, the lanes are locally narrowed and the road surface is raised, which prompts vehicles to slow down voluntarily when passing. Meanwhile, the raised road surface can also effectively reduce the speed of passing bicycles and E-bikes.

From the above Figure 6-16, it can also be seen that this design uses different pavement materials in the sidewalk area near the crosswalk to indicate the crossing position to pedestrians.

6.7.3 Enhance Street Facilities to Improve Pedestrian Experience

Based on the previous widening of sidewalks and improvement of crossing facilities, this design also adds various street facilities to further enhance the support for elderly pedestrians in the walking environment.

Table 6-8 Node Design - Improvements to the Pedestrian Environment
Source: Author

Dimension	Before Design	After Design
Urban Streets	The phenomenon of parking and business operations on sidewalks is prominent.	Non-motorized vehicle parking areas can be set up along Duobao Road and in some surrounding public spaces, such as specific areas around Fengyuan Meat and Vegetable Market, which can be opened to vendors.
	Lack of rest seats.	Rest seats can be set up along the roads, and sitting tree pits

Dimension	Before Design	After Design
		can be added to the street trees.
Community Environment	Lack of green spaces and tree shade.	New trees can be planted in areas with sufficient space, and artificial sunshades can be added in narrow spaces.
	There are problems of street vending and non-motorized vehicle parking in the community's internal roads.	Special non-motorized vehicle parking areas can be set up near the main entrances and exits of the community, and some public spaces can be opened to vendors.
	Public spaces lack rest seats.	Rest seats can be densely arranged along the main walking routes in the community.
	There are areas without light at night in Baoyuan Community.	Street lamps can be added.
	Lack of an identification system in the community.	Directional signs can be erected at the main intersections in the community.

