华南理工大学 South China University of Technology

Politecnico di Torino

专业学位硕士学位论文

Evaluation of Child-Friendly Public Spaces and Safety Enhancement Recommendations for Liuyun Community in Guangzhou

学 位 类 别	建筑学硕士
所 在 学 院	建筑学院
论文提交日期	2023 年 04 月

摘要

随着国内生育政策调整，儿童的数量将会显著地增长，并进而影响城市空间社会需求。作为儿童主要室外活动的社区公共空间是儿童健康成长重要的开放空间类型，其中儿童友好性是空间设计的重要方面。在注重城市高质量发展的新阶段，以及城市更新建设的背景下，建设儿童友好型社区成为社区更新的重要议题，如何满足下一代健康成长需要的美好家园是值得思考的理论与实践问题。本文聚焦社区公共空间，基于儿童友好的环境标准及其实践经验，尝试构建一套具有在地性、可操作实施的儿童友好社区公共空间评价体系，并运用到广州六运小区公共空间的儿童友好性评价以及安全性优化提升设计中，从而提炼和总结更具针对性的社区公共空间优化策略。

首先，概述国内外儿童友好理论研究的进展，总结不同时期儿童身心特点及对公共空间的需求，梳理各国最新的儿童友好空间建设指南，概括出儿童友好视角下社区公共空间的五大建设维度——空间构建、路径构建、活动运营、制度政策和邻里文化，并归纳了社区公共空间儿童友好性的六个影响指标：多样性、可达性、安全性、舒适性、自然性、参与性。其次，结合世界范围内儿童友好社区公共空间建设的相关案例研究，建立儿童友好环境的调查与评价框架，为广州六运小区的调研实践与策略提出提供参考与支持。

在理论与案例研究的基础上，结合六运小区具体地块的实际情况，采用 AHP 分析法构建了社区公共空间儿童友好评价的体系。评价体系以前文归纳总结的六个影响指标为评价标准，根据六运小区的实际情况和用户的评价对评价因子进行筛选，使得该评价体系更具地域性与可操作性。最终构建了由 6 项评价标准和 24 项评价因子构成的六运小区公共空间儿童友好性三层评价指标体系。根据评价体系对六运小区的公共空间以实地调研、问卷访谈等形式进行数据资料的获取，得出其儿童友好指数为 2.5035，处于一般友好状态，在空间的安全性、参与性和多样性方面表现较差。同时也明确了社区各类型公共空间和街道首要解决的儿童友好性提升的问题。通过得分率和影响因子得分情况，提出了安全性为主导，多样性、可达性、自然性、舒适性和参与性兼顾的设计原则。据此原则，以优秀案例为参照，从五大建设维度提出相应策略，形成儿童友好评价标准下的社区公共空间优化提升的工具箱。以广州市六运小区儿童友好的公共空间更新设计为例，从总体空间到各类型详细节点对六运小区公共空间进行了儿童友好性提升的设计。

概念性设计不仅仅是满足项目场址的儿童需求，更多是展现社区空间儿童友好化的理念，体现“儿童友好，必定是全民友好”空间愿景。

关键词：儿童友好；社区空间；空间评价；空间安全

ABSTRACT

With the adjustment of the domestic birth policy, the number of children will significantly increase, which will in turn affect the social needs of urban space. Community public space, as the main outdoor activity space for children, is an important open space type for their healthy growth, and child-friendliness is an important aspect of space design. In the new stage of emphasizing high-quality urban development and the background of urban renewal construction, building child-friendly communities has become an important issue for community renewal. How to provide a beautiful home that meets the needs of the next generation's healthy growth is a theoretical and practical problem worth considering.This article focuses on community public space, based on child-friendly environmental standards and practical experience, and attempts to construct a set of localized and operable child-friendly community public space evaluation system. It is applied to the evaluation of the child-friendliness and safety optimization of the public space in Guangzhou's Liuyun community, in order to refine and summarize more targeted community public space optimization strategies.

Firstly, the progress of domestic and international research on child-friendly theories is outlined, and the characteristics of children's physical and mental development and their demands for public space at different stages are summarized. The latest child-friendly space construction guidelines in various countries are reviewed, and five major construction dimensions of community public space from a child-friendly perspective are summarized, including space construction, path construction, activity operation, institutional policies, and neighborhood culture. Six influencing indicators of child-friendliness in community public space are also summarized: diversity, accessibility, safety, comfort, naturalness, and participation.Secondly, based on relevant case studies of child-friendly community public space construction around the world, an investigation and evaluation framework for child-friendly environments is established to provide reference and support for the research, practice, and strategy proposals for Guangzhou's Liuyun community.

Based on theoretical and case studies, combined with the actual situation of specific blocks in Liuyun community, the AHP analysis method was used to construct a system for evaluating the child-friendliness of community public spaces. The evaluation system uses the six

influencing indicators summarized in previous articles as evaluation criteria, and selects evaluation factors based on the actual situation of Liuyun community and user evaluations to make the evaluation system more localized and operational. Finally, a three-level evaluation index system consisting of 6 evaluation criteria and 24 evaluation factors for the child-friendliness of public spaces in Liuyun community was constructed. Based on the evaluation system, data and information were obtained through on-site research and questionnaire interviews on public spaces in Liuyun community, and its child-friendliness index was calculated to be 2.5035, indicating a general friendly status, with poor performance in terms of space safety, participation, and diversity. At the same time, the primary issues related to improving child-friendliness of different types of public spaces and streets in the community were identified. Based on the scoring rate and the score of influencing factors, a design principle that prioritizes safety while considering diversity, accessibility, nature, comfort, and participation was proposed. According to this principle and with reference to excellent cases, corresponding strategies were proposed from five construction dimensions to form a toolbox for optimizing and improving the child-friendliness of public spaces in the community based on the evaluation criteria. Taking the renovation and design of child-friendly public spaces in Liuyun community in Guangzhou as an example, the child-friendliness of public spaces in Liuyun community was improved from overall spaces to detailed nodes of various types.

Conceptual design is not just about meeting the needs of children on project sites, but more about demonstrating the concept of child-friendly community spaces and embodying the vision of "child-friendly, and thus people-friendly" spaces.

Keywords: child-friendly, community space, spatial evaluation, space safety

Contents

Chapter1 Introduction

1.1 Background

1.1.1 Increasing national attention and continuous child-friendly construction

Since 1989, when *the Convention on the Rights of the Child* introduced the "principle of the best interests of the child" as the theoretical basis for public policy formulation, the international community has paid comprehensive attention to the rights of children to survival, development, protection and participation[1]. The concept of Child Friendly City (CFC) was first introduced at the second United Nations Conference on Human Settlements in 1996, which refers to "a wise government that fully and thoroughly implements the Convention on the Rights of the Child in all aspects of the city, incorporating the child's rational recommendations into the decision-making system. The CFC concept involves all aspects of society and requires not only giving children the right to make decisions, but also providing them with a safe social environment and services to ensure that their needs are met[2]. In 2016, UNICEF released "Your Voice in Habitat," which argues that children need more accessible, safe, inclusive and resilient urban environments overall[3].In 2018, UNICEF published "Urbanization for Children - A Handbook on Child-Responsive Urban Planning", which cross-fertilizes multiple disciplines and explores city-friendly construction using knowledge from multiple fields such as economics, behavior, and behavioral science. Since then, many countries have been actively exploring the practice, and the United Nations has recognized more than 400 child-friendly cities, but none of the Chinese cities are on the list[4]. Since then, many countries have been actively exploring the practice, and the United Nations has recognized more than 400 child-friendly cities, but none of the Chinese cities are on the list.

In 1992, China became a party to the Convention on the Rights of the Child (CRC). Since then, the government has continued to issue the China Children's Development Program, focusing on issues such as children's health, education, social welfare, children and the environment, and children and legal protection[5]. At the 2016 National People's Congress, a representative proposed the construction of "child-friendly communities" and received support from all sectors. In December 2022, the National Development and Reform Commission, the Ministry of Housing and Construction, and the Office of the State Council Working Committee on Women and Children jointly issued the "Guidelines for the Construction of Child-Friendly Spaces in Cities (for Trial Implementation)" to accelerate the implementation of child-friendly spaces[6]. In the same year, the local standard of Shenzhen "Child-Friendly Public Service System Construction Guide" was grandly released[7]. Not only

that, several cities in the south have done out child-friendly city construction work, providing richer practical cases for child-friendly community construction. In the new stage of focusing on high-quality urban development, how to build the city into a beautiful home to meet the needs of the next generation's healthy growth is a theoretical and practical issue that scholars need to think about.

1.1.2 Fertility policy adjustment, childcare space demand elevated

Since the reform and opening up, in order to control the long-term healthy development of China's population proportion. The population fertility policy has changed from "only one child" to "two children with two parents" in 2002, to "two children alone" in 2013, and to the implementation of the "comprehensive two-child" policy in 2015. From "one child only" to the introduction of "two children alone" in 2002, to the launch of "two children alone" in 2013, to the implementation of the "comprehensive two-child" policy in 2015, the state has made continuous efforts to change the demographic environment and population rate.

By 2015, China's population of children aged 0-17 was 271 million, with 147 million boys and 124 million girls. While the number of births in China climbed to 17.86 million in 2016 following the implementation of the "comprehensive two-child" policy, the number of births in China declined significantly to 14.65 million in 2019. The natural population growth rate has dropped to 3.34% in 2019, after a brief fertility peak since the opening of the "full two-child" policy in the 13th Five-Year Plan[8].

The long-standing family planning policy has directly led to the "421" family model becoming the mainstream. With the liberalization of the "two-child" policy and the new civil code in 2021, the number of "422" and "423" families is likely to increase in the future. In addition, due to production changes, most women have entered the labor market, and dual-earner parents have become the mainstream trend in society. The increasingly fierce social competition has compressed the parenting time of young parents, while the differential distribution of educational resources and the imperfection of community childcare services have led to a serious reduction of children's outdoor activities. The elderly are being forced to take on the responsibility of "parenting". According to statistics, 80% of children in China are cared for by the elderly. Under these circumstances, many children are spoiled by their elders and exhibit problems such as self-centeredness, misfits, and poor stress tolerance.

The dramatic increase in the number of urban children, coupled with the lack and disparity of public resources, will put a strong pressure on society to raise children, in which case public

childcare space resources need to be supplemented. Theoretical research and design practices to build a more child-friendly social environment and to improve child-friendly in-depth practices at the community level are undoubtedly a solution to the "fertility anxiety".

As of 2019, China's urbanization rate has surpassed 60%, with a mobile population of 236 million. Although China has made considerable efforts and achievements in realizing children's rights, with rapid social development and urbanization, the country's urbanization rate has increased. However, with the rapid development of society and the rapid construction of cities, the work of building children's well-being faces higher demands and more challenges. The problems of unequal development across regions, urban children's life problems, unequal resources for child protection and education, mental poverty, and the relatively lack of basic urban social services for children have become more prominent.

1.1.3 Challenges and Opportunities for Child-Friendly Communities in the Context of Urban Renewal

Since 1990, China's cities have undergone large-scale urban construction, and the urban renewal movement has been gradually carried out along with the urbanization of China[9]. At present, China's urban construction has entered the period of stock planning, and the economic structure is facing the adjustment to innovation-driven. Under the double pressure of "tight constraint" of resources and industrial upgrading and transformation, urban renewal has become one of the main ways of urban construction in China.

In the urban construction of Shenzhen, Guangzhou, and Beijing, slogans such as "urban renewal", "three old transformations", "key village" transformation, and "community renewal" and other slogans. Other cities, such as Changsha and Wuhan, are also facing large-scale urban renewal issues. Currently, a new round of urban renewal is underway in major cities across the country. The process of community renewal will inevitably affect the lives of children in the community, and even the entire childhood of some of them. The child-friendliness of the community renovation process is expected to be an important indicator of the health of that renovation.

1.1.4 Lack of systematic child-friendly evaluation criteria in China

With the widespread dissemination of the concept of "child-friendly cities" and "child-friendly communities" in the international community, several cities in China have begun to explore the construction of child-friendly communities. Most of these explorations in China

are based on the renovation and upgrading of existing communities. Therefore, what are the problems of existing communities in terms of child-friendliness and how child-friendly they are is the biggest question that needs to be addressed before renovation and upgrading. In other words, a set of systematic and comprehensive child-friendly evaluation criteria to evaluate the child-friendliness of existing communities and explore the problems is a very important part of the child-friendly community construction.

