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Application of Inclusive Design in Urban Square-Optimizations for Haizhu Square in Guangzhou

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Application of Inclusive Design in Urban Square-Optimizations for Haizhu Square in Guangzhou

A Dissertation Submitted for the Degree of Master

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摘　　要

城市广场是人们进行交往、娱乐、休憩、观赏等活动的重要城市公共空间，作为市民生活的重要载体，其设计目的就是使所有群体方便、舒适地进行多样的活动。目前我国针对老年人、残疾人等少数群体的城市空间设计存在明显不足，包括环境设计、无障碍设计、公共服务在内的支持性措施尚处于比较缺乏的状态。

包容性设计在解决“特殊群体”户外空间活动的问题上提供了一种非常有效的方法，具有一定的借鉴价值。该理论的兴起源于对残障人士的密切关注以及日益严峻的人口老龄化。包容的城市环境，强调所有人群对公共空间享有平等自由的使用权利，强调容纳不同性别、年龄、能力状况的人在公共空间更好的参与社会活动，体现社会公平度。

通过Mayor Thomas M. Menino Park(USA), Schandorff Square (Norway) 和Superkilen Urban Park (Denmark)的案例研究，梳理包容性设计在城市公共空间中的应用方法，并对包容性设计进行三个维度的解析：物理空间，个人体验和当地语境。同时构建以评价标准和设计要点相结合的城市广场的包容性设计方法，并将包容性设计的新方法和新技术运用到实际设计的过程中，弥补现有的差距和不足，进而提升海珠广场的包容性，使其为更广泛的人群服务，同时也为包容性的城市环境建设提供参考。

本文共分为七个章节。第一章绪论，首先阐述研究背景及相关概念，其次对国内外相关研究现状进行概述，进而提出本文视角，最后确定研究方法和研究框架。第二章为包容性设计理论研究，首先对包容性设计的提出、理论模型、设计排斥理论进行阐述，然后解释包容性城市环境的设计原则、目标定位、评价标准，最后对包容性设计在户外空间的应用实践进行总结，为后续建立评价标准提供基础。第三章为案例研究，选取3个案例，从项目背景、目标以及设计方法进行分析。

第四章为方法论，首先对案例进行综述，其次对包容性设计在公共空间的维度进行整理，进而总结包容性设计的应用过程，最后构建城市广场的包容性设计要点及评价标准。第五章为海珠广场的现状评价，分为六部分：历史背景、气候条件、规划背景、设计范围、场地评估和问题总结。第六章为海珠广场包容性设计提升，根据问题提出三大设计策略：多元文化的融合，多种路线的可达，多样场所的包容。每项策略包含宏观层面、中观层面和微观层面的解决方法，力求将包容性设计全面覆盖到场地中。在场地详

细设计中，从步行空间设计、高差处理、活动空间设计和公共设施设计对场地进行优化。第七章为结论。

关键词： 包容性设计；城市广场；城市公共空间；多元群体

Abstract

As the vital carrier of the citizens' public life, urban square is one of the main places for people to engage in communication, rest, entertainment and other activities. The design purpose of urban square is to make it convenient and comfortable for all citizens to carry out various activities. At present, there are obvious deficiencies in urban space for minority groups such as elderly and the disabled, and the supporting measures, including environmental design, accessible design and public services, are still in a relatively lack state.

Inclusive design provides a very effective method which has certain reference value to solve the problem of "special groups" in outdoor spaces. The proposal of inclusive design theory stems from the close attention to the disabled and the increasingly population aging. The inclusive environment emphasizes that all groups have equal and free rights to use public spaces, and that people of different genders, ages, and abilities can better participate in social activities , reflecting social equity.

Through the cases studies of Mayor Thomas M. Menino Park(USA), Schandorff Square (Norway) and Superkilen Urban Park (Denmark), summarize the application method and process of inclusive design in public spaces, and analyze the three dimensions of inclusive design: the physical environment, the personal experience, and the local context. Then, construct the design points and evaluation criteria of inclusive design involving urban square. Apply the new methods and new approaches to the design process to make up for the existing gaps and deficiencies, thereby enhancing the inclusiveness of Haizhu Square, making it serve a wider range of people, and provide references for inclusive urban environment.

The thesis consists of seven chapters. The first chapter: Introduction, which first describes the background and definition of concepts, then summarizes the current research status and puts forward the perspective of this thesis, finally determines the methods and framework. The second chapter: Research on inclusive design theory. First, it expounds the background, theoretical model and exclusive design, and then explains principles, and objectives and evaluation of inclusive environment. Finally, the application of inclusive design in outdoor spaces in UK is summarized to provide a basis for the subsequent establishment of evaluation standards. The third chapter: Case studies. Three cases are selected and analyzed from the background, objective and approaches: 1) Mayor Thomas M. Menino Park(USA) ; Schandorff Square (Norway); 3) Superkilen Urban Park (Denmark).

The fourth chapter: Methodology, which firstly reviews the cases, then sorts out the

dimensions of inclusive design in public spaces, and summarizes the application method and process, finally constructs the design points and evaluation criteria of inclusive design involving urban square. The fifth chapter: Evaluation and Analysis of Haizhu Square, which includes six parts: historical background, climate condition, planning background, design scope, inclusive evaluation of the Haizhu Square and status summary. The sixth chapter: Inclusive design improvement of Haizhu Square. According to the SWOT analysis, three major objectives and strategies are proposed: inclusion of diverse heritage, accessibility and safety of diverse routes and inclusion spaces used by diverse groups. Each strategy includes solutions in macro level, meso level, and micro level, striving to fully cover the site with inclusive design. In the detailed design, the site will be optimized from the pedestrian spaces design, changes in level, activity spaces design and public facilities design. The seventh chapter: Conclusion.

Key words: Inclusive Design; Urban Square; Urban public space; Diverse groups

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Chapter 1 Introduction

1.1 Background

1.1.1 Huge base of vulnerable groups in China

According to a WHO survey of 59 countries, the proportion of people with disabilities and the elderly accounts for an average of 16% of the total population of these countries, and the proportion of developing countries (18%) is higher than that of developed countries (12%)[1]. China has the largest number of disabled people in the world. According to the statistics of the China Disabled Persons' Federation, by the end of 2010, the total population of disabled people in China was about 85.02 million, accounting for about 6.3% of the total population of the country[2]. According to international standards, countries and regions with a population over the age of 60 ≥10% of the total population, or countries and regions with a population over the age of 65≥7% of the total population are considered to have entered an aging society. According to the seventh Chinese census data, 60+ population is about 260 million, accounting for 18.7% of the total population, and the 65+ population is about 190 million, accounting for 13.5% of the total population. The data shows that China has entered a deeply aging society[3]. People with disabilities and the elderly are the largest minority groups in the world, who experience various life obstacles every day, such as labor and employment issues, accessibility to public spaces, and social marginalization caused by lack of online media attention.

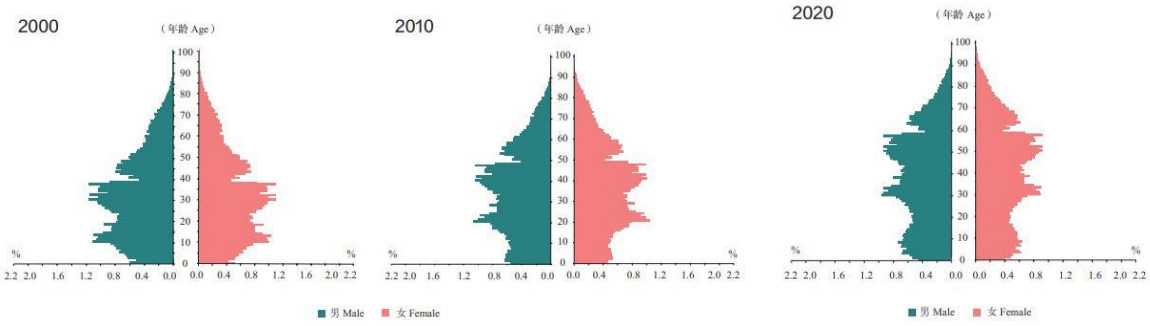


Figure 1-1 Pyramids from Population Censuses (Source[3])

1.1.2 Insufficient inclusion of urban public spaces

The comfort and convenience of public space are important conditions for modernization, and an inclusive environment reflects the city's acceptance of diverse groups of people. When it comes to the concept of "all people", we usually think of the "mainstream" people in daily life, while ignoring minority groups such as the disabled. The primary requirement of vulnerable groups for public space is accessibility, such as ensuring the safety of wheelchairs and walking outdoors, and clearly indicating green passages indoors.

At present, there are obvious deficiencies in the urban public space for diverse groups in China, including environmental design, accessible design, public services, etc., which hinder the vulnerable groups from entering the city and society to a certain extent. It is worth noting that in recent years, China has gradually improved its laws, regulations and planning system to improve its barrier-free environment. However, due to economic and conceptual reasons, there are still urgent problems to be solved in the construction of accessible environment, and there is still a big gap between the inclusiveness of public space and the actual needs of people. At present, in the construction of accessible environment in many cities in China, there are generally problems such as difficulty in using venues and facilities, insufficient number, hidden dangers, and lack of comfort, which directly affect the willingness of vulnerable groups in public spaces[4].

1.1.3 Create an inclusive and shared urban environment

The World Report on Disability (WRD) 2011 states: Disability is part of the human condition, almost everyone has temporary or permanent impairment at some point in life, and disability is caused by environmental factors and their bodies[5]. According to Kat Holmes, an advocate for fair design in the United States, a designer who achieves inclusive design "has the ability to unravel the mismatched interactions between humans and their world, and to suggest ways to mitigate them"[6].

Everyone should enjoy urban space equitably, including the disabled, the elderly, the sick, children, women and other groups of people, not just ordinary people. At the

same time, caring for diverse groups is the key to creating equity in the urban environment. The urban environment should make all citizens, especially the disabled, the elderly and other groups feel happy and satisfied, not only to meet physical needs, but also spiritual needs.

1.2 Definition of related concepts

1.2.1 Inclusive design

Inclusive design is defined as a concept that environments or products can be used regardless of the user's age or ability. Or a concept that removes obstacles arising from social, technological, political and economic processes by working with users. Inclusive design is committed to meeting the needs of diverse groups of people, emphasizing the comprehensiveness, integrity and continuity of design[7].

Inclusive design does not refer to a single discipline or a specific methodology. It should be a general guideline to design products and services for a wider range of people. The rise of inclusive design stems from a close attention to people with disabilities and an increasingly aging population. At the same time, the principle of function first has led to the mismatch between behavior and space, which has also made designers and architects consider the contradiction between people and the surrounding environment.

In the 1980s, the Universal Design Movement made "accessibility" one of the most important criteria for architecture and public space, which had became the consensus in design process. Inclusive design is not about specific products or environments to meet the needs of special groups, but about integrating various needs into the environment to benefit everyone. An inclusive environment, emphasizing that all groups of people have equal and free rights to public spaces, that people of different genders, ages, and abilities can participate in social activities, reflecting the fairness of society.

1.2.2 Urban square

(1) Research on theory

There is no unified standard for the concept of urban square, and scholars have conducted certain researches from different perspectives.

Table 1-1 Relevant Definitions of Square (Source: Completed by author)

Literature	Description of urban square
Kevin Lynch "The Image of City"	"The urban square should be located in the center of a highly urbanized area, enclosed by high-density buildings and structures, consciously used as a focal point of activity, usually paved, surrounded by streets, or well-connected, with elements that attract crowds and facilitate gatherings"[8].
Glare Cooper Marcus "People Places: Design Guidelines for Urban Open Space"	"The urban square is hard paved space inaccessible to cars, where people wander, relax, sit, dine and observe the world"[9].
Yoshinobu Ashihara "The Aesthetic Townscape"	From the perspective of space: "A square is an urban space that emphasizes the city surrounded by various buildings. It has a clear boundary line, preferably formed by the outer wall of the building, in a geometric shape; it forms a good closed space; the surrounding buildings should have a good ratio"[10].
Wang Jianguo "The Theory and Technique of Urban Design"	From the material point of view: "Square is a carefully planned and designed open space enclosed by buildings, structures or greenery"[11].
Principles of City Planning	From the perspective of function: "The square is set up due to the requirements of urban function, and it is a space for people's activities. The urban square is usually the center of urban residents' social activities, which can organize gatherings, transportation distribution, residents' sightseeing and rest, and commercial and trade exchanges"[12].

Encyclopedia of China	"Urban square is an open space surrounded by buildings, roads or green belts, and is the center of urban public and social life"[13].
"Urban Land Classification and Standard for Planning and Construction" GB50137-2011	The square land (G3) belongs to the green space (G) in the classification of urban construction land, and is the "urban public activity venue mainly composed of hard pavement". It is stipulated that the per capita green space and square land area should not be less than 10 ㎡/person"[14].
"Classification Standard of Urban Green Space" CJJ/T 85-2017	Square land refers to urban public activity venues with functions such as recreation, commemoration, assembly and risk avoidance. The standard proposes that the proportion of green space in the square should be greater than 35%[15].

Based on the above research, it is found that urban square needs people, places and activities to constitute its basic elements. The "urban square" studied in this thesis refers to the good accessibility, to provide various activities for citizens to conduct such leisure, entertainment, assembly and other activities. The public spaces enclosed by buildings, roads, rivers, which is also the material carrier reflecting urban characteristics, history and local culture.

(2) Classification and design features of urban square

Kevin Lynch describes the urban square as a node in the urban spatial form, which stands out for the characteristics of the city with vibrant focus. It is typically characterized by a paved ground, a sense of containment formed by buildings, or defined by street. It should have the characteristics of places that attract a large number of people.

As a kind of physical spaces, urban squares are open and public, which are affected by multiple factors such as social, economic and cultural factors. The meanings given to the urban square in different periods are also different.

Urban squares can be divided into the following types according to their functions:

A. Administrative square

Historically, the earliest function of the square is an administrative gathering, such as

Tiananmen Square in Beijing, which is mainly for military parades, celebrations and other gatherings, with a five-star red flag at the northernmost end. Stalin-style monuments and government buildings are built around the square. Such squares focus on large spaces and scales, emphasizing the overall atmosphere and environment. The Plaza de la Constitución is located in the center of Mexico City. The huge Mexican flag is erected in the center of the square. Every day, a grand flag-raising ceremony is held square, as well as major commemorative activities.

Figure 1-2 Cases of administrative square (Source: Google)

B. Theme square

Theme square is built to commemorate a major historical event or figure, and the common design technique is to use landscape sculpture, sketch, buildings, etc., to render the atmosphere. For example, Trafalgar Square in London was built to commemorate the Battle of Trafalgar. The statue in the middle of the square commemorates the naval officers who died in the battle. Every year on October 21, a large number of people gather here to hold memorial ceremony.

The core of square is usually the theme building or sculpture, so the overall layout, node design and infrastructure design need to match the theme of the square. Plaza de Mayo is located in Buenos Aires, which is the main political stronghold of the independence movement. In the center of the plaza is the oldest national monument: the Pyramid of May. Around the monument, there are green grass, flowers in full bloom all the year round, clear fountains and pigeons pecking at food.

Figure 1-3 Cases of theme square (Source: Google)

C. Traffic Square

The main purpose of traffic square is to evacuate people and relieve traffic pressure, which usually designed in combination with urban transportation hubs. The design of traffic square focuses on the rational and efficient organization of traffic, ensuring the rapid movement of vehicles and the convenience of pedestrians. Traffic square can be divided into two types. One is the front square of railway stations, bus stations and other transportation hubs. This type is characterized by a large square area and a great quantity hardened pavements, such as the station square in London King's Cross Station, covering an area of 7,000 ㎡ with a daily flow of 140,000 people.

The other is located near the intersection of the road in city center. The design focus on easing the traffic in core area and ensuring safety. The surroundings can be separated from the road by green belts to ensure the use of the inner spaces. For example, Times Square in New York is located at the intersection of Broadway and Seventh Street, with various billboards, dazzling advertisements, and various colored light filling every corner of the square. Businesses, restaurants and hotels are all around the square, serving the function of crowd evacuation and temporary pause.

Figure 1-4 Cases of traffic square (Source: Google)

D. Leisure square

The leisure square focuses on the humanized design of spaces, which allow users to relax and release pressure through the appropriate space scale. Located in Copenhagen, Israel Square is a “flying carpet” square that derives from its soft, undulating surface that floats above the ground. The southwest and northeast corners of the square are folded like two pairs of wings, creating a resting space while also providing shelter for underground parking garage.

The leisure square has flexible site selection and layout, and the overall space is not suitable for closure. While reflecting leisure and entertainment, the points can be appropriately added to make the square more attractive. Ricard Vines Square in Lleida, Spain, is a dance floor in the public space. The intricate paths show the steps of the Spring Dance, while the central landscape shows the graceful movements, bringing life to the whole space. Pedestrians can fully enjoy their own public space. Everyone can follow the path indicated by the dance without affecting each other.

Figure 1-5 Cases of leisure square (Source: Google)

E. Commercial square

Commercial square is mainly set up inside the business area for consumers to stay for a short rest. This kind of square is usually flexibly arranged in combination with commercial outlets, focusing on the unobstructed and convenient pedestrian streamline. The space inside the site is mainly limited by plants, pavement, water features and rest chairs.

For example, Parc Central Square in Guangzhou, which means shopping in the garden, has only two floors on the ground. The open park environment and the rolling green landscape create a unique and attractive place for socializing, relaxing and entertaining, providing a respite in the busy city center. Commercial functions are

largely underground to preserve the surface environment to create the new park. It is also seamlessly connected to subway system and bus network, with overhead footbridges connecting the surrounding buildings.

Figure 1-6 Cases of commercial square (Source: Google)

(3) Elements of the physical environment

Professor Cai Yongjie of Tongji University, in the book “Urban Square: Historical Context, Development Momentum, and Space Quality”, divided the physical elements of the urban square into interfaces, grounds and structures:

Interfaces: The interface is the element that encloses and defines the boundary of square space. The interface can be divided into hard boundary (building) and soft boundary (non-building). The former has a strong limiting effect, while the latter is weak. The role of buildings in the square has three aspects: The building limits the space scope by enclosing; The building, with its shape, becomes the center of the square; The building participates in the square space by forming “gray spaces”

Grounds: The ground is the foundation of physical environment. First of all, it should be flat, walkable, and suitable for all kinds of activities. Secondly, since the viewing angle of the person is about 40° downward when looking at it horizontally, the division of the ground decoration of the square has a great influence on the space effect. Finally, by raising and lowering the ground, different space areas can also be defined to meet people’s different needs and increase the diversity of space.

Structures: Square structures include buildings, monuments, sculptures, etc., which determine the function and formation of the square. The main building or landmark

conveys information to people through its image, through which rich expressive force can be produced, thus having the symbolic and social meaning in city.

1.3 Objective and Significance

1.3.1 Objective

As the vital carrier of the citizens' public life, urban square is one of the main places for people to engage in communication, rest, entertainment and other activities. The design purpose of urban square is to make it convenient and comfortable for all citizens to carry out various activities. However, there are still many deficiencies in environmental planning and design, recognition of values, economic basis and other aspects, leading to the inclusion of urban space needs to be strengthened.

At the same time, the elderly and the disabled do not need special designs that are only suitable for them, but want to live freely and integrate into the society. Inclusive design offers a very effective approach to address the problem of vulnerable groups in outdoor spaces. For example, the design of the ramp not only meets the needs of wheelchairs, but is also extremely convenient for those who push strollers, shopping carts, and pull suitcases.

To sum up, the objective of the thesis is to take Haizhu Square as site, through case studies to construct the design points and evaluation criteria of inclusive design involving urban square. Then apply the new methods and new approaches of inclusive design to the design process to make up for the existing gaps and deficiencies, thereby enhancing the inclusiveness of Haizhu Square, making it serve a wider range of people, and provide reference for inclusive urban environment.

1.3.2 Significance

Everyone will inevitably face aging and decline in physical function, as well as experience mobility difficulties in daily life. In the past, the standard of design was based on the behavioral characteristics of adult. In an era that embraces and

encourages diversity, individuality and needs are respected, and urban environments are moving towards minimizing barriers. How to allow people including the disabled, the elderly, children, etc. to use urban space comfortably and conveniently is the ultimate vision of inclusive design.

If the concept of inclusiveness is always integrated into the design process, it can bring more possibilities to users. The concept of inclusion emphasizes the equality of all people, including the elderly, the disabled, children, infants and ordinary adults, regardless of physical condition, age and social background.

With the progress of urban civilization and the development of construction, the awareness of fairness and humanism has begun to take root in the hearts of the people. The traditional practice of isolating special groups from society has been increasingly abandoned. Inclusive environment is where all people can participate in social life, and spirit also be satisfied. Inclusiveness hope to enable everyone, regardless of age, gender and physical condition, to live in peace, happiness, freedom and equality in cities.

1.4 Research Status

1.4.1 Overseas research status

(1) Research on inclusive design

Bernard Isaacs, professor of gerontology in the UK, once said: “Design for the young and you exclude the old; design for the old and you include the young”[16].

The United Kingdom promulgated relevant laws and regulations in 2005, and first proposed to apply inclusive design to outdoor environmental and renovation research. The inclusive design concept of “inclusive and innovative” was put into practice in the London 2012 Olympic And Paralympic Games, which mainly focuses on three aspects: service objects, public space environment and barrier-free facilities[17].

Pan J conducted a survey and summary from the aspects of contact, learning, use and adoption through quantitative questionnaire survey and interview. He proposed an inclusive design method based on convenient science and technology. At the same time, systematic and detailed research and analysis should be carried out on the

service object, communication and exchanges should be maintained at any time during the design and construction process, and the service users should participate in the entire construction process[18].

In the research of public space environment, Zhang Wenying summarized the principles and methods of inclusive design in public space by analyzing the British "Inclusive Design for Outdoor Space (I'DGO)" practice project of inclusive design for social public space. It proposes indicators of inclusion based on the preferences and needs of the elderly and people with disabilities[19].

Zhang Ying et al. analyzed experience in realizing inclusive design in open spaces through the study of three different types of cases in Japan and the United States, including strategies for balancing various stages of design, establishing laws and regulations, improving social inclusion and participation awareness, strengthening the construction of environmental facilities, etc[20].

Liu Xingxu et al. put forward four principles for building inclusive community streets by analyzing the needs of the elderly and the case of Portland, USA[21].

In terms of urban environment, Burton and Mitchell put forward the concept of inclusive “street for life” based on the survey and interviews of Alzheimer's patients. Through the analysis of physiological characteristics, environmental cognition and behavior characteristics of the elderly, the significance of streets for the elderly, especially for dementia patients was explained, and based on this, six evaluation and design principles of inclusive in living streets were put forward[22].

In Inclusive Design: Beyond Accessibility, Catherine Howell proposed that inclusive design theories and principles should be included in the basic theory or specification of accessible design, including the building and outdoor environment. He gave an example of the space renovation project in London's Harnike District, which uses inclusive design to encourage healthier behaviour through the redesign of road facilities to create shared spaces[23].

In 2007, Sasaki designed a sensory experience garden for the visually impaired at the Perkins Enlightenment School, starting with a wire-guided system, continuous seating for wheelchair use, and enhanced by five senses -- aromatic plants, pollinators, birds, and unique trees and sculptures. In addition, there are wayfinding signs to help visually impaired people.

Tangentyere Architects has adopted an inclusive design approach to buildings in remote areas in Australia, with a design practice including housing, schools, clinics, shops and child care centres[24]

Hanson examines the reasons why the design of public spaces in British urban centers fails to provide convenience for the elderly and the disabled. From the development history of design concepts, he examines the differences between general needs, special needs and inclusive design. and explores the impact of these different approaches on built environment legislation and architectural practice[25].

Goltsman and Iacofano summarize key points of inclusive design strategies for urban facilities including play spaces, plazas, rail transit, etc[26].

Washington, D.C.'s Comprehensive Vision for an Inclusive City (2003-2004), articulates the idea that inclusion should be embodied in citizen participation in decision-making[27].

Taking Indian cities as an example, Malhotra puts forward the theory that inclusive urban planning can better improve the quality of urbanization development[28].

The "New Urban Agenda" officially reviewed and approved by the third United Nations Conference on Housing and Sustainable Urban Development in 2016 takes inclusiveness as a core concept, emphasizing the promotion of social connectivity and equity through the rational allocation of public resources and inclusive[29].

(2) Research on urban square

At the end of the 19th century, Camillo Site analyzed the formal laws, spatial relations and relationship with the European urban squares in "Der Städtebau nach seinen künstlerischen Grundsätzen" [30].

In "Urban Space", R. Creel proposed that urban space is composed of squares and streets, and used the principle of topology to divide the space form of the square and expounded the relationship between the square and the surrounding buildings[31].

F. Gibbard extended from the sculptural arrangement of buildings and their spaces to squares in "Town Design", and emphasized the importance of aesthetics and artistic value to urban square spaces[32].

Cliff Mumford discusses the components of the city—streets, squares and buildings from the perspective of urban design in terms of spatial arrangement, design and

structural function[33].

In the 1960s and 1970s, with the rise of postmodernism, Norwegian architect Christian Norberg-Schulz founded architectural phenomenology and proposed a new design concept in “Genius Loci, Towards a Phenomenology of Architecture” , non-physical design, using the spirit of place to design the site, to achieve “Genius Loci”[34].

The Danish scholar Jan Gale integrated sociology, environmental psychology, urban planning and other related research, and divided outdoor activities into three types: necessary activities, social activities, and spontaneous activities. It provides a certain theoretical basis for the future behavior analysis of square space design[35].

Glare Cooper Marcus has conducted research on various outdoor spaces in the United States, including squares, from multiple perspectives such as location, scale, boundary, topography, plants, and facilities, starting from people's behavior and needs, focusing on various aspects, summarize the problems existing in the construction of urban public space, and put forward design guidelines and suggestions[36].

Shu Takahashi summarizes the behaviors occurring in different scales of space hierarchies according to the division of gradually expanding scales from around us, and studies the spatial design resulting from the interaction between environment and behavior[37].

1.4.2 Domestic research status

(1) Research on inclusive design

Faced with the protection of traditional street space and the planning of new streets, Liu Lei analyzed the reasons for deviating from the inclusive trend from the aspects of street space environment, social order and economy, and summarized the inclusive evaluation elements, so as to form a growth space with multiple values and improve the quality of street travel, so that streets can meet the needs of diverse users[38].

Facing the current trend of social aging, Tan Xinyan combines the research of gerontology to analyze the relationship between the physical and mental conditions of the elderly, the quality of life and the outdoor environment, and listens to the needs of the disadvantaged and the marginalized groups and sum up the principles and design

methods of inclusive design in the construction, improve the inclusiveness of vulnerable groups and promote the realization of justice and fairness of social public facilities[39].

Liu Zuyun transformed the controlling system into inclusive system based on the thinking of community, and achieved the effects of guidance and participation, rationality and irrationality in community governance[40].

Planning is the basic means of constructing urban order, and cooperative planning is the basic method of building an inclusive city[41].

Taiwanese scholar Wu K analyzed a large number of questionnaires about the inclusion of urban park from tourists' view, and divided the users into two categories: the special needs and the general needs. Based on the principle of inclusive design, three levels of tourists needs were identified: security (high priority), accessibility (moderately high), and regular maintenance (average)[42].

Cao Genrong (2017), based on the perspective of planning care, analyzes various requirements for the inclusive construction of urban streets from transportation, economy and society, and constructs a framework of elements affecting the inclusiveness of urban streets[43].

Sun Yuan (2014) proposed a comprehensive guidance system design based on the inclusive concept for the guidance problem of traffic system. The design process includes prototype testing, pedestrian movement research, and interactive guide system design. The inclusive design concept is introduced into the guide system for the first time[44].

Xiao Hong (2016) focused on analyzing the cognitive barriers of tourists with different cultural backgrounds to scenic spots, combining inclusive design with interactive guide system[45].

Based on the "intergenerational conflict" in public space, Li Xiaoyun analyzed the fairness, flexibility, identifiability, accessibility, comfort, and diversity, coherence, safety and their guiding significance for community construction of all age groups, from the aspects of micro spaces, pedestrian networks, children's spaces, multi-level participation, etc., proposed micro-update strategies for community public spaces to promote the realization of all-age communities[46].

In August 2008, the Royal Academy of Arts, in collaboration with the British Chamber

of Design and the Hong Kong Design Centre, held the “48 Hours of ‘Symbiosis and Co-creation’ - Inclusive Design Competition”, with one designer with experience in inclusive design in each group.

In October 2010, Tongji University opened the postgraduate course “Inclusive Design and User Research”. In the same year, the Inclusive Design Research Center was officially established. Since 2017, the center has held an international academic forum every year to share the latest research and practical experience of inclusive design. In Delta's Hospital Service Design, the design team evaluated and improved the existing medical process by collecting a large amount of doctor-patient data, combining role-playing and building models.

Tsinghua University Accessibility Development Institute was established in 2016. The academy conducts research on groups with different perceptions and actions, involving public policy, law, design, technology, products, and education, with the aim of reshaping and improving the quality of living environments.

In 2021, the China Academy of Architecture Design and the School of Architecture and Urban Planning of Shenzhen University will jointly establish the Accessibility Technology Research Center. Obstacles plus garden landscaping and other fields of attempt.

(2) Research on urban square

Domestic research on urban square started late, but with the increasingly important role of urban square in public space, related theoretical research has gradually become more abundant.

Wang Ke et al investigates new squares in China and proposes relevant principles for the design of squares[47].

Cai Yongjie studies the classic squares in several cities as cases, and proposes an evaluation system for quantitative research on the quality of urban squares, and uses this system to sort out domestic urban squares and explore the social dynamics behind their development[48].

Xu xiaodong takes the existing street and square space system in China as examples, starts from the “people-oriented”, explored the six principles of humanized space design in street squares and put forward corresponding methods based on the

practical problems[49].

In recent years, the research on square spaces can be summarized in three types:

Summary of square design cases. Zhao Zhongchao analyzed and summarized the construction situation and design points of Quancheng Square[50]. Taking Hongshan Square in Wuhan as an example, Li Yuexi conducts research on accessibility design for pedestrian spaces[51]. This kind of papers mainly studies the design methods and principles of square space through the actual projects, and focuses on technical level.

Discussion on the theory of square design. Wei Qiaobin discusses the design of modern urban squares in China from three perspectives: space composition, peripheral architecture and personalized creation[52]. This type of papers focuses on the summary of square design from the perspective of society and culture, and integrates multidisciplinary knowledge for research and analysis.

Evaluation of the use of square. By investigating the relationship between citizens' actual feelings in the built environment of the square and the design of the square, Yang Cheng tried to reveal the different degrees of importance of the main factors affecting the satisfaction of the use of the square[53]. Zhang Guihong et al. took the post-use evaluation of the square as the theoretical basis, and selected 23 indicators to establish a square space evaluation system to evaluate the comprehensive quality of the square[54]. Based on the evaluation of the use of square and on-the-spot research, this type of papers makes a stage-by-stage evaluation and summary of the use of square, and puts forward suggestions for renovation that are more in line with the needs of users.

1.4.3 Perspective of this thesis

Through collation of relevant literature domestic and overseas, it can be found that:

Researches and project practices in Europe countries started earlier, in which the inclusive design, urban square, and assessment standards have relatively completed, covering not only the physical environment, but also the characteristics and needs of the people. In terms of practice, foreign countries, such as UK, have relatively complete guidance and regulations, focusing on the construction of inclusive

environment at multiple levels such as material, economy, and society.

In China, the concept of inclusive design was introduced in 2010. At the theoretical level, it mainly focuses on urban-scale transportation planning, barrier-free design inside buildings, and renovation of aging blocks. However, there are still few researches on square design in urban public spaces. At the practical level, the regulations and guidelines related to inclusive design by the government and various organizations are still in infancy, and the results of excellent projects are not abundant.

Therefore, this thesis mainly focus on urban squares and explore the transformation strategies that can be adopted in this type of urban public space from an inclusive perspective. By summarizing cases in different countries, an inclusive system for urban squares including evaluation standards and design points will be constructed. Taking Haizhu Square as the design object, the inclusive concept run through the entire design process, which aim to make up and narrow the existing gap, transform the current situation of the square, and to provide design guidance for urban public space.

1.5 Methods and Framework

1.5.1 Methods

(1) Literature research:

By referring to relevant journal articles, works, etc., the collected data are sorted, classified, summarized and analyzed, and the mature methods and related theories of domestic and foreign scholars on inclusive design and urban square design are grasped in the process of data integration.

(2) Case studies:

Through the study of excellent urban public space inclusive design cases in various countries, inclusive design methods and strategies will be sort out, and provide a basis for subsequent design.

(3) Site evaluation:

The site is evaluated with inclusive evaluation criteria through on-site observation behavioral mapping.

(4) Design application:

Select Guangzhou Haizhu Square as the research object, first evaluate it according to the inclusive design standard square, and use the inclusive design method to make up for the existing deficiencies, and at the same time, it can provide design reference for the same type of urban space.