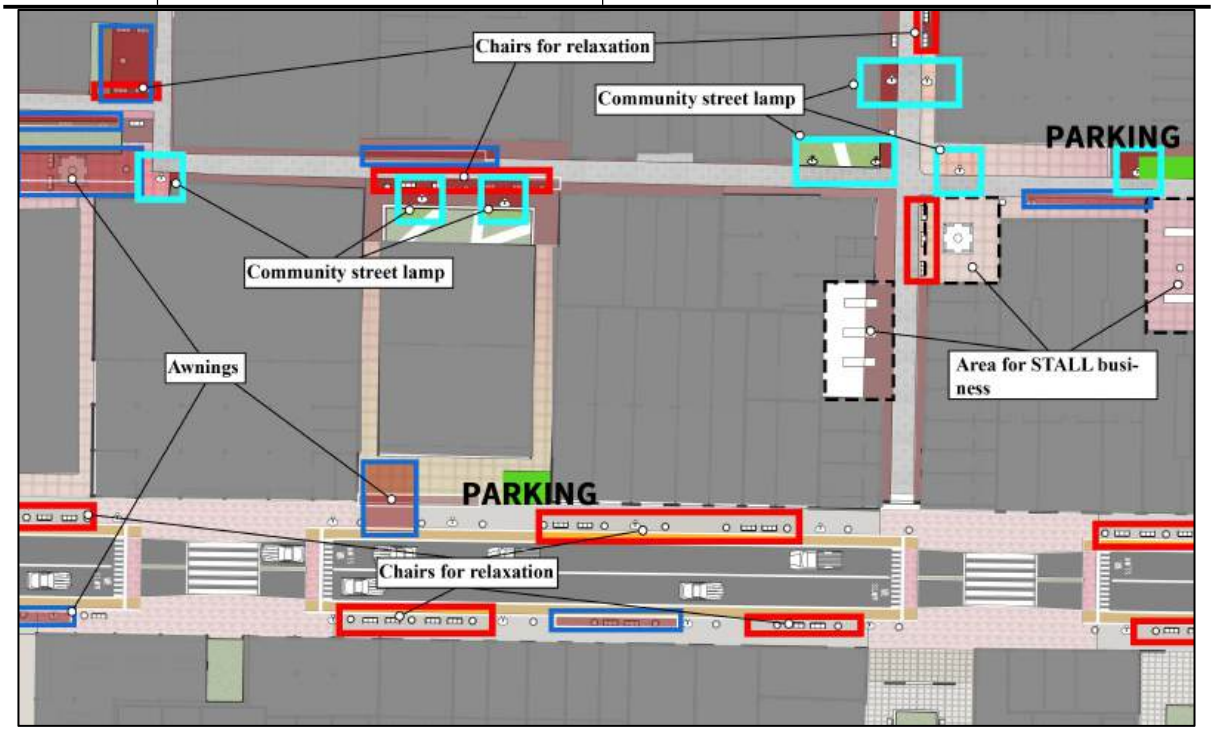


Figure 6-20 Duobao Road Node - Enhancing the Pedestrian Environment
Source: Author

At the urban street level, this design has set up dedicated non-motorized vehicle parking areas on the vacant land along Duobao Road and near Fengyuan Fresh Food Market within Baoyuan Community, preventing excessive bicycles and E-bikes from parking on the road. In response to the problem of street vendors occupying the sidewalks on Duobao Road, this design has created a dedicated area in the public space around Fengyuan Fresh Food Market in Baoyuan Community for these vendors to gather and sell their goods, preventing them from occupying the road and facilitating unified management. Considering the need for rest seats by the elderly, this design has placed some seats near the walking paths within the area and added sitting tree pits for the street trees. The detailed design of the walking space on Dabao Road can be seen in Figure 6-21.