1.2 Purpose and Significance

1.2.1 Purpose

In the context of a new round of urban renewal in China, it is urgent and necessary to develop community renewal under child-friendly evaluation criteria. This paper summarizes the experience of child-friendly community public space construction from the perspective of child-friendliness by studying and analyzing relevant cases at home and abroad and combining the physical and mental characteristics of children, and uses the Guangzhou Liuyun neighborhood as an example to focus on the design strategies for enhancing the safety of community public space under child-friendly evaluation in community regeneration. In summary, the objectives of this study are:

(1) There is an urgency and necessity to update the construction of community public space under child-friendly evaluation criteria. The author would like to advocate child-friendly values in this paper.

(2) Through the study and analysis of relevant cases at home and abroad, and taking into account the physical and mental characteristics of children and a series of problems existing in the community nowadays, the principles and strategies of community renewal construction under child-friendly evaluation criteria are constructed.

(3) The principles and strategies are put into practice in a community public space with improved safety, using the Guangzhou Liuyun neighborhood as an example.

1.2.2 Significance

At present, the research on community construction under child-friendly evaluation in China is not very mature, and there is a lack of relevant theoretical research and practical exploration. This thesis focuses on the development process of child-friendly communities and the related concepts and theories, and summarizes the child-friendly evaluation criteria of communities, and formulates the related community construction renewal design strategies, so as to enrich

the theoretical research on community renewal construction under child-friendly evaluation criteria, which has theoretical and universal significance.

At present, many cities in China put forward the slogan of creating CFC, but the practical approach is still in the exploration stage. In this paper, we take Liu Yun District as an example to clarify the value orientation of community regeneration, sort out the regeneration mechanism, and study the practical cases of excellent child-friendly communities at home and abroad, so as to come up with practical suggestions on the criteria and improvement of child-friendly evaluation of local communities, which have practical and exemplary significance.

1.3 Concept Definition

1.3.1 Child-Friendliness

The concept of child-friendliness first appeared in the field of pedagogy and psychology in 1960 and was invoked in the Convention on the Rights of the Child, which was adopted in 1989. Child-friendly means child-friendly, able to defend the rights and interests of children and to realize their physical, psychological, cognitive, social and economic needs and rights by improving their living environment. The main criteria for measuring child-friendliness include the child's material well-being, physical and mental health and safety, the child's access to education, the child's relationship with others, the child's behavior, and the child's expectations of his or her rights.

1.3.2 Community

The concept of "community" is a sociological concept pioneered by the German sociologist Tennessee, originally referring to a territorial community formed on the basis of value identity and emotional ties, and its connotation has evolved over time to include four core elements: people, space, social interaction and social emotion.

The territorial scope of the community studied in this paper is mainly based on the division of relevant government departments, and the community is managed by the upper level streets, whose scope and boundary are divided by the civil affairs department of the national government, and is governed by the residents' committee formed by the residents in the community.

1.3.3 Community Renewal

Nowadays, China's urban development has moved from incremental expansion to the stage of stock planning. We need to revitalize the residual value of urban space through urban renewal, and community renewal is an important part of urban renewal. As the community is the most closely related area of people's lives, we find that it is the focus of various conflicts as city builders slowly return their focus to the daily life of each individual. Community renewal is also the most basic way to improve the human living environment. In terms of value orientation, it has shifted from purely physical space construction to focus on the needs of people and the endogenous sense of belonging and cohesion of urban residents. In this paper, we define community renewal as "the necessary improvement, reconstruction, and maintenance of community space, as well as the act of promoting a sense of belonging and cohesion among residents[9].

1.3.4 Community Public Space

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1.4 Research Methods and Framework

1.4.1Research Methods

(1) Literature reading method

Through collecting, organizing, reading, recording and analyzing the literature and conference reports on child-friendly communities and related topics at home and abroad, we have a basic overview and understanding of the conceptual connotation and related expansion of child-friendly communities. We also provide a more detailed overview of the value orientation and the main mechanisms and methods used in the construction of child-friendly communities. This will provide sufficient preliminary work and theoretical guidance for further practical

research and analysis later.

(2) Field survey method

The main method is to obtain relevant information and data by means of field visits and non-participatory observation. The observations include the distribution of children's use of public space in different communities and their daily use. At the same time, the behavioral patterns and activity characteristics of children of various age groups in the community are recorded and analyzed, recorded and photographed for archival purposes.

(3) Questionnaire survey method

The questionnaire method is a more widely used method in social surveys at home and abroad. A questionnaire is a form used for statistics and surveys, in which questions are formulated in the form of questions. The questionnaire method is a method that the researcher uses this controlled measurement to measure the problem under study, so as to collect reliable information.

(4) Interview method

The interview method is a basic psychological research method in which the interviewer and the interviewee talk face-to-face to understand the psychology and behavior of the interviewee. The interview method has different forms depending on the nature, purpose, or target of the research problem.

(5) Empirical summary method

The method of summarizing experience is a method to systematize and theorize the specific situation in practice activities by summarizing and analyzing them, and to raise them to experience. Summarizing and promoting advanced experience is one of the more effective leadership methods that have been used for a long time in human history.

1.4.2 Research Framework

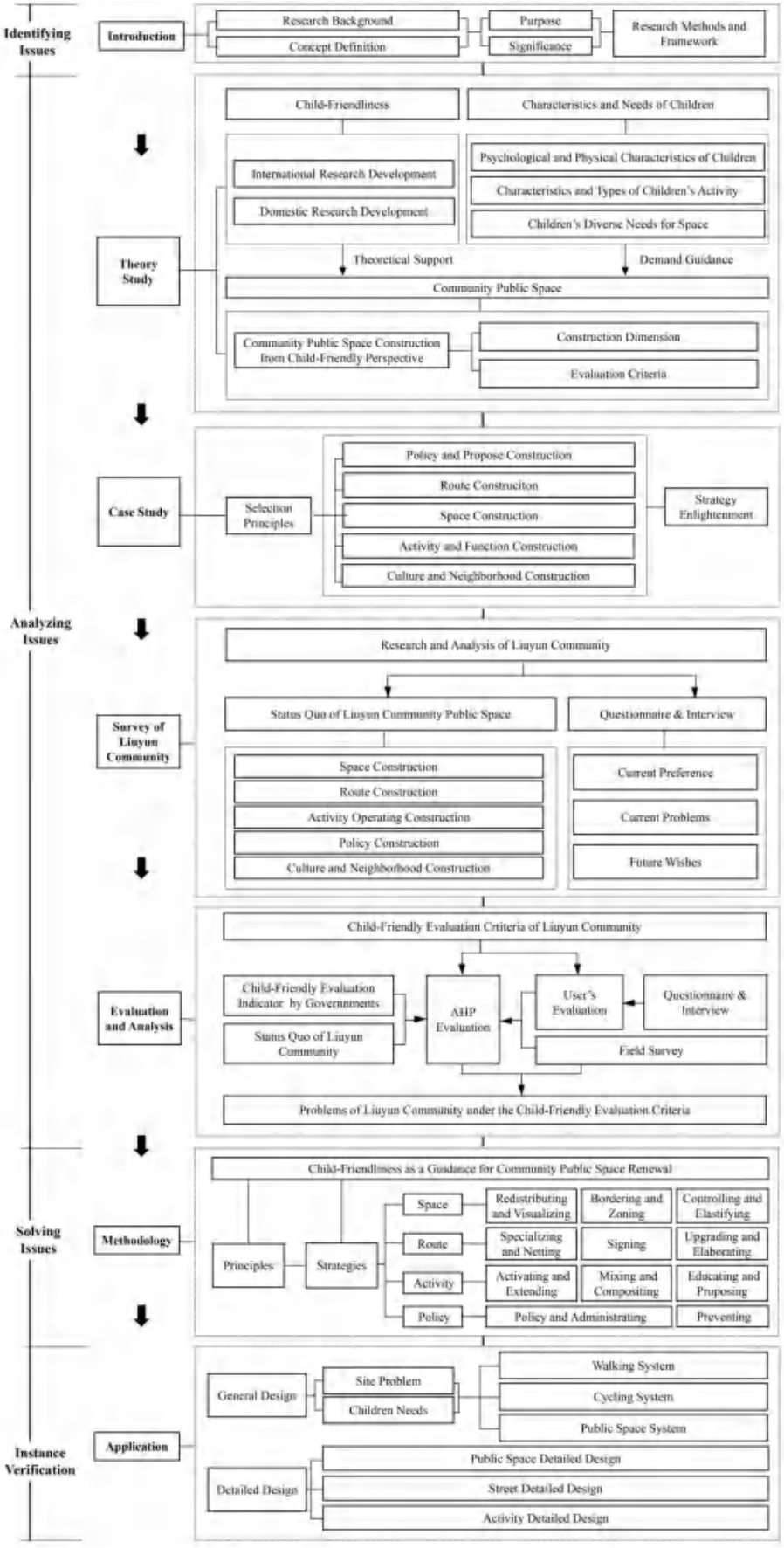


Fig.1-1. Research Framework (Source:drawn by author)

Chapter 2 Theoretical Basis

2.1 Literature Review of Child-Friendliness

2.1.1 International Research of Child-Friendliness

1. Connotation explanation

"A child-friendly city is defined on its website as a system of urban governance that listens to children and realizes their priorities, rights and needs[10]. Using the Convention on the Rights of the Child as a legal basis, the four basic rights of children - participation, protection, development and survival - and the twelve rights derived from them are realized in the city (Table 2-1). Of these, guaranteeing children's right to participation is a prerequisite. In urban public affairs, CFC requires city governments to give priority to children's rights and interests, incorporate children's opinions into the decision-making system, and develop policies and systems to protect children's rights and interests, thereby shaping a child-friendly urban physical and social environment.

In 2018, the definition was simplified and integrated on the CFC website, resulting in nine rights objectives (Table 2-2). Extracting their key words, it can be more clearly seen that child-friendly cities should be built in three areas: policy, space, and services, and at the space level, children should be provided with "space for play and recreation", "safe and clean environment", and "green space," while at the implementation level, there is a spatial sequence of "family-community-city. Community is one of the important spatial levels.

Table. 2-1 Analysis of the connotation of child-friendly city (Source:drawn by author)

12 Rights Included in Child-Friendly Cities
(1) Influence on city decisions
(2) To freely develop opinions about the city
(3) Participation in family, community and social life
(4) To participate in cultural and social affairs
(5) Equal access to all public facilities as city residents regardless of race, creed, income, gender, or disability
(6) Freedom from violence, exploitation and abuse
(7) To have access to safe drinking water and a sanitary and healthy living environment
(8) Access to basic social services such as health, transportation, education, etc.
(9) Freedom to see friends and play
(10) Having natural space full of flora and fauna
(11) Live in a pollution-free environment
(12) Walking safely alone in the streets

Table. 2-2 Interpretation of the latest concept of child-friendly cities (Source:drawn by author)

9 rights objectives of CFC integrated in 2018
(1) Freedom from violence, exploitation and abuse
(2) To have a good start in life and grow up healthy and happy
(3) Have access to quality social services
(4) Experience quality, inclusive and participatory education and skills development
(5) Be able to develop opinions and perspectives on decisions that affect them
(6) Participate in family, cultural, urban/community, and social life
(7) Live in a safe, protected, and clean environment with access to green spaces
(8) Make friends, have space for play and recreation
(9) Regardless of their ethnicity

2. International development of child-friendly theory research

During the industrial revolution, the rapid development of urbanization led to environmental degradation that threatened the lives and health of the residents, and the government authorities took measures to improve the living environment of people (including children) to protect the residents' right to live, but for a long time the protection of children's rights was hidden under the tide of urban construction.