1.5.2 Framework

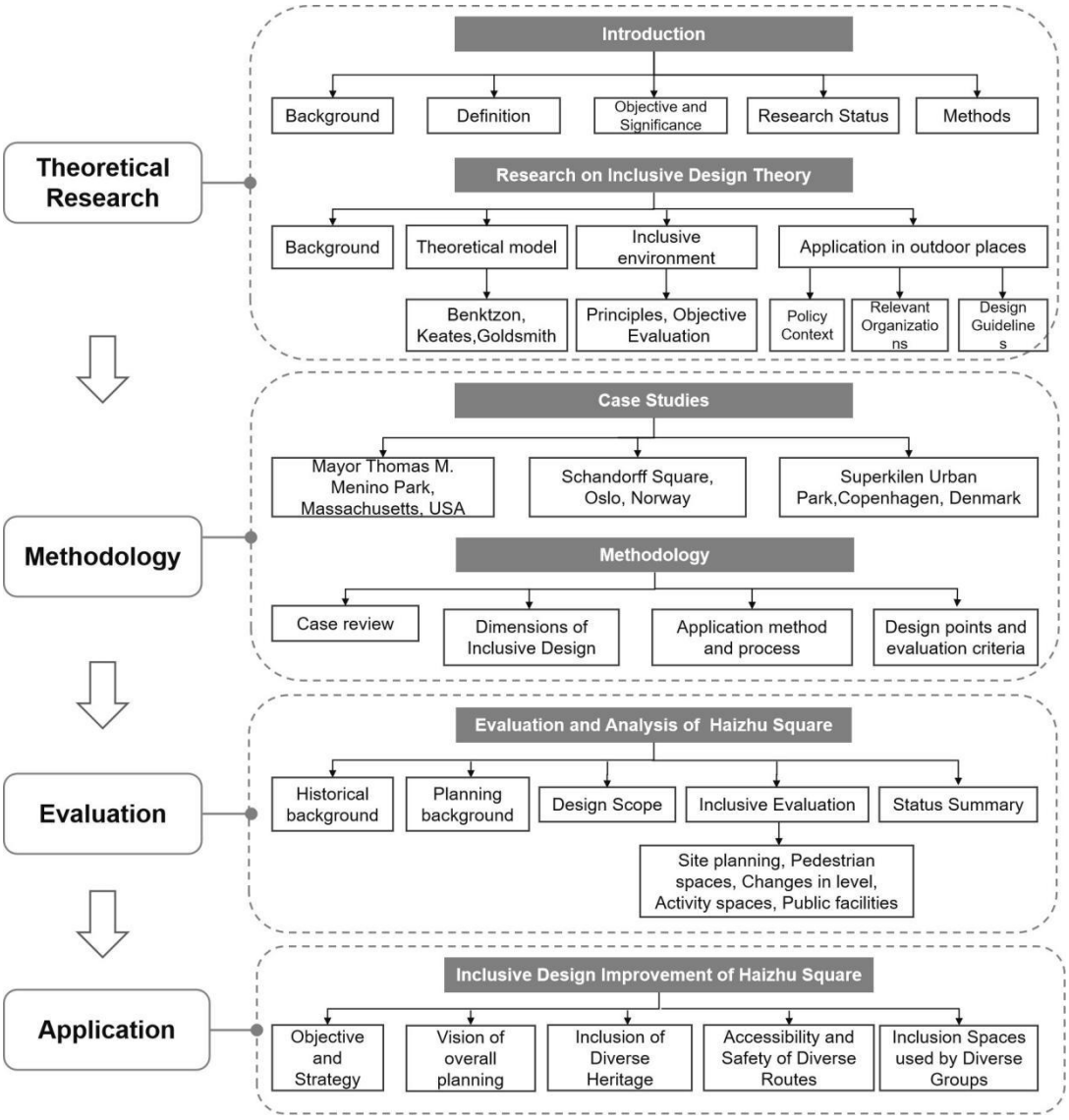


Figure 1-2 Framework of the thesis (Source: Completed by author)

Chapter 2 Research on Inclusive Design Theory

2.1 Theoretical background

The concept of inclusive design originated in the United Kingdom in the 1990s, and is also known as "Design for All" and "Universal Design" in Europe and the United States.

At the end of the 20th century, the design embraced the medical definition of disability and began to distinguish between "general" and "special" needs. Typically, special needs-based design assumes that the user is a young adult, the standard model of human scale. It is then designed for special needs, such as children, the elderly, people with mental illness, and women. Meeting special needs seems like a solution to the problem, however, for buildings and cities, these special needs measures lead to a lack of attractiveness, while the "special" environment is also announcing and reminding the public of the disability of the user. Therefore, this method is also known as the design method that separates the designers from the users[55].

Due to the lack of inclusive design, everyone is a potential or actual victim of architectural disability. Poorly designed urban environments can present barriers for the elderly, children, strollers, wheelchairs, and people with physical, sensory, or cognitive impairments. Even in young, healthy people, certain features may not be a hindrance but an inconvenience. Up to 90% of people may face barriers in the built environment in some way at some point, study shows[56].

With the progress and development of urban civilization, the awareness of fairness and humanism has begun to take root in the hearts of the people, and the urban environment design method has shifted from customizing a special environment for people with special needs to a direction that pays more attention to "inclusive design".

The British Design Council defines inclusive design as "a mainstream design or service framework that can be easily used by as many people as possible in a wide range of contexts, without the need for specialized special design"[57].

Inclusive design aims to remove barriers that create excessive segregation. It enables everyone to participate equally, confidently and independently in everyday activities. Inclusive design not only considers the needs of traditional users, but also includes

the needs of potential users, enriches the diversity of user needs, realizes the fairness of space experience, and achieves the goal of inclusive design.

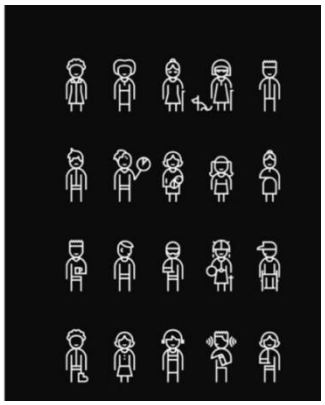


Figure 2-1 Extreme users and inclusive design (Source: A S Cifter)

Figure 2-2 Microsoft's Inclusive Design Tookit
(Source: https://www.microsoft.com/design/inclusive/)

2.2 Theoretical model of inclusive design

2.2.1 Benktzon- pyramid model

In response to the principle of inclusive design, some people believe that solutions are not possible in most cases, and some people will be excluded forever. So Benktzon came up with a diagram of a "design pyramid" to illustrate that inclusive design is not difficult to achieve[58]. He divided the crowd into 3 different levels. The bottom of the Benktzon pyramid is a large number of able-bodied people, the middle tier includes people with reduced abilities, and the top tier is a small number of people with severe disabilities, including "wheelchair users and people with severe physical disabilities". This model assumes that if environments are designed for groups at a certain level, they will automatically be used by everyone in the lower level.

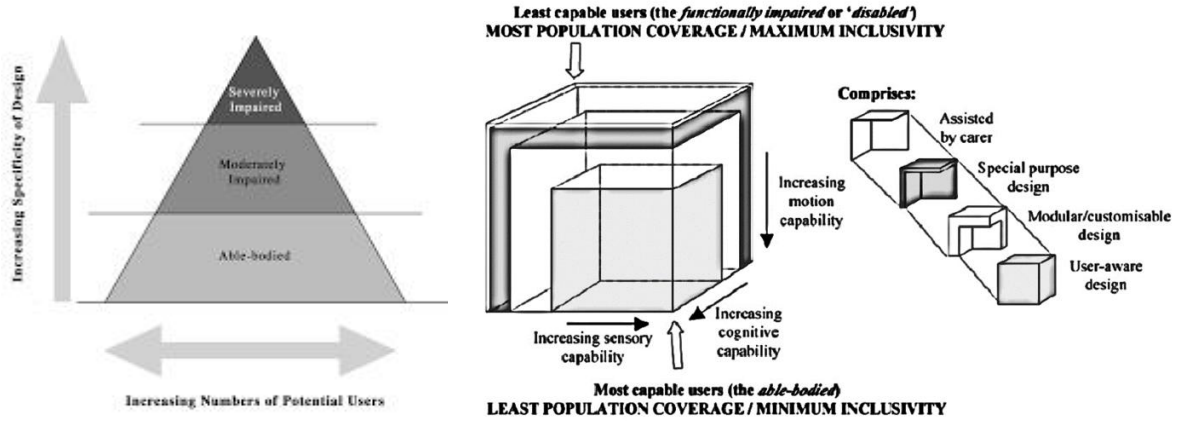


Figure 2-3 Benktzon- pyramid model (Source[58])

Figure 2-4 Keates-cube model (Source[59])

2.2.2 Keates-cube model

Based on the Benktzon pyramid, Keates proposes a more complex model called the "Inclusive Design Cube"[59]. This is a forward-looking design method, hoping that designers will pay more attention to the capabilities of each group from the beginning of design, rather than targeting special groups such as the disabled.

The model connects capabilities, crowds and design decisions in a compact cube. Each axis of the cube represents the user's movements, sensations, and cognitive abilities, and the enclosed volume represents the contained population. The gray area with the largest volume represents the ability of inclusive design to create environments that are usable by the majority of the population, while acknowledging that these environments may not be usable by the less able populations along the 3 dimensions. For the most extreme black part of the cube, and the most functionally impaired population, a custom design may be required through special design. For people with moderate impairments represented by white, if the principle of inclusivity is adopted, the design can be optimized on a more general scale. That is to say, inclusive design requires the use of technology and design methods to increase the user's mobility, sensory, and cognitive abilities, thereby expanding the potential use of the environment.

2.2.3 Goldsmith-pyramid model

Goldsmith proposes the pyramid model from an architectural point of view[60]. Goldsmith takes people's barriers to mobility very seriously and further segments users based on changes in physical abilities. It combines the user's physical ability, behavioral characteristics and user needs to carry out multi-angle analysis methods, as well as a design classification that takes into account tolerance and flexibility, which has a very important enlightening effect on other inclusive design practices.

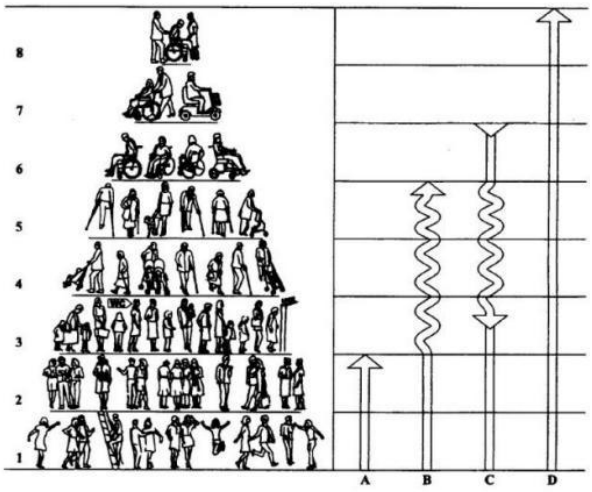


Figure 2-5 Goldsmith-pyramid model (Source[60])

2.2.4 Exclusive design

In the field of product design, researchers from the Engineering Design Center of Cambridge University proposed a user capability-product requirement framework to evaluate the degree of matching between users and products. Professor P. John Clarkson gave a concise criterion for the identification of exclusion: when the requirements for using a particular product in a given environment exceed the user's ability, design exclusion occurs[61].

Passive exclusion: Poorly inclusive environments are understood as environments that require users to be more capable than they are, or that the design fails to meet users' use needs. The design disables model takes design disables as the basic concept, and it is believed that the obstacles caused by users to the design disables should not be attributed to the user's own conditions, but the compatibility between

the design disables, environmental conditions and the user's ability should be reflected[62].

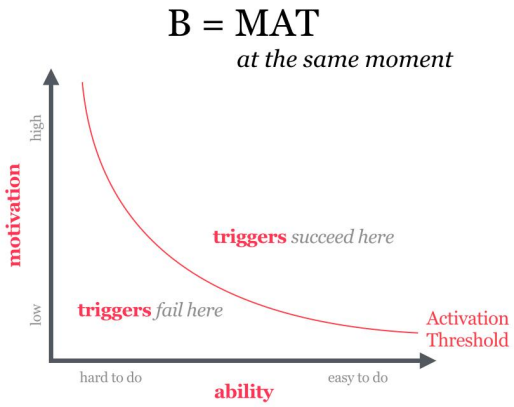


Figure 2-6 Fog's Behavior Model (Source[63])

Positive exclusion: Fog's Behavior Model points out that the triggering of behavior is the joint action of the actor's ability, psychological motivation and triggering factors, and summarizes the psychological motivation into three aspects: pleasure, hope and acceptance. It is not a sufficient condition to trigger the behavior of the target group only to have the ability of behavior without sufficient psychological motivation[63].

2.3 Inclusive environment

2.3.1 Design Principles

An inclusive environment is one where all users, regardless of their abilities, can comfortably, effectively and safely carry out their daily activities without being limited by the poor design, maintenance or management of the built environment. The principle of inclusive design aims to accommodate the widest range of body shapes, sizes and modes of movement, allowing designers to ensure that the environment meets the needs of the widest range of users. Therefore, inclusive design is not only about reducing environmental stress and alleviating architectural disability, but also about achieving greater social equity and justice.

7 principles of inclusive design by North Carolina State University:

Table 2-1 Principles of inclusive design (Source: North Carolina State University)

Equitable Use	The design is useful and marketable to people with diverse abilities.
Flexibility in Use	The design accommodates a wide range of individual preferences and abilities.
Simple and Intuitive	Use of the design is easy to understand, regardless of user's experience, knowledge, language skills or current concentration level.
Perceptible Information	The design communicates necessary information effectively to user, regardless of ambient conditions or ability.
Tolerance for Error	The design minimizes hazards and the adverse consequences of accidental or unintended actions.
Low Physical Effort	The design can be used efficiently and comfortably and with a minimum of fatigue.
Size and Space for Approach and Use	Appropriate size and space is provided for approach, reach, manipulation and use regardless of user's body size, posture or mobility.

2.3.2 Objective

Urbanization has become the basic trend of social development. According to data released by the United Nations, the urban population is growing three times faster than the overall population, making cities the engines of economic growth, employment and opportunity creation. Cities can be diverse, vibrant and exciting places for young and old alike. There is a growing awareness that all users of the environment should be able to carry out their work and leisure activities efficiently, safely and joyfully according to their abilities[64].

However, the urban environment is the most concrete and representative material space for the obstacles faced by the vulnerable groups. The environment built in the city cannot take good care of the needs of the disabled, the elderly, children and other vulnerable groups. Therefore, from a design perspective, an inclusive urban environment should address two issues:

First, the design of the urban environment should first solve the problem of "can or not". On this level, the basic purpose of inclusive cities is "seamless travel", that is,

from building to building, place to place, everyone can effortlessly take advantage of the various modes of transportation in the city from the starting point to the destination.

Second, the design of the urban environment should solve the problem of "good or not". Creating attractive outdoor environments is critical to encouraging and maintaining a healthy, active lifestyle. Jacobs observed that when people's informal connections increased, there was less street crime, a better social environment, and people showed a greater sense of well-being in their surroundings. This shows that inclusive urban spaces help improve people's quality of life[65].

2.3.3 Evaluation

In 2004, the Oxford institute for sustainable development carried out the WISE (well-being in sustainable environment) research. WISE studies how the built environment, from the architectural scale to the urban scale, affects the well-being, physical and mental health, and quality of life of occupants and other users. The study found that urban spaces are designed with adult healthy men as users: visual landscapes, height differences connected by steps, and homogeneous spaces, although these designs are not intentional, but inevitably turns the urban environment into a space that is only friendly to a few. The exclusion suffered by the elderly, children, women, disabled and other groups is beyond the understanding of ordinary designers or users. The factors that lead to these exclusions include differences in users' gender, age, health and other factors. Urban spaces should respect the differences of users and strive to reduce the sense of difference in experience. The inclusiveness of the urban environment cannot be roughly equal to the accessibility of the space, but to ensure that each user can use the space freely, equally and independently.

In terms of how to evaluate an inclusive environment, Burton and Mitchell put forward the evaluation principles for outdoor environment based on research on the characteristics and needs of Alzheimer's patients, and divided them into 6 aspects: familiarity, comfort, accessibility, legibility, security and uniqueness.

Table 2-2 Evaluation of inclusive environment (Source: [22])

Familiarity	Familiarity refers to the user's recognizability of community public spaces, streets, buildings, etc., which is determined by spatial form, spatial scale, spatial rhythm, functional organization, and visual factors.
Comfort	The outdoor environment will not bring physical and psychological discomfort to the user, who can reach the destination comfortably and safely enjoy the spaces and carry out activities.
Accessibility	Outdoor environment allow users to enter, reach, and use freely and safely without affecting their health, senses, and physical strength. The spaces are interconnected and have smooth pedestrian routes and crossings.
Legibility	Legibility refers to the user's recognition of the outdoor environment, whether the spaces are concise and pure, whether the nodes are reasonable and clear, whether there are distinct signage, etc., can all affect the judgment of environmental legibility.
Security	Safe environments allow people to move, use and enjoy themselves without the threats and worries of surrounding elements.
Uniqueness	Uniqueness refers to the degree to which the user understands the environment. The spaces should avoid homogenization to enable users to clearly distinguish the purpose of the square space.

2.4 Application of inclusive design in outdoor places in UK

In the past, inclusive design was mainly concentrated in the fields of industrial design, product design, man-machine interactive, etc. The UK was the first to advocate the application of inclusive design in the outdoor environment and achieved great results.The project “Inclusive Design for Getting Outdoor (I'DGO)” in UK is dedicated to the application of Inclusive Design in the planning, design and renovation of outdoor environments, and seeks the most effective ways to shape Inclusive outdoor environment[66].

At the same time, the UK has a comprehensive and multi-level system, from Acts of Parliament to national planning frameworks, local plans, to detailed building

regulations and standards, which promotes accessible and inclusive places in a variety of ways and sets specific requirements. This hierarchical system, including legislation, policy, and regulations, creates a framework for inclusive design, and because of its vision, it has played a crucial role in the development of inclusive design in the UK.

2.4.1 Policy Context

Below is a summary of the UK policy context on inclusive design:

Table 2-2 Policy context in UK (Source: Completed by author)

	Policy	Summary
Legislation	The Equality Act 2010 	The Equality Act is a very broad piece of legislation which legally protects people from discrimination in the workplace and in wider society. The Equality Act 2010 gives rights to nine 'protected characteristics': Age, Disability, Gender reassignment, Marriage, Pregnancy and maternity, Race, Religion, Sex, Sexual orientation
Planning:	The National Planning Policy Framework, 2018 	NPPF, which sets out the planning policies for England and how they should be applied, clearly identifies the need for planning policies and decisions to create places that are safe, inclusive and accessible, and which promote health and well-being.
	London Plan, 2016 Policy 7.2 - An inclusive environment	The Mayor will require all new development in London to achieve the highest standards of accessible and inclusive design and supports the principles of inclusive design which seek to ensure that developments can be used safely, easily and with dignity by all regardless of disability, age, gender,

		ethnicity or economic circumstances
Building Regulations:	Approved Document M – Access to and use of Buildings Vol 1: Dwellings, 2016 Approved Document M – Access to and use of Buildings Vol 2: Buildings other than dwellings, 2016	
British Standards:	BS 8300-1:2018 Design of accessible and inclusive built environment Part 1: External Environment	
Local Planning Policies:	Inclusive Design Standards	The Standards are a single document to inform development partners and act as a benchmark against which LLDC can measure levels of inclusive design achieved.

2.4.2 Support by Relevant Organizations

(1) Sensory Trust

Sensory Trust is a UK registered charity that coordinates and consults on inclusive design. It integrates real human experience into the realization of technology, creating an environment that attracts people and encourages better connections between people and places, so that people can really participate in the environment. Sensory Trust provides and implements a methodology for the design and management of outdoor spaces through a close partnership with the environment, contributing to the accessibility of spaces, signage systems and website development

(2) Commission for Architecture and the Built Environment (CABE)-Spaceshaper

Spaceshaper is a practical toolkit for collecting data, opinions, and measuring the quality of a public space. In the process of evaluating the space, Spaceshaper not only pays attention to the suggestions of experts in relevant fields, but also fully understands the real feelings of space users. Such as: the accessibility of the routes to the destination; how the activity spaces promotes the occurrence of the activity; how to meet the needs of different groups; how to keep the outdoor spaces clean and tidy; how to make the users safe and comfortable; whether the materials are used appropriately; how the locals evaluate the spaces; how the users of the spaces feel,

etc.

2.4.3 Design Guidelines - Queen Elizabeth Olympic Park

Based on the general understanding and support of the whole society, the UK has successively formulated inclusive design guidelines in many fields including housing, transportation, and public spaces, which have played an important role in practice.

The Queen Elizabeth Olympic Park has been well-received for its high degree of inclusiveness and accessibility, and obtained the “Award for Equality and Diversity” by the Royal Town Planning Institute[67]. The London Olympic Committee and the Paralympic Committee aimed to “create the most inclusive Olympic Games”, and had implemented inclusive strategies throughout the entire process from procurement, design to construction, involving buildings, public spaces, landscapes, infrastructures, etc. At the same time, LLDC supported the Built Environment Access Panel (BEAP) in which all members had vast experience and knowledge of inclusive design, to review all the developments in Park.

The “Inclusive Design Standards” set by the London Legacy Development Corporation (LLDC) in May 2019, including the Design Quality Policy, Equality and Inclusion Policy, Inclusive Design Strategy, and Olympic Park Design Guidelines, have greatly influenced the construction of inclusive urban environment in the UK.

From the perspective of inclusive design, LLDC provides detailed guidelines for four key parts: inclusive neighborhoods, movement, residential developments and public buildings.

Table 2-3 Design guidelines in urban environment
(Source: LLDC’s Inclusive Design Standards)

Category	Design Guidelines
Inclusive neighborhoods	Site planning
Movement	Public realm; Wayfinding and orientation; Signage; Pedestrian routes (Widths, Seating, Street furniture, Pedestrian surfaces, External tactile

	paving); Changes in level (Ramps, External stairs, Handrails, Passenger lifts, Bridges); Cycling infrastructure (Cycle lanes, Cycle parking); Shared space; Parking and drop-off; Public toilets; Assistance dog facilities; Inclusive play
Residential developments	Inclusive housing (Drop-off/visitor parking, Residents' Parking, Approaching the home, Inclusive amenity, Communal lifts, Considerations for supporting older Londoners and multi-generational housing, Faith and cultural considerations); Student accommodation
Public buildings	Entering the building (Entrances, lobbies, Access controls, Reception areas); Horizontal circulation; Vertical circulation; Sanitary facilities; Changing facilities; Multi-faith facilities; Audience seating; Refreshment facilities; First aid facilities; Internal Lighting; Signs and information; Acoustics and communication systems; Emergency egress

In the "Inclusive Design Standards", design guidelines related to urban squares are organized into 10 parts as follows, which include: Site planning, Pedestrian routes, Rest points, Pedestrian surfaces, Changes in level, Cycling infrastructure, Parking, Public toilets, Inclusive play areas and Wayfinding and signage.

Table 2-4 Design Guidelines related to urban squares

(Source: LLDC's Inclusive Design Standards)

Design Guidelines - Summary	Illustration
01 Site planning	
Inclusive design principles should be integrated into the site's master plan from the outset. During the master planning stage, key considerations are: the links to public transport, the choice of routes, how topography and architecture affect the accessibility and usability of the site for all users. Outdoor spaces should encourage pedestrians to get out and enjoy outdoor spaces and access services and amenities. The master plan should be welcoming to visitors and encourage use from the surroundings; make optimum use of the topography for provision of easy access in to; prioritize pedestrian movement; promote healthy streets; enable easy navigation, facilitate navigation; have variety and difference.	

02 Pedestrian routes

The design of pedestrian routes should provide routes that are intuitive and easy to use; provide the same quality of experience for all different options of overcoming levels (either by graded route, lifts or by steps); avoid the use of winding routes and excessively long graded routes; provide seating located along pedestrian routes; the steps must be clearly identifiable, especially for a person who is blind or partially sighted.

03 Rest points

Seating / rest points should be provided at regular intervals no more than 50m apart; be obvious and clearly visible along main circulation routes; be located in areas naturally sheltered from the weather.

Seats should be located on an accessible surface; have adequate clear space alongside to allow wheelchair and scooter users to sit; have varying seat heights; enable a wheelchair user to transfer laterally onto a bench, with a level transfer space of 1200mm located at one end and an arm rest set in at 500mm to 750mm from the transfer space; armrests that are approximately 200mm above seat height level; back rests that are at least 300mm high from seat level.

04 Pedestrian surfaces

Pedestrian surfaces should be firm and slip resistant and be hard enough so that wheels and sticks do not sink into them; be hard-wearing, durable and easily maintained; even and stable, with any variation of surface profile not exceeding ±5mm; avoid the use of busy patterns, including stripes; avoid the use of highly reflective materials.

05 Changes in level

Ramps should have gradients no steeper than 1:15; be provided with adjacent stairs if over a 300mm rise; have a surface width

between walls, upstands and kerbs of no less than 1500mm; have a cross-fall gradient of not more than 1:50; incorporate intermediate landings at least 1800 x 1800mm.

External stairs should not be dissected by ramps or graded routes as to produce feathered/tapered steps. Where stairs are provided they should no less than 2 risers and no more than 20 steps in a single flight; a minimum unobstructed width of 1200mm.

External lifts should be situated in safe locations with clear sight of the entrances; be provided with suitable shelter from the weather; the lift car should be a minimum of 2000 x 1400mm to allow wheelchair users to turn 180°; have a clear, level manoeuvring space of at least 1500x1500mm at the front of the entrance; have suitable door opening widths; have braille reminders on button surface.

GRADIENT	GOING OF A FLIGHT	MAXIMUM RISE
1:20	10m	500mm
1:19	9m	474mm
1:18	8m	444mm
1:17	7m	412mm
1:16	6m	375mm
1:15	5m	333mm

06 Cycling infrastructure

Cycles paths should have the gentlest camber to facilitate comfortable and safe cycling, whilst allowing for drainage; incorporate a raised, central delineator strip, to help people with a visual impairment keep to the pedestrian side; be no less than 2m wide, to allow wheelchair users and prams to pass shared paths; footpaths and cycle tracks should be appropriately separated, preferably with a change in level with kerb should be at least 60mm high.

The minimum gap between cycle bays should be 1000mm; at least one bay for non-standard cycles should be allocated at the end of a row of cycle parking stands, with these bays a minimum of 1500mm width.

07 Parking

Accessible parking bays should have dimensions of 2.4 x 4.8m; have a 1.2m access zone between bays; have the international symbol of disability on the surface of the bay; be within 50m of building entrances; provide parallel parking bays for on street parking of 3.6 x 6m; give consideration to making provision for

wheelchair accessible vehicles.	
08 Public toilets	
Inclusive toilet should provide adequate manoeuvring space for disabled people; cubicles are to have a minimum width of 800mm; one urinal suitable for a disabled person who is ambulant is to be provided for every four urinals; diameter of grab rails should be 32-35mm with a clear area between the rail and the wall of between 50-60mm.	
09 Inclusive play areas	
Inclusive play ensures that all children, young people and older people of any ability have equal access to and equal participation in local play and leisure opportunities; Play areas should be accessible to wheelchair users and other disabled children and adults, with main circulation routes through the play-space to be wide enough to allow two wheelchair users to pass one another and one wheelchair user to turn 180°(1800mm); have observation points; provide a range of play challenges to meet various different ages and abilities and incorporate play spaces; provide quiet areas to enable sensory experiences of a gentler manner.	
10 Wayfinding and signage	
Wayfinding should provide orientation through the landmarks which may include trees, building facades or public art; make appropriate use of tactile paving and guidance paving;consider smartphone apps and other new wayfinding technologies. Signage should have tone and visual contrast; simple and careful language; simple symbol; architectural elements; smart technology.	

2.5 Chapter summary

The inclusive design theory stems from the close attention to the “special groups” and the increasingly population aging. Meeting “special needs” seems like a solution to solve problem of groups, however, for buildings and cities, the “special environment” is also announcing and reminding the public of users’ disability. Inclusive design aims to remove barriers that create excessive segregation, and accommodate the widest range of body shapes, sizes and modes of movement, allowing designers to ensure that the environment meets the needs of the widest range of users. In response to the principles, some scholars came up with different models to illustrate how to achieve inclusive design. Then, this chapter explains what an inclusive urban environment is in terms of principles, objectives and evaluations. The UK was the first to advocate the application of inclusive design in the outdoor environment and achieved great results, it has a comprehensive and multi-level system, which promotes accessible and inclusive places in a variety of ways and sets specific requirements. Based on the general understanding and support of the whole society, the UK has successively formulated inclusive design guidelines in many fields, among which taking Elizabeth Park as an example, the design guidelines are explained in detail, in order to provide theoretical support for subsequent design strategies and approaches.

Chapter 3 Case Studies

3.1 Mayor Thomas M. Menino Park, Massachusetts, USA

3.1.1 Background and Objective

Figure 3-1 Aerial view of Mayor Thomas M. Menino Park (Source: Weston & Sampson)

Design is a response to social demands. The design and construction of Menino Park has its rich historical background and influences from surrounding buildings. Menino Park was designed through several events: Spaulding Rehabilitation Hospital opens a new branch in the former Charleston Navy Yard; and served as the places to treat injured runners and spectators after the Boston Marathon bombing Event; while visiting the new building, Mayor Menino saw the potential for a new accessible, all-inclusive playgrounds.

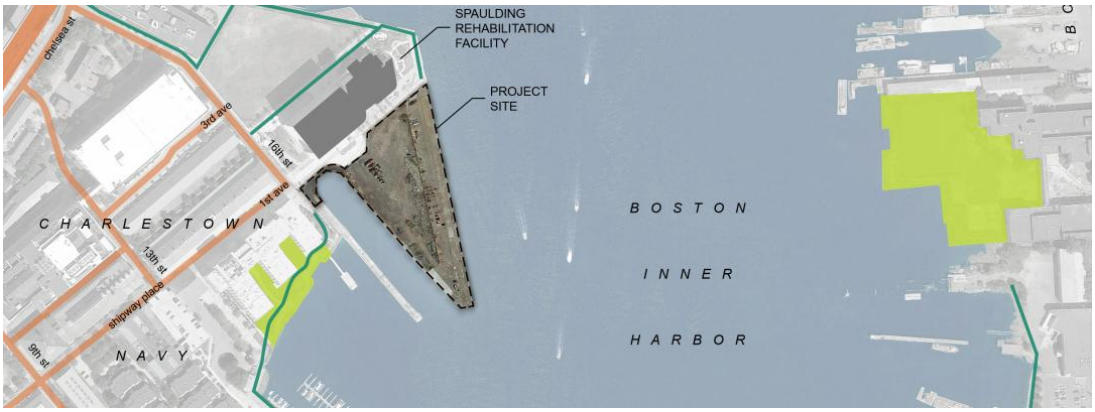


Figure 3-2 Site location and Master plan (Source: Weston & Sampson)

The design of project connects the internal park with the external harbor promenade, filling a gap in Boston's waterfront corridor. The concept of inclusion is at the core of the entire park, which aims to provide a healing place for people of all ages and abilities to heal from mental and physical problems. The project team invited physicists and occupational therapy/rehabilitation specialists from Spaulding Hospital and the community to provide valuable insights into the design process while being part of the public outreach. Additionally, the team communicated extensively with the client, the Mayor's Office, Spaulding Hospital, the Charleston community, municipal agencies, contractors and subcontractors throughout the design process.

3.1.2 Approaches

01 Application of history elements

The design of park is inspired by its history (the former World War II dry dock) and the use of sustainable elements, such as the reuse of granite blocks used to hold back the sea, which have now been turned into seating, forming a stepped “dry dock” wall that defines the space. The height of these steps creates a sense of enclosure, providing space for patients with sensory problems while creating stunning views of the harbour.