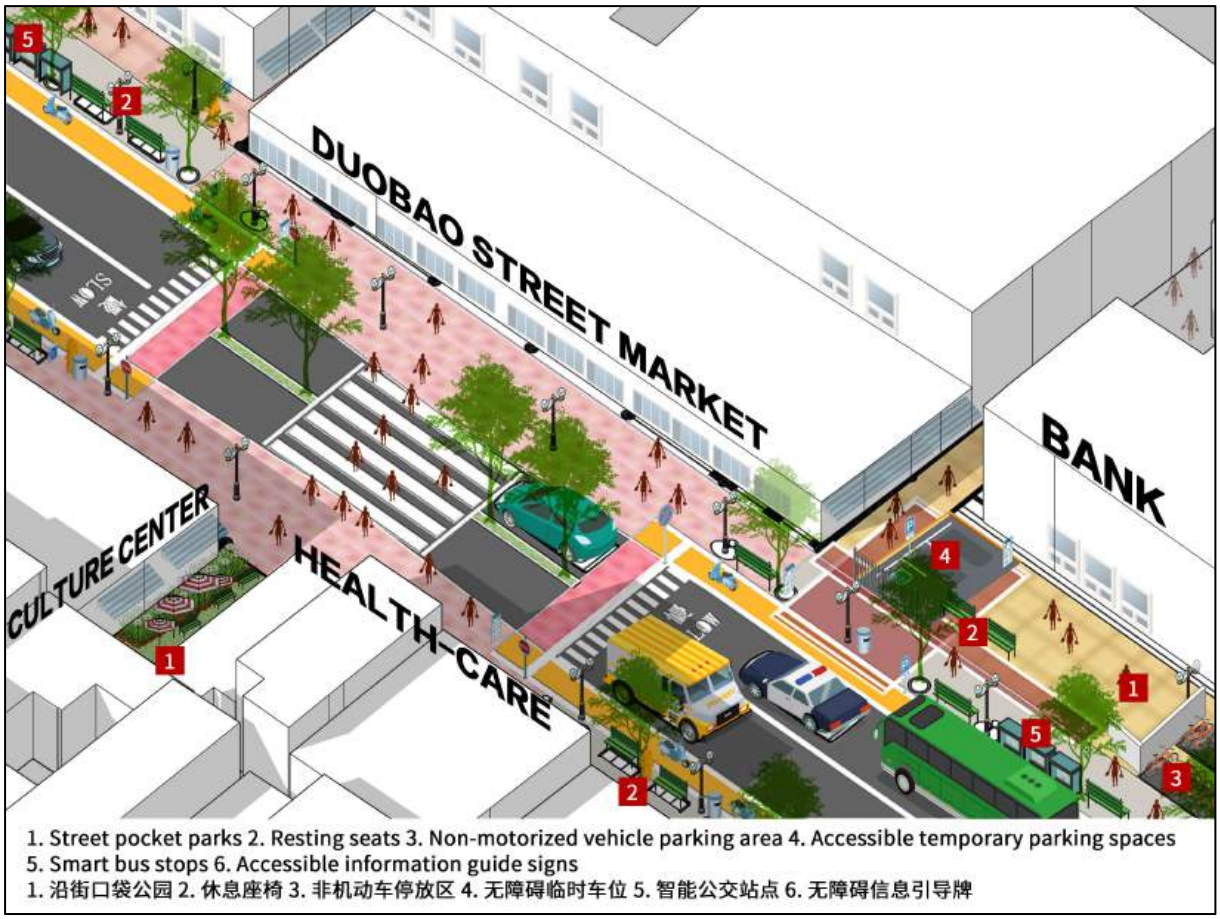


Figure 6-21 Detailed Pedestrian Environment of Duobao Road
Source: Author

At the community environment level, this design has planted new trees in areas with sufficient space within the community and added some artificial sunshades in narrow spaces. Through these measures, it provides shade for elderly residents who are active in the community. At the same time, this design has installed additional street lamps in the areas without light at night within the community, enhancing night lighting. Additionally, it has set up signboards at the main road intersections within the community to help elderly residents find their way. The detailed design of the elderly functional cluster and outdoor space in Bao Yuan Community can be seen in Figure 6-23.