In 1886, the emergence of the "Sand Garden" in Boston marked the beginning of a large-scale playground movement in the United States, and playground associations were established in various places, and even developed into municipal departments or committees in individual cities, which included playgrounds as part of their urban development plans and Fully investigated the needs of children for playgrounds[11]. The Geneva Declaration of the Rights of the Child, issued in 1924, formally introduced the concept of "the rights of the child" and awakened the awareness of countries around the world to the importance of child development and the rights of children[12]. In 1948, the Universal Declaration of Human Rights stated that "the child has the right to special care and assistance" and elaborated on the rights of everyone, such as education, protection and freedom of expression, which directly contributed to the creation of the Declaration of the Rights of the Child[13]. The Declaration of the Rights of the Child, adopted by the United Nations General Assembly in 1959, sets out 10 principles of children's rights that support a comprehensive understanding of children's needs and better achieve the "best interests of the child"[14]. The adoption of the Convention on the Rights of the Child by the United Nations General Assembly in 1990 clarified the importance of children as rights holders and laid the foundation for the launch of proposals and actions

for a child-friendly environment in the late 1990s, which has contributed to the subsequent development of children's well-being and causes(Fig.2-1).

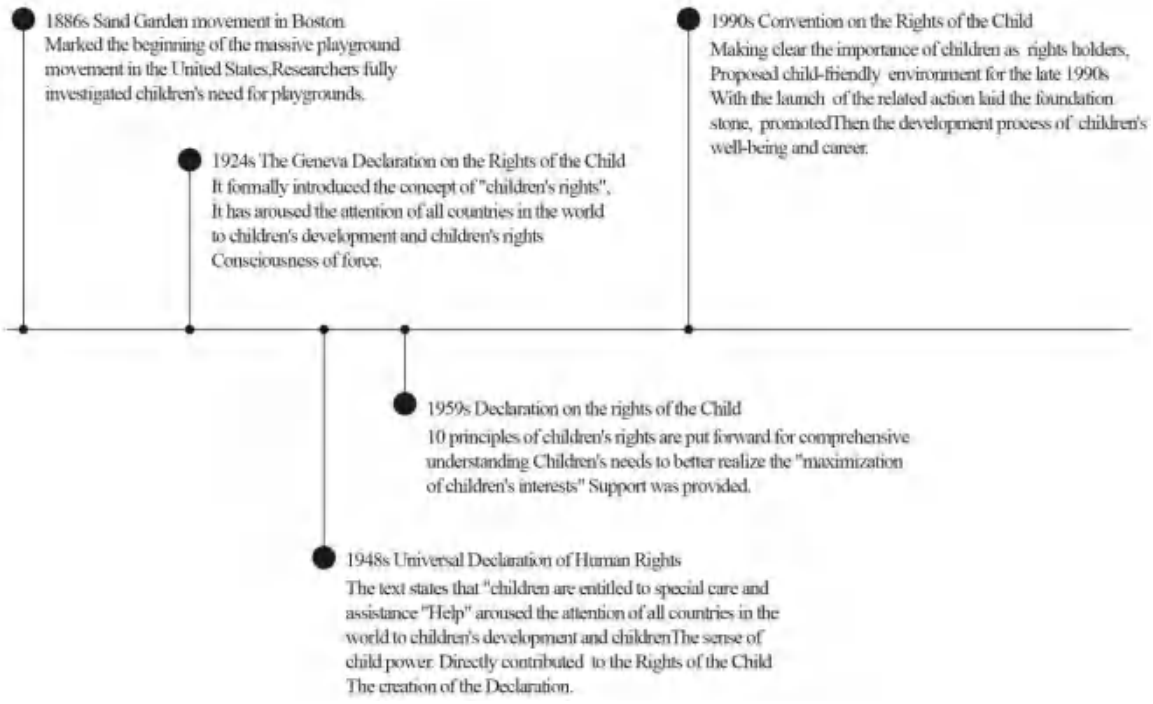


Fig. 2-1 International theoretical development of children's rights (Source:drawn by author)

At the same time, the United Nations plays a key role in building the Global Child-Friendly Cities Initiative. UNICEF, founded in 1946, has been a permanent member of the United Nations since 1953. The organization drafted the Convention on the Rights of the Child (CRC), which was adopted by the United Nations General Assembly in 1990 and is recognized worldwide and signed by more than 200 countries and territories. Through its programs and international platform, UNICEF has begun to promote the Child-Friendly City certification in countries around the world, providing a theoretical basis for cities and supporting cities and communities to develop policies and urban practices on the theme of child-friendly communities.

To protect children's rights and interests, promote the healthy growth of children, and implement and help implement the Child-Friendly Cities initiative, UNICEF has published a number of books on child-friendly cities. UNICEF has issued several manuals related to the construction of child-friendly cities (Tables 2-3), and each country and regional foundation will tailor the published documents according to the specific situation of the location, which will not only provide guidance on the experience of child-friendly city implementation, but also provide a basis for child-friendly city certification.

Table. 2-3 UNICEF Releases Documents Related to Child-Friendly Cities and Communities(Drawn by author)

Document	Release Date	Core content
Convention on the Rights of the Child	1989	The principle of "the best interests of the child first" has been proposed as the theoretical basis for the formulation of public policy, and the international community has placed comprehensive emphasis on the rights of children to survival, development, protection and participation.
"Child-friendly city" concept	1996	It is recommended that the needs of children be taken into account in urban and street planning, requiring green environments for children and guaranteeing their right to walk alone in the street and to meet with friends.
Building Child Friendly Cities-A framework for action	2004	The concept of Child Friendly Cities is equally applicable to governance of all communities which include children, large and small, urban and rural. The framework is intended to provide a foundation for adaptation to suit all localities.
"Your Habitat for Humanity Voice"	2016	It is recommended that the needs of children be taken into account in urban and street planning, requiring green environments for children and guaranteeing their right to walk alone in the street and to meet with friends.
Urbanization for Children - A Handbook of Responsive Urban Planning for Children	2018	Cross-fertilization of multiple disciplines, using knowledge from multiple fields such as economics, behavior, and behavioral science to explore city-friendly construction.
Handbook on Building Child-Friendly Cities and Communities	2019	A concise overview of the evidence, common challenges and lessons learned, including a set of step-by-step guidelines for building child-friendly cities that can be adapted locally to suit local institutions, priorities and requests.

2. Exploration of child-friendly theories and practices abroad

In terms of practice, European countries started earlier. In the Netherlands, the concept of "living courtyard" was introduced around 1970. This concept advocates changing the previous concept of car-centered construction into a people-centered one, shaping the sense of scene in the community streets, optimizing the street space of the community and turning the streets into more attractive spaces. The city of Delft in the Netherlands is committed to creating

children's routes and building a network of streets where children can travel independently, thus linking activity spaces and forming a continuous and orderly network of activity spaces. In 1986, Delft became the first city to build a complete bicycle network[16].

The concept of "Home Zone" was introduced in the UK in 1995, which focuses on the integration of community space resources and provides a holistic design approach to provide an overall good community public environment for children by enhancing the attractiveness of streets, creating multi-functional fun activity venues and building a safe and convenient travel network for children[17]. Subsequent research found that since implementing this concept, traffic accidents and crime rates in the UK have decreased, and over eighty percent of parents have begun to encourage children to play alone in their immediate home area. In 2004, London introduced a "walking bus" policy, in which two parents lead a group of children to and from school, which is not only environmentally friendly and healthy, but also greatly facilitates community interaction and communication and helps build good neighborhood relations.

The city of Denver, USA, has transformed abandoned schools and old, dilapidated playgrounds into multi-purpose, fun outdoor spaces for children. The format is called " Landscapes"[18].In addition to simple renovation and renewal, Denver is also linking individual spaces together to form a continuous network of activity spaces of different scales, providing a more comprehensive coverage of the city. In addition, New York has also launched the "Complete Streets" project, which links all the child-friendly projects around Eighth Avenue, Brooklyn and Central Park pedestrian streets to form a continuous sequence of activity spaces.

Japanese cities are more people-oriented, focusing on the sensory experience as well as the spiritual needs of people. Japanese scholars are more concerned with the daily needs and sensory experiences of community residents. In the mid-1980s, Narufumi Suzuki and his research team proposed the "Common Domain Theory," which is a theory that encourages residents to create a rich common space of shared community. Such spaces permeate all corners of the residential area and meet the needs of children's daily lives in a comprehensive manner. In addition, Mr. Manabu Senda of Japan has also done a lot of practical exploration on children's play space. He believes that children's healthy growth is closely related to natural space, and that the space next to the building should be closely integrated with the building to create a playground, such as the Yoyogi Forest Childcare Park and the Aichi Children's Comprehensive Center.

To sum up, each country has a different focus and approach to building child-friendly

communities due to different national conditions, geographic and historical factors, and people's living habits. However, each country is actively promoting "child-friendly" communities in its own way and with its own understanding, trying to give children a better living environment. As a community is the place where children spend most of their time, the most important thing to ensure the growth of children's lives is the creation of space quality.

2.1.2 Domestic Research of Child-Friendliness

1. Development of child-friendly theory research

The theoretical study of community public space from the perspective of children in China started late and only began to develop in the 1980s. In terms of publications, *Planning and Design of Children's Playgrounds in Residential Areas* written by several professors, including Fang Xianfu, Li Xiongfei and Wang Quande, was published in 1986, which described the development of children's playgrounds, mainly introducing the planning and design of children's playgrounds for children of different age levels as well as the configuration of facilities and equipment[19].Subsequently, in 1992, Professor Fang wrote a book entitled *Children's Playground Design and Examples*, which is mainly a selection of actual cases at home and abroad, introducing the decorative art, technology and construction techniques of children's playgrounds, the repairing and cleaning technology of old building facades, as well as the color varieties and usage functions[20]. Wang Jiangping and Yao Shizhang conduct extensive research on domestic and foreign practice cases[21], which aims to explore the basic content and development trend of public space design in residential areas and summarize the development and construction experience of residential environments at home and abroad. Its content involves the design of children's and elderly people's activity sites, with detailed requirements for the design elements of children's activity sites(Fig. 2-2).

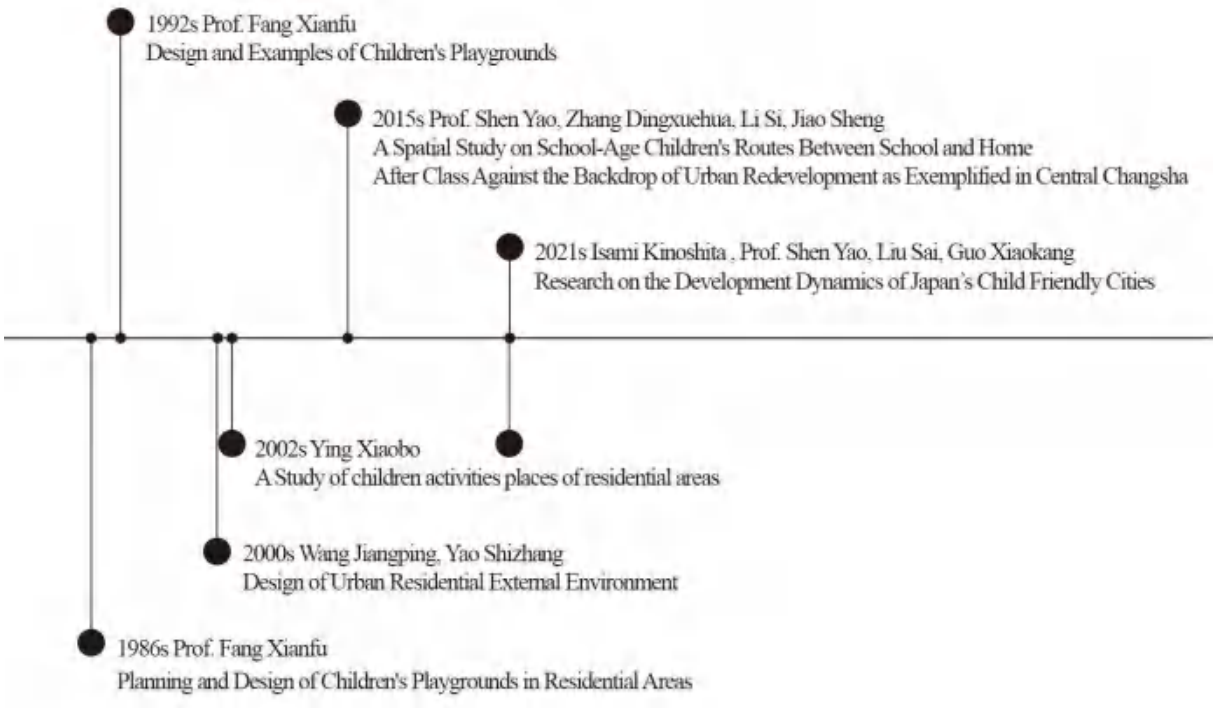


Fig. 2-2 Domestic theoretical development of children's rights (Source:drawn by author)

In terms of research on journal articles, a quantitative visualization analysis was conducted by searching for the keyword "child-friendly" on CNKI. In the field of architecture science and engineering, there are a total of 172 papers, with the number slowly increasing since 2015 and rapidly increasing since 2020(Fig. 2-3). The high-frequency keyword map(Tables 2-4) and keyword co-occurrence map(Fig. 2-4) show that public space, community public space, and urban design are the most concerned topics.