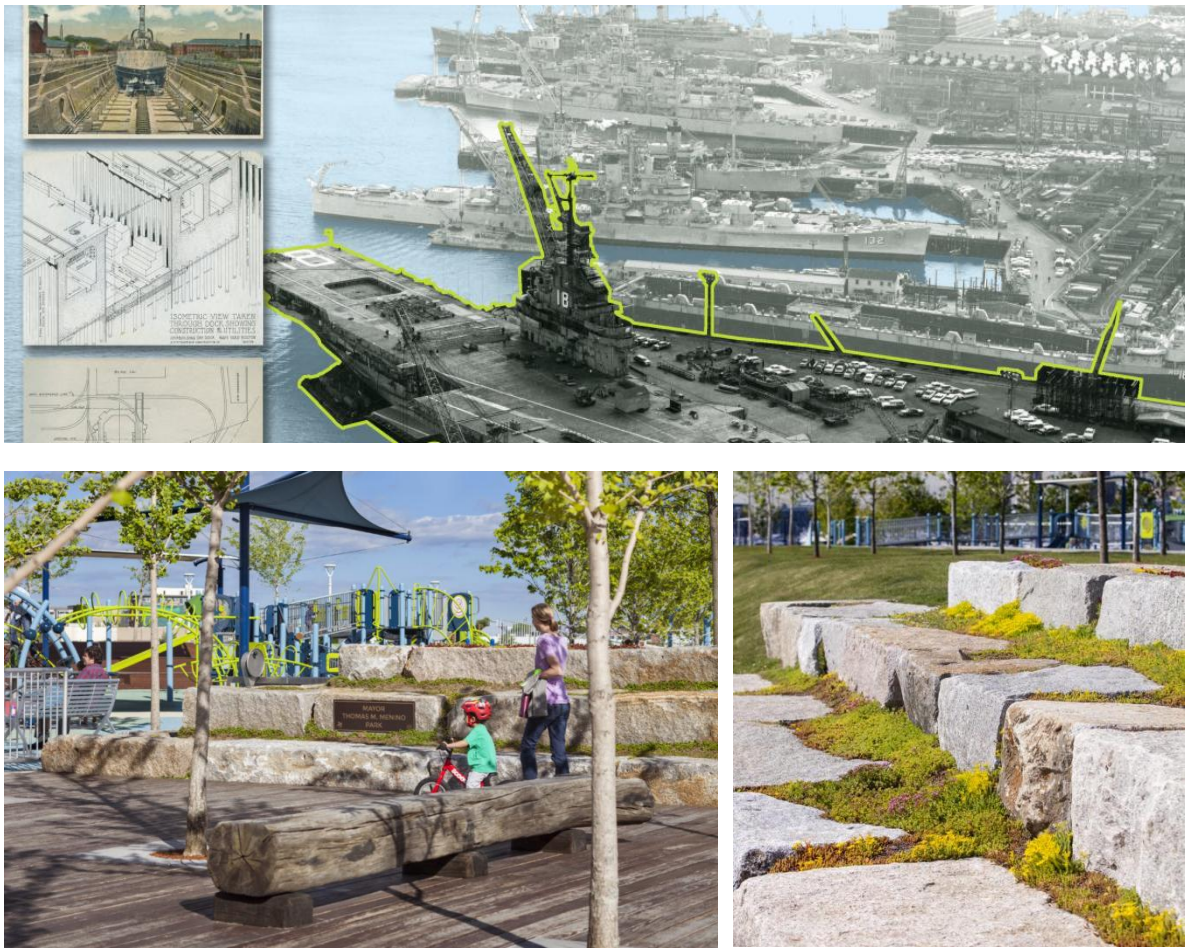


Figure 3-3 Application of dry dock (Source: Weston & Sampson)

02 Serving for all ages

Menino Park has embedded the concept of inclusion into every level of design, creating a sense of belonging and community. The overarching goal of the project is to be more inclusive than legally required, and the playground symbolizes the highest level of accessibility. The park offers countless recreational activities, physical therapy and exercise opportunities for people of all ages, including the well-connected harbor promenade and its informative signage, as well as spectacular water views. The new park is a compelling open space resource designed to provide a respite from everyday urban life and a healing place for those facing health challenges.

The park has equipped with 60 carefully selected barrier-free amusement facilities for a wide range of physical training and exercise. All the routes and functions provide equal enjoyment for people, with children and carers can climb to the highest point through the stacked and undulating haystacks, sharing the fun of outdoor play. There is no “specific routes” in Menino Park, where everyone, regardless of ages or abilities,

can play, explore and grow together.

Figure 3-4 Serving for all ages (Source: Weston & Sampson)

03 Combination of ramp and site

The highlight of the park design lies in the organic combination of pedestrian routes and ramp facilities with the site. Whether in forms, functions and materials, the design of accessible landscape seems to exist for this site, which not only for the disabled group, but also considers the people with sensory impairments, as well as people of different ages with rehabilitation and recreation. The goal of accessibility has been incorporated into the attractive and vibrant landscape and facilities, which is also the best interpretation of inclusive design. The open path of the park allows all visitors to enter the exercise and rehabilitation area, children's play area,harbor promenade area, and gently sloping rest platform without barriers.

Figure 3-5 Combination of ramp and site (Source: Weston & Sampson)

3.2 Schandorff Square, Oslo, Norway

3.2.1 Background and Objective

Schandorffs Square is a public space renovation project based on the inclusive design. It was completed in 2009 by ø Stengen & Bergo AS, a Norwegian landscape architecture firm. Located in central Oslo, Schandorffs Street, a cul-de-sac, is transformed from a parking lot into Schandorffs Square, an urban green space. This transformation has resulted in an inclusive transportation route and social space for everyone to enjoy. The biggest challenge of the design was the seven-meter height difference.

The square is surrounded by well-known motives of Oslo: the Trinity Church to the south, a centrally-planned Gothic church with brick facades;the Deichman Library to the east, featuring an imposing row of columns forming the entrance to one side of the square and the home for the ancient sculpture of the Apostle of Greenland;Hans

Egede, has finally got rid of surrounding parked cars and can now rest calmly in a decent green setting.

Figure 3-6 Renovation of Schandorff Square (Source: Stengen & Bergo AS)

3.2.2 Approaches

The intended design has been to create a central urban green space with simple but sober means. The walkway's body - surface and retaining walls - are made of concrete cast in situ. The small plazas are covered with light gray granite paving, resting on walls performed of cortén steel, creating an overall warm tone.

Figure 3-7 Master plan and Section of Schandorff Square (Source: Stengen & Bergo AS)

The square creates an important slope of 7 meters height difference between two

streets, making it a challenge for accessibility design to cross the square without steps. ø Stengen & Bergo decided from the very beginning to embrace inclusive design as a key approach to park design. The original road gradient is 15%, and the design requirements are adjusted to a maximum of 5% in the final rendering. In the process, they gained valuable input from different user groups and conducted tests involving wheelchair users.

01 5% continuous ramp

The square connects the old buildings with the modern office buildings, and an elegant meandering sloping walkway has become iconic and characteristic of the square.The slope was transformed into a walkway with a maximum gradient of 5%. In order to meet the slope requirements, the new walkway needs to pass through the existing wall. Fortunately, this was accepted by the authorities responsible for preserving the regulations. With enough space left at the corner of the road, the granite paved road is seamless. There are handrails and balustrades on the walkway and all the stairs, while the side handrails are multi-tiered to cater to different people. The stairs also have marked steps and hazard warning areas, with tactile paving at the top and bottom.

Figure 3-8 Seamless and continuous ramp (Source: Stengen & Bergo AS)

02 Rest Spaces

Accessibility for all has been successfully implemented, providing plenty of places for tired walkers to rest.The flat form of the sidewalk not only responds to the gentle slope, but also creates a variety of meeting spaces. On the side next to the stairs there is a large hard floor and the furniture includes free-standing chairs so the wheelchair can

easily be placed around the table.At the same time, a smooth wooden multi-level rest platform is designed at the corner of the road by taking advantage of the change of height difference. Disabled parking is available at the end of the square.

Figure 3-9 Diverse rest spaces (Source: Stengen & Bergo AS)

03 Selection of landscape plants

Planting became an important aspect of the square, with ø Stengen & Bergo working with the Allergy and Asthma Association of Norway to find the right combination of allergen-free plants for all seasons and without maintenance. The lawn contributes to a peaceful neighbor-ship to the Trinity church. Two large trees are carefully preserved through the construction period, and create together with mass plantings of flowering iris, catnip, lavender and lady's mantle to a lush and beautiful effect, mainly in blue through the season. A planted cherry grove with white spring blooming will soon contribute to a healthy and good urban environment in a dense area. Along the ramp small squares and vegetated surfaces meet in a finger-woven pattern. The old existing sculpture of the Apostle of Greenland, Hans Egede, has finally got rid of surrounding parked cars and can now rest calmly in a decent green setting.

Figure 3-10 Selection of landscape plants in site (Source: Stengen & Bergo AS)

04 Good visual contrast

Schandorffs Square is accentuated with a different hue than other squares in the city. Next to the walkway and square, the adjacent vegetation and Corten steel edges provide a good visual contrast with the light surface of the slope and serve as a guiding element. Emphasis was placed on the colour of the material and contrast of the surface, while non-slip materials were used. Corten steel is used for vertical walls, which combine with various blue tones of raw concrete, stone, lawn and perennial plants to produce a warm mood. From a cost point of view, the materials used are not particularly expensive, but great attention is paid to every detail, with clean lines and gorgeous contrast, and good navigability.

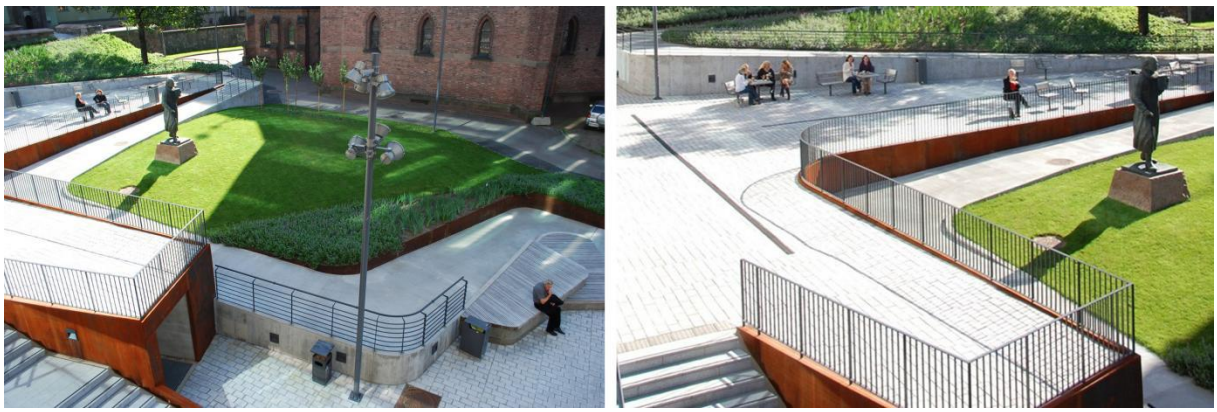


Figure 3-11 The good coordination of colors and materials (Source: Stengen & Bergo AS)

Schandorffs Square has become an attractive central urban green space for many people to enjoy. Fixed timber seating, hidden high-voltage cables, soft landscaping and newly planted cherry groves create a tranquil oasis and popular gathering place in a dense urban setting.

3.3 Superkilen Urban Park, Copenhagen, Denmark

3.3.1 Background and Objective

As outdoor public places for people to gather and communicate, how to make the park truly become places for people to interact in the community, especially in the multicultural community, has always been the subject of discussion by designers.

Superkilen Park is located in the Nørrebro district north of central Copenhagen, Denmark. The Nørrebro district is the most ethnically diverse community in the city, home to people from more than 60 countries. The design concept of the entire project is based on the idea of turning the public spaces into an inclusive container that showcases the living elements of the residents of more than 60 different countries , making every resident of diverse backgrounds feel at home. The inclusiveness of urban life reflects local identities rather than segregating people into rigid groups.

The design of Superkilen Park is not finalized by designers at one time, but involves the participation of the public - the choice of colors and materials, the Thai boxing ring, the Moroccan fountain, and the Turkish chairs are all the results of the public's participation in the selection. After completion, the park becomes a display place for world culture.

Figure 3-12 Aerial view of Superkilen Urban Park (Source: Google)

3.3.2 Approaches

The public space formed by Superkilen along the two sides of the building is about 750 meters, with a total area of 3,000 ㎡, consisting of three main areas: the Red

Square, the Black Market and the Green Park, each with different spatial and functional characteristics

The Red Square is conceived as an extension of the sports and cultural activities that take place at Nørrembrohall sports center. A range of recreational offers and the large central square allows the local residents to meet each other through physical activity and games. The colored surface is integrated both in terms of colors and material with the Nørrebrohall and its new main entrance, where the surface merges inside and outside in the new foyer. Facades are incorporated visually in the project by following the color of the surface conceptually folding upwards and hereby creating a three-dimensional experience. By the large facade towards Norrebrogade is an elevated open space, which almost like a tribune enables the visitors to enjoy the afternoon sun with a view. In addition to the cultural and sports facilities, the Red Square creates the setting for an urban marketplace which attracts visitors every weekend from Copenhagen and the suburbs.

The second space, the Black Market, is the heart of Superkilen. Permanent tables, Turkish benches or grill areas turn this space into an outdoor living room where neighbors can gather around the Moroccan fountain, or play chess for instance. The wavy white lines on the dark pavement mark the directionality of the square and curve around the elements that appear along the way. To create better and more transparent infrastructure throughout the neighborhood, the current bike paths will be reorganized, new connections linking to the surrounding neighborhoods are created, with emphasis on the connection to Mimersgade, where citizens have expressed desire for a bus passage. This transition concerns the whole traffic in the area at outer Norrebro and is a part of a greater infrastructure plan. Alternatives to the bus passage include signals, an extended middle lane or speed bumps.To protect from the street ending at the north east corner of the square and to meet the wishes from the neighbors, we have folded up a corner of the square creating a covered space.

In the third area, the Green Park, its soft hills and surfaces appeals to children, young people and families. A green landscape and a playground where families with children can meet for picnics, sunbathing and breaks in the grass, but also hockey

tournaments, badminton games and workout between the hills. The neighbors asked for more green so we ended up making the green park completely green – not only keeping and exaggerating the curvy landscape, but also painting all bike- and pedestrian paths green. Armenian picnic tables next to Mjølnerparken with South African BBQ's, a volcano shapes sports arena for basket ball and football, a line dance pavilion from Texas, muscle beach from LA with a high swing from Kabul, Spanish ping pong tables and a pavilion for the kids to hang out in. The green park is turning into Mimers Plads on the top of the hill to the south. From the top of the hill you can almost overlook the entire Superkilen.

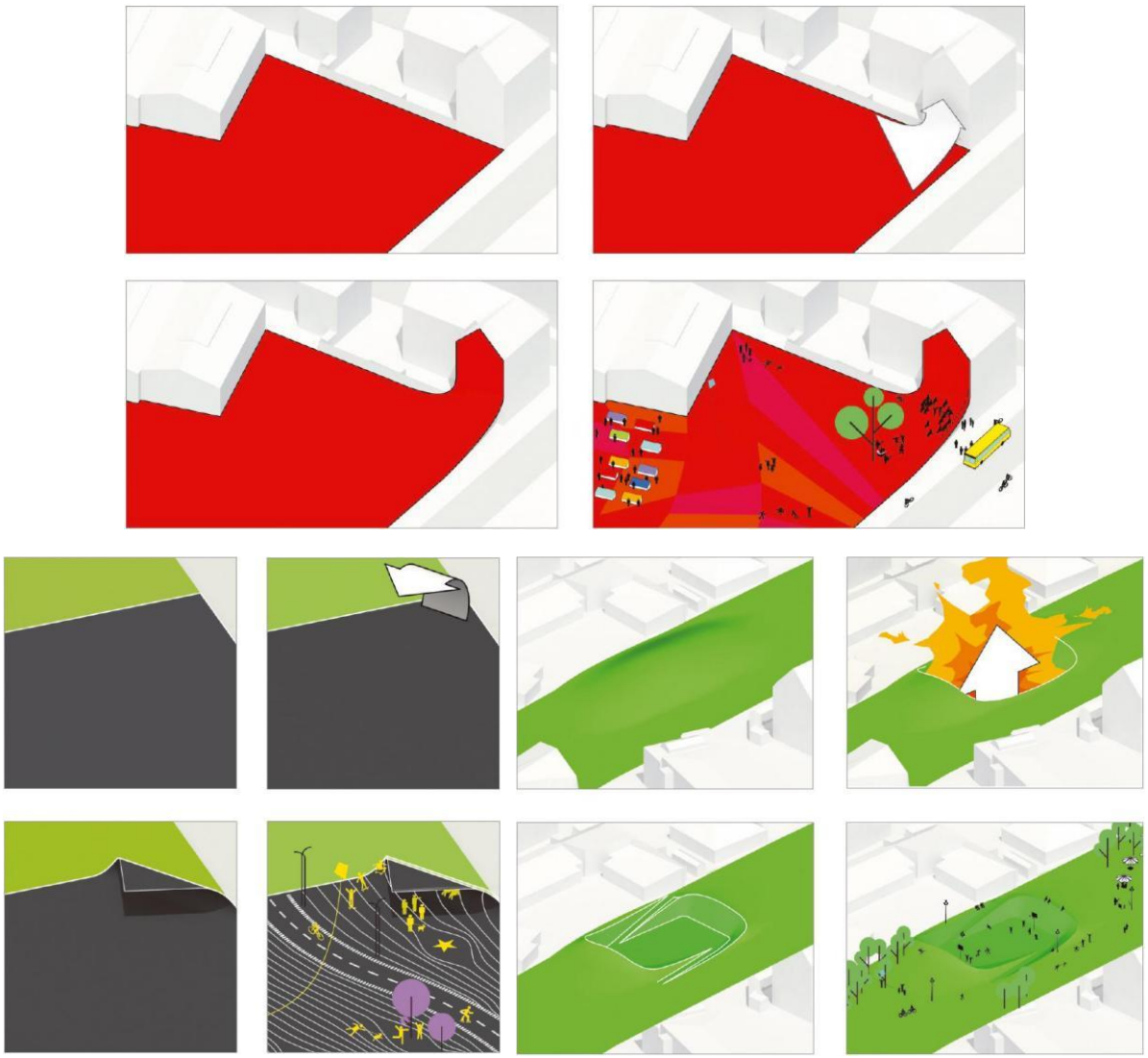


Figure 3-13 Concept generating of the Red Square,the Black Market, and the Green Park (Source: BIG Architects)

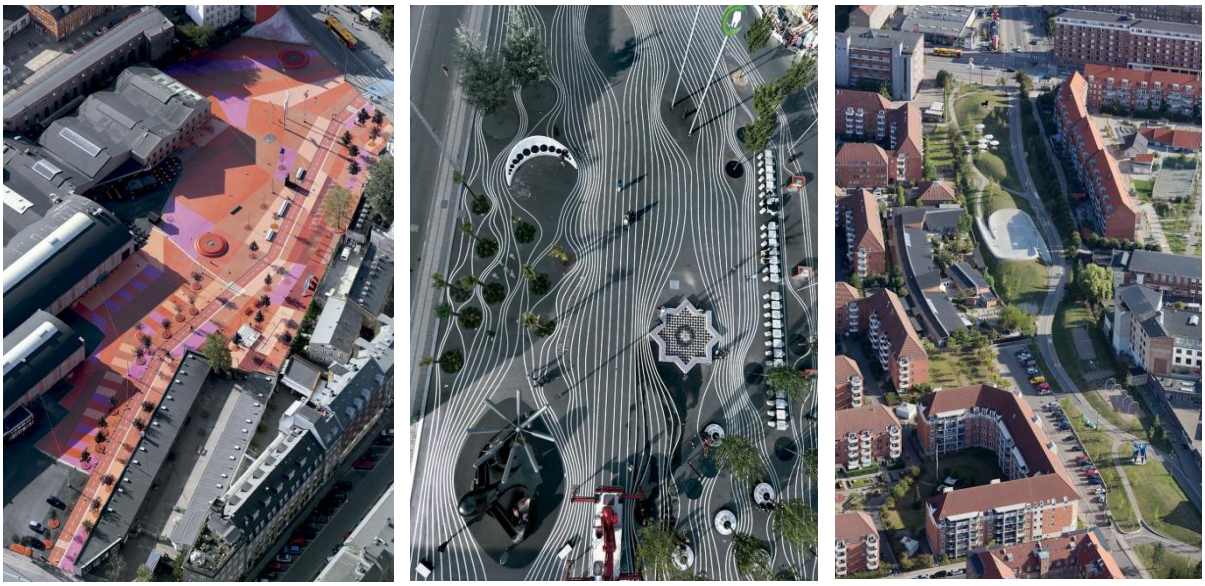


Figure 3-14 the Red Square,the Black Market and the Green Park

(Source: BIG Architects)

In the Red Square, Russian and Chinese neon signs share the space with a Jamaican sound system, circle swings from Irak and a boxing ring from Thailand. Shades of red and pink spread across the objects, merging the surroundings without hiding the diversity of furniture and objects. In the Black Square, a more intimate space, remarkable for the dynamic white lines spread over its inky ground, where chess tables and barbecue grills rub shoulders with a Moroccan fountain, Chinese palm trees and an oversized black Japanese octopus playground. In the Green Park A bull silhouette from Spain and a doughnut-shaped sign from USA overlook diverse areas to rest, play, grill or exercise while exploring urban objects from many different countries.

Figure 3-15 Furnishings and activities in Site (Source: BIG Architects)

Superkilen has succeeded in joining two residential areas formerly divided by a fence and has reconnected the surrounding areas to the rest of the city. Pedestrian and cycling traffic has increased between two major roads and the park encourages people to become more active. It provides a stimulating environment, particularly important for children.The park acts as a meeting place for residents of Denmark's most ethnically-diverse neighbourhood and attracts visitors from across the city and around the world. It has rejuvenated the problematic area and brought together the sixty different nationalities living nearby. In addition to the wide range of ethnicities using the park, it attracts a wide range of ages, from small children with their parents

to elderly people.

3.4 Chapter summary

In this chapter, three typical cases of inclusive design of urban public space are selected and their design strategies are investigated and analyzed respectively. Through the comprehensive comparison of these cases, the following will discuss how to adopt specific methods to improve the inclusiveness of urban public space in design practice under the guidance of the ideas and theories of inclusive design.

Mayor Thomas M. Menino Park is located within Boston Inner Harbor. The design and construction of Menino Park has its rich historical background and influences from surrounding buildings and several events. The design aims to provide a healing place for people of all ages and abilities to heal from mental and physical problems, and connect the internal park with the external harbor promenade, filling a gap in Boston's waterfront corridor.

Located in central Oslo, Schandorffs Street, a cul-de-sac, is transformed from a parking lot into an urban green space based on the concept of inclusive design. The intended design has been to create a central urban green space with simple but sober means.

Superkilen Park is located in the Nørrebro district north of central Copenhagen, Denmark. The Nørrebro district is the most ethnically diverse community in the city, home to people from more than 60 countries. The design concept of the entire project is based on the idea of turning the public spaces into an inclusive container that showcases the living elements of the residents of more than 60 different countries , making every resident of diverse backgrounds feel at home. The inclusiveness of urban life reflects local identities rather than segregating people into rigid groups

Chapter 4 Methodology

4.1 Case review

In the third chapter, three typical cases of inclusive design of urban public space are selected and their design strategies are investigated and analyzed respectively. Through the comprehensive comparison of these cases, the following will discuss how to adopt specific methods to improve the inclusiveness of urban public space in practice under the guidance of the ideas and theories of inclusive design.

4.1.1 Backgrounds and Objectives

(1) Mayor Thomas M. Menino Park, Massachusetts, USA

The design and construction of Menino Park has its rich historical background and influences from surrounding buildings. Menino Park was designed through several events: Spaulding Rehabilitation Hospital opens a new branch in the former Charleston Navy Yard; and served as the places to treat injured runners and spectators after the Boston Marathon bombing Event; while visiting the new building, Mayor Menino saw the potential for a new accessible, all-inclusive playgrounds. The concept of inclusion is at the core of the entire park, which aims to provide a healing place for people of all ages and abilities to heal from mental and physical problems.

(2) Schandorff Square, Oslo, Norway

Located in central Oslo, Schandorffs Street, a cul-de-sac, is transformed from a parking lot into an urban green space based on the concept of inclusive design. The intended design has been to create a central urban green space with simple but sober means. The square creates an important slope of 7 meters height difference between two streets, making it a challenge for accessibility design to cross the square without steps.

(3) Superkilen Urban Park, Denmark, Copenhagen

Superkilen Park is located in the Nørrebro district north of central Copenhagen, Denmark. The Nørrebro district is the most ethnically diverse community in the city, home to people from more than 60 countries. The design concept of the entire project is based on the idea of turning the public spaces into an inclusive container that showcases the living elements of the residents of more than 60 different countries , making every resident of diverse backgrounds feel at home. The inclusiveness of urban life reflects local identities rather than segregating people into rigid groups.

4.1.2 Strategies and Implementations

(1) Mayor Thomas M. Menino Park, Massachusetts, USA

Table 4-1 Strategies and Implementations of Menino Park (Source: by author)

Strategy	Implementation
Application of history elements	Reuse of granite blocks used to hold back the sea; a stepped “dry dock”wall that defines the space
Serving for all ages	Well-connected harbor promenade; informative signage; a compelling open space resource; spectacular water views
Combination of ramp and site	Accessible landscape; open paths allow all visitors to enter without barriers

(2) Schandorff Square, Oslo, Norway

Table 4-2 Strategies and Implementations of Schandorff Square (Source: by author)

Strategy	Implementation
5% continuous ramp	Seamless granite paved road; handrails and balustrades on all stairs; hazard warning marking
Rest Spaces	Plenty of rest places for walkers; multi-level rest platform
Selection of landscape plants	Work with the Allergy & Asthma Association; allergen-free plants; large trees are preserved
Good visual contrast	Corten steel; raw concrete; stone; lawn; perennial plants; perennial plants; clean lines, gorgeous contrast and good navigability

(3) Superkilen Urban Park,Copenhagen, Denmark

Table 4-3 Strategies and Implementations of Superkilen Urban Park (Source: by author)

Strategy	Implementation
Division of function zones	The site is divided into three main areas: the Red Square is used for sports and cultural activities; the Black Market is an outdoor living room where people can gather around; the Green Park have soft hills and a playground which can appeal to children, young people and families.
Put furnishings and activities in zones	Various urban furnishings is placed in different areas to make people of diverse backgrounds feel at home.

4.2 Dimensions of Inclusive Design in public spaces

Through the review of case studies, the factors of inclusive design in public spaces can be divided into three dimensions: the physical environment, the personal experience, and the local context.

4.2.1 The physical environment

Factors under this dimension are mostly tangible and can be measured or observed objectively, making it easier to evaluate. This may include, but is not limited to:

Physical access: physical features that make the space usable by people of all ages and abilities. (e.g. transportation connectivity, crossing, stairs, pedestrians routes).

Social access: Having social or visual representation in the space that resonate with people and create sense of safety, comfort and empowerment. (e.g. cultural elements, historical representation).

Access to activity: The space is multifunctional and able to accommodate different activities. (e.g. available amenities, sufficient seating within the space, space for gathering, play areas for diverse people).

4.2.2 The personal experience

This dimension explores the relationship between personal experience and public space. Interlocking factors such as gender, age, sexuality, race, ethnicity, religion, cultural background, socioeconomic status, personal values and lived experiences can all affect how people interact with and perceive public space. It also affects how people interact and perceive others in the same space.

4.2.3 The local context

Apart from the built form of public space and the personal experience that comes with each public space user, the process and context is also a significant dimension of inclusive design in public space. Knowing the specific context and process (e.g., historical, political, planning) of a public space can help us understand what factors are affecting its inclusiveness. Some local context of a given public space may include context and background, history and development, significance, formation process.

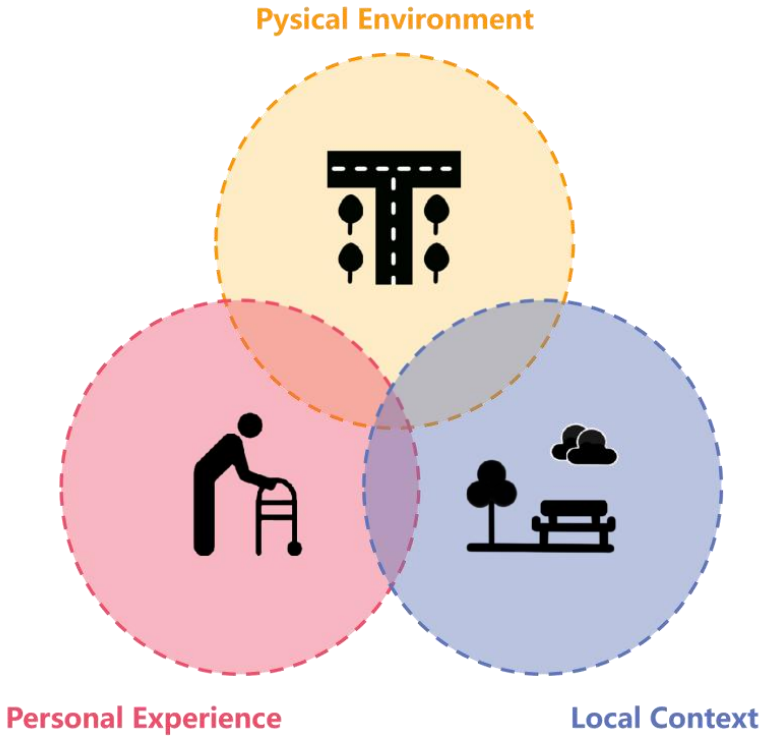


Figure 4-1 Dimensions of Inclusive Design in Public Spaces

(Source: Completed by author)

4.3 Application method and process

Firstly, the context and background of the project should be studied, (e.g. history and development, overall planning, geographical condition). Secondly, summarize design objectives, and problems/conflicts that should be solved.(e.g. transportation, change of levels, racial conflict). Then, formulate personalized strategies according to site requirements, and the inclusive standards can be take as a reference. After that, the site will have evaluations whether inclusive criteria have been met. If so, the ultimate version will be generated, which will also improve the inclusive criteria.

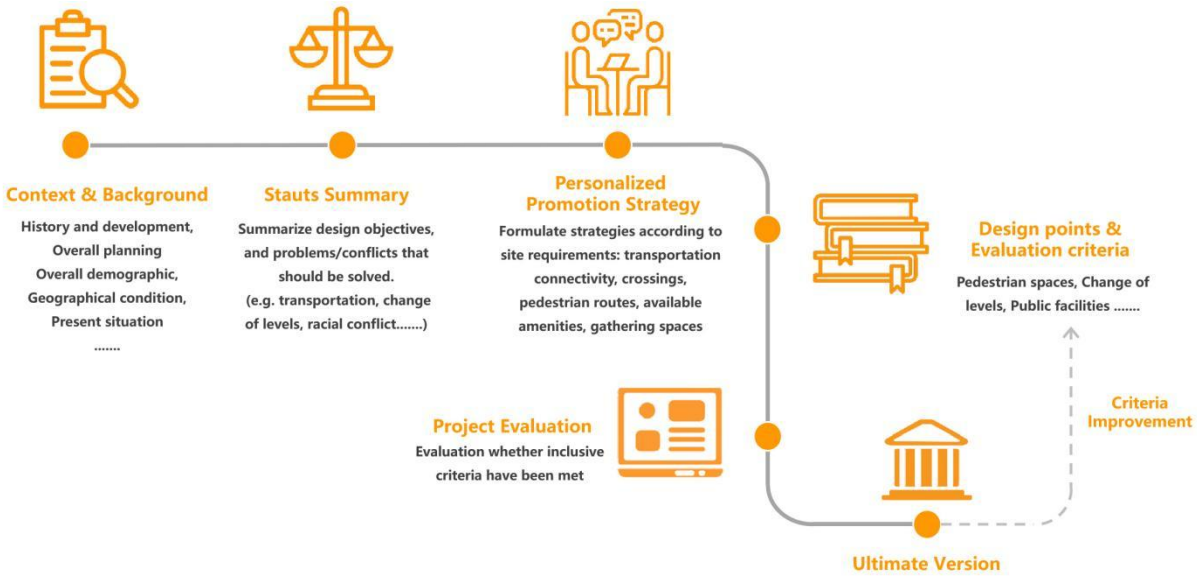


Figure 4-2 Application method and process of Inclusive Design

(Source: Completed by author)

4.4 Design points and evaluation criteria

Through the design guidelines and implementation strategies, the design points and evaluation criteria of inclusive design involving urban square can be summarized into 5 categories and 14 sub-categories:

01 Site planning - Site planning.

02 Pedestrian spaces - Pedestrian routes; Crossings; Parking; Cycling infrastructure; Pedestrian surfaces; Tactile paving.

03 Changes in level - Ramps; Footbridge; External lifts.

04 Activity spaces - Inclusive play areas.

05 Public facilities - Seating; Public toilets; Wayfinding and signage

The details of design points and evaluation criteria of inclusive design involving urban square can be seen in Appendix1 and Appendix 2.

4.5 Chapter summary

In this chapter, by reviewing the three cases, the dimensions of inclusive design in public spaces can be sorted out:

• The physical environment (physical access,social access, access to activity);

• The personal experience (gender, age, sexuality, race, ethnicity, religion, cultural background, socioeconomic status, personal values and lived experiences);

• The local content (context and background, history and development, significance, formation process).

Then, summarizes the application method and process of inclusive design in public spaces: Context and background -- Design objectives -- Personalized strategies -- Evaluations -- Ultimate version.

Finally, through the design guidelines and implementation strategies, the design points and evaluation criteria of inclusive design involving urban square can be summarized into 5 categories and 14 sub-categories.