6.7.4 Multi-functional Elderly Function Cluster near Duobao Road

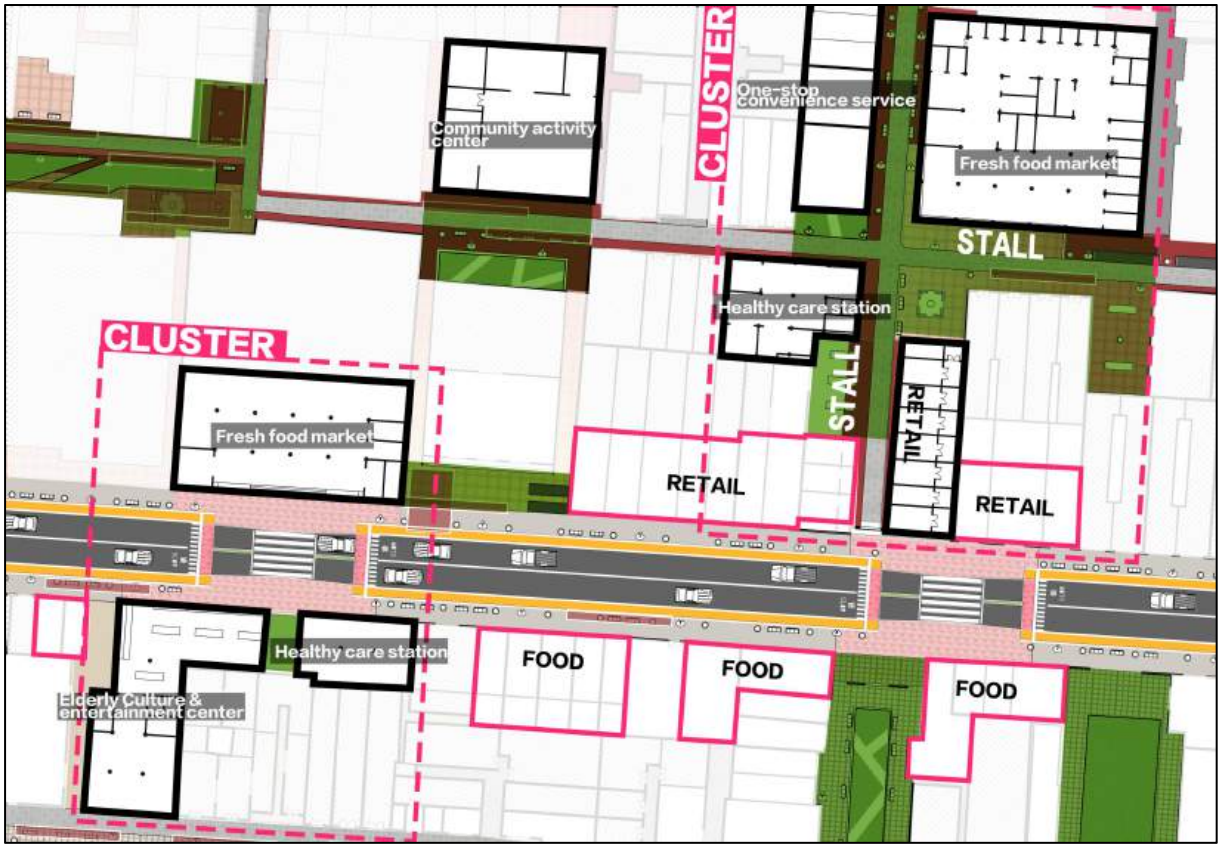


Figure 6-22 Duobao Road Node - Elderly Function Cluster
Source: Author

This design specifically plans an elderly function cluster for senior residents, located at the position shown in Figure 6-19. Multiple facilities closely related to the lives of the elderly are concentrated on both sides of Duobao Road. This area is at the junction of Baoyuan Community, Taihua Community, and Yongqingfang Community, and is also within the 5-minute living circle of Changhuayuan Community. Therefore, the elderly function cluster here has high accessibility for elderly residents in these communities.

Table 6-9 Node Design - Elderly Facilities Function Cluster
Source: Author

Dimension	Before Design	After Design
Urban Facilities	Lack of outdoor fitness areas, cultural activity stations, convenience service points and community activity centers. The elderly-related functions such as vegetable markets, elderly activity venues and elderly assistance facilities in the study area are scattered and have not formed a cluster.	A functional group of elderly facilities should be developed around "Duobao Street Market" and "Fengyuan Fresh Food Market", integrating functions related to elderly life into a relatively concentrated area and adding new functions such as cultural entertainment, convenience services and basic health care.
	Community staffs mentioned that the space around the fresh food market could be developed and utilized.	