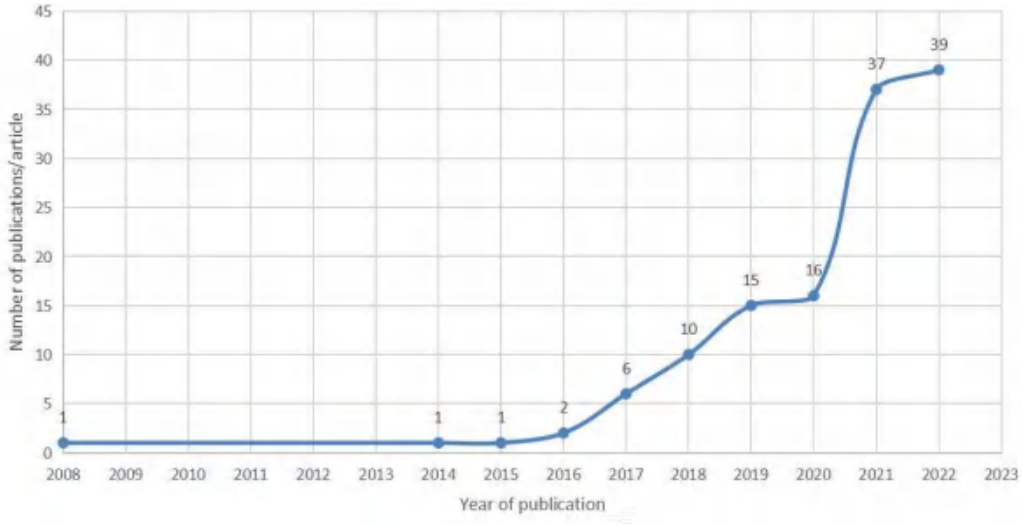


Fig. 2-3 Number of relevant literature published from 2008 to 2022（Source:drawn by author）

Table. 2-4 High-frequency keyword statistics（Source:drawn by author）

Number	Frequency	Centrality	Keywords
1	14	0.32	child friendly
2	11	0.55	children friendly
3	10	0.27	public space
4	5	0.09	landscape design
5	5	0.42	community public space
6	5	0.12	urban park
7	4	0.09	child friendliness
8	4	0.11	urban design
9	3	0.43	open space
10	3	0.07	child-friendly city

Fig. 2-4 Keyword co-occurrence graph（Source:drawn by author）

In terms of literature, Professor Shen Yao of Hunan University has devoted herself to the study of child-friendly city construction in recent years. Her "Review of the Development Process of Child-Friendly Cities in Japan" summarizes Japan's experience in the construction of child-friendly cities to provide reference for the construction of child-friendly cities in China[22]. In "Study on Children's School Dismissal Path Space from the Perspective of Urban Renewal", Professor Shen Yao takes the central urban community of Changsha as the research object, analyzes the characteristics of children's school dismissal path space in the community where old and new buildings coexist, and explores feasible road space planning and design strategies from a child-friendly perspective with the goal of promoting the organic renewal of the community and the integration of children's daily life[23].Yin studied the relationship between children's activities and the environment of community public space, established a

theoretical framework, and proposed elements and strategies for the design of children's activity sites that are conducive to children's physical and mental health[24].

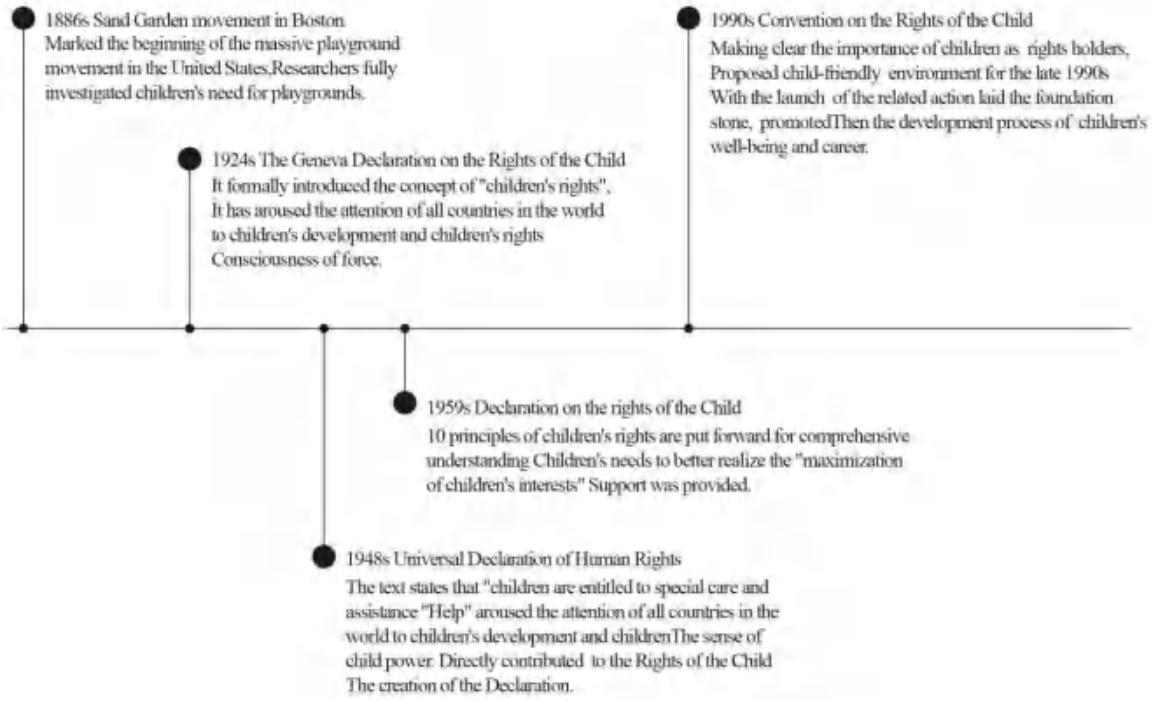


Fig. 2-5 Domestic theoretical development of children's rights (Source:drawn by author)

In order to meet children's needs for a better life and to make urban construction conform to the social development trend as soon as possible, the corresponding codes and construction guidelines issued by the state have also addressed children's activity space. Starting from the "Planning and Design Code for Urban Residential Areas (GB50180-93)" published in 2002, there is a specification requirement for the central green space in residential areas [25]. The "Guidelines for Environmental Landscape Design in Residential Areas" introduced in 2004, the planning and design configuration of community public space for children's activities has made requirements[26]. The Accessible Design Code (GB50763-2012) sets specifications for the vegetation configuration and site elements of children's activity sites[27]. Subsection 8.2 of the Residential Green Space Design Standards (CJJ/T294-2019) provides requirements for the location and facilities, paving, etc. of children's activity areas[28]. Subsection 4.5 of the Residential Health Performance Evaluation System provides recommendations for sight lines, theme selection, and site surfacing for children's outdoor spaces. Recommendations are also made for the location, configuration of facilities, and design of indoor activity spaces such as community children's activity centers[29]. In 2020, at a seminar on child-friendly city construction and child-friendly community practice held in Chengdu with the theme of "Building a livable city - starting from child-friendly", the China Community Development

Association officially promulgated the "Code for Child-Friendly Community Construction"[30]. China has the first code dedicated to child-friendly community construction. However, there are still major shortcomings in this specification. The whole specification is brief and general, and the regulations for each construction direction are not detailed enough, and the indicators for space creation are not systematic and clear enough, and the guidelines for actual construction are still far from adequate.

2. Domestic child-friendly theory and practice exploration

In recent years, China has been trying to promote the construction of child-friendly cities from different perspectives. Since 1990, China has signed the United Nations Convention on the Rights of the Child, and the Law on the Protection of Minors, adopted in 1991, clearly states that minors have the rights to survival, development, protection and participation. Since 2006, UNICEF has been promoting the concept of child-friendly cities in China, and in 2009, the State Council Working Committee on Women and Children and other departments held the first "High-level Forum on Creating Child-Friendly Cities". In 2011, the State Council promulgated the China Children's Development Program (2011-2020), which set out the main goals and strategic measures for children's development in four areas: children's health, education, legal protection and the environment. In 2016, delegates to the National People's Congress submitted a proposal on incorporating "child-friendly communities" into community development planning at all levels of government, which pointed out that children play an important role in community development, but currently children in China are facing threats such as traffic safety, limited outdoor activities, and lack of access to targeted community public services(Fig. 2-6). In early 2021, the Outline of the 14th Five-Year Plan and 2035 Vision for National Economic and Social Development of the People's Republic of China clearly proposed to promote the concept of child-friendly cities in urban planning, and included 100 pilot child-friendly cities in the "The Fourteenth Five-Year Plan[31].

In October of the same year, the National Development and Reform Commission and other 23 departments "Guidance on Promoting the Construction of Child-Friendly Cities" clearly put forward five major systems such as friendly social policies, friendly public services, friendly rights protection, friendly growth space, and friendly development environment. At the local level, cities such as Changsha, Shenzhen, Shanghai and Wenzhou have put forward strategies and action plans to build child-friendly cities, and have achieved good practical results.

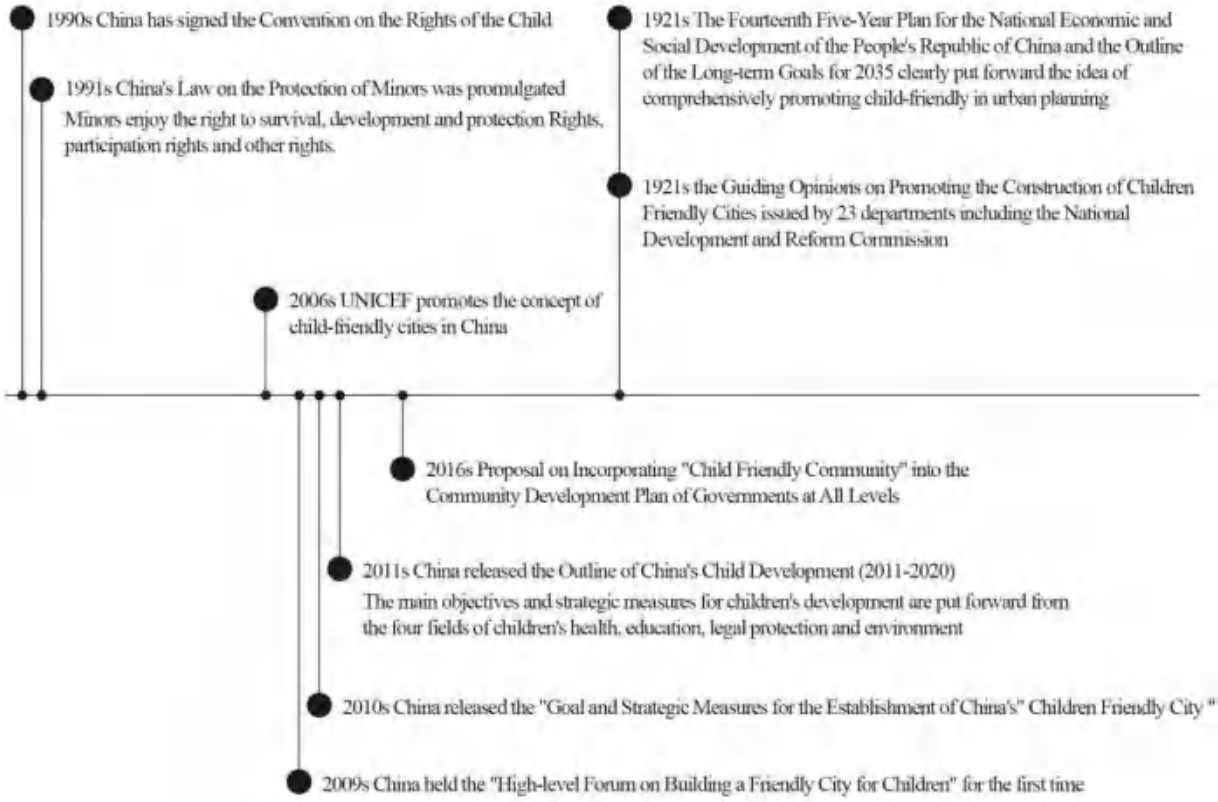


Fig. 2-6 Domestic theoretical development of children's rights (Source:drawn by author)

In 2015, Changsha responded to UNICEF's initiative to create a "child-friendly city". In 2019, the Changsha Natural Resources and Planning Bureau, the Education Bureau and the Women's Federation jointly issued the "Three-Year Action Plan for Creating a Child-Friendly City" (2018-2020). (2018-2020)". In 2020, Changsha set up a leading group for the creation of "child-friendly cities", gradually forming a government-led, socially engaged and nationwide action system.