Chapter 5 Evaluation and Analysis of Haizhu Square

5.1 Historical background

The development of Haizhu square has its own historical conditions: Before the Anti-Japanese War, the area near the square was a prosperous area in the city center. In the early days of the Japanese invasion of China, it suffered large-scale damage. On the eve of liberation, the Haizhu Bridge was bombed when the Kuomintang retreated.

In 1950, the Guangzhou Municipal Government decided to repair the Haizhu Bridge, further cleaned up the areas of rubble and ruins, and arranged greenery in open space, simultaneously set up a roundabout intersection at the Weixin South Road to adjust the traffic, gradually forming a bridgehead square that was not only convenient for transportation, but also for citizens to relax.

Figure 5-1 Guangzhou Haizhu Square in the 1950s [56]

5.1.1 Two planning schemes

（1）Planning Scheme by Mo Bozhi in 1959[68]

The properties of Haizhu Square in Mo Bozhi's planning was determined by several factors:

The historical process of the development of Haizhu square and its relationship with surrounding enterprises made it a center for foreign reception and economic activities;

The square was the intersection of north-south and east-west traffic lines, serving as a

key position to regulate transportation;

In terms of planning, the square was located at the midpoint of the original axis of Guangzhou. The north end of the axis was Yuexiu Park, Sun Yatsen Memorial Hall, Municipal People's Committee Buildings, and the south end was Xiaogang Park and Liu Wangdian Square. Therefore, Haizhu square played an important part role in citizen’s activity and public space.

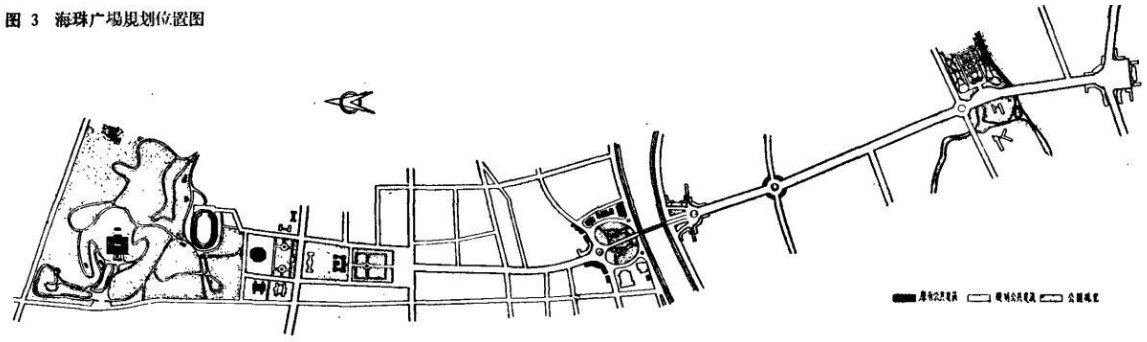


Figure 5-2 Planning of the original axis of Guangzhou [56]

Taikang Road on the east side and Yide Road on the west side were slightly straightened on the basis of original routes to make them suitable for the layout of the building. The turning radius of the road was increased to 20m, and the diameter of the central roundabout at Weixin South intersection was expanded to 40m to adjust left-turn traffic. Due to the large traffic volume around the square, the parking places should be distributed in surrounding building lots.

The square landscape was dominated by parterre. All overhead cables were changed to underground, and the trolleybus line went around the outer circle of the square. Some fountains and sculptures were built inside the square, the lower part of the approach road was dismantled to connect the east and west parts for the convenience of citizens.

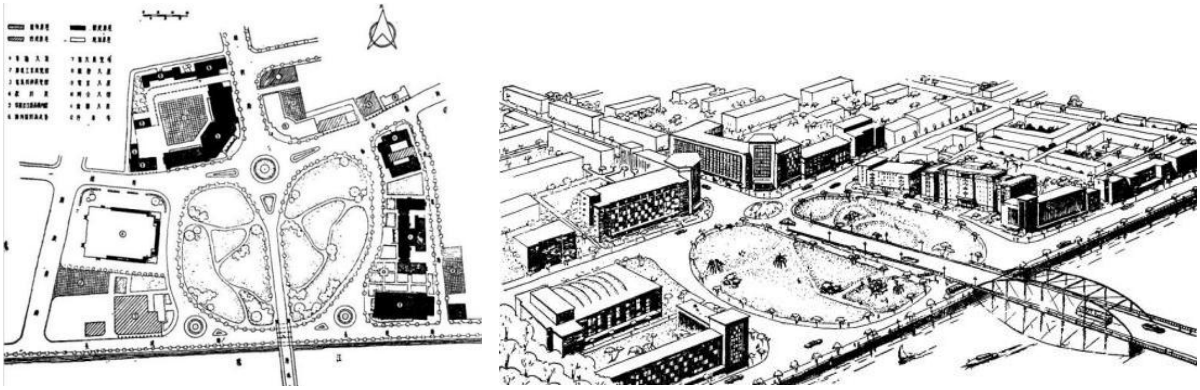


Figure 5-3 Planning and Aerial View of Haizhu Square [56]

In order to adapt to the properties of Haizhu square, the configuration of surroundings should be dominated by high-rise buildings such as Exhibition Halls, Guest Houses. Due to the Canton Fair, after the completion of the design of Haizhu square, a series of surrounding buildings came into being: New Exhibition Hall of China Export Commodities (Lin Keming, 1959); Exhibition Hall of Guangzhou Export Commodities (Mai Yuxi, 1958); Prime Hotel (1957); Guangzhou Hotel ((Mo Bozhi, She Junnan, 1968), etc. Haizhu Square became a place of public life closely related to special exhibition activities in the period of New China.

（2）Renovation plan in 2019[69]

In 2019, in order to celebrate the 70th anniversary of the founding of the People's Republic of China, the Guangzhou Municipal Government decided to upgrade Haizhu Square. The renovation proposed that the square should highlight the characteristic theme, which could show reveal history of revolution through red culture, and made it become the venue for celebration. By extracting the Lingnan culture, and arranging the radiation with the statue as the center, the square composition of “Pentagon + Kapok + Radiation” was finally formed. In the celebration, a flag-raising ceremony was introduced into square, where a larger pentagon parterre was arranged beside the statue with 4 pentagon squares in park to form the graphic image of the Five-Starred Red Flag.

5.1.2 Texture evolution of site

The spatial texture of Haizhu Square has evolved during different periods, with unique historical backgrounds. In the beginning, the square was the intersection of

north-south and east-west traffic lines, serving as a key position to regulate transportation, also it was located at the midpoint of the original axis of Guangzhou, so the texture is dominated by large lawns with winding paths in site. With the improvement of living standards, it also serves as a place for citizens' leisure activities, and two circular walking paths is added to the texture later and the spaces are more private. The 2019 renovation proposed that the square should highlight the characteristic theme, which could show reveal history of revolution through red culture, and made it become the venue for celebration. Therefore, the texture has changed into “Pentagon + Kapok + Radiation”.

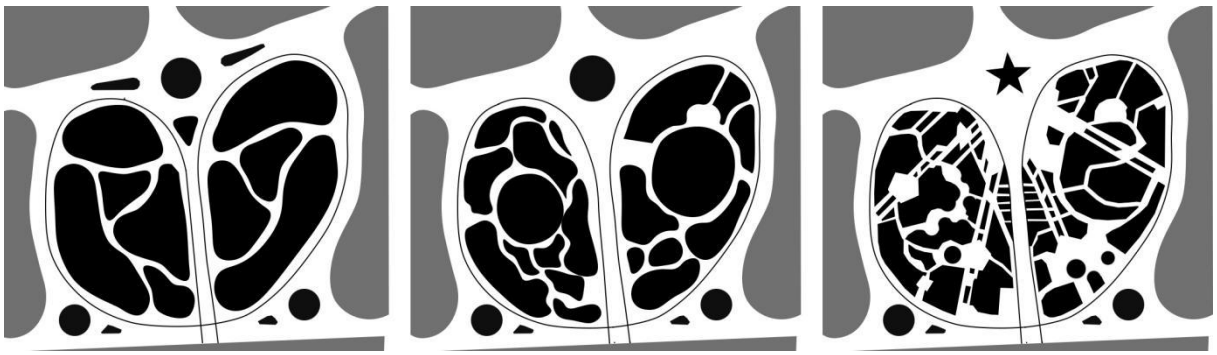


Figure 5-4 Texture evolution of site since the 1950s (Source: Completed by author)

5.2 Climate condition

The Tropic of Cancer traverses Guangzhou, which is located in the subtropical zone, and has a marine subtropical monsoon climate, with the characteristics of sufficient heat, abundant rainfall, small temperature difference and long summer.

5.2.1 Temperature

Guangzhou has sufficient solar thermal resources. The average temperature is 21℃, the extreme maximum temperature is 38.6℃- 39.3℃, and the extreme minimum temperature is 0.0℃- 2.3℃. The hottest month appears in August, with an average temperature of 32℃, and the sultry period often lasts for four months. The coldest month is January, with an average temperature of 12℃.

The research on comfort temperature shows that the somatosensory temperature is less affected by humidity under normal temperature conditions, and mainly depends

on the air flow rate and dry-bulb temperature. However, under the condition of high temperature, wet-bulb temperature becomes an important indicator. When the skin is in a dry state, the evaporation rate of sweat is mainly controlled by the secretion rate of sweat, and is relatively less affected by air humidity.

However, when the skin surface is relatively humid, the evaporation rate is greatly affected by the air humidity. In this case, the balance between the heat gain by radiation and loss by evaporation is similar to the process of wet-bulb temperature detection. Under the circumstances, wet-bulb temperature is the main reference.

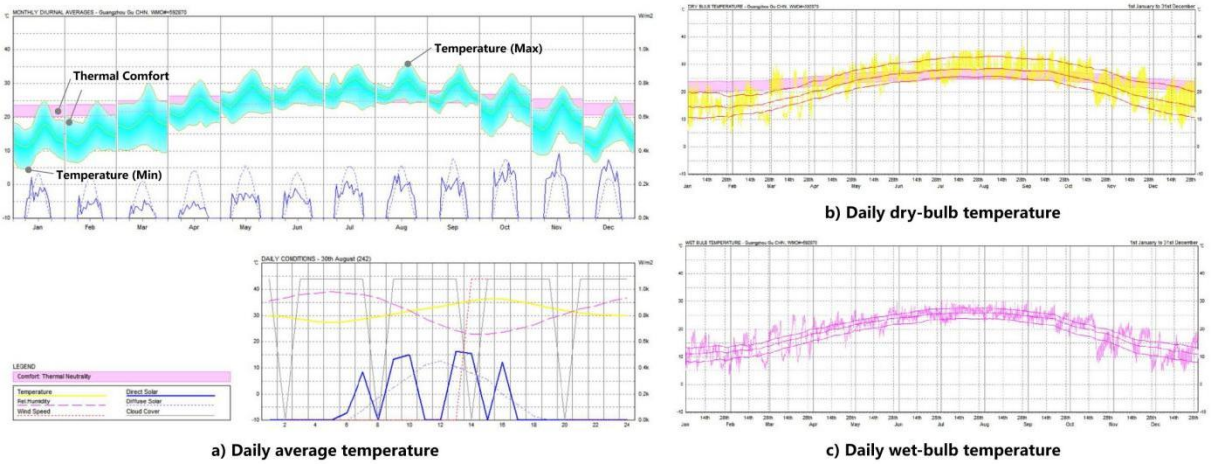


Figure 5-5 Guangzhou temperature statistics (Source: Ecotect simulation)

5.2.2 Humidness

Another notable feature of Guangzhou's climate is high humidity and abundant rainfall, the annual precipitation is about 1720 mm and the average relative humidity is 77%. In the whole year, the rainy season in Guangzhou is from April to June, and is hot and many typhoons from July to September.

Humidity refers to the content of water vapor in the air, under normal circumstances, the humidity gradually increases with the rise of the temperature. The content of water vapor in air has multiple expressions, such as absolute humidity, relative humidity, specific humidity, saturation vapor pressure and so on. Among them, absolute humidity refers to the weight of water vapor in a unit volume of air (g/m^3), and a more commonly used indicator is relative humidity, the ratio of the absolute humidity of the air at a certain temperature to the maximum moisture content of the air.

In the figure, the X axis - Hr (Hours), the Y axis - Wk (Weeks), the Z axis - relative humidity. The seasonal marine climate in Guangzhou is obvious, resulting in a high relatively humidity, which is lower at noon and higher in the morning and evening. Usually, in the hot conditions of summer, the excessive air humidity will make the body feel stuffy, and almost no one stays in the outdoor places.

In the psychrometric chart, the yellow line is the comfort zone under natural conditions, and the orange line is the comfort zone under natural ventilation. Good natural ventilation can significantly accelerate the water evaporation and reduce the relative humidity of the air. Therefore, by creating a reasonable outdoor ventilation, the humid environment and comfort of the outdoor spaces can be improved.

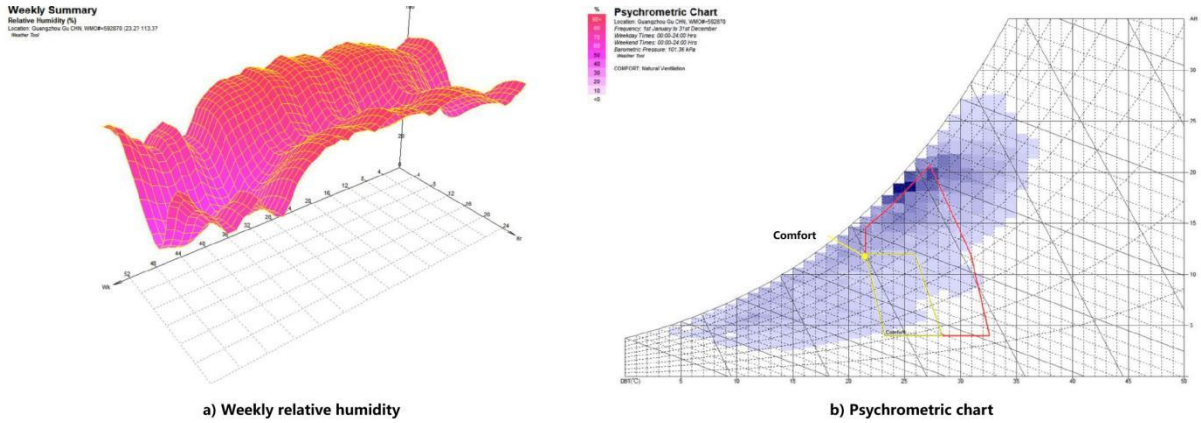


Figure 5-6 Guangzhou Humidity statistics (Source: Ecotect simulation)

5.2.3 Solar radiation

In the figure, the incident solar radiation is highest in July and August in Guangzhou. The purple curved lines in the stereographic diagram represent the sun's orbit on the first day of each month, the lines perpendicular to the sun's orbit represent each hour of the day, the lines that diverge from the center to the sun indicate the corresponding solar azimuth, and the concentric circles represent the solar altitude.

The optimal orientation of the buildings around Haizhu Square mainly refers to the heat obtained by the solar radiation of the buildings. Under the optimal orientation, the buildings gain the most heat from solar radiation in winter. The orientation of the yellow area is the best orientation, 16° from south to east. For spaces with unfavorable orientations, appropriate light environment design should be considered.

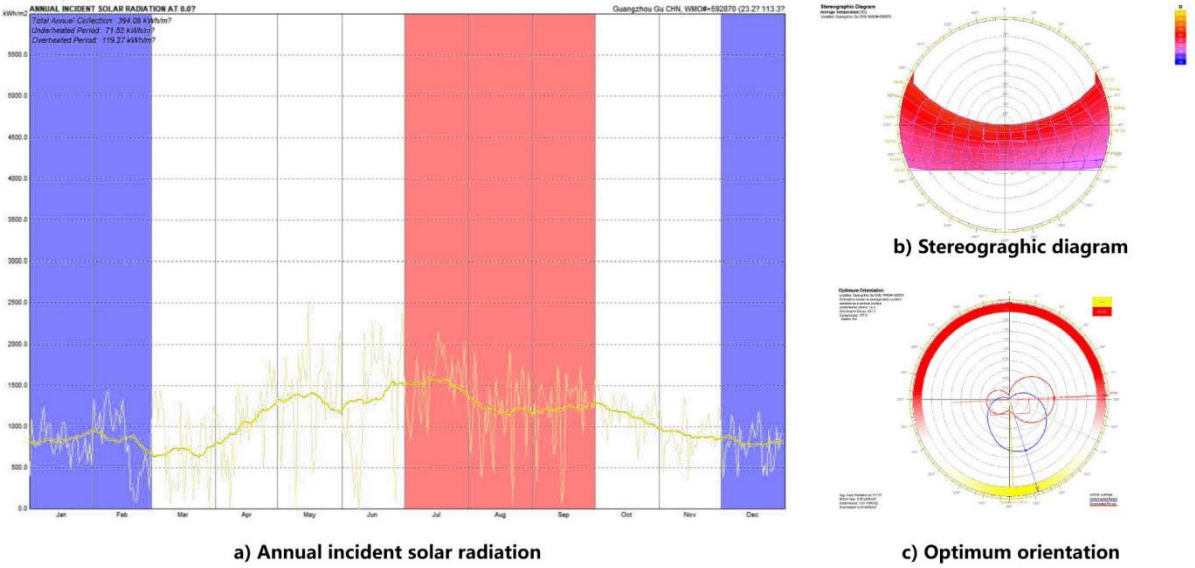


Figure 5-7 Guangzhou solar radiation conditions (Source: Ecotect simulation)

5.2.4 Wind environment

The average wind speed in Guangzhou is relatively small, with an annual average wind speed of only 1.9m/s, 1.9m/s-2.1m/s in winter and 1.6m/s-1.9m/s in summer. However, many typhoons hit in in summer, resulting in short-term severe wind. The southeasterly wind prevails in Guangzhou in summer, with a static wind rate of 6.7%, and the dominant wind direction in winter is northerly, with a static wind rate of 18.2%.

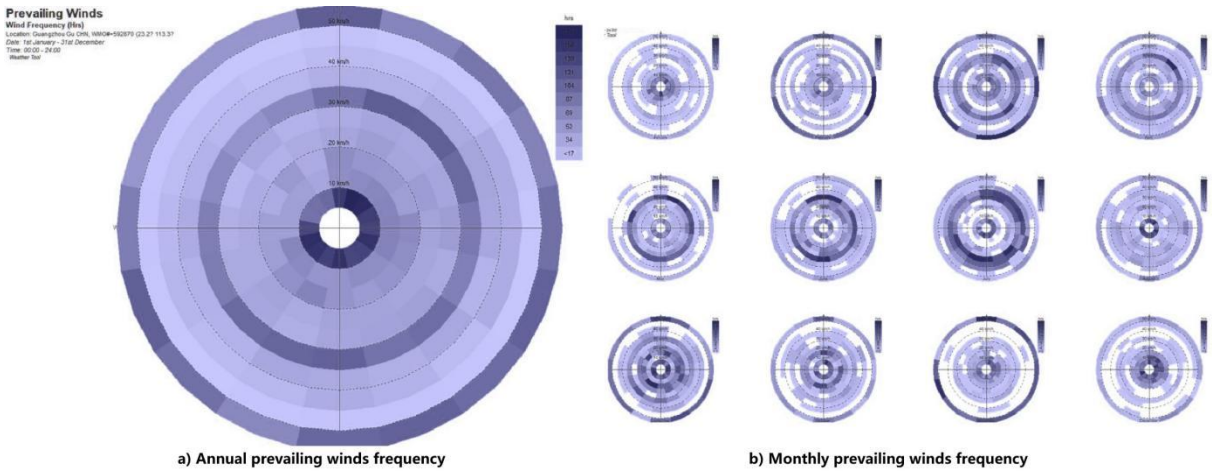


Figure 5-8 Guangzhou wind frequency statistics (Source: Ecotect simulation)

5.3 Planning background

5.3.1 In Guangdong Province

Guangzhou, the capital of Guangdong Province, is an important international trade center, foreign exchange center and comprehensive transportation hub in China. In the overall development strategy, it is positioned as a national central city. In the Pearl River Delta region, strengthen regional cooperation, expand hinterland, and make it become the agglomeration and radiation center of Guangdong Province. At the same time, Guangzhou should deepen the cooperation between Hong Kong and Macao, leading the integrated development of the Pearl River Delta. In the Guangzhou-Foshan-Zhaoqing Economic Circle, Guangzhou has accelerated the construction of the Economic Circle, focusing on promoting the development of city clusters.

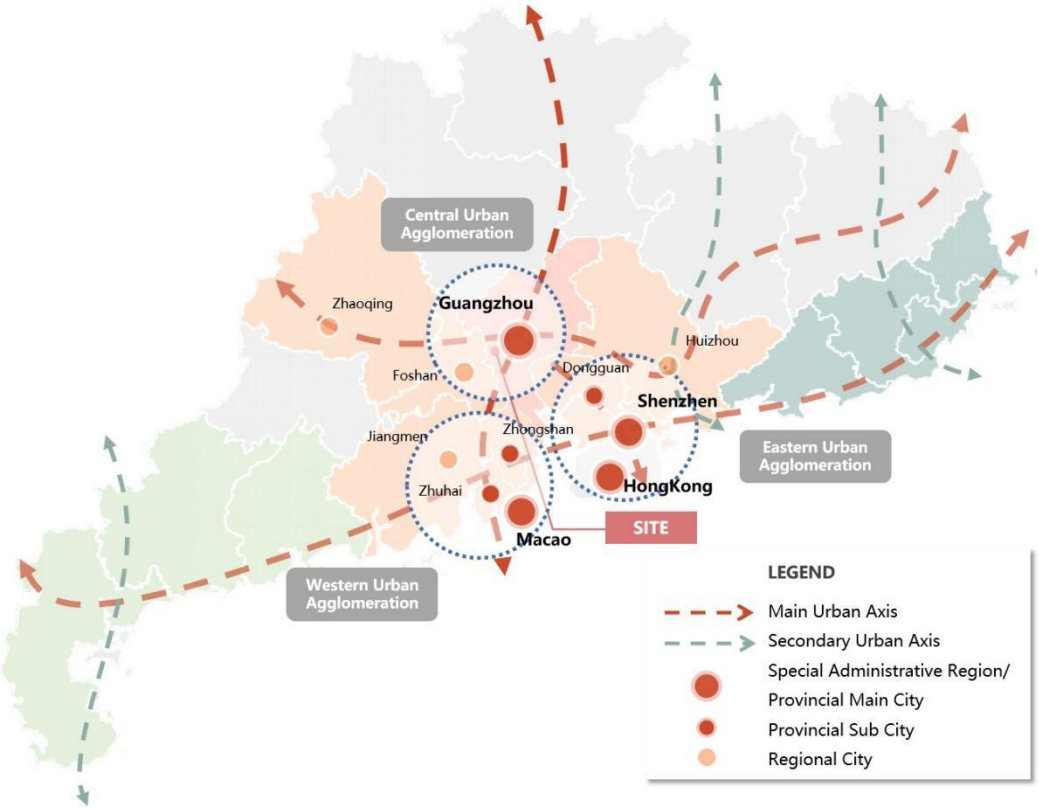


Figure 5-9 Guangzhou in Guangdong Province (Source: Completed by author)

Focusing on infrastructure construction, industrial cooperation, and government

interoperability, the interconnection between cities in the province has been continuously strengthened. The networked urban agglomeration in the Greater Bay Area is under construction with interconnection of transportation facilities, sharing of municipal facilities, and joint maintenance of the ecological environment. Guangzhou, which is an international comprehensive transportation, business center, and an important hub for technological innovation, is undoubtedly an important core.

5.3.2 In the Greater Bay Area(GBA)

Against the background of the major national strategy in the Greater Bay Area, Guangzhou is firmly seizing the development opportunities to support Hong Kong's "re-industrialization" in its competitive areas, promote the innovative development of state-level zones, and work with Hong Kong to jointly build a Guangdong-Hong Kong Intelligent Manufacturing Cooperation Zone. Based on the characteristics of similar development level and status, Guangdong and Shenzhen focus on learning from each other, building and sharing in scientific and technological innovation, industrial collaboration, and business environment to serve and support the development of the province. Based on the continuous and integrated development of Guangzhou-Foshan, which is making full use of its advantages to further promote the integration of the two cities, stimulate the extreme strong momentum of Guangzhou-Foshan in the Greater Bay Area, and support the city integration to take the lead in the urban integration practice. Based on geographical advantage across the Pearl River, Guangzhou will deepen cooperation with Dongguan, Zhongshan and other cities to create Guangzhou-Foshan-Zhaoqing Economic Circle.

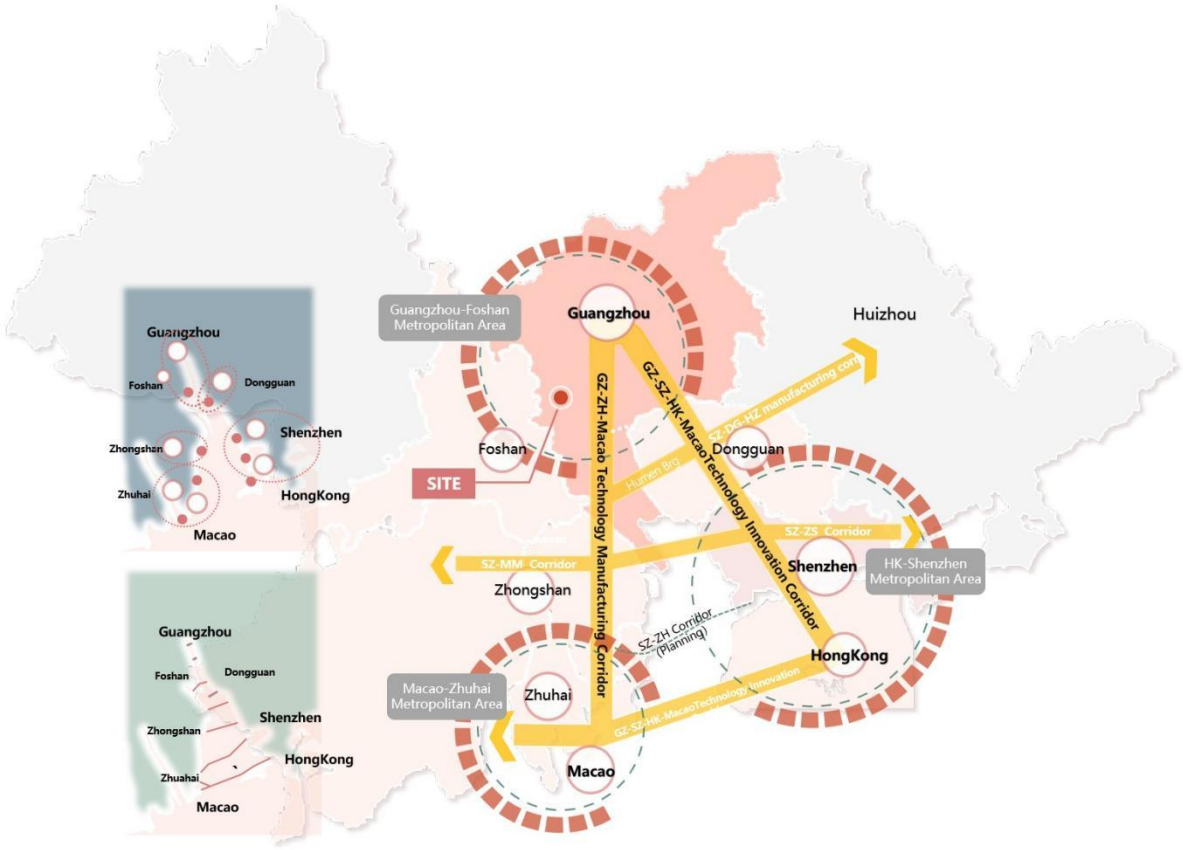


Figure 5-10 Guangzhou in the Greater Bay Area (Source: Completed by author)

5.3.3 In Guangzhou City

Yuexiu District, located in the middle of the original axis, is one of the main urban groups and the core area of modern services in Guangzhou. The original axis connects the Airport Economic Zone and Nansha Sub-center, forming the main development axis of the city. At present, Guangzhou is dominated by modern service industry (Site Location), led by emerging industries and supported by advanced manufacturing. Also it has built the Guangzhou-Shenzhen Science and Technology Innovation Corridor and the Pearl River Innovation Belt to create innovation zones with global influence.

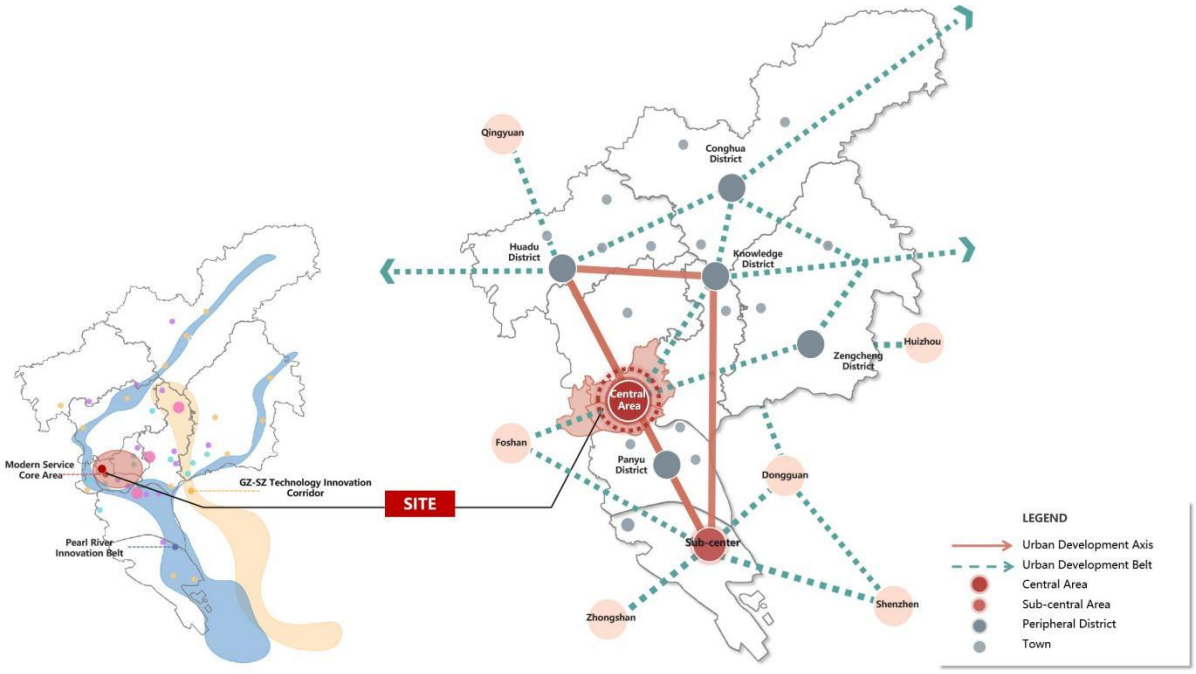


Figure 5-11 Layout of leading industries and spatial structure of Guangzhou City (Source: Guangzhou Urban Master Plan (2017-2035))

5.3.4 In Yuexiu District

With the development of urbanization, Yuexiu District has formed an industrial spatial layout of “one axis, three belts and six zones”. One axis - the original axis of Guangzhou. Three belts - Huanshi Road digital economy innovation belt, Dongfeng Road headquarters economic industry belt and Yanjiang Road innovation finance agglomeration belt. Six zones - modern business exhibition zone, ultra HD video innovation zone, Huanghuagang science and technology zone, health industry innovation zone, Beijing Road cultural and tourism zone, and industrial integration cooperation zone. The site is located at the intersection of the original axis of Guangzhou and Yanjiang Road innovation finance agglomeration belt, which brings more possibilities and opportunities for future development.