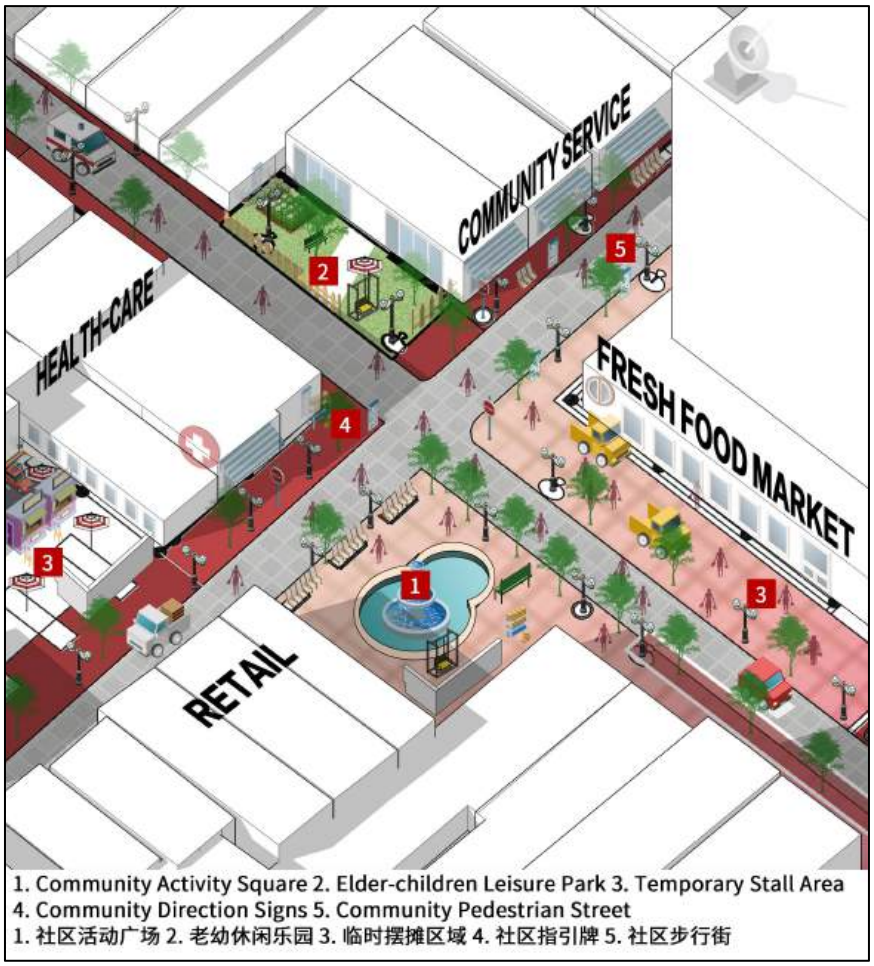


Figure 6-23 Detailed Pedestrian Environment of the Baoyuan Elderly Cluster
Source: Author

The design has arranged various elderly living facilities such as community activities, cultural entertainment, and health care around the local residents' frequently visited Duobao Street Market and Fengyuan Fresh Food Market. At the same time, there are many restaurants and retail stores in this area, so the dense distribution of multiple functions in this area can well meet the living needs of elderly residents and bring convenience to their lives.

Figure 6-24 Functional Intention of the Elderly-Children's Leisure Park
Source: Author

6.8 Policy Recommendations

To create a more age-friendly walking area in Duobao Road, the spatial-level renovations involved in the design proposal are only one aspect. To better respond to the needs of elderly residents, some policy support may also be required. This study proposes the following policy recommendations.

Firstly, increase financial investment. The government can set up a special fund to support the renovation of walking spaces, and at the same time encourage social capital participation to form a diversified investment mechanism. At the community level, a specific portion of the funds of the residents' committee can be allocated or funds can be raised from all residents to be specifically used for the maintenance of the public space environment within the community, ensuring that the renovation results can be maintained for a long time.

Secondly, encourage public participation. Through community meetings, public consultations, and other means, widely solicit the opinions and suggestions of residents, especially elderly residents, and let the public participate in the design and decision-making process of walking spaces to improve the acceptance and practicality of the project.

Finally, strengthen long-term supervision and evaluation. On the one hand, a sound supervision and evaluation mechanism should be established to regularly evaluate the construction effect of elderly-friendly walking spaces, promptly identify problems and make improvements to ensure that all measures are implemented. On the other hand, elderly residents can be organized to form a supervision team to supervise and guide illegal occupation of roads and other behaviors in relevant areas, thereby ensuring the long-term smoothness of walking spaces.

6.9 Summary

Based on the research results of the previous chapters, this chapter proposes specific design strategies and plans for optimizing the elderly-friendly walking space in the surrounding area of Duobao Road. Firstly, it systematically expounds the ideas and methods of the design strategies from multiple aspects such as improving the quality of the walking environment, adjusting the functions of some roads, constructing a connected walking network, creating age-friendly exemplary walking zones, arranging public spaces around the loop, and building an elderly function center. Then, it details various specific design plans, including the demolition, modification, and retention of buildings, the adjustment of roads at all levels, the improvement of various facilities, the construction of a public space system, and the construction of the age-friendly exemplary walking zones, forming a relatively complete

design framework. Subsequently, several node spaces are selected for detailed expression, more comprehensively demonstrating how the design plan responds to the site problems discovered in the previous Chapter 5. Finally, the design plan is further discussed and summarized from the perspective of policy recommendations, providing multi-dimensional guidance and reference for the construction of elderly-friendly walking spaces. Through these efforts, the aim is to create a safer, more comfortable, convenient, and pleasant walking environment for elderly residents in the surrounding area of Duobao Road, improving their quality of life and sense of happiness.

Conclusion

Research Summary

In the rapid aging process of China, the quality of life of the elderly has increasingly drawn attention. Enhancing the walkability of urban walking spaces has become an important part of building an age-friendly city. This study takes the Duobao Road area in Liwan District, Guangzhou City as the empirical site. Through the construction of a research design framework of "Research tool - Problem identification - Design response", an optimization solution for the walkability in aging areas has been formed, providing a reference model for the age-friendly transformation of pedestrian environments in similar urban areas.