Shenzhen promulgated and implemented the Shenzhen Children's Development Plan for the 1990s, the Shenzhen Children's Development Plan (2001-2010), and the Shenzhen Children's Development Plan (2011-2020) in 1995, 2001, and 2012, respectively. The development results achieved in the fields of children's health, education, welfare, legal protection and environment have laid a good foundation for the construction of a child-friendly city.In 2015, Shenzhen proposed to build a child-friendly city.In 2018, Shenzhen issued the Shenzhen Strategic Plan for Building a Child-Friendly City (2018-2035) as well as the Shenzhen In 2021, Shenzhen issued the first local guideline for building a child-friendly city in China, "Opinions on Building a Child-Friendly City by Demonstrating First (2021- 2025).

In 2017, Shanghai released the 13th Five-Year Plan for the Development of Women and Children, proposing the creation of a child-friendly city. In 2019, the Shanghai Women and

Children's Working Committee proposed to create a child-friendly city in the city based on a series of studies, such as "Study on the Indicator System of Child-Friendly City in Shanghai" and "Study on Optimizing the Configuration of Children's Activity Spaces in the City". Based on a series of studies such as "Shanghai's "Child-Friendly City" Indicator System" and "Study on Optimizing the Allocation of Children's Activity Spaces in the City", the Shanghai Women and Children Working Committee proposed to create child-friendly communities in the city, starting from the communities where children live, and gradually promote the construction of child-friendly cities.

Wenzhou, Zhejiang Province, has incorporated the construction of child-friendly cities into Wenzhou's 14th Five-Year Plan for Social Development and Basic Public Service Systems and 14th Five-Year Plan for Children's Development, among other important strategic plans. Wenzhou has combined its own advantages in children's industry and creatively introduced "child-friendly industry", forming a unique policy-friendly, service-friendly, rights-friendly, space-friendly, environment-friendly and child-friendly city,

In general, China's child-friendly cities have had their initial sprouting and development. However, compared with the developed countries, the relevant theoretical and empirical research has started late, the accumulation of basic research data is not enough, and the practice models in different places still need to be summarized and optimized.

3. Shortcomings of existing domestic theory and practice

I. Domestic research mostly focuses on specific children's activity spaces

Domestic research on children's activity spaces is mostly focused on fixed activity sites, analyzing existing domestic and foreign excellent cases and making suggestions for the design of children's activity spaces in China from the perspective of children's psychological needs and behavioral characteristics, with the direction of research favoring the micro level. However, children's activities are random and sporadic, and it is difficult for them to stay in one place for a long time, and children's activities are diverse in form and purpose. In practice, although there is a strong call for the construction of "child-friendly" cities in major cities across the country, it is still mainly limited to the formulation of policy guidelines or the improvement of the natural environment with low-cost investment.

II. The current planning and design specifications for public service facilities for children in residential areas still need to be improved

In 2018, the new Planning and Design Standards for Urban Residential Areas GB 50180-2018

(Design Standards) was introduced. The new Design Standards provide graded living circle standards, which provide solutions to improve the quality of community space and neighborhood relations. The control index and setting regulations for public green space have been optimized, with new requirements for green space per capita, and clear area requirements for sports space in parks, as well as requirements for activity areas for the elderly and children. From the Design Standards, we can see that the state pays attention to the quality of community space and the quality of outdoor activities, but there are no specific requirements for the scale and area of children's activity areas in the Design Standards. In addition, the mother and child room, child health care room, and children's library are not included in the specifications for the configuration of supporting facilities.

III. Community public spaces ignore the needs of children

The existing planning and design of community public space is basically focused on the needs of adults only, and the needs of children have been neglected for a long time. Although the current community public spaces are equipped with special children's playgrounds according to the Guidelines for Environmental Landscape Design in Residential Areas, in actual construction, most of the children's activity venues are small in scale, with rudimentary equipment and obvious color coping problems. A large number of children's playgrounds are just a small piece of open space with a set of simple children's play facilities. According to a survey, most children refuse to go out and stay at home because they think there is nothing interesting in the neighborhood. The planning and design of community public spaces should not only consider the needs of adults, but also consider the planning and design of community public spaces from the perspective of children, which does not mean that public spaces in the community should be the exclusive domain of children.

IV. Few special studies on safety

There are few special studies on child-friendly safety in China. Domestic research on children's activity sites is still insufficient, especially for the safety of children's activity sites. Domestic research on children's activity sites mainly stands on the macro perspective of urban planning to study the relationship between children's activity sites and cities, or mainly introduces the status of children's activity sites abroad, and is less involved in the current situation in China. When exploring the design methods of children's activity fields, most of them introduce the design methods and strategies in general, and the exploration of the safety of the field is relatively sketchy. In this study, through the investigation and survey of the

current situation of children's activity fields in residential areas, the evaluation of standards, and the questionnaire survey of parents' and children's needs for the safety of children's activity fields in residential areas, we find the design methods to improve the safety of children's activity fields, and put them into practice.

2.2 Characteristics and Needs of Children

2.2.1 Definition of Children

There are some differences between the international community and the academic community in the definition of a "child". The international community generally recognizes that "a child is a person under the age of 18 years" as defined in the Convention on the Rights of the Child. The medical community, on the other hand, considers children to be "children up to the age of 14 years" based on their physical growth and development. The child psychologist Jean Piaget (based on the differences in children's thinking and perception) divided children's cognition into four stages at the ages of 2, 7, and 12. This is in line with the theory of children's cognitive development and the theory of children's sensitive period education on the one hand, and the pre-school, kindergarten, elementary school and secondary school learning stages in China on the other hand, which is in line with the Chinese education system(Fig. 2-7). Therefore, this planning design selects "0-12 years old children" as the research object, and the planning design takes into account the educational stage of children, and differentiates the spatial content according to preschool children (0-3 years old), early childhood children (4-6 years old), and elementary school children (7-12 years old).

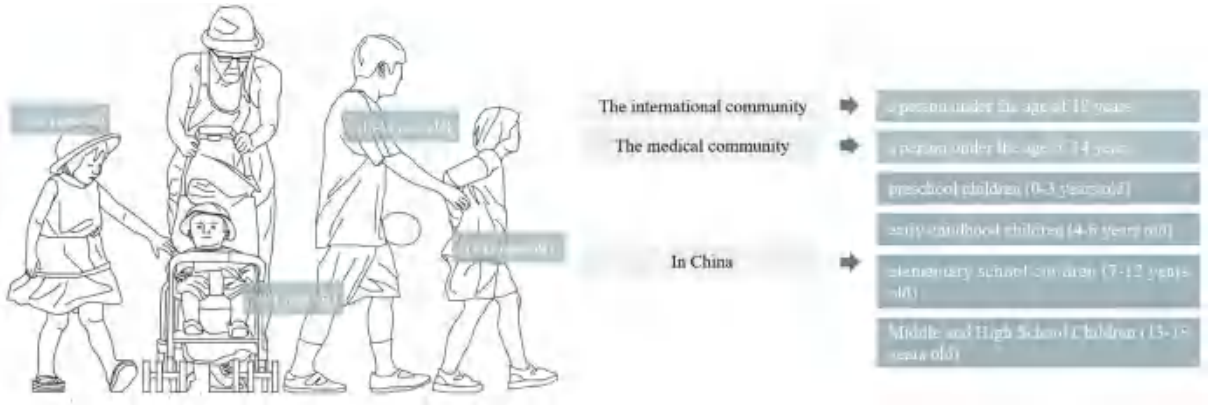


Fig. 2-7 Domestic and other definition of a child (Source:drawn by author)

2.2.2 Psychological and Physical Characteristics of Children

1. Children's physiological scale

The physiological scale of children is completely different from that of adults, and the same scale of space brings different experiences to children and adults. In terms of children's body scale, the average length of a newborn is 0.5m, 0.75m at the age of 1, and grows about 0.05m per year thereafter, with the basic height of a preschooler (4-6 years old) being 0.95-1.05m and a school-age child (7-12 years old) being 1.10-1.35m. As children grow older and their body height increases, their range of motion will gradually expand and their ability to move will increase(Fig. 2-8). Therefore, the planning and design of public spaces in residential areas need to take into account the differences in height scales of children of different ages and create appropriate space scales to meet the needs of children of all ages. In terms of children's visual scale, the visual range will expand with age: the visual range of adults is generally 120 degrees up and down and 150 degrees left and right, while the visual range of 6-year-old children is only two-thirds of that of adults, about 70 degrees up and down and 90 degrees left and right, and will gradually expand each year thereafter(Fig. 2-9).

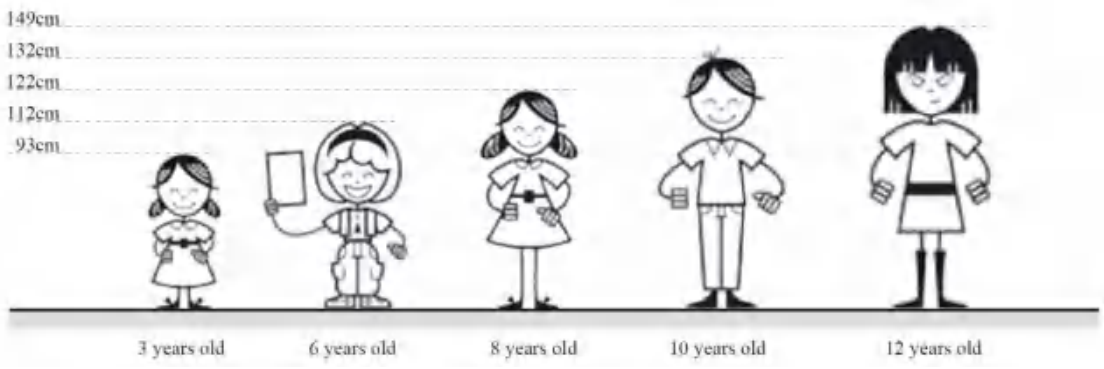


Fig. 2-8 Scale for children of different ages (Source:drawn by author)

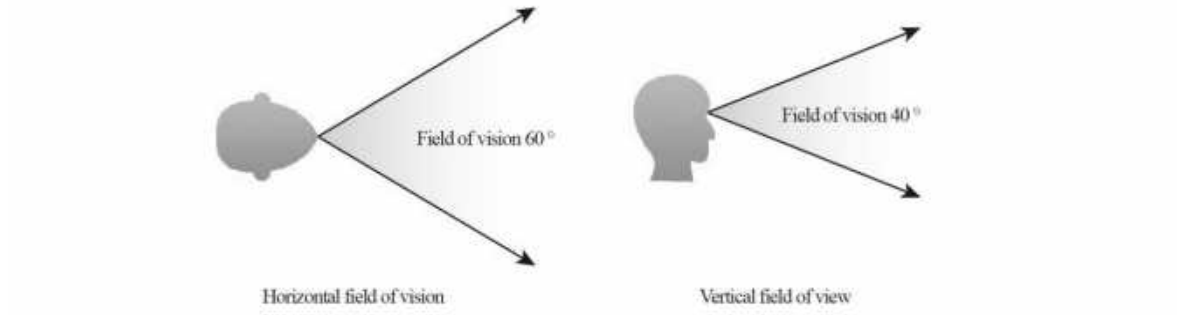


Fig. 2-9 Diagram of the child's field of vision (Source:drawn by author)

2. Psychological characteristics of children

(1) Children are curious and like to take risks. In previous research on the cognitive relationship between children and their environment, we found that the source of children's curiosity is their desire to know about unknown environments. Children always encounter many unknown environments as they grow up, and exploring unknown environments helps

them build cognitive structures in their brains. Therefore, we can find that children are always curious about things around them, like to explore in unknown environments, and have a sense of adventure. In the design of public spaces in communities, we can guide children's behavior and satisfy their curiosity through changing and hiding spaces.