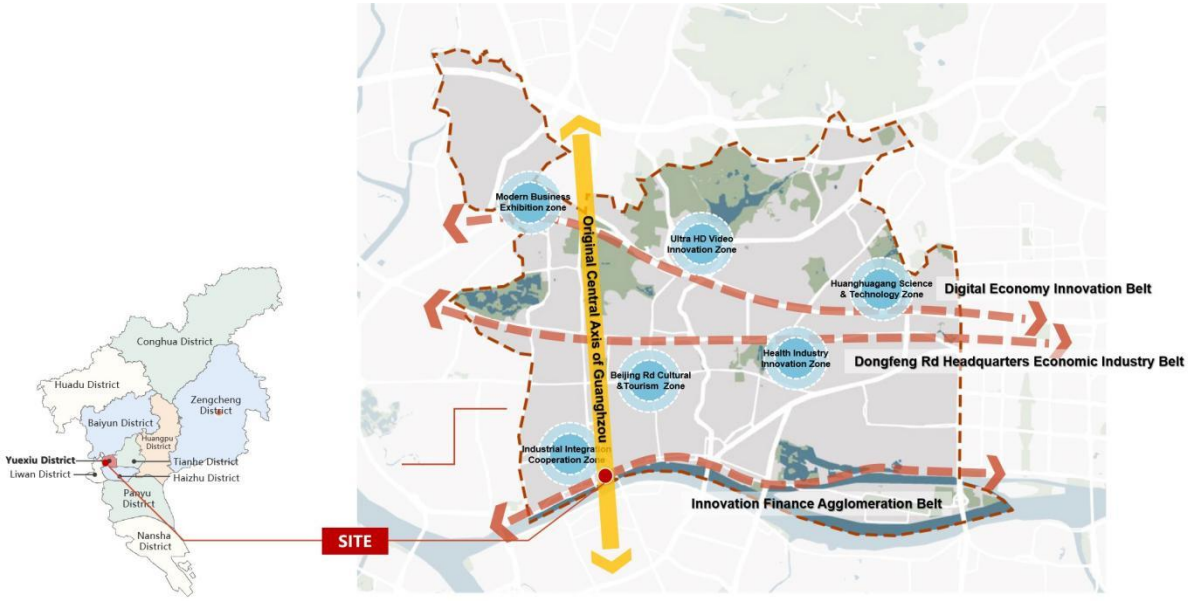


Figure 5-12 Location and industrial spatial layout of Yuexiu District

(Source: Outline of the 14th Five-year Plan of Yuexiu District)

5.3.5 In original axis of Guangzhou

The square was located at the midpoint of the original axis of Guangzhou. The space sequences from north to south are: Yuexiu Park, Sun Yatsen Memorial Hall, the People's Park, Qiyi Road and Haizhu Square, all the places played an important part role in citizen's activity and spatial structure in Guangzhou City.

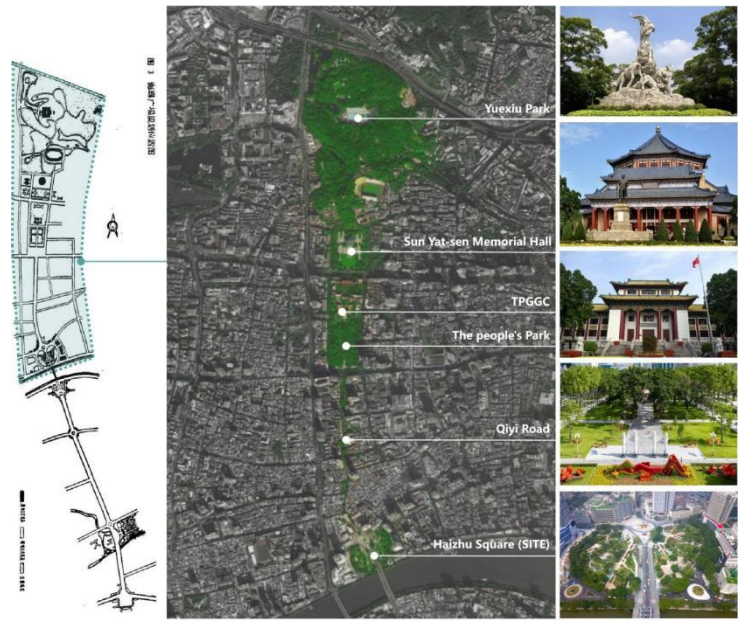


Figure 5-13 Space sequences of original axis of Guangzhou (Source: Completed by author)

5.3.6 Regional resources of site

(1) Transportation

The square has good traffic accessibility, where two metro lines intersect with 7 metro entrances. The network of bus stations covers the site, Haizhu bridge and Jiefang Bridge connect Yanjiang Road and Binjiang Road. In addition, Tianzi pier can be reached within 10 minutes. The transportation around the site are diversified to meet the needs of different groups of people.

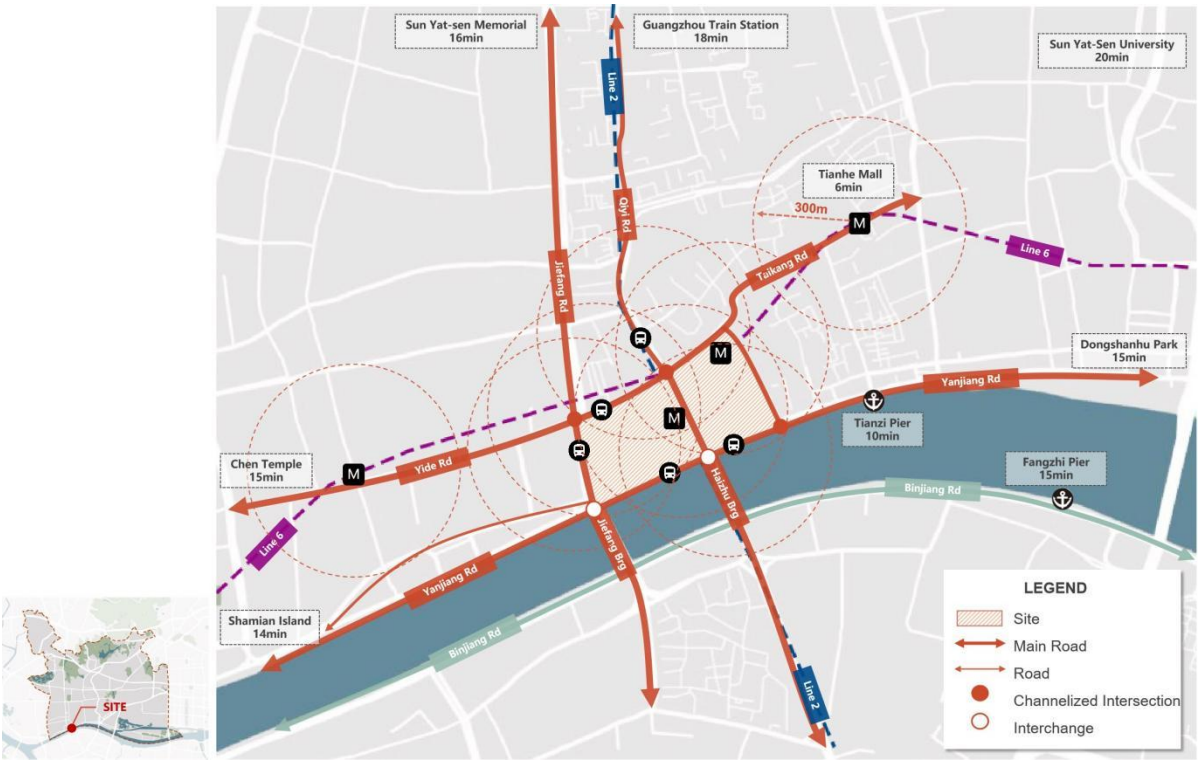


Figure 5-14 Transportation resources in the region (Source: Completed by author)

(2) Heritage

The site is located in Beijing Road Cultural Tourism Zone, with abundant heritage resources. Guangzhou liberation Memorial statue just in the center of Haizhu Square, in addition to the Overseas-Chinese Museum, Zhaoqing Guild Hall and other historical buildings. Famous attractions such as Shishi Sacred Heart Cathedral, Wuxian Temple and Guangdong Xianxian Museum are located on the periphery of the site.

Figure 5-15 Heritage resources in the region (Source: Completed by author)

(3) Facilities

A variety of business facilities are distributed around the site: Commerce, banks, heritages hospitals and schools. The details of distribution of facilities in the region just shown in the figure.

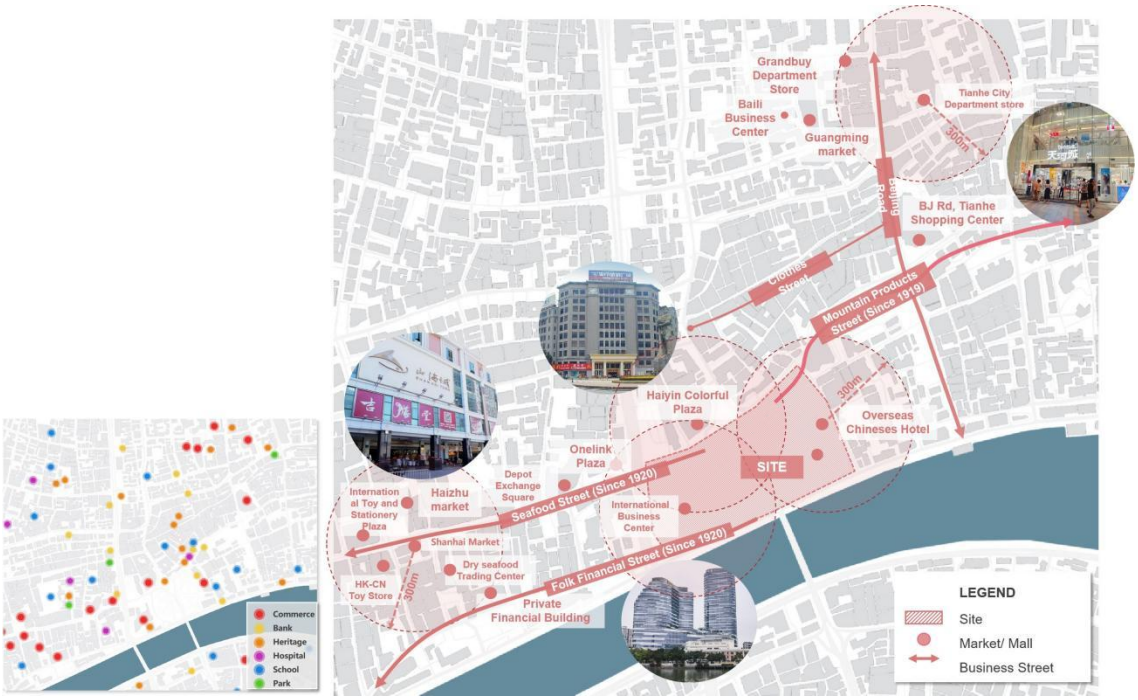


Figure 5-16 Facilities resources in the region (Source: Completed by author)

(4) Landscape

The site is located in Old Town, Pearl River Front Channel, with rich waterfront landscape. However, in addition to the site itself, there are very few places for citizen's leisure and entertainment, and most of them are street spaces and pocket parks.

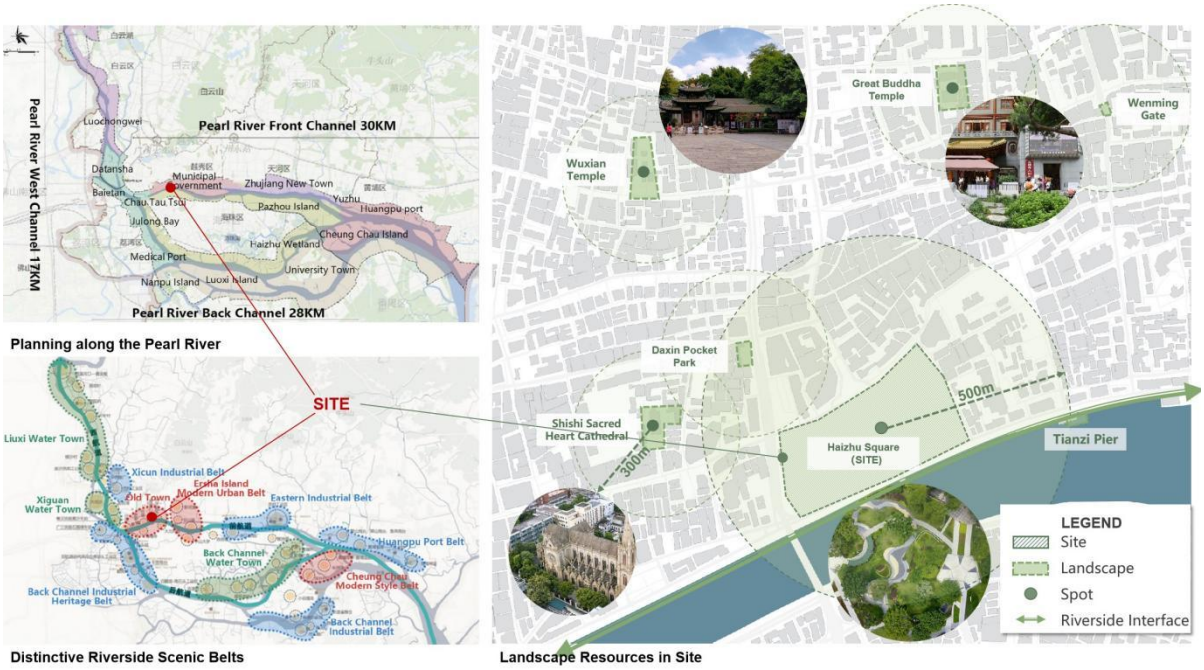


Figure 5-17 Landscape resources in the region (Source: Completed by author)

5.4 Design Scope

Haizhu Square is composed of the green park, the entrance square of surrounding buildings and the riverside landscape belt. Formed by the surroundings interface and the Pearl River, the design scope extends to Xinghuan International Business Center in the west, Prime Hotel in the east, Yanjiang Road in the south, and Yide Road/Taikang Road in the north, with a total area of about 9.95 hectares. The square has good traffic accessibility, where two metro lines intersect with 7 metro entrances and exits.

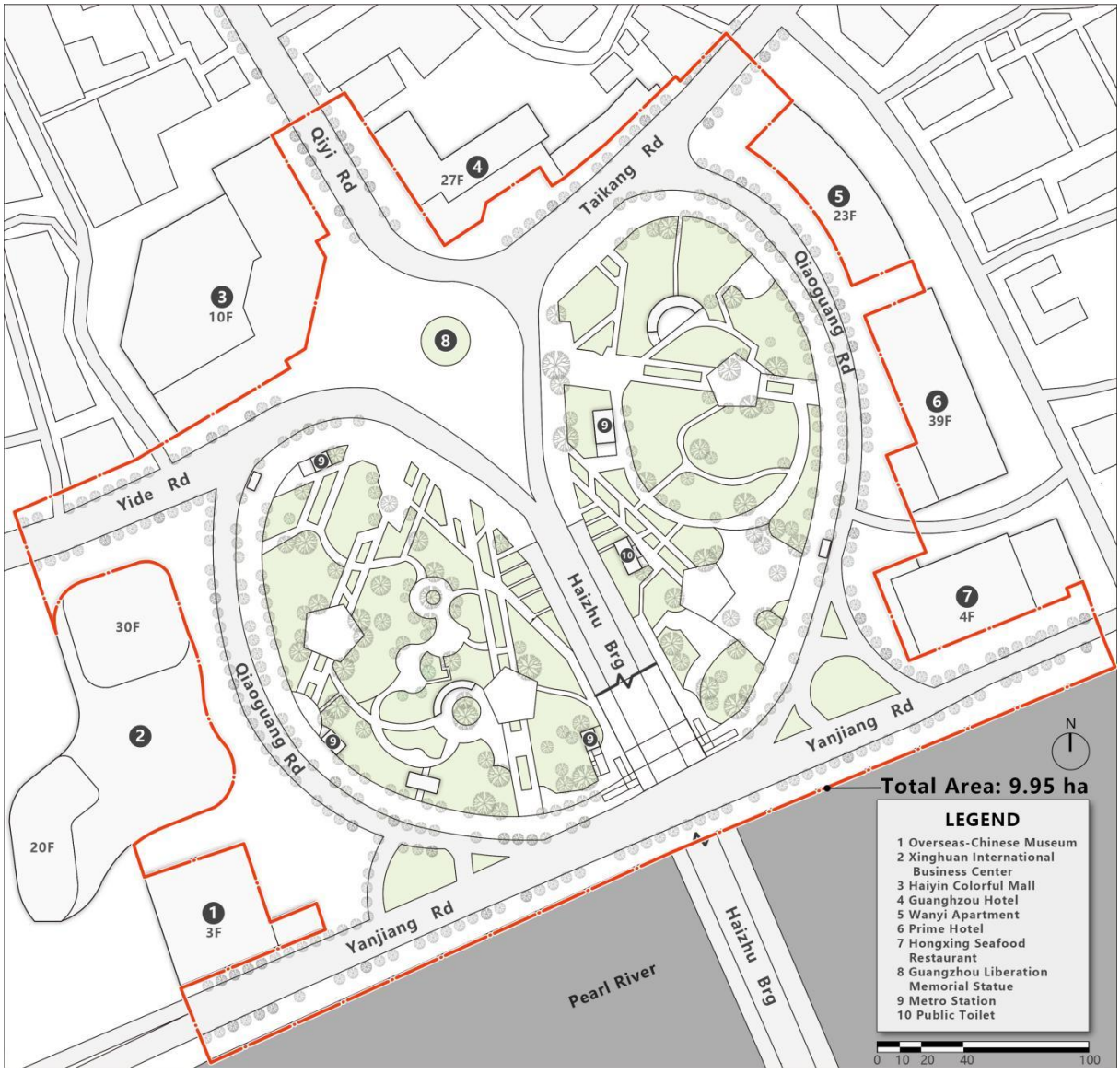


Figure 5-18 Design Scope of Haizhu Square (Source: Completed by author)

5.5 Inclusive Evaluation of the Haizhu Square

Combined with Appendix 1&2 Design points and evaluation criteria, evaluate the status quo of Haizhu Square. The evaluation can be divided into five parts: Site planning, Pedestrian spaces, Changes in level, Activity spaces, Public facilities.

5.5.1 Site planning

(1) Space interface

The square should have appropriate scale. The architectural boundaries of Haizhu Square from west to east are: Overseas-Chinese Museum (4F), Xinghuan International Business Center (30F), Haiyin Colorful Mall (10F), Guanghzou Hotel (27F), Wanyi Apartment (23F), Prime Hotel (39F). The expanded view of the building facades around the square is shown in the figure. It can be seen that the height-to-width ratio of Haizhu Square is about 1:2.5, and the buildings enclosed on three sides form a good scale relationship with the square.

Figure 5-19 Space interface of Haizhu Square (Source: Completed by author)

(2) Space node

The main structure of Haizhu Square is the "Guangzhou Liberation Memorial Statue", which is located in the center of the square. It was shaped in 1959 to commemorate the tenth anniversary of the liberation of Guangzhou. The statue is carved from granite stone, 11.5 meters high, with a square base, 3.6×4.3 meters. The main body is a soldier of the People's Liberation Army, with a millet bag on his shoulders, a bullet belt around his waist, a rifle in his right, a bouquet in his left, smiling and staring into the distance.

The Haizhu Bridge, which bisects Haizhu Square, also has symbolic significance. It is an important place where the Chinese People's Liberation Army liberated Guangzhou into the city in 1949. It records the history of Guangzhou for nearly a hundred years, so that the square has a more profound cultural connotation.

Figure 5-20 Guangzhou Liberation Memorial Statue & Haizhu Bridge

(Source: Completed by author)

（3）Connections between site and surroundings

In site planning, the main focus is the connection between the site and surrounding areas, the entrances of building and the accessibility interface on the ground floor. At the same time, the flow of vehicle and pedestrians crossing the street were counted during peak hours on weekdays. Terrain is not considered at this stage due to the small fluctuation of its height.

The roads with large traffic flow are mainly the Central Roundabout, Haizhu Bridge and Yanjiang Road; the densely pedestrian crossing areas are the intersection of Yide Road, Central Roundabout and Taikang Road. Heavy traffic poses a risk factor for pedestrians. In front of the statue, a large number of non-motorized vehicles pass through randomly, causing obstacles to vehicles and pedestrians. Non-motor vehicles are parked at will, occupying pedestrian space, and the road surfaces are seriously lifted, affecting the comfort of pedestrians.

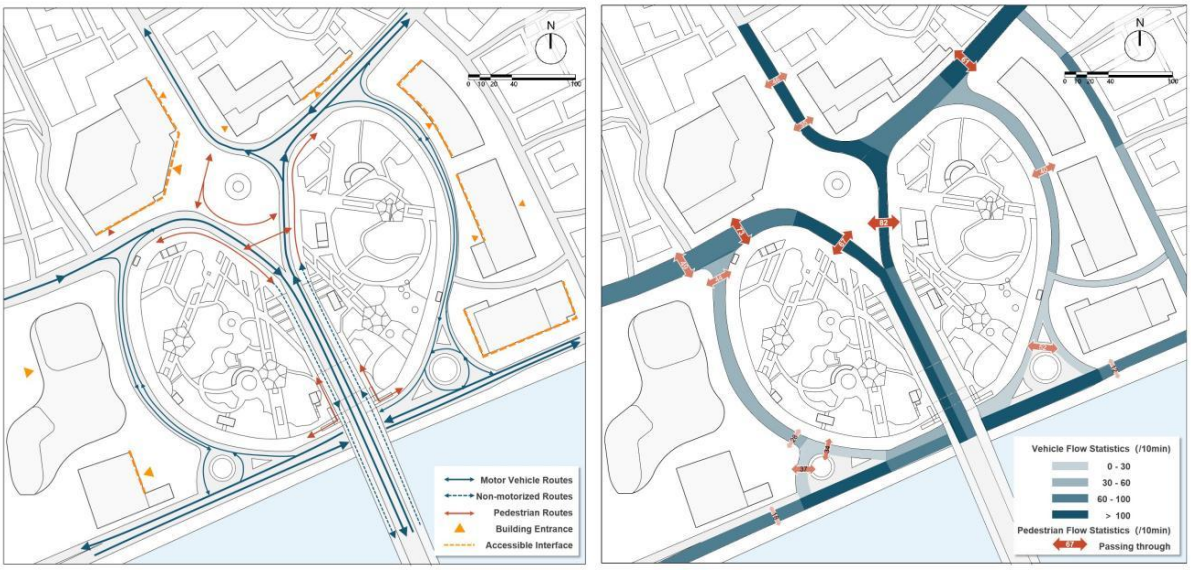


Figure 5-21 Entrances of buildings and accessibility interfaces around site

Figure 5-22 Traffic flow statistics during peak hours on weekdays

(Source: Completed by author)

5.5.2 Pedestrian spaces

The evaluation of walking space mainly focuses on the following aspects: (1) Pedestrian routes; (2) Pedestrian crossings; (3) Parking spaces; (4) Cycling infrastructure; (5) Pedestrian surfaces; (6) Tactile paving.

(1) Pedestrian routes

In the pedestrian space, the first step is to draw the pedestrian routes, then to measure the width of routes. Considering the accessibility of people with different abilities, the 0-3m sidewalks will be widened to adapt to the use of diverse people. As

can be seen from the figure, most routes in the site are over 3m, which can accommodate two wheelchair users to pass each other.

Figure 5-23 Width of pedestrian routes in site (Source: Completed by author)

(2) Pedestrian crossings

According to the 5.3.1 flow statistics of vehicles and pedestrian, it is found that there are dense people passing through at the intersection of Central Square and Yide Road, and take the two as examples to redesign the Pedestrian crossings.

In the Central Square, there are guardrails around the statue, so the spaces reserved for pedestrians have been greatly narrowed. Meanwhile there are a large number of non-motor vehicles and pedestrians crossing the street in this area, which is unorganized and dangerous. The fence only has an opening on the south side , hindering citizen's contact with the statue.

At the intersection of Yide Road, the kerb slope still have a height difference with asphalt pavement, on which are manhole covers and drainage outlets. On the north side of the crossings is Haiyin Colorful Mall, the south side is Metro Entrance (B1), and the southwest side is Xinghuan International Business Center. The crossings have no waiting area for pedestrians, often crowded with people, and the width of the crosswalk is slightly cramped.

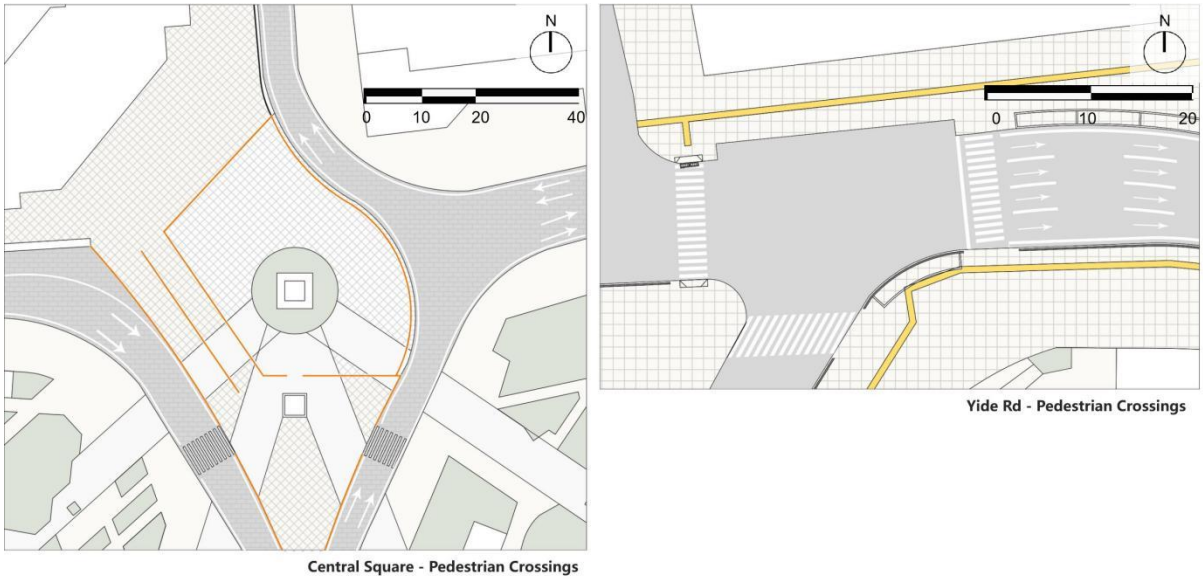


Figure 5-24 The Pedestrian Crossings of Central Square and Yide Road
(Source: Completed by author)

(3) Parking spaces

The main problems of parking space on the site are as follows: First, some parking spaces are more than 50m away from the square; Second, there is a lack of accessible parking; Third, the layout of the several parking lot occupies the sidewalk. At present, the site has 122 ground parking (including 2 larger parking), 19 side parking and 0 accessible parking. Obviously, the number of ground parking spaces cannot meet the demands of the crowd, and most of them are dedicated to apartments and hotels.

Taikang Road Parking Lot is the only public parking spaces within site, and take it as an example for inclusive design. According to the on-site measurement, the size of the ground parking space is 2500 × 5000mm, the surface is relatively smooth, which is made by marble. Due to the unreasonable layout, the parking lot occupied the sidewalks, part of the spaces people can not pass through. The size of the side parking is 7500 × 2500mm, the asphalt pavement is clearly marked, but there is no accessible parking.

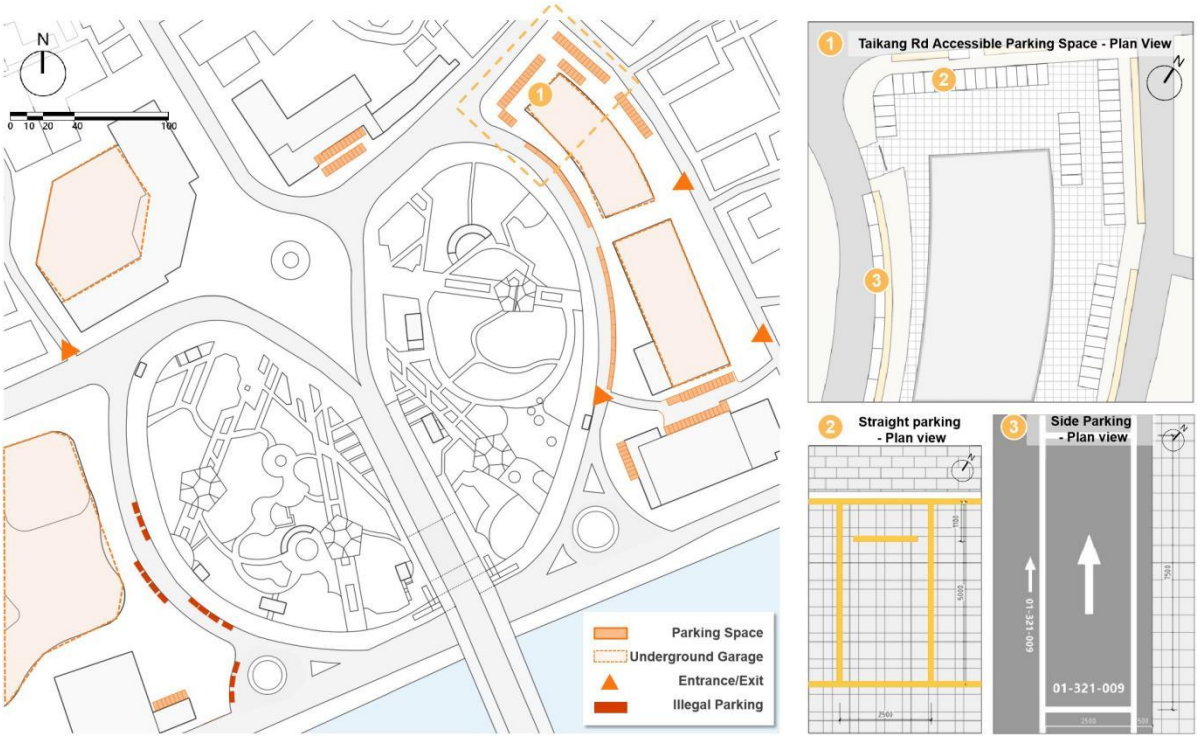


Figure 5-25 Distribution of parking spaces in site

Figure 5-26 Plan of Taikang Road parking space, Straight parking and Side parking (Source: Completed by author)

(4) Cycling infrastructure

Cycling infrastructure mainly focuses on cycle parking areas and cycle lanes.

The cycle parking areas in the site are sufficient and distributed in the open space in front of the building and the riverside belt, but there are mixed parking of bicycles and non-motor vehicles. The width of parking area is 1600mm, and the length varies from 3-8m according to the actual situation.

The cycle lane is located on Yanjiang Road, with a width of 2500mm, asphalt pavement, and bicycle sign. However, there is no separation belt between vehicle lane and cycle lane, and the vehicle flow on the left side is relatively large, which is more dangerous for cyclists. There is a height difference of about 800mm between cycle lane and sidewalk.

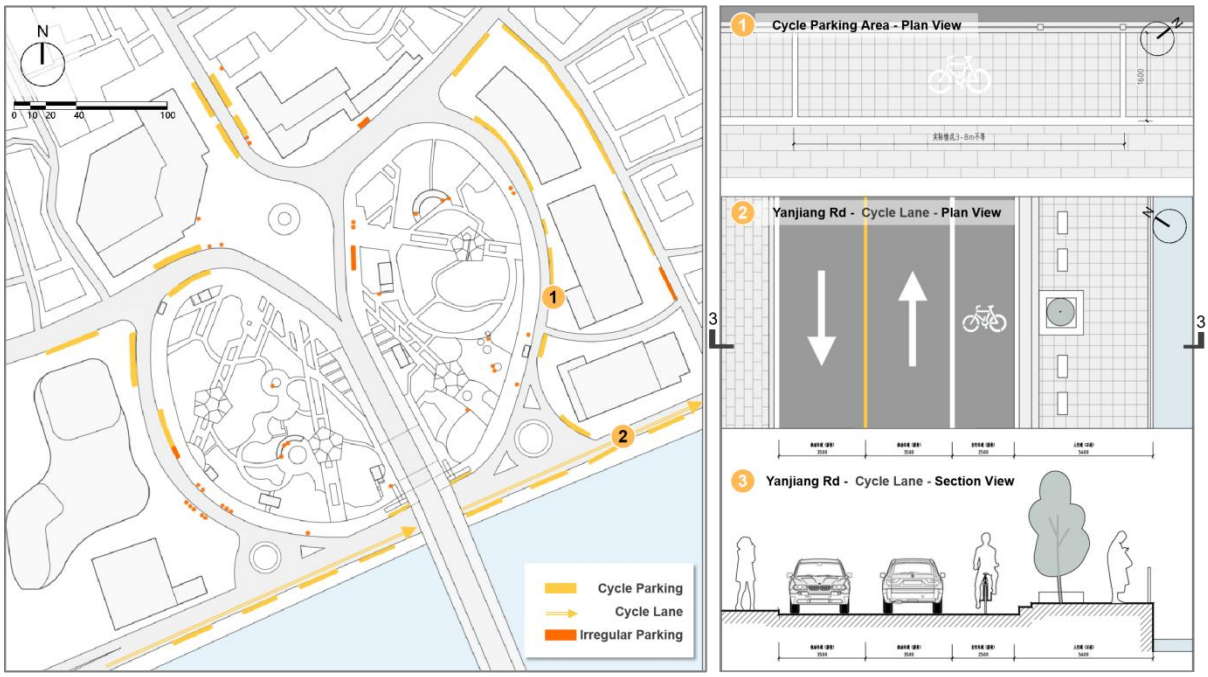


Figure 5-27 Distribution of cycle parking areas in site

Figure 5-28 Plan and Section of cycle lane in Yanjiang Road (Source: Completed by author)

(5) Pedestrian surfaces

According to the evaluation criteria of inclusive design, the surfaces of the pedestrian pavement should be hard, smooth, non-slip, and simple pattern. In pedestrian surface, the greening park is taken as the research object, and pavement materials are classified and evaluated according to the above four elements. It can be seen from the figure that most of the pavement texture is hard, which is not suitable for the elderly and children to walk for a long time. The stitching pattern of pentagon square is too complex, which will lead to visual confusion. And cobble, gravel filling surface should be replaced.