(1) Tool Innovation: Develop a Checklist for Walkability in Aging Urban Areas

This study comprehensively employs methods such as literature research, case analysis, and interviews with relevant stakeholders. Starting from the current mainstream age-friendly frameworks, it integrates the discussions and conclusions on the quantification of walkability and the assessment of walking space environments from various literatures. Combined with interviews with relevant practitioners in the elderly care industry, a comprehensive checklist has been developed from three dimensions: urban street environment, community walking environment, and urban facility support. This provides a scientific basis for the analysis and optimization of walkability in aging urban areas.

(2) Issue Identification: Reveal the Issues of the Walking Space in Duobao Road Area

Taking the Duobao Road area, which has a relatively severe aging problem, as the study area, this study conducted a survey using the constructed checklist and also carried out a questionnaire survey among the elderly residents in the area. As a result, this study has detailed the main problems existing in the walking space of the area, filling the research gap on the degree of aging-friendliness of walking spaces in the old urban areas of Guangzhou. This also to some extent demonstrates the effectiveness of the checklist constructed in this study.

(3) Systematic Design: Proposing Targeted Design Strategies and Specific Plan

In response to the problems identified in the survey, on the one hand, this study quantified some solutions based on the recommended indicators specified in the checklist, such as widening sidewalks to a specific width and adding crossing facilities to ensure appropriate spacing. On the other hand, by referring to excellent design cases and relevant literature, a series of feasible design strategies were proposed, such as building age-friendly demonstration walking areas and creating elderly functional clusters. Thus, on the base map of the Duobao Road area, this study has formed specific design plans.

Reflections and Outlook

(1) Study Reflections

Although this study has achieved certain results in both theoretical and practical aspects, there are still some shortcomings. Firstly, there are limitations in the construction of the checklist. The literature and examples selected for the construction of the checklist have certain limitations. The literature mainly comes from a few key authors, and the number of examples is also insufficient. This may lead to the regulations in the checklist not being comprehensive enough, and thus the applicability and generalizability of the toolkit need further verification.

Secondly, the degree to which the checklist content and specific design proposals respond to the needs of the elderly needs to be improved. To respond to the needs of the elderly as comprehensively as possible, this study referred to some literature related to gerontology and conducted a questionnaire survey. However, due to time constraints and the cooperation of elderly residents, the number of questionnaires was small, which may not fully reflect the needs of the elderly.

Finally, there are certain limitations in the design strategies. Although the proposed design strategies and schemes have taken into account the historical and cultural background of the research site as much as possible, some buildings still need to be demolished or renovated. These operations may be affected by various factors in the actual implementation process, such as policies, funds, residents' willingness, and technology. This requires further refinement and adjustment.

(2) Future Prospects

Looking to the future, there is great potential in the field of elderly care. Improving the age-friendliness and walkability of urban environments is an inevitable path to building healthy cities. To further improve the results proposed in this study, the following aspects can be explored in the future.

Firstly, the research scope should be expanded. In the future, more relevant literature and cases should be collected, sorted, and referred to. At the same time, in-depth cooperation with experts in the field should be considered to improve the checklist and enhance its universality and authority. Efforts should be made to obtain empirical opportunities, expand the research area, and apply this tool in more urban spaces in different places to further verify its effectiveness.

Secondly, data collection and analysis should be deepened. Support from relevant government departments should be sought to obtain more comprehensive and accurate urban

data and traffic flow information. Advanced data analysis techniques should be used. Cooperation with community organizations and elderly care centers should be strengthened to collect the needs and ideas of elderly residents in the community more widely and comprehensively, and to better understand their views on walking spaces, thereby providing stronger support for the research and ensuring that the research results truly achieve “age-friendliness”.

Thirdly, design strategies and implementation should be refined. In the process of formulating and implementing design strategies, in addition to paper-based work, various practical factors such as economic effects, social effects, and interest balance should be fully considered. Communication and collaboration with relevant stakeholders should be strengthened to ensure the feasibility and sustainability of the design proposals.

Finally, multi-disciplinary integration should be strengthened. The optimization of age-friendly walking spaces involves multiple disciplines. In the future, cross-disciplinary research with psychology, gerontology, traffic engineering, and medicine should be strengthened to enhance the age-friendliness of walking spaces from multiple perspectives.