(2) Seeking partners and attaching to parents. Attachment to parents or other guardians is a normal psychological need for infants and children. According to the famous psychologist Walloon, "attachment to parents is one of the necessary conditions for the development of children's personality". Parental care and interaction with partners can reduce anxiety and insecurity in children, and attachment to parents can create a sense of security in children that they will be there when they need them, even when they are alone, which is beneficial to some extent for the development of independence. In addition to attachment to parents, children are often congregative, attracted to other peers and activities, and they can develop social skills in the process of interacting with peers. Therefore, when designing public spaces in the community, the presence of parents should be taken into consideration, and places for parent-child activities should be set up, as well as places for children to interact and play.

(3) Self-centeredness and exclusivity. Children's psychological activities and behavior before the age of five are self-centered, and children's behavior at this age is based on personal preferences and feelings, unrestrained and arbitrary, and at the same time, they do not have a comprehensive judgment of their own situation when carrying out activities, and are prone to ignore the dangerous factors in the surrounding environment, and are very vulnerable to injury. Therefore, when designing the space, it is necessary to provide an absolutely safe environment and make appropriate protection measures. In addition, children are exclusive in the process of activities. Children generally choose to play with partners of similar age, gender and preference, and exclude groups different from them. Therefore, we need to pay attention to the partitioning of children's activity spaces for different age groups and different activities to prevent bullying.

(4) The mentality of following the crowd, like to imitate. Imitation is the main channel for children to improve their abilities, including imitating their parents, imitating movies and TV shows, and imitating older children. At the same time, the phenomenon of following the crowd is also common in children's groups, which is reflected in the fact that I want to have the toys that others have, and I want to watch the cartoons that others see. Therefore, when designing the space for children's activities in the community, we need to pay attention to the influence of space elements on children, and we should establish the correct image as the object for children to imitate, so as to eliminate the negative influence of bad information on

children.

(5) Desire for praise and strong desire for expression. In interaction with others, children like to express themselves in front of people and make themselves the focus, and they want to be appreciated and approved by adults. Some experiments show that appreciation brings more motivation to children than criticism, in which children are motivated to accomplish the tasks their parents want them to achieve, while criticism brings more rebelliousness to children. In play, children enjoy the sense of accomplishment in accomplishing their goals and are motivated to actively participate in the game and to challenge themselves to improve their abilities. Therefore, in the process of interacting with children, we should first pay attention to the gentle tone of voice and encourage children with praising words, and at the same time, we should pay attention to setting the game at a reasonable level of difficulty according to the children's own level when setting the form of the activity.

2.2.3 Types and Characteristics of Children's Activity

The types of children's outdoor activities are classified by age: infant (0 to 3 years old), toddler (3 to 6 years old), childhood (6 to 12 years old), and adolescent (12 to 14 years old), with different forms of activity spaces for different age groups.

The types of children's activities are mainly classified into spontaneous and social activities according to individual wishes. According to the mode of interaction, children's activities can be divided into individual play, parallel play and joint play. Functional, creative, constructive and rule-based activities can be classified according to cognitive level. Functional activities can form memory and facilitate the mastery of experience; creative activities such as role-playing, learning skills after imitation, playing house and other activities; constructive activities can promote children's creativity, imagination and manipulative ability by creating models and scenes, such as building castles and blocks. Rule-based activities promote children's awareness of social relationships, such as jumping through a grid and skipping (Fig. 2-10).

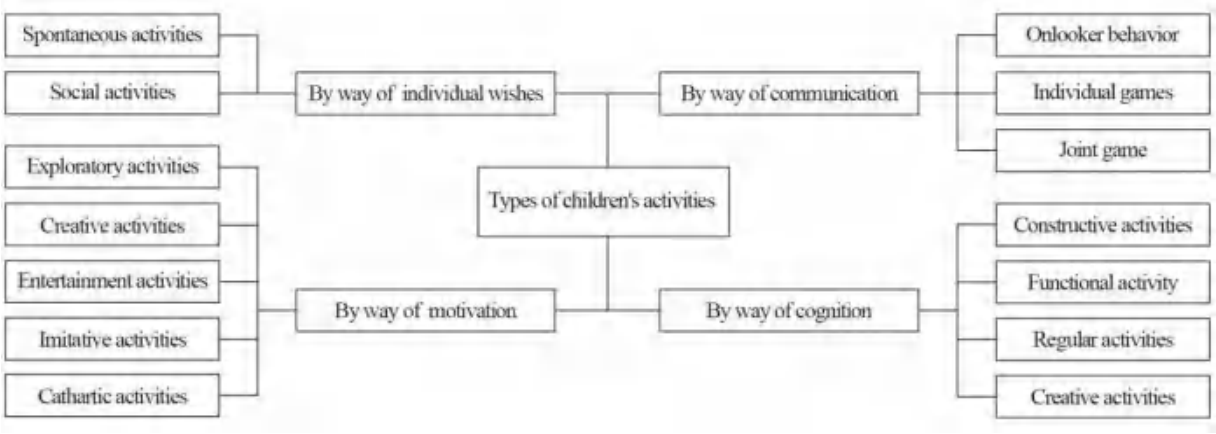


Fig. 2-10 Children's activity type classification chart (Source:drawn by author)

According to the motivation of activities, they are classified as exploratory, creative, recreational, imitative, and cathartic. Exploratory activities are for acquiring knowledge and information and satisfying curiosity; creative activities are for gaining satisfaction and joy in challenging and surpassing oneself; recreational activities are for pleasure and changing the content of activities without purpose; imitative activities are for acquiring abilities and promoting growth; and cathartic activities are for relieving emotions and treating psychological problems.

After observing and analyzing children's behavior in public spaces, the author categorized the following characteristics:

First, congregation at the same age. Because children of different ages differ in height, weight, and other aspects of appearance, and because the interests of children at different ages vary greatly, children of similar ages have an inexplicable attraction to each other, so age is usually the primary basis for choosing children to group together in public spaces.

From observation, it can be seen that children aged 4-7 years prefer public spaces with strong naturalness and simple elements, while children aged 8-12 years have a stronger curiosity and desire to know, and are more attracted to complex and unfamiliar things.

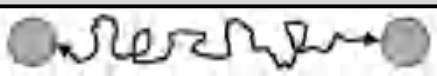
Second, the regularity of time. In terms of the four seasons, children spend more time in outdoor public spaces in spring and fall than in other seasons, with winter being the least frequent. In terms of weather conditions, the number of children who were active in sunny weather was significantly higher than in rainy weather. In terms of time of day, children were mainly active in public spaces from 9:00 a.m. to 11:00 a.m., 3:00 p.m. to 5:00 p.m., and 6:00 p.m. to 8:00 p.m. Of course, these are inevitably related to the control of the children's guardians who, for safety and comfort reasons, prohibit children from being in the public

spaces of the neighborhood during certain seasons or times of the day.

Third, the closeness to nature. It is the nature of children to like nature and to be close to nature. Unlike rural children who have many opportunities to contact the original natural environment, children who live surrounded by reinforced concrete are more curious about natural elements such as water bodies, plants and animals, soil, sand and gravel in public space, because these natural things are rarely touched in the family environment and are more attractive to them. Therefore, children are more interested in public spaces with more natural things, and they are more willing to get in touch with natural things and play in natural areas within the same public space.

Fourth, the activities are random and varied. A characteristic that distinguishes children from adults is that children are still immature, often self-centered, curious, with limited attention and low concentration. Their behavior is different from the continuity and purposefulness of adults' activities and from the intermittent nature of older adults' activities, and they are easily attracted to other things in their surroundings during their activities(Table. 2-5).

Table. 2-5 Characteristics of behavioral activity trajectories of different age groups(Source:drawn by author)

Group	Characteristics	Diagram
Children	Polygon, randomness	
Middle Youth	Purposeful, continuous	
Seniors	Discontinuity	

Fifth, activity dependence. Because of their physiological immaturity, children are highly dependent on the spatial environment, guardians, and playmates for activities in public spaces. For example, they prefer to have their parents accompany and wait around the public space, or even participate in activities together, and prefer to do activities in the familiar public space.

2.2.4 Children’s Diverse Needs for Space

The starting point of children's perception of the environment is at the age of 5, so the study of the way children live in their surroundings should be analyzed. Scholars have identified three basic developmental needs: the need for environmental awareness and broad cognition[32]; the need for health, safety and physical activity; and the need to express emotions. Children need the freedom to create "creative messes," and the reduction in children's play behaviors is detrimental to their resilience development. Research shows that

children are particularly attracted to wild spaces (informal spaces) such as hills, trees, streams, or places where they can climb, jump, run, or hide because they allow the greatest amount of interaction with their environment. Children need safe and unrestricted play, unsupervised outdoor activities, safety in the physical and social environment, contact with nature, group activities, private spaces, freedom of movement[33].

The urban environment should provide a vehicle for children's physical and mental health. On the one hand, it should provide a comfortable environment for children's physical growth, support healthy brain development, improve mobility, protect bone growth and health, and reduce the likelihood of obesity. On the other hand, the urban environment should also consider children's mental health needs, such as compassion and creativity, and provide places and spaces to develop children's stress tolerance, social skills, problem-solving skills, and risk assessment skills (Fig.2-11).

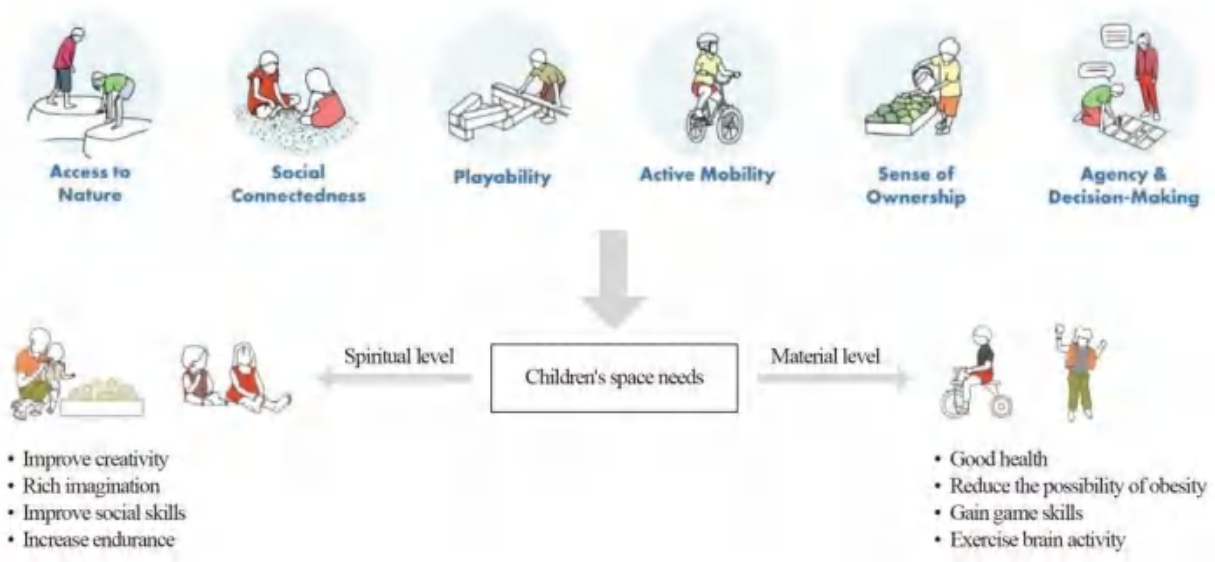


Fig. 2-11 Children's need for community space (Source:drawn by author)

Japanese architect Mitsuru Senda proposed that children prefer four types of spaces: natural spaces, open spaces, hidden places, and abandoned open spaces, and that children's playgrounds can meet the communication between adults and children[34]. The scholar Chatterjee proposed the concept of "Place Friendly" based on the perspective of children's friendship, and based on children's daily activities, he suggested that these places include: 1. providing opportunities for children to develop their attitude of caring and respecting places; 2. promoting the exchange between children and places according to the affordability of places; 3. Provide opportunities to learn about environmental protection and promote hands-on experience to enhance children's ability to protect the environment; 4. Allow children to create

and control territories and protect these territories from harm; 5. Provide private experiences and allow children to have their own secrets; 6. Allow children to express themselves freely in appropriate places[35].