No.1-2: Soft, flat, non-slip, and simple in pattern. It is recommended to keep and use.

No.3-8: Flat, non-slip, simple in pattern, but too hard and not comfortable. It is recommended to reduce the hardness.

No.9-11: Flat and rich in patterns, but smooth surface and poor drainage. It is recommended to keep the pattern and improve the roughness.

No.12-14: Uneven, smooth, and complex in pattern. It is recommended to replace.

Figure 5-29 Material evaluation of pedestrian surfaces (Source: Completed by author)

(6) Tactile paving

The tactile paving includes two aspects:

On the one hand, the overall connectivity is recorded whether the tactile paving routes are reachable. According to the figure, it can be seen that there are many obstacles in tactile paving, such as trees, manhole covers, street lamps, barricades, etc., and there are routes mutations in some locations.

On the other hand, whether there are tactile paving missing is recorded. The missing locations are mainly in the location of spaces in front of XIBC, sidewalks, metro entrances and top and bottom of pedestrian footbridge.

Figure 5-30 Current situation of tactile paving in site (Source: Completed by author)

5.5.3 Changes in level

The pedestrian footbridges in the site are located on both sides of Haizhu Bridge. There are 36 steps (20+16), with a total height of about 5400mm and a width of 3500mm. The width of the middle ramp is 400mm, with 50% slope gradient, which is far greater than the inclusive evaluation standard (1:12).

Through on-site observation, it is found that pedestrians often push bicycles arduously on the footbridge. The upper and bottom of the bridge are not provided with buffer spaces and tactile paving. Under the bridge is the metro entrance, with dense people flow. At the same time, the width of the stair platform is about 2000mm (<width of footbridge 3500mm).

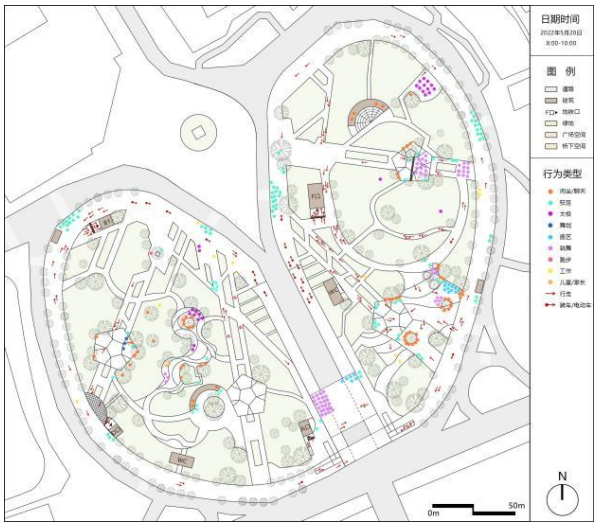
Figure 5-31 The plan and elevation of pedestrian footbridge (Source: Completed by author)

5.5.4 Activity spaces

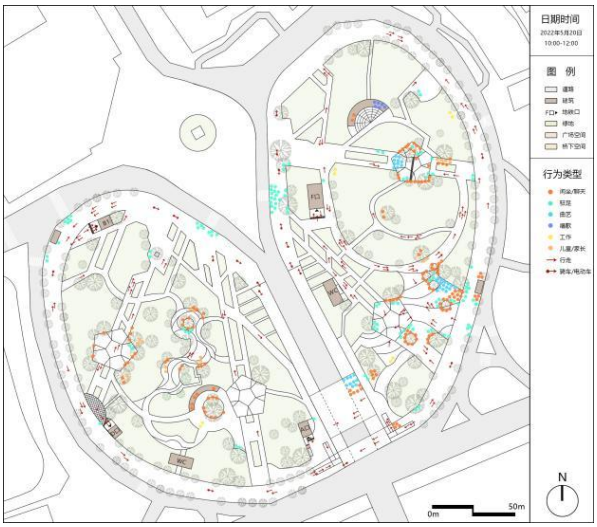
Behavioral map analysis is an environmental behavioral technique that uses a map or plan to observe systematacially. It describes the status of the space being used, collects information such as the content, time, frequency and location of the behavior, and records the data on plan at pre-designed time intervals.

In the survey of Haizhu Square, the observation and recording of the behavior map were carried out in the selected time periods: 16.00-20.00 pm (2022-05-18), 12.00-16.00 pm (2022-05-19), 8.00-12.00 am (2022-05-20). Then make a recording every 30 minutes, and draw the 4 recordings in two hours on a plan to form 8.00-10.00, 10.00-12.00, 12.00-14.00, 14.00-16.00, 16.00-18.00, 18.00- 20.00, a total of all-day behavioral maps of Haizhu Square covering 8.00-20.00.

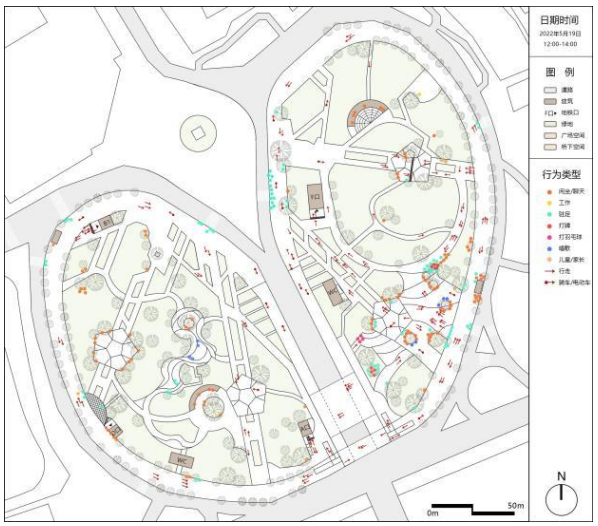
When drawing the behavior map, different color graphics are used to record different behaviors. The behavior map can reflect the characteristics of crowd distribution, flowing and problems in space, providing reference for the subsequent design.



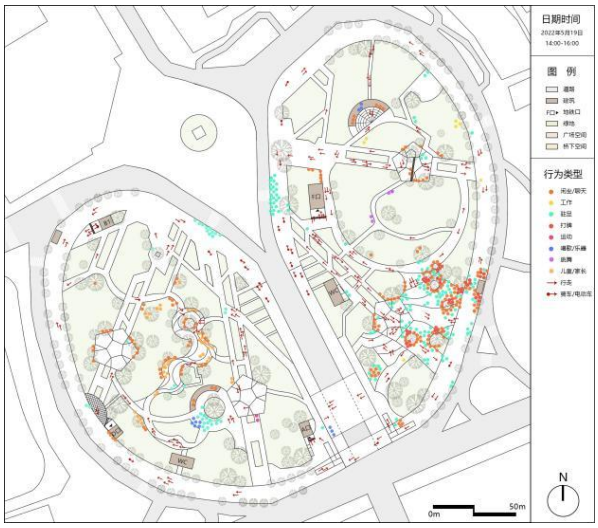
a) Behaviors map in 8.00-10.00am



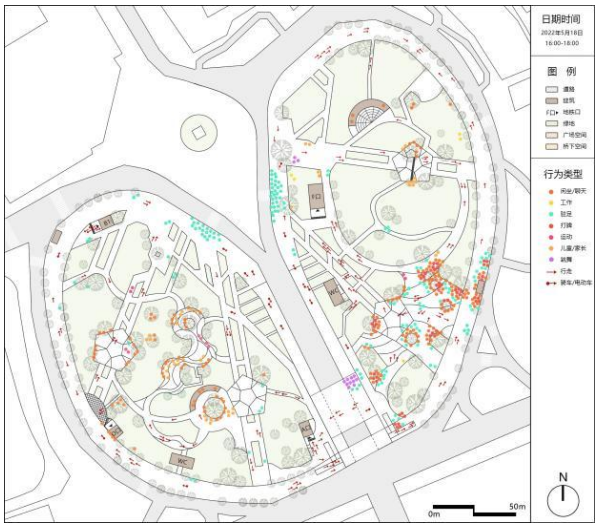
b) Behaviors map in 10.00-12.00am



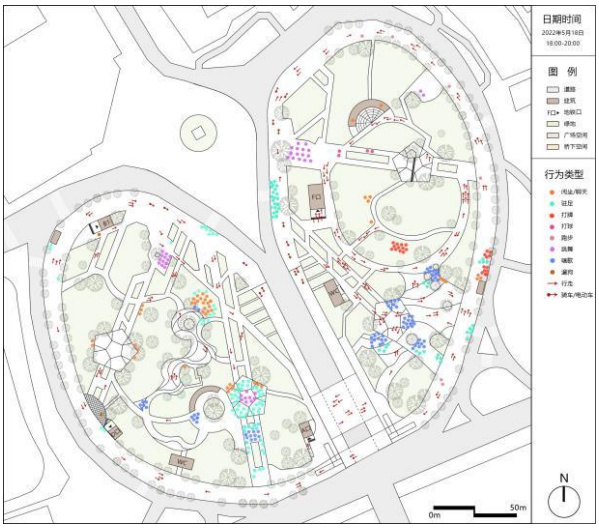
c) Behaviors map in 12.00-14.00pm



d) Behaviors map in 14.00-16.00pm



e) Behaviors map in 16.00-18.00pm



f) Behaviors map in 18.00-20.00pm

Figure 5-32 Behaviors maps (Source: Completed by author)

Figure 5-33 All-day behaviors record and observation (Source: Completed by author)

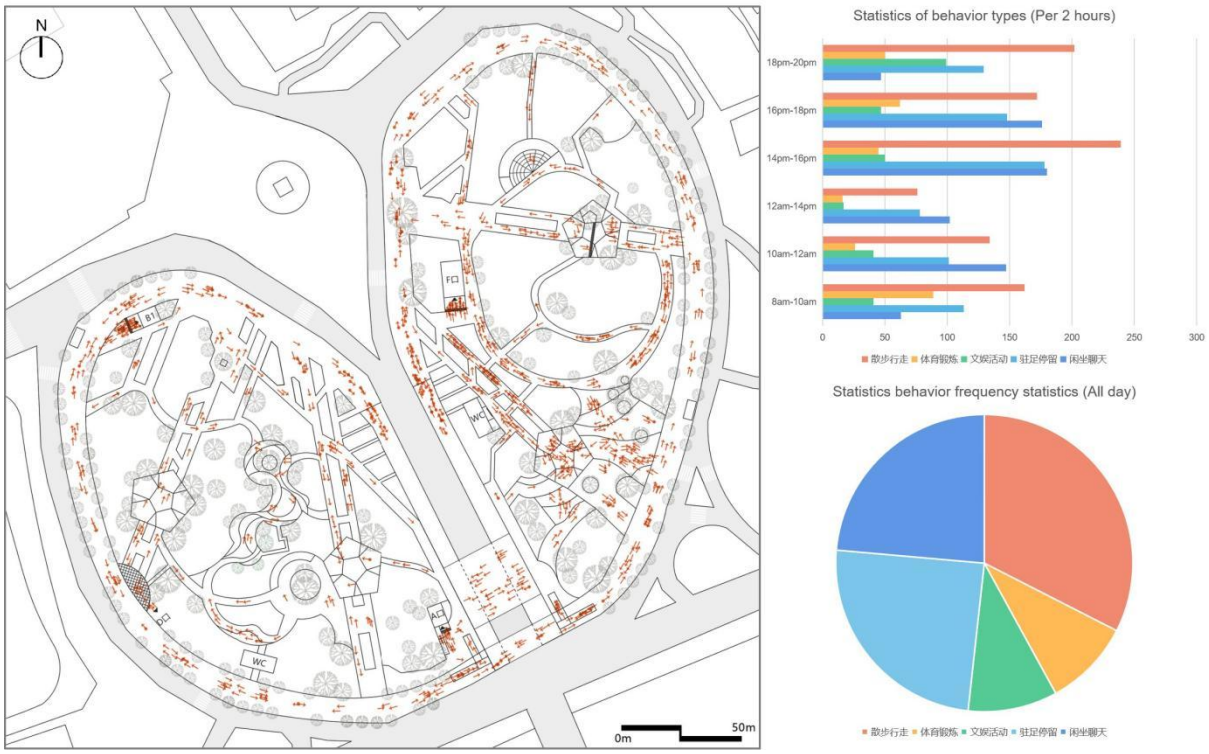


Figure 5-34 All-day walking tracks record and behaviors frequency statistics (Source: Completed by author)

It can be seen from maps that the main audience of Haizhu square is the elderly, and the types of activities are cultural and entertainment performances (Cantonese opera, trumpet, singing, etc.), exercise (dancing, sword dancing, striking, etc.), leisure and sitting. Secondly, the target group is children, and the types of activities include scooter scooters, sand playing, activities with other children, etc. Parents generally sit in flower beds, but there are no entertainment facilities for children and parental observation areas in the square.

Then, around 5:00 pm, a large number of students left school, mostly three or five groups walking, chatting, playing, etc. The venue did not provide corresponding facilities for the students group. Finally, at night, the group of middle-aged and young people gradually increased, mostly dancing, exercising, running, walking the dog, etc. In the site, walking occurs most frequently, often in the peripheral loop with large flows of non-motor vehicles pass through, and the surface is too hard, which is not conducive to exercise activities. Followed by leisure sitting, but the site has insufficient rest facilities, most of them are parterre seats.

5.5.5 Public facilities

In the Public facilities section, the main focus is on the Rest points and Public toilet.

(1) Rest points

First, record the distribution of rest points in site, as shown in the figure below. Most of the seats are parterre seats, there are 14 fixed seats (stone), the movable seats (plastic stools) are mostly distributed near the newsstand.

Next, measure the seat size. The parterre seats can be divided into three sizes: Type 1 has a narrower width (about 200mm), and Type 2 has a shorter height (about 300mm). Type 3 has no armrest and backrest, and the height level does not change.

In summary, distribution of rest points and size of seats do not meet the inclusive design standards and need to improve in the subsequent design.

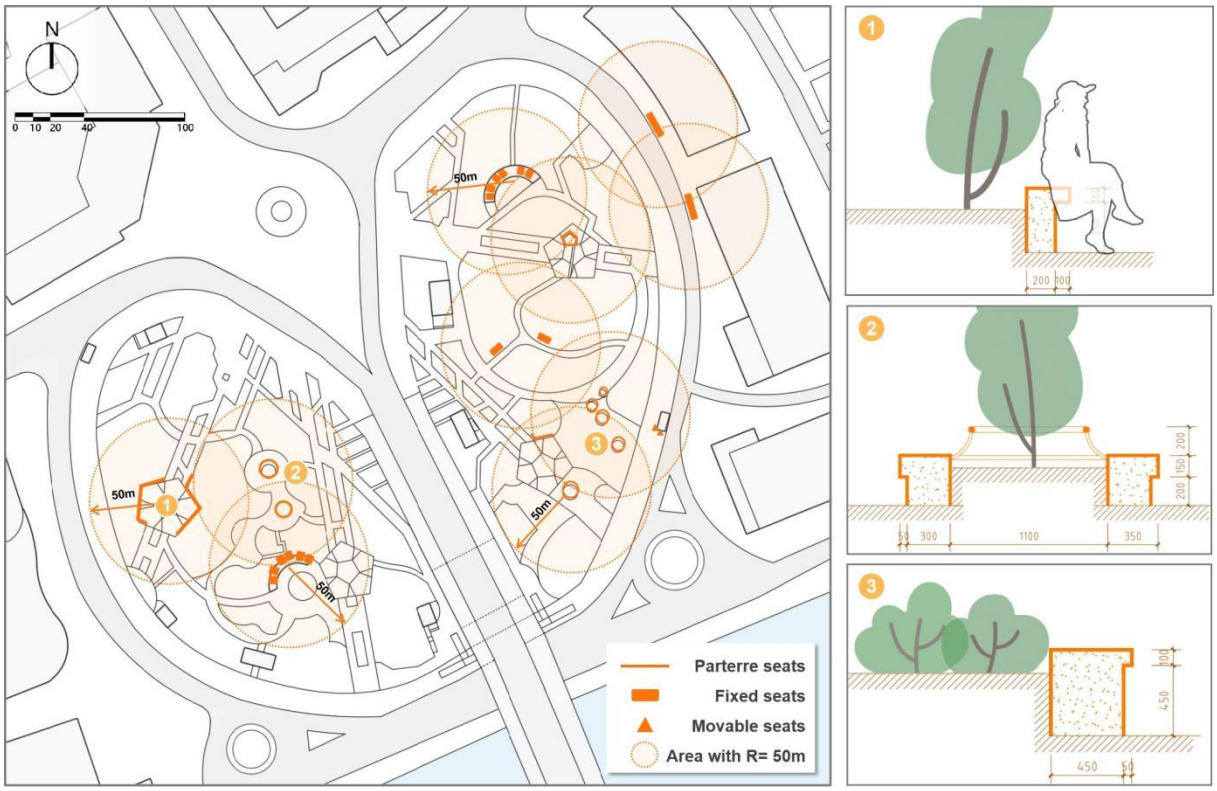


Figure 5-35 Distribution of rest points and size of seats (Source: Completed by author)

(2) Public toilet

The public toilet is located on the east side of Haizhu Square. There are wooden grilles and green decoration at the entrance of toilet, which produce good effects. The slope on one side of the entrance is gentle (15%, which meets the requirements), which is suitable for wheelchairs, but on the other side is relatively large (40%), and the width of the passage is only 1400mm. Accessible toilet is set up separately, with a plane size of about 1800×3200mm (meets the requirements). The door is 900mm (inside) and cannot allow wheelchairs to rotate180° . There are horizontal handrails and vertical handrails in the accessible toilet, but no anti-skid treatment. The sink is close to the wall,some facilities such as nursing stations are lacking.

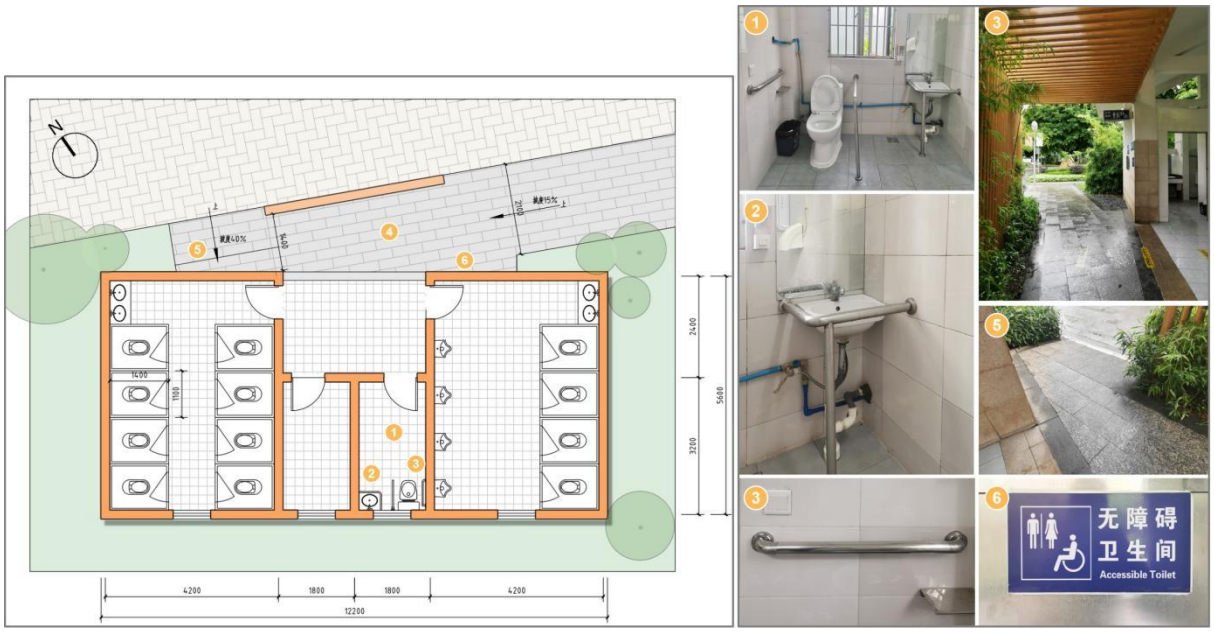


Figure 5-36 Plan and Dimensions of Public toilet (Source: Completed by author)

5.6 Status Summary - SWOT Analysis

After detailed analysis of region and evaluation of the site in 5 categories and 13 sub-categories, three opportunities and three challenges for Haizhu Square are summarized:

3 Opportunities:

• The Haizhu Square is located at the midpoint of the original central axis of Guangzhou, with a superior geographical location.

• It is surrounded by historical buildings with rich cultural heritage, and faces the Pearl River with abundant landscape resources.

• Businesses, residential areas, hospitals, schools, etc. are distributed around the square, and about 3000 citizens participated in public activities per day.

3 Challenges:

• The statue does not form a sense of ceremony in spatial sequence, and the separation prevents interaction between the statue and the crowd.

• The square absences connections and accessibility with the surroundings, which does not meet the need of vulnerable groups.

• The square lacks diversified spaces, which limits activities and communications among citizens.

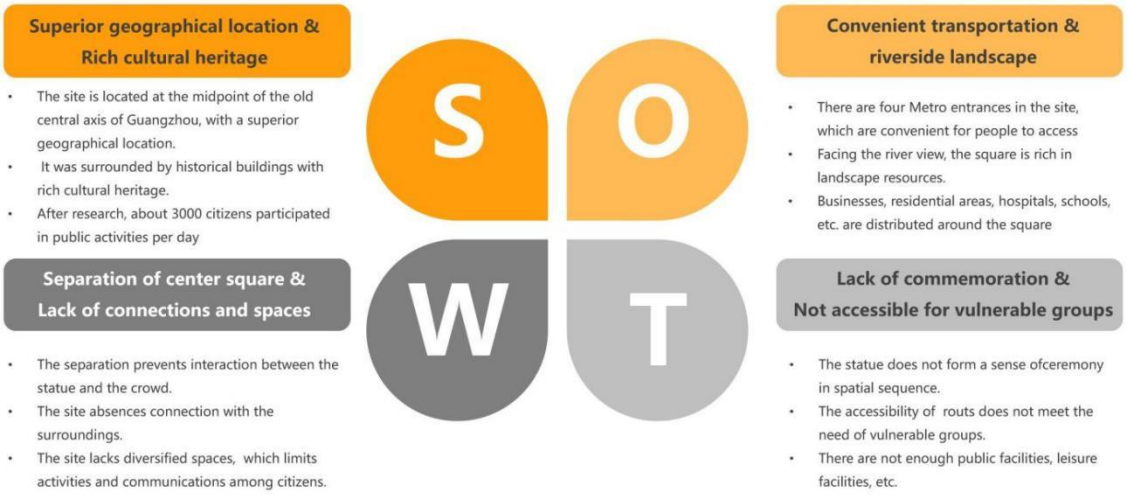


Figure 5-37 SWOT Analysis of Haizhu Square (Source: Completed by author)

5.7 Chapter summary

This chapter first analyzes the historical background of Haizhu Square, which was firstly set up to adjust the traffic, gradually forming a bridgehead square that was not only convenient for transportation, but also for citizens to relax.

Then from macro to micro, the planning background of the site has been analyzed in the Guangdong Province, the Greater Bay Area, Guangzhou city, and the Yuexiu District level. As the Haizhu Square is located at the original axis of Guangzhou, the space sequences of the overall axis are described, and resources of transportation, heritage, facilities and landscape within the region are studied.

Combined with Appendix 1&2 Design points and evaluation criteria, evaluate the status quo of Haizhu Square. The evaluation can be divided into five parts: Site planning, Pedestrian spaces, Changes in level, Activity spaces, Public facilities.

After detailed analysis of region and evaluation of the site in 5 categories and 13 sub-categories, three challenges for Haizhu Square are summarized.

Through the above analysis, the studies have a comprehensive understanding of the backgrounds, current situations and inclusiveness of Haizhu Square, and provide basic information for subsequent optimization and improvement.

Chapter 6 Inclusive Design Improvement of Haizhu Square

6.1 Objective and strategy

6.1.1 Design objective

In Chapter 5, the status quo of Haizhu Square has been evaluated and 3 challenges are summarized.

3 Challenges:

• The statue does not form a sense of ceremony in spatial sequence, and the separation prevents interaction between the statue and the crowd.

• The square absences connections and accessibility with the surroundings, which does not meet the need of vulnerable groups.

• The square lacks diversified spaces, which limits activities and communications among citizens.

3 Objectives:

Therefore, the three objectives for optimizing and improving Haizhu Square are formulated. It is hoped that inclusive design will make Haizhu Square to be:

• A renewed culture legacy.

• A welcoming and accessible square.

• A flexible and inclusive event venue.

Figure 6-1 Design objectives of Haizhu Square (Source: Completed by author)

6.1.2 Overall planning strategy

In response to the previous design objectives, the overall planning strategies are put forward based on inclusive design research.

Strategy 1: Inclusion of Diverse Heritage

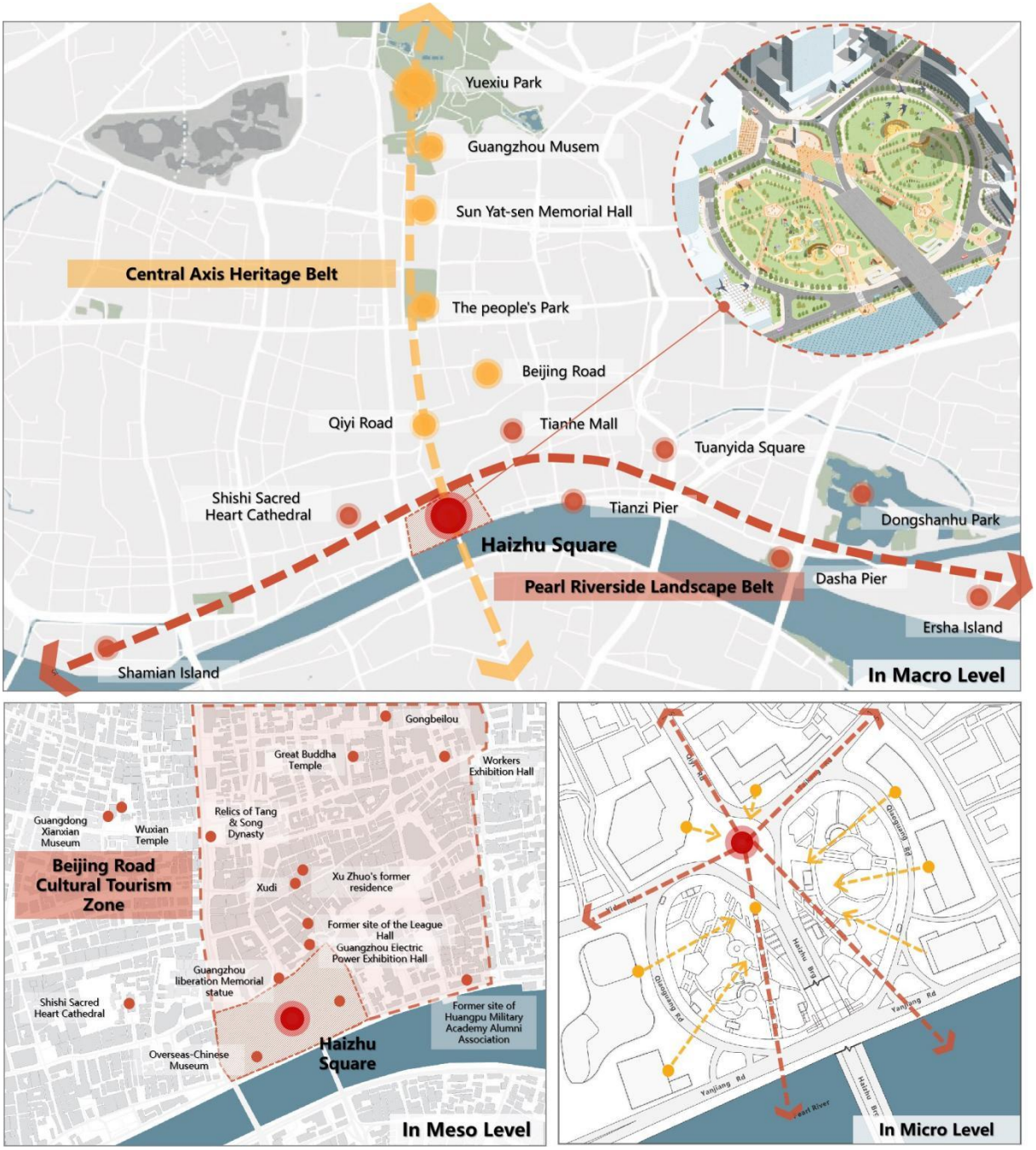


Figure 6-2 Strategy 1: Inclusion of Diverse Heritage (Source: Completed by author)

In macro level, with the site as the core, the central axis heritage belt and Pearl Riverside Landscape belt will be created to connect heritage resources.

In meso level, integrate the existing resources of Beijing Road Cultural Tourism Zone to make it more abundant as a whole.

In micro level, make several convenient connections to all building entries and all gathering spaces. And, there will be a variety of activity places on the connections, where will bring opportunities for different groups to communicate and interact.

Strategy 2: Accessibility and Safety of Diverse Routes

In macro level, improve the public transportation networks in the region, and set up different transportation modes, such as subway, expressway, expressway, shipping, bicycle, etc., so that make it suitable for people with different purposes and abilities to reach and experience.

In meso level, deal with the connection of all routes around site, consider how cyclist, pedestrian, wheelchair uses, and drivers enter the square, and alleviate the transportation conflicts between vehicles and pedestrians

In micro level, it is hoped that the square will be accessible and approachable to all groups. Therefore, go deep into the interior of site and consider the actual feasibility and specific approaches, including safe and accessible pedestrian crossings, accessible parking, and tactile paving. All the pedestrian routes will be well-lit ans easy to navigate, and also adequate for wheelchair dimensions. Also there will be avoidance of abrupt vertical changes of level, and set multiple-levels handrails in the provision of ramp.

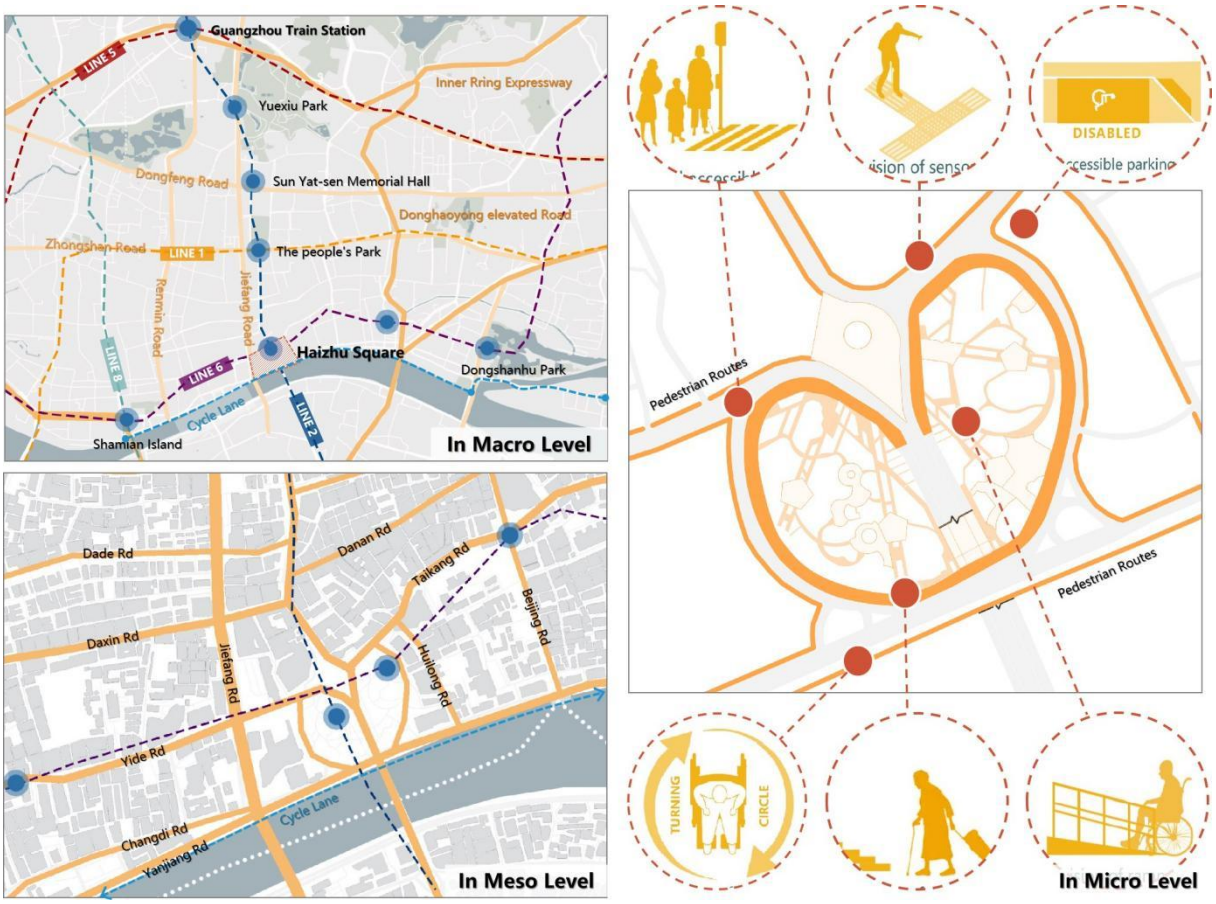


Figure 6-3 Strategy 2: Accessibility and Safety of Diverse Routes

(Source: Completed by author)

Strategy 3: Inclusion Spaces used by Diverse Groups

It is not difficult to see that there are various occupation types in the region: doctors, workers, managers, students, tourists and residents etc. Through interviews and behavioral maps, the demands of activities can be sort out, as shown in the figure below. These requirements will be reasonably placed in Haizhu Square, which will ensure that all children, young people and older people of any ability have equal participation in local play and leisure opportunities, so that it can better serve a wider range of people.