In conclusion, this study provides a beneficial exploration and practice for the optimization of age-friendly walking spaces. Continuous efforts are still needed in the future to better meet the travel needs of the elderly and improve their quality of life.

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Appendix 1

广州市多宝路周边步行环境质量调查问卷

您好！我是华南理工大学建筑学院的一名硕士生，现在正在针对老年群体开展街道步行环境的改善研究，诚邀您用 5-8 分钟填写问卷。所收集的所有信息仅用于研究，感谢您的支持！

**1.您的年龄段是？［单选题］*

○60-65 岁　　○66-70 岁　　○71-75 岁　　○76 岁及以上

○其他

**2.请问您是？［单选题］*

如果您居住在周边社区，请选“周边居民”；如果您是由外地或本市其他地方专门来此观光的，请选“游客”。

○周边居民　　○游客　　○其他

**3.您的日常步行外出的频率是？［单选题］*

○ 每天≥3 次　　○ 每天 1-2 次　　○ 每周 3-5 次　　○ 基本不步行外出

**4.请问您单次外出步行时长通常为？［单选题］*

您日常因事外出过程中花在步行上的大致时间

○ <10 分钟　　○ 10-20 分钟　　○ 20-30 分钟　　○ >30 分钟

**5.请问您对于当下周边的步行环境的满意度是？［单选题］*

此处的步行环境包括道路两侧的人行道、小区内部的道路、公共活动场地等各类可供步行的区域。

很不满意　　○1　　○2　　○3　　○4　　○5　　很满意

**6.请问您对与当下步行道路的平整度和无障碍设施的满意度是？［单选题］*

此题想要知道您在日常外出时是否会因人行道不平整、台阶等，行走不方便而感到困扰。

很不满意　　○1　　○2　　○3　　○4　　○5　　很满意

**7.您觉得当前城市道路的人行道宽度是否满足需求？［单选题］*

此处“城市道路”主要指多宝路、恩宁路、龙津西路、宝源路、宝华路、逢源路等。

很不满意　　○1　　○2　　○3　　○4　　○5　　很满意

**8.您认为当前区域的夜间照明是否充足？［单选题］*

很不满意　　○1　　○2　　○3　　○4　　○5　　很满意

**9.雨天时，您对于步行道路的防滑程度感到满意吗？［单选题］*

很不满意 ○1 ○2 ○3 ○4 ○5 很满意

**10.您在步行时，是否常常遇到电动车穿行、冲撞？［单选题］*

很不满意 ○1 ○2 ○3 ○4 ○5 很满意

11. 您在外出步行时最需要的设施是？（多选）［多选题］*

□休息座椅 □遮阳棚/树荫 □公共厕所 □清晰路标

□防滑路面 □过街语音提示 □其他_____

12.您认为当前该区域的步行道最需改善的障碍类型是？［单选题］*

○台阶过多 ○斜坡缺失 ○路面凹凸、破损

○非机动车、商铺占道 ○垃圾桶等市政设施阻碍 ○其他 _____ *

13.日常步行主要目的地（多选）:［多选题］*

□菜市场 □公园 □医疗机构 □公交、地铁站

□茶楼/商铺 □亲友家 □中小学、幼儿园 □养老中心

14.您在恶劣天气（例如下雨、大风、高温等）时是否坚持外出？［单选题］*

○ 照常出行 ○ 减少出行 ○ 完全不出

15.您在外出时，是否需要辅助工具步行？［单选题］*

○不需要 ○拐杖

○轮椅 ○其他 _____

16.您认为当前街道最需增加或者改善的无障碍设施是哪个呢？［单选题］*

○ 连续盲道 ○ 扶手栏杆 ○ 缓坡改造

○ 电梯/升降台 ○ 加宽人行道

17.您最常遭遇的步行困扰是什么呢？（选填）

_____

18.您当下最希望改善下面区域哪些位置的步行体验呢？（选填）（可描述位置）

_____

非常感谢您的耐心填写和参与！如需进一步沟通，也欢迎短信或微信联系。

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