Overall, the friendly spaces children need should not only give children the opportunity to learn skills, but should also ensure that children can keep their secrets in the space.

2.3 Community Public Space from Child-Friendly Perspective

2.3.1 Dimensions of Community Public Space Construction from a Child-Friendly Perspective

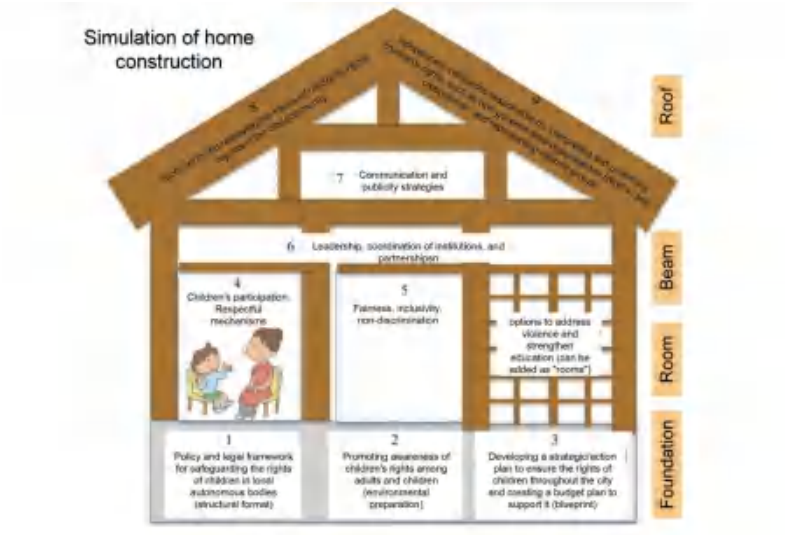


Fig. 2-12 CFCI nine major constructions (Source:drawn by author)

The Child-Friendly Cities Initiative (CFCI) proposes nine major building elements to improve the child-friendliness of cities from a macro perspective(Fig. 2-12). Each country responds to the nine building elements of CICI from three aspects: space construction, social activities, and policy initiatives according to its own situation, and the focus of each city's response varies. By summarizing the studies of scholars from various countries, we can conclude that there are five major building blocks of child-friendly communities - space building, travel building, activity operation building, neighborhood building, and policy building. The next section will briefly explain the 5 major building elements with relevant literature and real-life cases, and provide a general direction for the next research and study.

1. Space construction

To optimize the community environment from the perspective of children, it is necessary to first understand the needs of children, and second, to meet the needs of other residents living in the community, and to integrate the needs of children and residents into the community

environment. Integrating the exploration of child-friendly communities and children's needs in each country, at the spatial level, the four main aspects of construction include play space, interactive recreation space, nature experience space, and hiding and exploring space (Fig. 2-13). However, it should be especially noted that child-friendly community space is not about building an exclusive space system for children, but about respecting children's rights and interests in all aspects and effectively serving children's physical, psychological, and behavioral needs, so as to enhance the child-friendliness of the space.

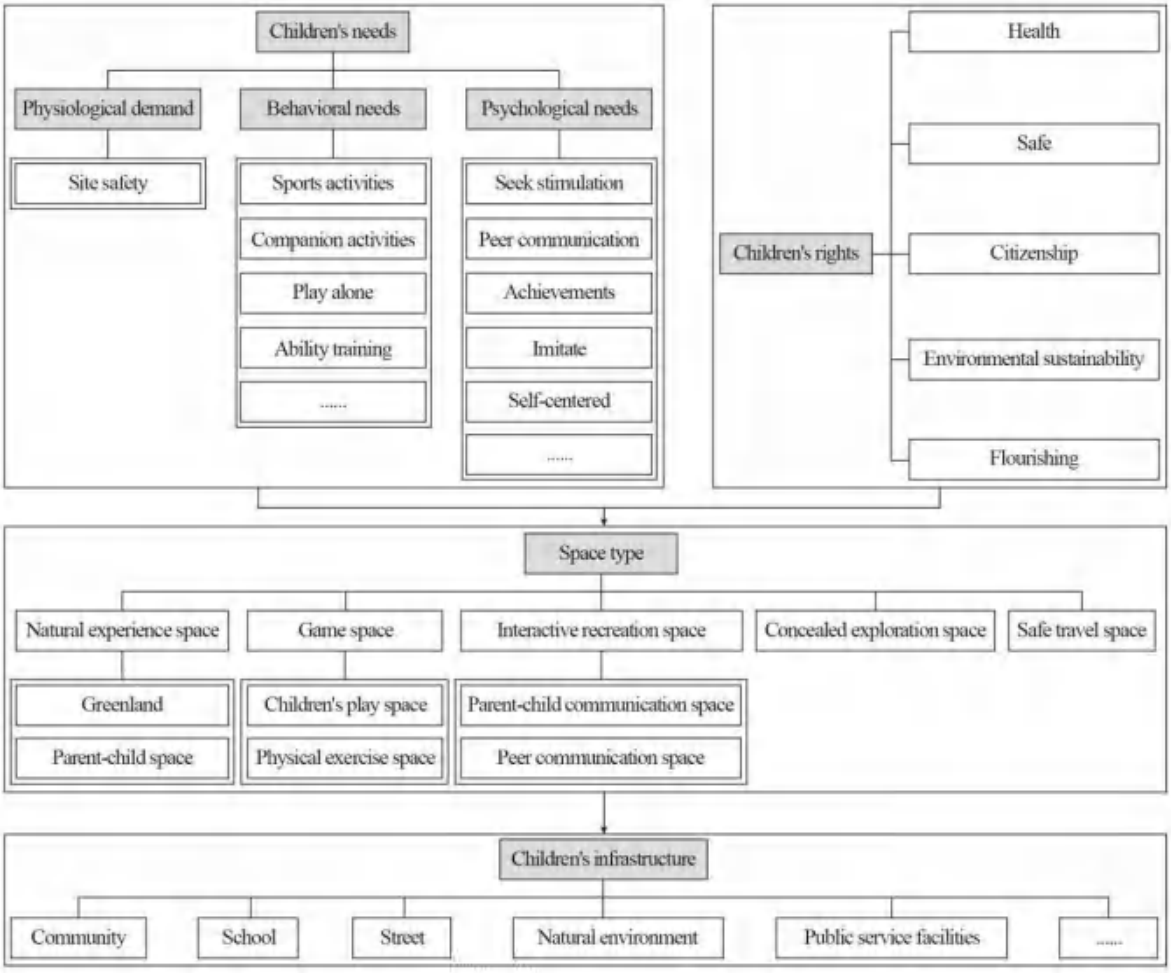


Fig. 2-13 A network of child-friendly spaces with children's needs and children's rights as the starting point (Source:drawn by author)

(1) Play space

There is definite research evidence that children are learning all kinds of things through play, such as learning interpersonal, creative, and adaptive skills, and that play has an irreplaceable role in children's social, emotional, and cognitive development. For the characteristics of child-friendly communities, the play space is mainly an outdoor play space, while divided into formal play space and informal play space. The formal play space is a space specially built for children and used by children; the informal play space can be an open space in a

corner or a certain lawn. According to the cognitive development and activity characteristics of children in different age groups (Table. 2-6), different kinds of play spaces can be set up (Fig. 2-14) to achieve diversified play spaces.

Table. 2-6 Characteristics of children's outdoor activities and stages of physical and mental development(Source:drawn by author)

Age	Characteristics of outdoor activities	Stage
Before 2	Activities led by parents, or lead toddlers in open space	Perceptual stage
3-6	Have certain thinking ability and curiosity, active, weak in independent activities	Intuitive stage
7-12	Entering childhood, with increasing thinking ability and high activity level	Intellectual development stage
12-15	Increased ability to think logically and independently, participates in multiple activities	Moral, intellectual and physical development stage

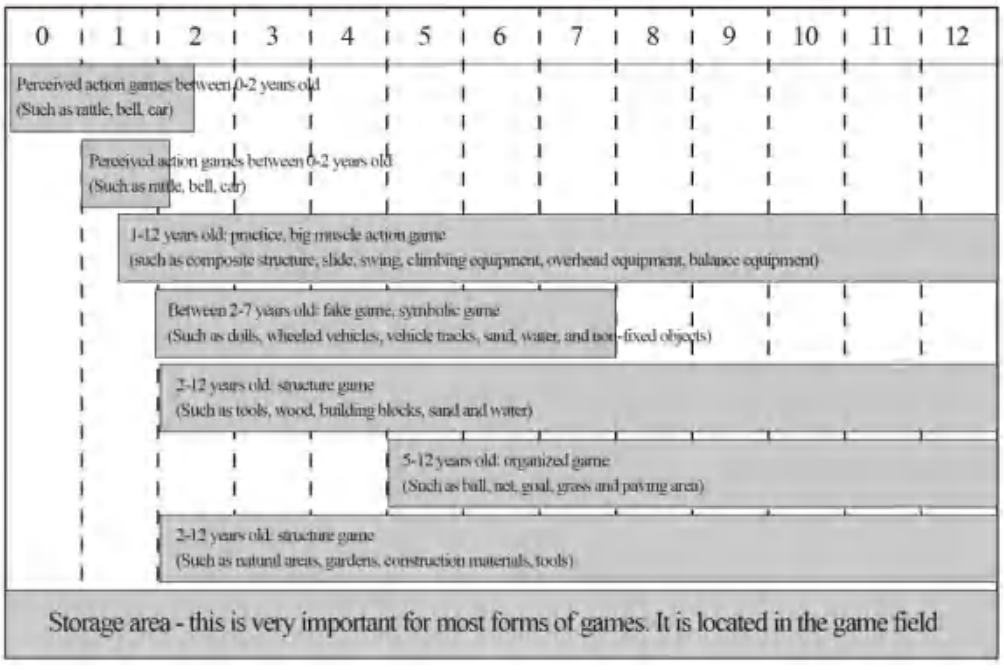


Fig. 2-14 Child-friendly space network with children's needs and children's rights as the starting point (Source:drawn by author)

The play space should try to achieve the goal of allowing children to play freely, safely and without barriers, and meet the needs of children in socialization, emotional expression, sports and games, so it also requires the play space to have openness, diversity, sharing and accessibility. In order to meet the above requirements, we should also make use of the surrounding environmental resources as much as possible to form informal play spaces, while linking formal play spaces to form a network of play spaces in the community.

At the same time, sports spaces that meet the needs and characteristics of children should be set up in the community for children to use for physical exercise. Physical exercise space and play space belong to one type of space, and children are playing and doing physical exercise at the same time, so physical exercise space can be integrated into play space. For the type of outdoor games that can be spawned through urban space design.

(2) Interactive recreation space

Set up parent-child equal interaction space, peer interaction space and neighborhood communication space to help children better communicate with their parents, community residents and peers in a friendly and equal manner.

(3) Nature experience space

Children need natural and buildable props or facilities to play sports or games. Adopt natural ways and façade design to create children's play space and focus on the role of natural elements in it. A naturalized environment can improve children's independence and contribute to their emotional, social and physical development.

(4) Hidden exploration space

Respect children's nature, explore children's independent learning ability, and leave space for children to explore and play on their own.