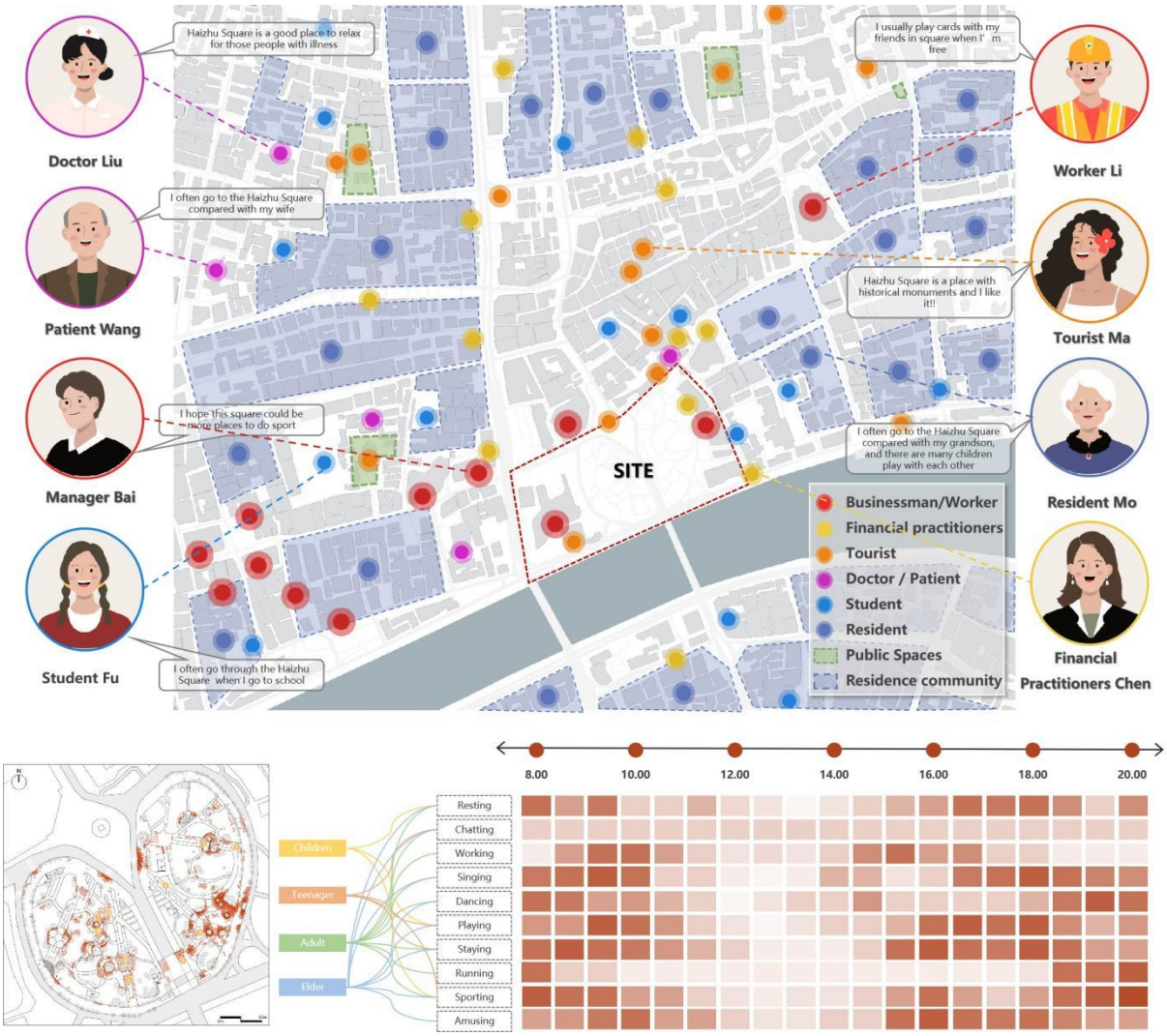


Figure 6-4 Diverse Groups in Region and Demand Analysis of Activities

(Source: Completed by author)

6.2 Vision of overall planning

6.2.1 Master Plan

In the final vision of the site, it is hoped that a “Reinvigorated Civic Heart of Haizhu” can be created, integrating the 3 objectives of "a renewed culture legacy, a welcoming and accessible square, and a flexible and inclusive event venue" and 3 strategies of “inclusion of diverse heritage, accessibility and safety of diverse routes and inclusion spaces used by diverse groups” into the site as a whole. The master plan is shown below.

Figure 6-5 Master Plan of Haizhu Square (Source: Completed by author)

6.2.2 Ultimate vision

The ultimate vision of Haizhu Square is shown in the figure below.

Figure 6-6 Axonometric view of Haizhu Square (Source: Completed by author)

6.2.2 Spatial structure

First of all, with the memorial statue as the core of the square, it will extend to the Pearl River in spatial sequence, forming two main axes. Secondly, the peripheral building entrance squares (Overseas-Chinese Museum, Xinghuan International Business Center, Prime Hotel) as the endpoints to generate secondary axes. Finally, combined with the entrance of the metro station, the overall spatial structure of “One core, Five axes and Multiple points” will be shaped.

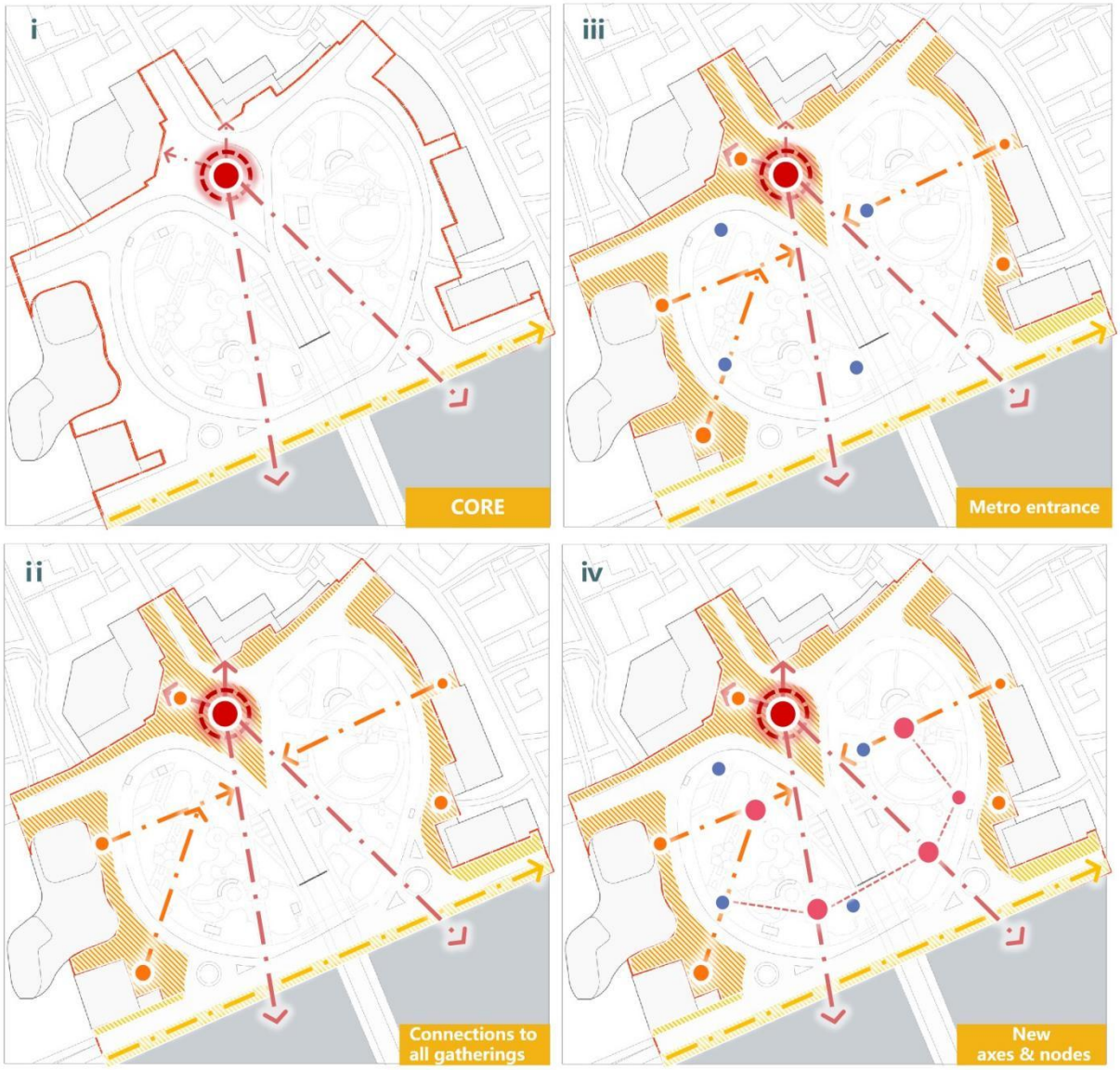


Figure 6-7 The overall spatial structure of “One core, Five axes and Multiple points”

(Source: Completed by author)

6.3 Inclusion of Diverse Heritage

6.3.1 Overall design

Within the region, the site will connect the important heritages around it to generate characteristic routes, making them more complete and inclusive cultural places. At the same time, inside the site, relying on the spatial structure, the Guangzhou liberation Memorial statue will be extended in the spatial sequences to Yide Road, Qiyi Road

and the Pearl River, instead of being limited to Haizhu Square. Finally, several convenient connections to all building entries and gathering spaces will be made.

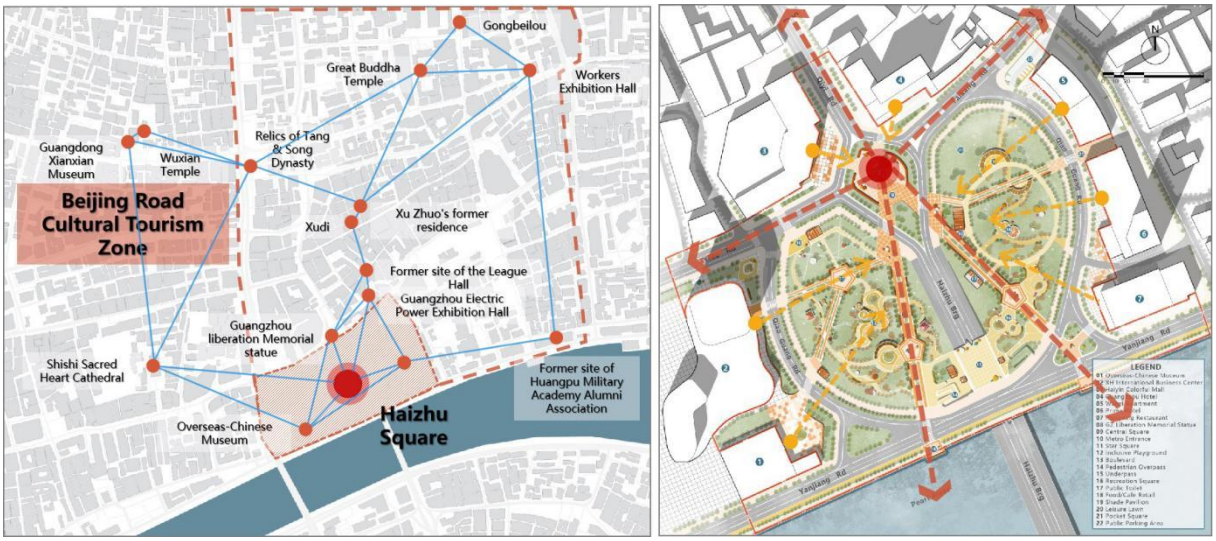


Figure 6-8 The overall design of “Inclusion of Diverse Heritage”

(Source: Completed by author)

6.3.2 Site design

Select three key points in the axes spaces for detailed design. The first is the central square, the second is the boulevard in main axis, and the third is the riverside square, as shown in the plan and section.

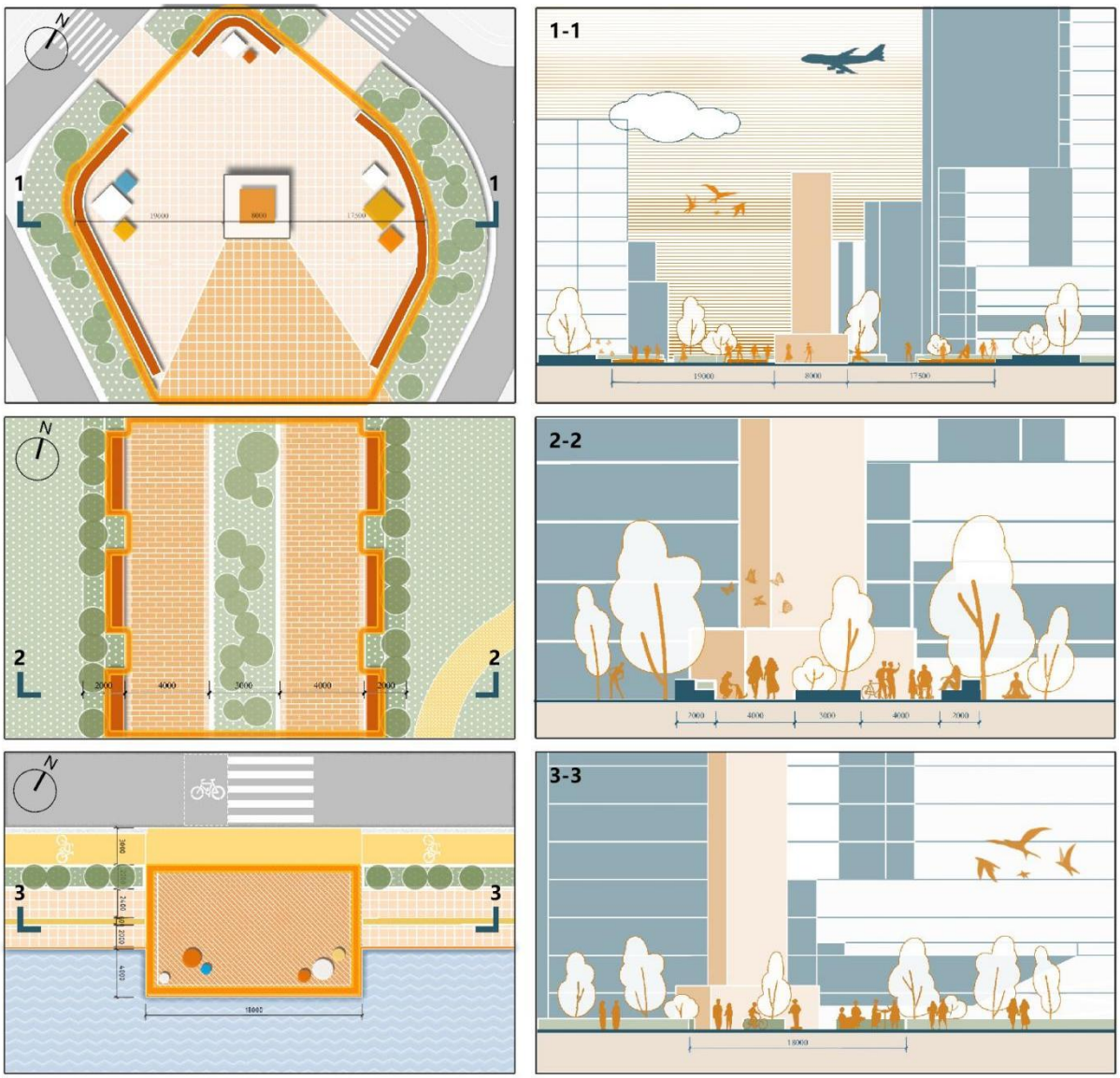


Figure 6-9 Plan and section of three key points (Source: Completed by author)

6.4 Accessibility and Safety of Diverse Routes

6.4.1 Overall design

One thing is to adjust road around the square on the basis of the original networks. Firstly, to widen Qiyi Rd, Qiaoguang Rd, Yanjiang ERd, and to narrow Yide Rd and Taikang Rd. Secondly, narrow the turning radius of vehicles to 5m in order to decrease the speed of vehicles and ensure the safety of pedestrians. Finally, set up side parking spaces in the widened carriageways (Qiaoguang Rd), and leave enough spaces on

the sidewalks to arrange waiting areas, landscapes, parking spaces, rest points, etc.

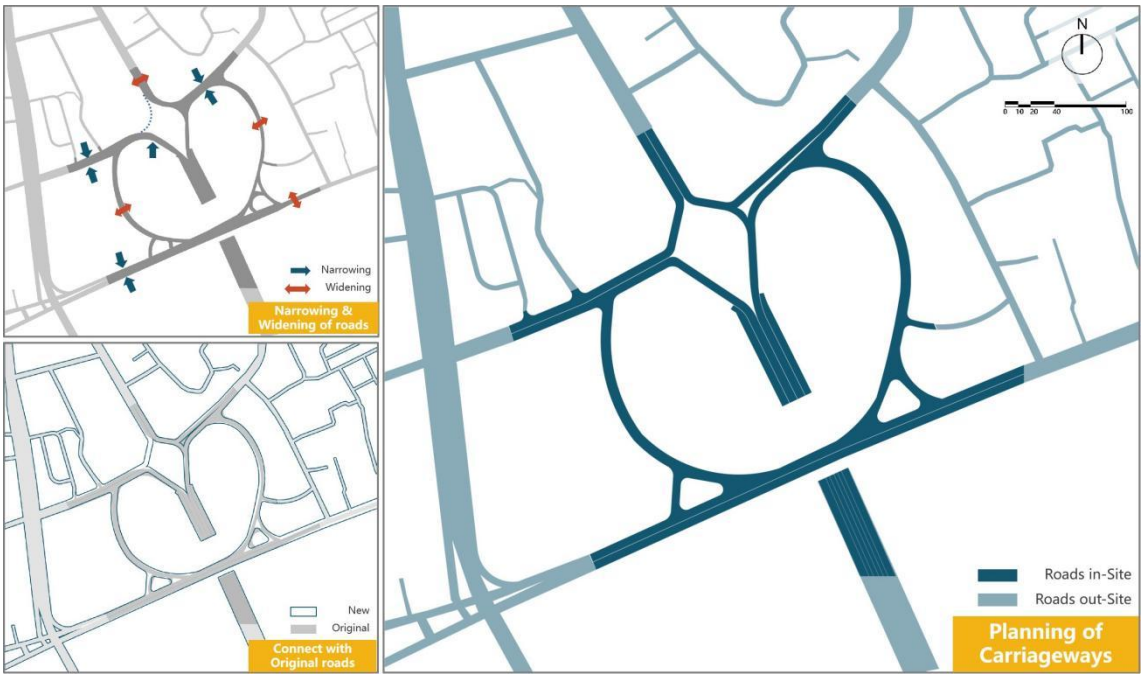


Figure 6-10 The overall design of carriageways (Source: Completed by author)

The other is to redesign the pedestrian routes. First of all, according to the original routes, set up 4-6m pedestrian routes around the site. If there is enough space, green isolation belts, bicycle parking, seats, etc. can be set up. Secondly, in the square, the logic of the path networks will be sorted out and structural adjusted. The width of path will be kept more than 3m to ensure different groups of people to pass through.

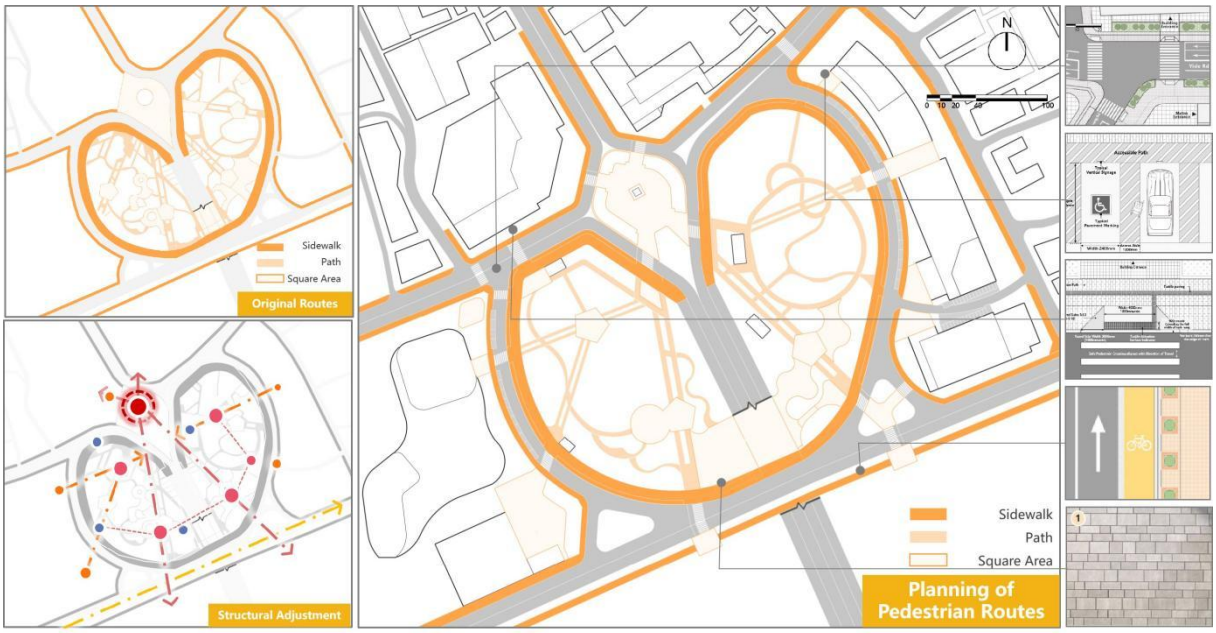


Figure 6-11 The overall design of pedestrian routes (Source: Completed by author)

6.4.2 Site design

After the evaluation, combining with inclusive design points, the accessibility and safety of diverse routes will be optimized from the following aspects: (1) Pedestrian crossings; (2) Parking spaces; (3) Cycling infrastructure; (4) Pedestrian surfaces; (5) Changes in level.

(1) Pedestrian crossings

Taking the pedestrian crossings of Central Square and Yide Rd as examples:

In Central Square, firstly the vehicle road will be narrowed to make a larger gathering place, and the original fences will be removed to allow pedestrians to enter freely. Secondly, increase the width of the pedestrian crossing to 10m, and add a cycle crossing (3m). Finally, buffer zones and seats will be set up in the squares entrance and around the statue.

At the intersection of Yide Rd, first obstacles such as drainage ditches, manhole covers, etc., will be removed to keep the clear sight of pedestrians. Secondly, the crossings will be widened to 8m, 6m, and 4m depending on actual situation. The slope

of the curb is 5%, and there will be 600mm wide tactile pavement at the bottom, which is connected to tactile pavement inside the site. The detailed design is shown in the figure.

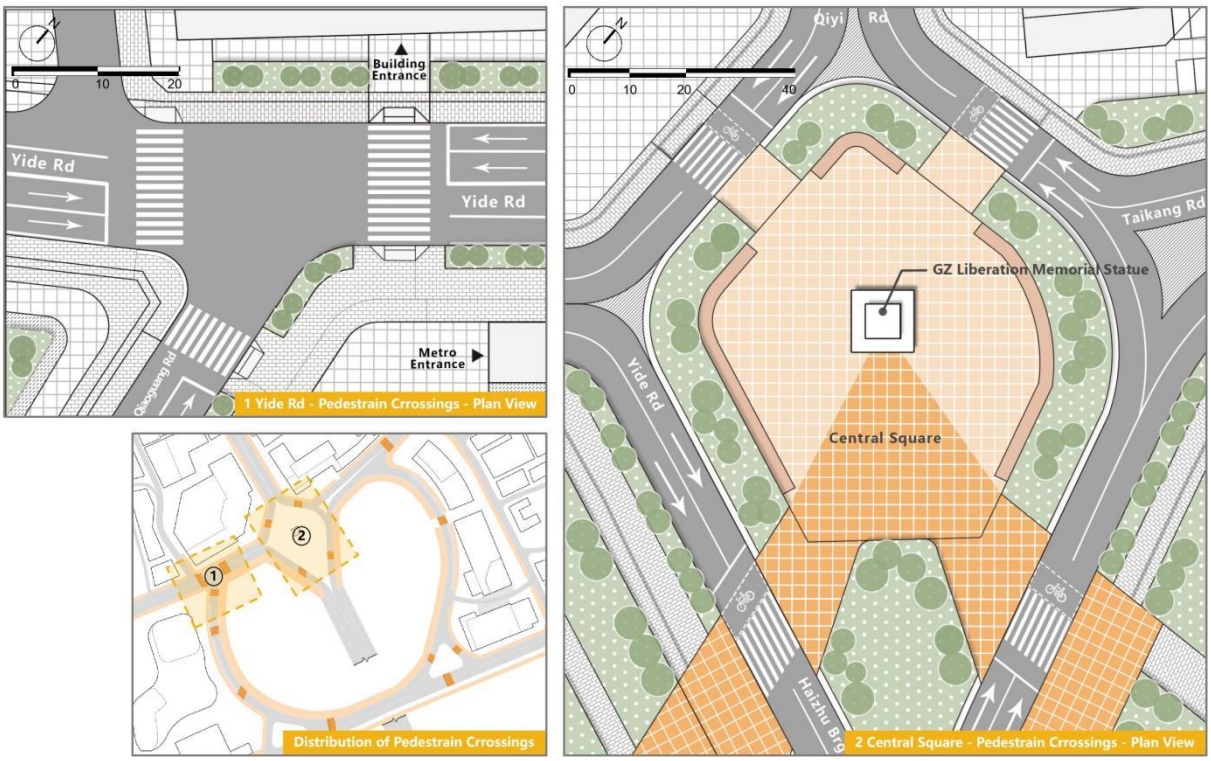


Figure 6-12 The design of Pedestrian crossings (Source: Completed by author)

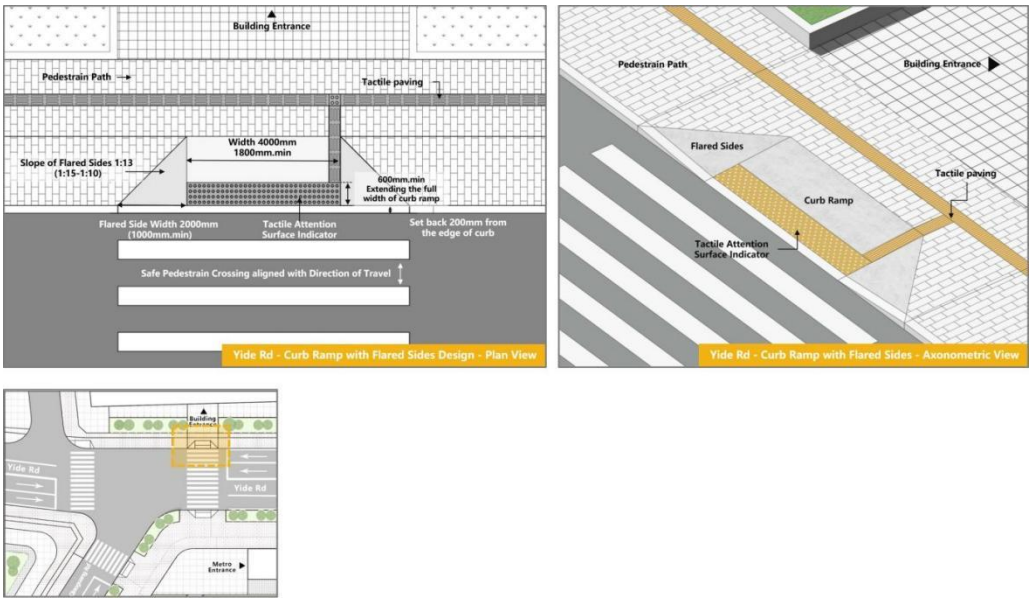
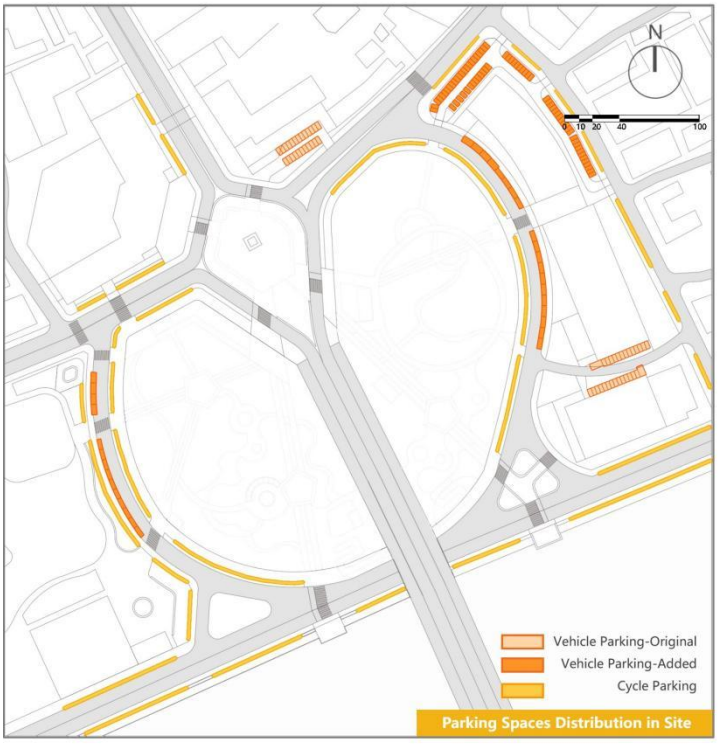


Figure 6-13 The design of curb ramp with flared sides (Source: Completed by author)

(2) Parking spaces

In the planning ofcarriageways, the width of Qiaoguang Rd will be widen to 10m, with less traffic flow, and side parking spaces can be set up. After the renovation, there will be 175 ground parking spaces (the original 122), including 35 side parking spaces (the original 19) and 13 accessible parking spaces, accounting for 7% of all parking spaces.



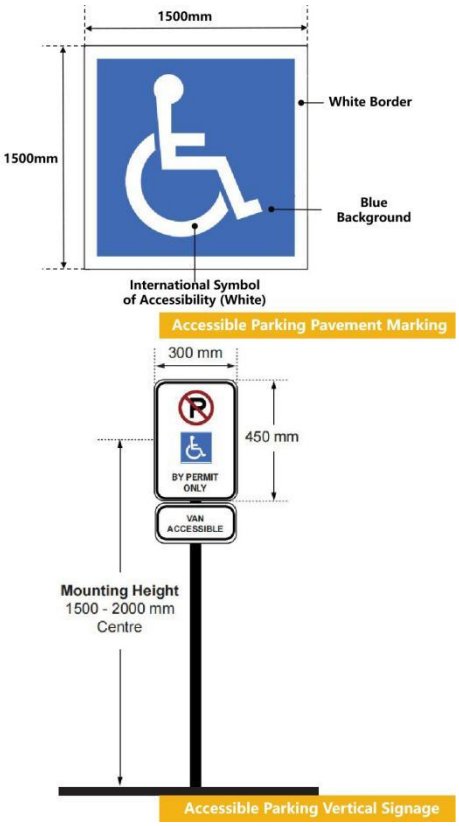


Figure 6-14 New planning of parking spaces in site

Figure 6-15 Design of accessible parking marking and signage

(Source: Completed by author)

The plan of Taikang Road parking space is shown in the figure. The number of ground parking has been increased to 70 (the original 54), including 5 accessible parking. There will be 18 side parking (the original 19), including 3 accessible parking. The size of the ground parking is adjusted to 2400 × 4800mm (original 2500 × 5000mm) according to the inclusive design standard, with 1200mm access aisle on both sides, and accessible marking will be printed on the ground. The size of the side parking is

adjusted to 3000 × 7500mm (original 2500 × 7500mm), and accessible parking is adjusted to 4000×7500mm.

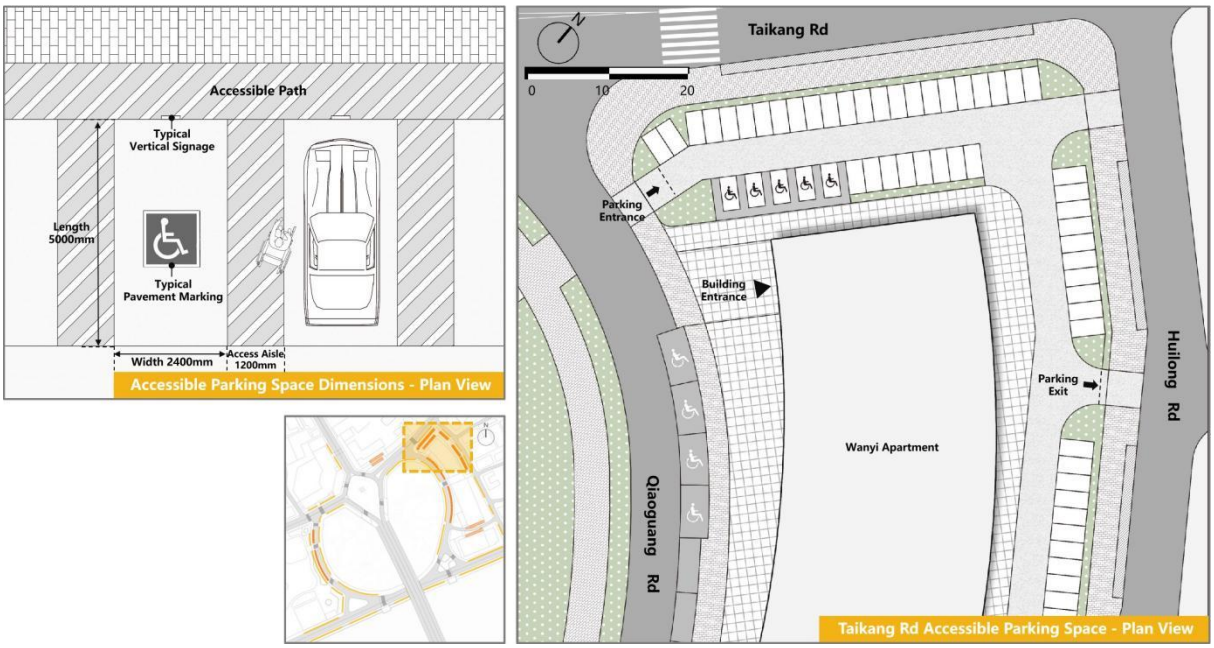


Figure 6-16 Plan of Taikang Rd parking space

Figure 6-17 Plan of accessible parking dimensions (Source: Completed by author)

(3) Cycling infrastructure

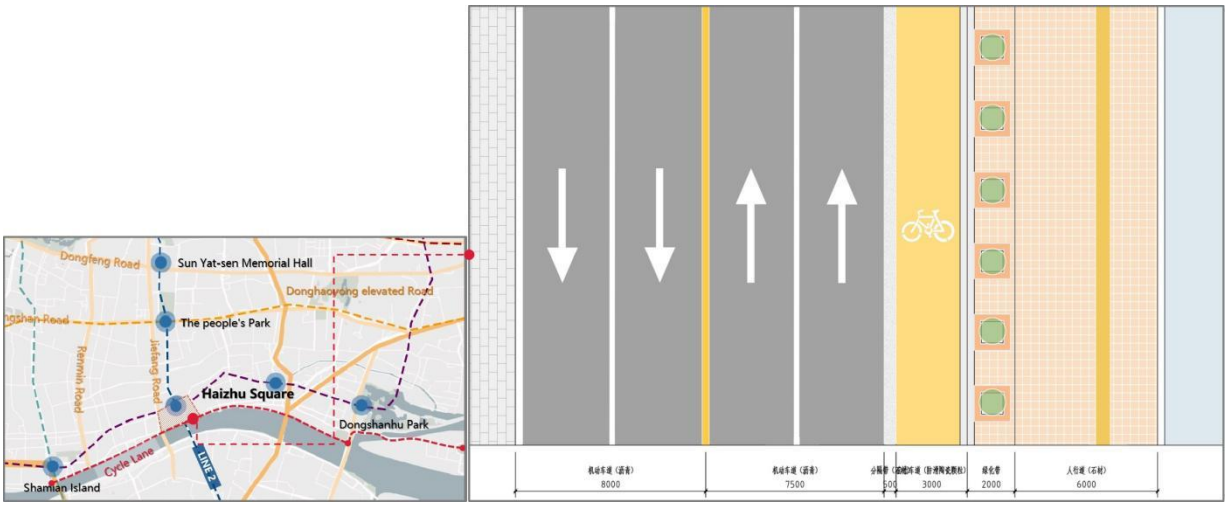


Figure 6-18 Design of cycle lanes (Source: Completed by author)

In the design of cycle lanes, taking Yanjiang Road as an example. After widening

vehicle lane to 16m in the planning of carriageways, the width of original sidewalk will be increased to 8m, of which 2m will be used as green belts and rest points, and the cycle lane will be widened from 2.5m to 3m. At the same time, a separation belt (500mm) will be set beside carriageway. At last, the surface of cycle lane surface will be changed from asphalt pavement to anti-skid ceramic particle.

(4) Pedestrian surfaces

In pedestrian surfaces, the material which is soft, flat, non-slip, and simple in pattern will be keep and use in pedestrian routes. The pavements and details of pedestrian surfaces after optimization is shown in figure.

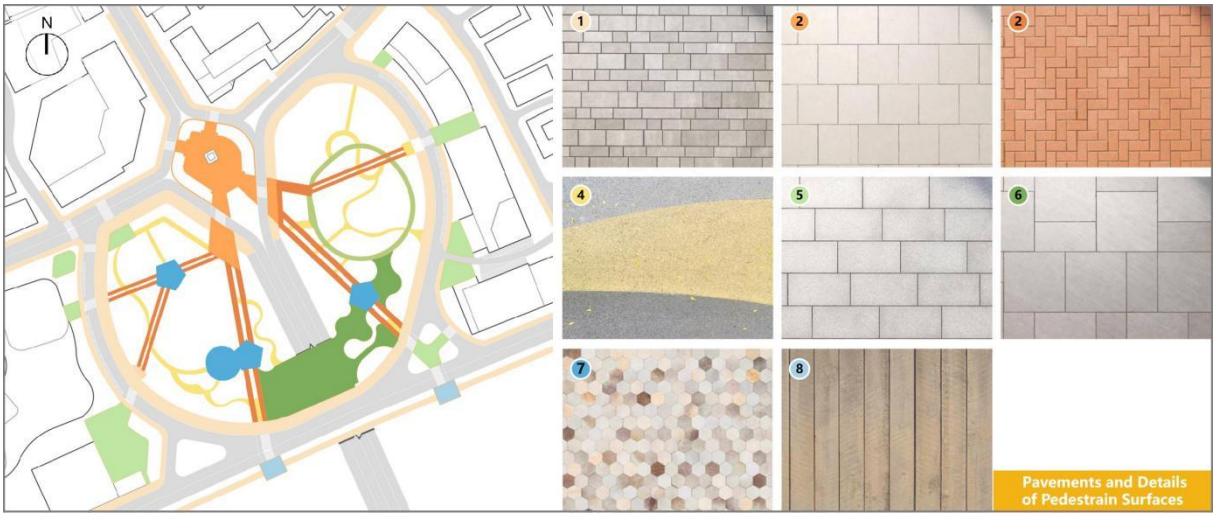


Figure 6-19 Pavements and details of pedestrian surfaces (Source: Completed by author)

(5) Changes in level - pedestrian footbridge

In actual observation, it is found that there are a large number of people who need to push bicycles on the pedestrian footbridge, so it will be designed in the shape with s full gentle slope. The height of the bridge remains the same (5400mm). Due to the sufficient space in site, the slope will be 10% in consideration of the length of the routes, so that cyclists, wheelchair users, and people with luggage can walk on effortlessly. Resting platforms will be set up on the two sides of footbridge, where people can enjoy the beautiful scenery of the Pearl River. The surfaces are made of

granite by seamless splicing, coordinating with warm-colored handrails, making simple and elegant lines.

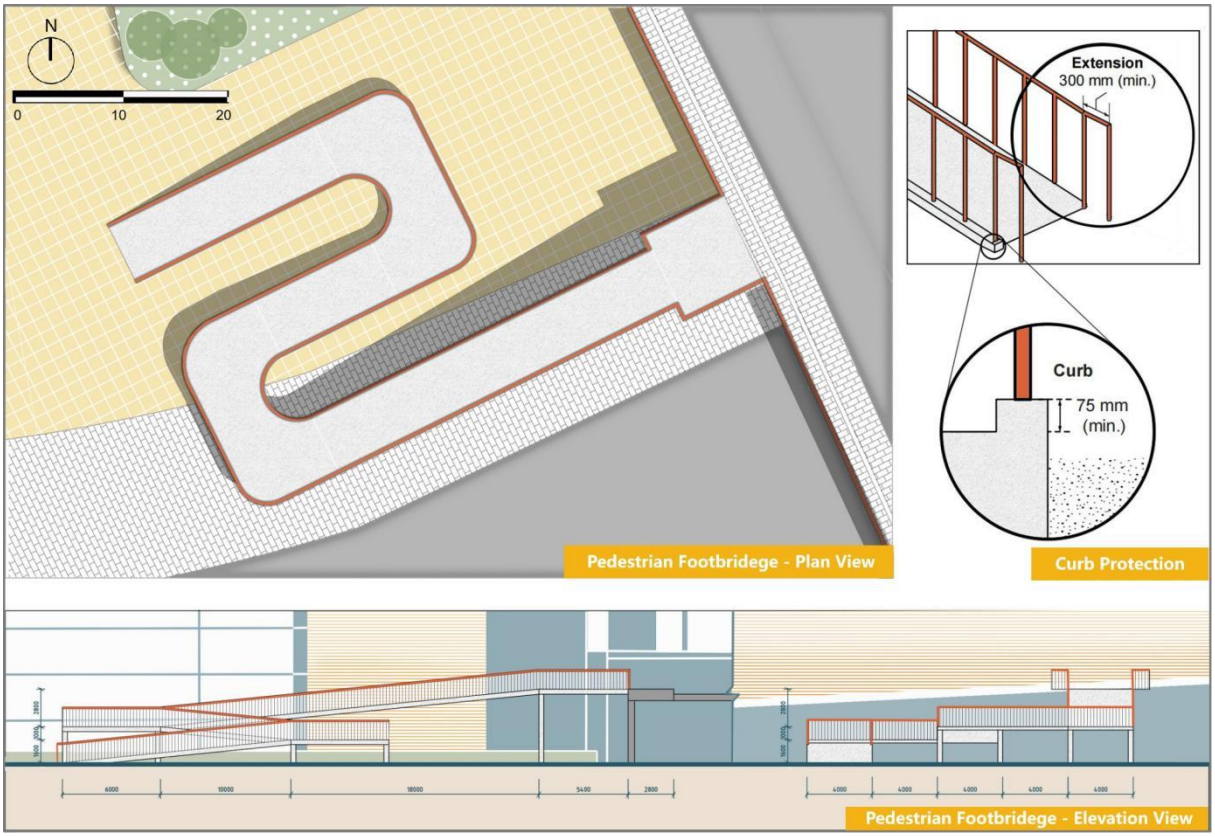


Figure 6-20 Plan, elevation and details of pedestrian footbridge

(Source: Completed by author)

6.5 Inclusion Spaces used by Diverse Groups

6.5.1 Overall design

Different activity spaces are set up in the site according to the demands of different groups of people, such as soft lawns for sunbathing, wide boulevards for cooling, pavilions for people to rest, circular paths for walking and running, amusement spaces for children to play, and venues for large gatherings. All the spaces will ensure that all children, young people and older people of any ability have equal participation in local play and leisure opportunities, so that it can better serve a wider range of people.

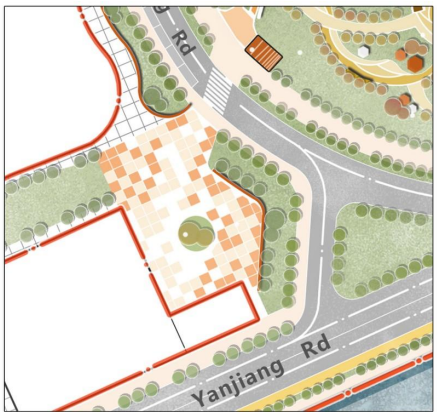
Figure 6-21 The overall design of activity spaces (Source: Completed by author)

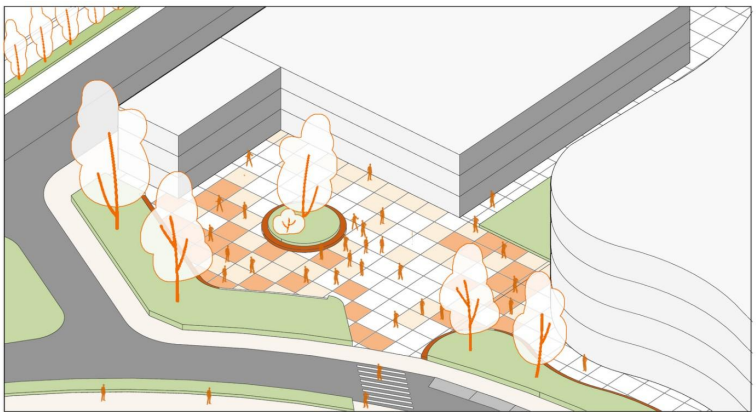
At the same time, in chapter 5.4 Inclusive Evaluation of the Haizhu Square, it was found that the site lacked convenient service facilities. Therefore, some functions will be placed in the site, such as accessible toilets, changing rooms, retail spaces, newsstands, etc., which not only enrich the life of citizens, but also ensure safety and convenience.

Figure 6-22 Distribution of public facilities (Source: Completed by author)

6.5.2 Site design

Several typical activity spaces are selected for display in the figure:





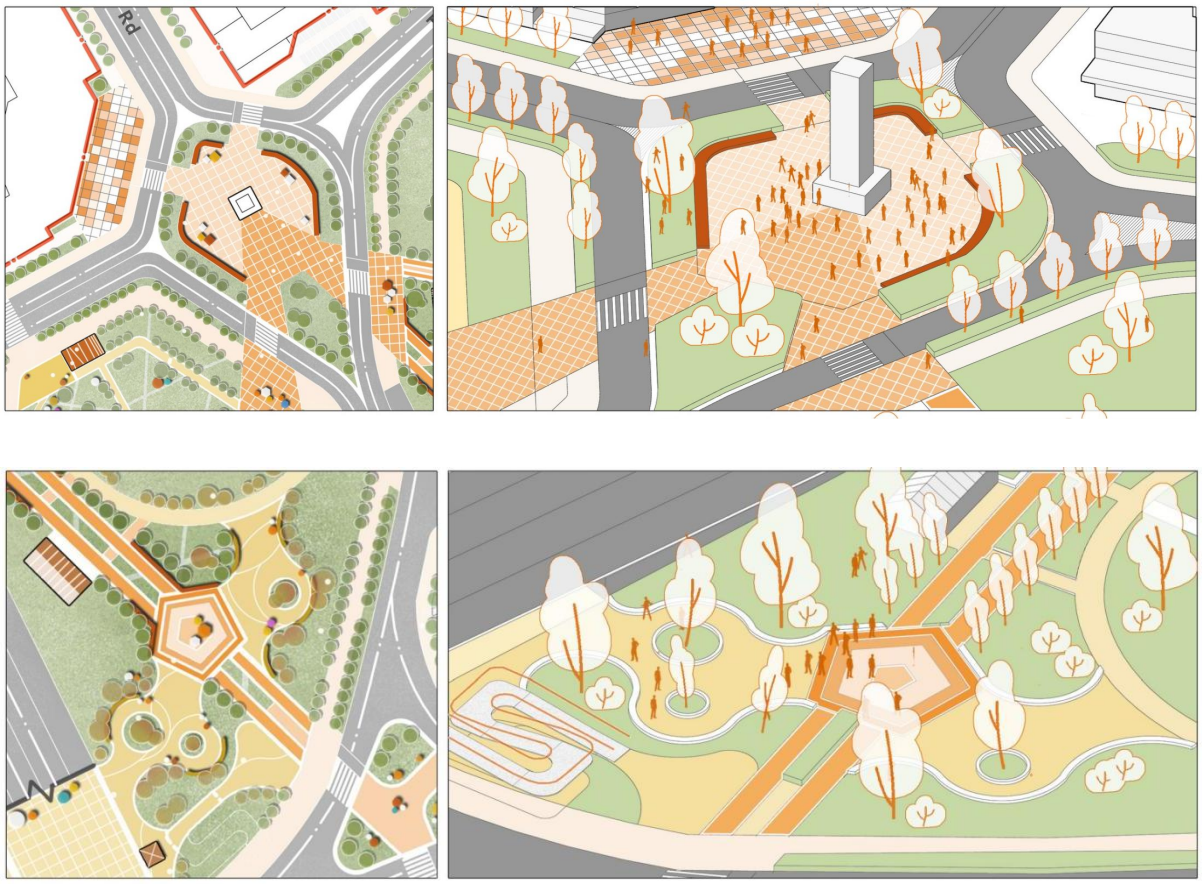


Figure 6-23 Display of typical activity spaces (Source: Completed by author)

6.6 Chapter summary

In the final vision of the site, it is hoped that a “Reinvigorated Civic Heart of Haizhu” can be created, integrating the 3 objectives of "a renewed culture legacy, a welcoming and accessible square, and a flexible and inclusive event venue" and 3 strategies of “inclusion of diverse heritage, accessibility and safety of diverse routes and inclusion spaces used by diverse groups” into the site as a whole.

In “inclusion of diverse heritage”, the site will connect the important heritages around it to generate characteristic routes, making them more complete and inclusive cultural places. And several convenient connections to all building entries and gathering spaces will be made.

In “accessibility and safety of diverse routes”, firstly improve the public transportation

networks in the region, and set up different transportation modes. Then deal with the connection of all routes around site, set up different routs of cyclist, pedestrian, wheelchair uses, and drivers enter the square. Lastly, go deep into the interior of site and consider the actual feasibility and specific approaches, including safe and accessible pedestrian crossings, accessible parking, and tactile paving.

In “inclusion spaces used by diverse groups”, different activity spaces are set up in the site according to the demands of different groups of people, such as soft lawns for sunbathing, wide boulevards for cooling, pavilions for people to rest, circular paths for walking and running, amusement spaces for children to play, and venues for large gatherings. All the spaces will ensure that all children, young people and older people of any ability have equal participation in local play and leisure opportunities, so that it can better serve a wider range of people.

Chapter 7 Conclusion

7.1 Main conclusion

(1) Application method of inclusive design in urban square

Based on the analysis and research of Mayor Thomas M. Menino Park, Schandorff Square, Superkilen Urban Park, this thesis sorted out the application method of inclusive design in urban public spaces. Through the design guidelines and implementation strategies, the design points and evaluation criteria of inclusive design involving urban square can be summarized into five categories: site planning, pedestrian spaces, changes in level, activity spaces, and public facilities.

(2) Pedestrian spaces design

In pedestrian design, the minimum width of the main access routes is at least 1800mm. To avoid obstacles in the passage, the minimum width that can be reduced is 1200mm, but its length cannot exceed 2000mm.

For narrow pedestrian roads (less than 3000mm) or especially busy intersections, a waiting area over 5000mm wide shall be provided. The minimum crosswalk width is 2400mm; Curb slope 1:20-1:12.

Parking Spaces should be within 50 meters of building entrance.The size of side parking should be 3600mm × 6000mm. Accessible parking should be 2400mm × 4800mm,with 1200mm safe passage.

The maximum transverse slope of the cycle lane is recommended to be 1:40; Width not less than 2 meters; Pavements and cycle paths should be properly separated.

The profile of any surface should not change more than ±5mm, with non-slip, smooth, wear resistant, durable, easy to maintain.

Tactile pavement width should be 300-600mm and the pavement distance from the kerb should not less than 500mm.

(3) Changes in level

In changes in level, the slope should not exceed 1:15; The transverse slope shall not exceed 1:50; A platform with a slope width of no less than 1500mm, and no obstacles in the middle.

Footbridge steps should not be less than two, not more than 20, continuous height should be consistent; The minimum width is 1200mm, the length of the stair platform is not less than the width of the stair, preferably 1800mm.

In order to allow wheelchair users and other accompanying passengers, the elevator car should be at least 2000 x 1400mm, allowing the wheelchair user to rotate 180 degrees individually; The elevator entrance shall have at least 1500mm × 1500mm operable space.

(4) Activity spaces design

In activity spaces design, The main route through the activity space should be wide enough to allow two wheelchair users to pass through, with one wheelchair user able to turn 180° (1800mm); Combined with the space to provide multi-sensory design, including the use of color, texture, sound, movement, vibration, water, light, tactile experience, smell and taste.

(5) Public facilities

In public facilities, seating is to be no more than 50 meters apart; 50% of the seats should be of varying height, with at least one seat of 380, 480 and 580 mm height; Allow wheelchair users to transfer laterally to the bench with 1200mm horizontal transfer space. The armrest is about 200mm higher than the seat to form a visual contrast with the rest of the seat.

The minimum size of public toilets plane is 2200mm×1500mm to ensure sufficient space for wheelchair users in the toilet, and 1500mm×1500mm wheelchair rotation space should be ensured in front of the toilet. Every four urinals are equipped with a

disabled urinal with handrails.

Wayfinding should provide orientation through the landmarks which may include trees, building facades or public art; make appropriate use of tactile paving and guidance paving;consider smartphone apps and other new wayfinding technologies.

7.2 Research innovation

(1) Elements integration of inclusive design and urban square

The factors of inclusive design in public spaces can be divided into three dimensions: the physical environment, the personal experience, and the local context. The physical environment, which are mostly tangible and can be measured or observed objectively, include physical access (e.g. transportation connectivity, crossing, pedestrians routes); social access (e.g. cultural elements, historical representation) and access to activity (e.g. available amenities, sufficient seating within the space, space for gathering, play areas for diverse people). At the same time, the physical elements of the urban square can be divided into interfaces, grounds and structures. Through the combination of the two to achieve inclusive design of urban square, and provide a theoretical basis for subsequent research.

(2) Summary of method and process in inclusive design

Firstly, the context and background of the project should be studied, (e.g. history and development, overall planning, geographical condition). Secondly, summarize design objectives, and problems/conflicts that should be solved.(e.g. transportation, change of levels, racial conflict). Then, formulate personalized strategies according to site requirements, and the inclusive standards can be take as a reference. After that, the site will have evaluations whether inclusive criteria have been met. If so, the ultimate version will be generated, which will also improve the inclusive criteria.

(3) Application and evaluation in Haizhu Square

After a detailed evaluation of the site in 5 categories and 13 sub-categories, three challenges for Haizhu Square are summarized:

• The statue does not form a sense of ceremony in spatial sequence, and the separation prevents interaction between the statue and the crowd.

• The square absences connections and accessibility with the surroundings, which does not meet the need of vulnerable groups.

• The square lacks diversified spaces, which limits activities and communications among citizens.

Therefore, the three objectives for optimizing and improving Haizhu Square are formulated. It is hoped that inclusive design will make Haizhu Square to be:

• A renewed culture legacy.

• A welcoming and accessible square.

• A flexible and inclusive event venue.

Last, through the application inclusive design, three strategies are put forward:

• Inclusion of Diverse Heritage

• Accessibility and Safety of Diverse Routes

• Inclusion Spaces used by Diverse Groups

7.3 Research deficiencies and prospects

(1) Inclusive design only considers physical elements

From the dimensions of inclusive design, the factors relating to public spaces are: the physical environment, the personal experience, and the local context. This research only recombine the elements of the urban square in the physical environment. Inclusiveness is not just a simple design, such as legislation and regulations, people's consciousness, maintenance by managers, and citizen-participatory construction will

all affect the inclusiveness of public spaces. At the same time, the types of urban squares are rich and diverse. This research only takes Haizhu Square as the object, which integrates transportation, citizen leisure, and ceremony. There is still possibilities for a wider range of square types to study.

(2) An inclusive environment

Urban square is the main type of public space, but not all of it. In order to create an inclusive urban environment, there are also other public spaces need to study, such as streets, parks, landscapes, neighborhoods, etc. It is hoped that urban square will be used as a starting point to promote inclusive urban environment research and make the urban inclusive system more perfect. Inclusive environment is where all people can participate in social life, and spirit also be satisfied. Inclusiveness hope to enable everyone, regardless of age, gender and physical condition, to live in peace, happiness, freedom and equality in cities.

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Appendix

Appendix 1 The design points of inclusive design involving urban square

(Source: Completed by author)

Category	Design Point
Site planning	
01 Site planning	Inclusive design principles should be integrated into the site's master plan from the outset. During the master planning stage, key considerations are: the links to public transport, the choice of routes, how topography and architecture affect the accessibility and usability of the site for all users. The master plan should be welcoming to visitors and encourage use from the surroundings; make optimum use of the topography for provision of easy access in to; prioritize pedestrian movement; promote healthy streets; enable easy navigation, facilitate navigation; have variety and difference.
Pedestrian spaces design	
02 Pedestrian routes	provide routes that are intuitive and easy to use; provide the same quality of experience for all different options of overcoming levels; avoid the use of winding routes and excessively long graded routes; provide seating located along pedestrian routes; the steps must be clearly identifiable, especially for a person who is blind or partially sighted.
03 Crossings	The layout of intersections needs to take into account the road environment, adjacent intersections, traffic and pedestrian flow, existing routes, traffic speeds, etc.; drainage ditches should be avoided; guardrails should not be used; Crosswalks and waiting areas should be in line with the flow of people.

04 Parking	Accessible parking Spaces should be clearly identifiable and have continuous directional signs; Be as close to the main entrance as possible; Parking Spaces shall have flat surfaces and adjacent pavements shall be designed to be non-slip and have a lower chute to allow safe access; Charging equipment for parking Spaces makes it accessible to all.
05 Cycling infrastructure	Cycle lanes have gentle radians for easy riding; Add a raised central divider to help visually impaired people stay on the pedestrian side; Wide for wheelchair users and strollers; Use different coloured surfaces and materials in different directions of the route; Bike racks should be clearly identified when not in use and provide a visual contrast to their surroundings in all weather conditions.
06 Pedestrian surfaces	Pedestrian surfaces should have smooth, solid and non-slip surfaces. Gravel, gravel, sand or gravel filling surface is not suitable; Avoid using complex patterns, including stripes; Avoid using highly reflective materials.
07 Tactile paving	Indicate the forward should be strip blind, in the starting point of the blind, the end of the blind, turning should be set up dot shape hint blind; The thickness below the tactile part of the blind path surface should be consistent with the sidewalk; Blind path should be continuous, no obstacles in the way; Avoid manhole cover laying; The color is medium yellow
Changes in level	
08 Ramps	Avoid using ramps on major routes; There should be no obstacles on the ramp; If the height is more than 300mm, adjacent stairs are provided; Surface visual contrast to prove the presence of ramps; Non-slip surface.

09 Footbridge	Flyover stairs should not be divided by ramps to prevent feathery steps; In the area with large flow of people, the upper and lower entrances and exits of the overpass shall be equipped with buffer zones; The top and bottom of the stairs are equipped with blind pavement; Flyovers should provide suitable viewing heights for pedestrians; Overlong footbridges should have rest points.
10 External lifts	Provide adequate shelter from wind and rain; Easy to identify, the elevator door and the surrounding visual contrast; Equipped with sound and visual signal system; The elevator button surface is set with braille reminders

Activity spaces design

11 Inclusive play areas	Provide diverse Spaces for people of different ages and abilities, and provide the same opportunities for use; Provide quiet areas; Provide shelter from wind and rain. Easy to identify and direct pedestrian routes; Provide at least one step-less accessible route within an area; Sufficient light, natural monitoring, no dead corner; Avoid unnecessary elevation differences, and when elevation differences are required, the design plan should provide routing options. Play areas should be accessible to wheelchair users, children and adults; Set observation points; Provide space for parking strollers, wheelchairs, etc. Offering a range of gaming challenges to cater to people of different ages and abilities.

Public facilities design

12 Seating	On major traffic routes; Situated on an accessible surface; Well-designed and easy to use; Away from the weather, especially wind and rain; Stay away from major pedestrian routes; Adequate space should be provided beside seats for wheelchair users; No highly reflective finishes; Most seats have backrests and armrests.

13 Public toilets	Set up enough vertical handrails and horizontal handrails, toilet side should be set down handrails and easy to operate and use; Other Settings including soap dispenser, toilet paper holder, etc. should be able to use with one hand and make the people with limited arm movement barrier-free and safe use; Baby changing facilities; Good visual contrast.
14 Wayfinding and signage	Wayfinding should provide orientation through the landmarks which may include trees, building facades or public art; make appropriate use of tactile paving and guidance paving;consider smartphone apps and other new wayfinding technologies. Signage should have tone and visual contrast; simple and careful language; simple symbol; architectural elements; smart technology.

Appendix 2

The evaluation criteria of inclusive design involving urban square (Source: Completed by author)

Category	Evaluation Criteria
Pedestrian spaces design	
02 Pedestrian routes	The minimum width of the main Access routes is at least 1800mm, which is the minimum space required for two wheelchair users to pass each other. To avoid obstacles in the passage, the minimum width that can be reduced is 1200mm, but its length cannot exceed 2000mm.
03 Crossings	For narrow pedestrian roads (less than 3000mm) or especially busy intersections, a waiting area over 5000mm wide shall be provided; The minimum crosswalk width is 2400mm; Curb slope 1:20-1:12; It is recommended that the minimum width and length of an island be 2000mm and 7200mm respectively

04 Parking	Parking Spaces should be within 50 meters of building entrance; On-street Parallel parking space: the parking space shall be parallel to the curb with a size of 3600mm×6000mm; Off-street parking Spaces: the size of parking Spaces is 2400mm×4800mm, and the space between parking Spaces is 1200mm; One side of the parking space should also have a 1200mm safe passage
05 Cycling infrastructure	The maximum transverse slope of the bike path is recommended to be 1:40; Width not less than 2 meters; Pavements and cycle paths should be properly separated, preferably with a height difference from the road shoulder, the height should be at least 60mm, and consideration should be given to sloping edges;
06 Pedestrian surfaces	The profile of any surface should not change more than ±5mm. Cross wrestle not greater than 1:50; Non-slip, smooth, wear resistant, durable, easy to maintain
07 Tactile paving	Blind lane width should be 300-600mm; The blind road distance from the kerb is not less than 500mm; There are steps, obstacles and so on in the sidewalk, in the distance of 250-500mm set up prompt blind road; The specifications of the tactile strip and the tactile dot indicating the blind track should meet the requirements
Changes in level	
08 Ramps	The slope should not exceed 1:15; The width from the wall and shoulder should not be less than 1500mm; The transverse slope shall not exceed 1:50; A platform with a slope width of no less than 1500mm, and no obstacles in the middle; Middle docking point 1800 x 1800mm

09 Footbridge	Footbridge steps should not be less than two, not more than 20, continuous height should be consistent; The minimum width is 1200mm, the width between handrails is not less than 1000mm, the length of the stair platform is not less than the width of the stair, that is, not less than 1200mm, preferably 1800mm
10 External lifts	In order to allow wheelchair users and other accompanying passengers, the elevator car should be at least 2000 x 1400mm, allowing the wheelchair user to rotate 180 degrees individually; The elevator entrance shall have at least 1500mm × 1500mm operable space; The elevator door width is determined according to the actual flow of people
Activity spaces design	
11 Inclusive play areas	Designed according to different human scales and practical needs, the main route through the play space should be wide enough to allow two wheelchair users to pass through, with one wheelchair user able to turn 180°(1800mm); Combined with the space to provide multi-sensory design, including the use of color, texture, sound, movement, vibration, water, light, tactile experience, smell and taste
Public facilities design	
12 Seating	Seating is to be no more than 50 meters apart; Seat height between 450mm-480mm; 50% of the seats should be of varying height, with at least one seat of 380, 480 and 580 mm height; Allow wheelchair users to transfer laterally to the bench with 1200mm horizontal transfer space at one end and a handrail at 500mm to 750mm distance from the transfer space; The armrest is about 200mm higher than the seat to form a visual contrast with the rest of the seat; At least 500 mm space between handrails; The height of the seat back must be at least 300mm

13 Public toilets	The minimum size of Public Toilets plane is 2200mm×1500mm to ensure sufficient space for wheelchair users in the toilet, and 1500mm×1500mm wheelchair rotation space should be ensured in front of the toilet, if the door is internal, Then in the bathroom must be set up a loss of 700mm x 1100mm buffer space. Clothes hook should be set at 1050mm and 1400mm away from the ground; Handrail diameter 32-35mm and do non-slip processing; Every four urinals are equipped with a disabled urinal with handrails
14 Wayfinding and signage	Wayfinding should provide orientation through the landmarks which may include trees, building facades or public art; make appropriate use of tactile paving and guidance paving;consider smartphone apps and other new wayfinding technologies.

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Finally, I hope to give this thesis to my grandmother, hoping that the thesis can make a small contribution to the development of inclusive design in Chinese cities, so that my

grandmother and more seniors like her can enjoy more equally and conveniently in city development and colorful life.

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