2. Route construction

3. In the construction of children's travel, the main focus is on safety, continuity and place accessibility, creating a path of passage that can safely and conveniently lead to reach community activity places and play spaces, which is one of the important elements of building a child-friendly community. The access space should meet the needs of children walking and riding, set obvious signs, create a good lighting environment and safety design in the safety of children's paths to do hard. At the same time, the paths should be set in a space visible to most community residents to achieve a good passive surveillance effect and provide implicit protection for children's travel(Fig.2-15).

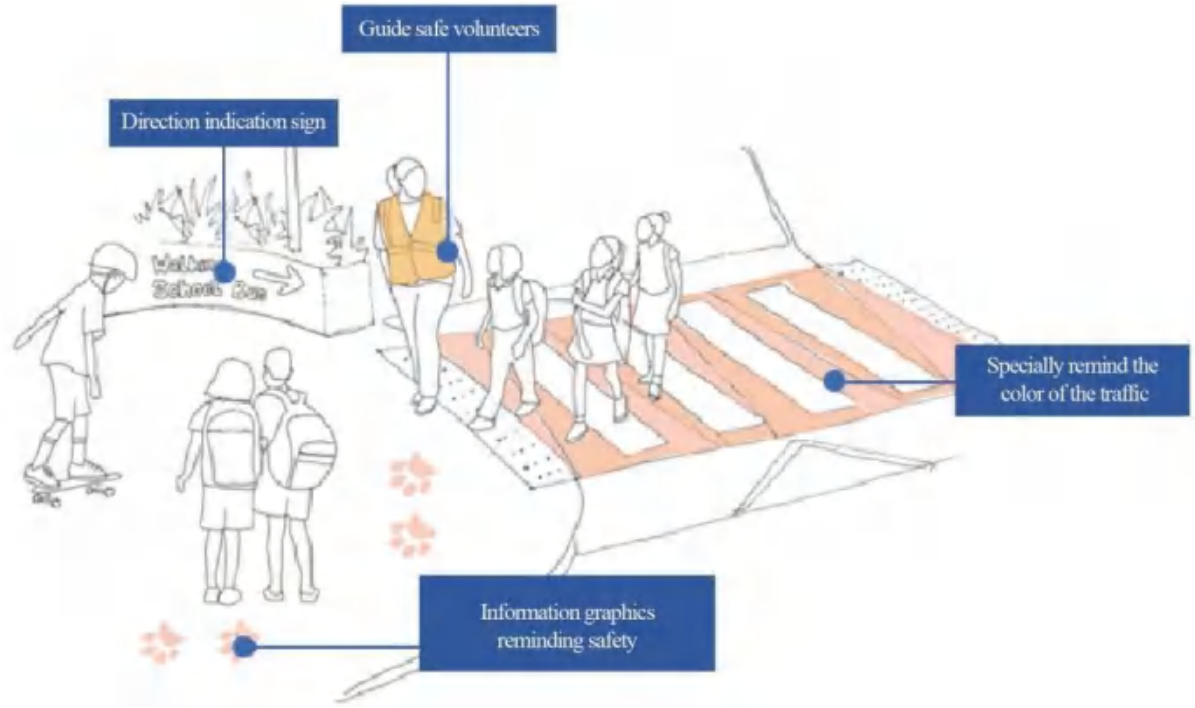


Fig. 2-15 Signs on the route for children (Source:drawn by author)

3. Activity and maintenance Construction

Activity operation and maintenance update construction refers to a group of full-time workers in the community with relevant professional knowledge and community management workers who can be inducted after a period of training. The relevant workers are required to have the ability to guide and promote children to play correctly and positively; organize community residents and children to participate in the community construction, and carry out daily updates and maintenance of the relevant infrastructure and playgrounds in the community. In the community design, the operation and maintenance of the activities are the last part of the design, and the community design is truly completed when the activities are implemented in this last part.

In the construction of activities for child-friendly communities, activities can be divided into daily activities and event activities. Daily activities are usually activities held in the community in daily life, such as daily games, community maintenance activities, planting, etc. Event activities are activities held on specific holidays or community-specific days, such as activities held in the community for Children's Day, community harvest festivals, etc.

4. Neighborhood and cultural construction

In his book "Community Design", Japanese community designer Ryo Yamazaki says, "More important than designing space is connecting people." This is especially true in child-friendly

communities, where a series of hard conditions are built and activities and services are operated, and friendly relationships between children and neighbors are fully established. We foster good parent-child relationships and parent-parent relationships, and promote the cultivation of friendly relationships between children and community residents.

For the construction of residents' neighborhood relationship mainly involves: nearby businesses, elderly people who are also disadvantaged, community residents, schools and care institutions or training and education institutions. Nearby businesses can provide material support for children, such as providing toys and stationery, organizing various activities related to children, and providing potential surveillance effects to implicitly combat violence against children; children and the elderly can form a harmonious relationship of mutual help and assistance; establishing good neighborhood relations can form a culture of caring and valuing children in the community and reduce The establishment of good neighborhood relations can create a culture of caring and valuing children in the community and reduce the confrontation between children and residents; schools and care and training institutions can provide educational services for children while bringing business opportunities to them, forming a good cycle of relationship.

On the other hand, according to the group standard of "Child-Friendly Community Construction Standards" issued by the China Community Development Association, it is also necessary to build culture in the community. The main purpose of cultural construction is to popularize the concept of child-friendliness among residents through various channels, combine the local culture of the community, and improve the mechanism to support the development of child-friendly cultural activities.

5. Policy construction

In terms of policy construction, according to the standard of "Child-Friendly Community Construction Standards" promulgated by the China Community Development Association, it is mainly divided into promoting the establishment of cross-sectoral cooperation structures, providing financial support, establishing child participation mechanisms, and establishing follow-up guidance and feedback mechanisms. Among them, Shenzhen and Changsha have issued specific policy reports, which contain the scope of policy implementation, implementation subjects, and implementation goals.

2.3.2 Evaluation indicators criteria for community from a child-friendly perspective

Assessment and evaluation of the spatial environment is one of the important ways in finding existing spatial problems. Countries are also actively trying to establish guidelines for child-friendly community assessment. As mentioned in the previous study, child-friendly cities are mainly about establishing a network of safe and continuous play spaces at the spatial level and providing children with easy access to basic social services. The spatial assessment revolves around these two core keywords.

In 2008, the EU launched the Child-Friendly Communities Assessment Guide tool for children aged 0-18, parents and community workers, which was adopted by UNICEF. The tool focuses on the development of indicators to assess the child-friendliness of communities at the policy, service provision and space levels. At the spatial level, it mainly includes safe places for play and sports (formal and informal activity spaces), parks and green spaces, and safe slow walking paths. The Canadian province of BC, on the other hand, assesses different spatial types, including ten major spatial types such as neighborhood environments, parks, and family service support systems, where the spatial level mainly involves play spaces, neighborhood environments, and green space systems. In addition, Japan, the Netherlands and the United Kingdom have set goals or standards for child-friendly environments from the perspective of spatial environments. The Guidelines for the Design of Child-Friendly Neighborhoods, developed after the conference, call for the early establishment and improvement of neighborhood environments for children's play and independent travel, and focus on the safety of street space and streetscape shaping, suggesting that child-friendly neighborhoods should be suitable for children to walk, ride, walk through and have a pleasant environment; Professor Mamoru Senda of Japan proposed the "Twelve Rules for Child-Friendly Cities and Built Environments" to guide the design of children's play space from the indoor and outdoor space levels.

The assessment indexes of community space environment in the above documents are summarized according to different types of space, and the guidelines for space construction are shown in Table 2-7, which mainly include three aspects: play space, infrastructure construction, and safety and maintenance. In terms of game space construction, the assessment is mainly carried out in three aspects: game space, access space and game facilities:

(1) In terms of play space design, the play space is required to be open, continuous, barrier-free, spacious, shared and diverse. The play space should allow children to play freely and

without obstacles, and fully meet the needs of children's social, sports and personal games. Therefore, in addition to the formal play space, as many surrounding resources as possible should be used to form a play space network, and at the same time, provide space for children to fully contact with nature.

(2) Access space. A safe and convenient access path to the play space is one of the important elements in the construction of children's play space network. The access space should meet the needs of children walking, riding and convenient walking, with obvious signs, good lighting and safety design.

(3) In terms of play facilities, emphasis is placed on the all-age sharing of play facilities, which can provide children with opportunities to take risks and stimulate imagination and creativity, and promote mutual communication; in the selection of materials, the main focus is on whether natural elements are used and whether the construction of facilities can effectively promote children's interaction with nature.

The construction of infrastructure is one of the prerequisites for children to enjoy basic social services conveniently. The assessment focuses on three aspects: healthcare, education, and health, and suggests that community level should have childcare facilities and a spatial system to support childcare; it emphasizes the shared nature of public facilities, such as schools open to parents and children's spaces in public libraries.

Table. 2-7 Guidelines for building child-friendly community spaces by country(Source:drawn by author)

Aspect	Key	Specific content	Country
Games Space	Physical Space	Buildings and cities should provide guarantees of realistic opportunities for diverse experiences during children's growth and development	Jan
		Residential areas that welcome children and allow them to play in public areas	UK
	Openness	Outdoor spaces should guarantee freedom of movement and should not be enclosed, emphasizing openness	Jan
		Planning and design should analyze safety factors such as children's exposure to crime. In addition, attention should be paid to the characteristics of closed management of children that should not be overprotected	Jan
	Continuity	In order to provide children with sufficient opportunities to play, special play spaces are needed, and other spaces around them should also have as many playful features as possible	Jan
	Accessibility	The play space has barrier-free design	UN

	Spaciousness	The outdoor space should have a certain size of outdoor ground	Jan
	Shareability	Play space can be used for children of all ages to play	Jan
	Diversity	Shaded areas to avoid direct sunlight	UK
		There are natural places (such as gardens, fields, forests, parks, etc.) that can be accessed and used for activities	UK
		Provide a variety of opportunities for sensory stimulation of nature, from the immediate natural environment to the natural environment, and provide spatial conditions in which activities can take place	Jan
		Trees, bushes, and natural areas on campus provide creative learning and play environments for children (including preschoolers)	Can
		Community efforts to preserve green spaces and wild and undeveloped lands as parks and open spaces for children	Can
		Parks planned and developed close to and in conjunction with schools	Can
		Children have access to community gardens so that they can plant, tend and pick flowers and vegetables There are residential gardens where children and youth can plant and cultivate their favorite flowers and vegetables	Can UK
		Community common spaces allow children and adults of all ages to gather for social activities	UK
		Provides opportunities for children to play and make friends, promoting interaction between different age groups and families	Jan
		Public facilities that provide family-based play spaces for families with children	Jan
		A wide range of environments that encourage a variety of children's play, including social and physical play	Can
		Available and suitable open paved areas (suitable for activities such as roller skating, practice cycling, etc.)	UK
		There are safe and comfortable spaces for informal activities for children and youth	UK
Games Space	Diversity	Where children can play informal sports (such as street field hockey) safely and without complaint	Can
		Space for children's activities that allows for noisy and energetic play to occur without objection from adults	Can

Traffic Space	Secure, continuous, and reachable	Safe spaces for walking, riding, and access where children can easily and safely reach their destinations (e.g., downtown, recreational facilities, major parks)	NL Can
		Well marked, well lit and safely designed pathways	Can
Game Facilities	Shared by all ages	The facilities and elements of the playground are suitable for children and youth of all ages	UK
	Adventurous	The game has an appropriate level of adventure (i.e., a game that is challenging but does not cause serious injury)	UK
	Stimulates imagination	The play elements allow children and youth to have appropriate imaginative space	UK
	Stimulates Creativity	Play elements allow children and youth to use their creativity	UK
	Promotes communication	Play elements encourage adults to interact and communicate with children and adolescents	UK
	Materials Selection	Play facilities contain natural elements (e.g., trees, sand, water)	UK
		Water elements are playable and suitable for children and adolescents (e.g., shallow pools, natural or artificially constructed streams, ponds, etc.)	UK
		Manufactured play equipment that always adds natural areas	Can
Infrastructure Facilities	Medical facilities	There are clinics, hospitals, etc., with emergency care facilities	UN
	Child Care Facilities	Analyzing and studying the knowledge related to nurturing children's growth, providing a social system for reassuring childcare and its corresponding space construction, such as childcare, schools, etc.	Jan
	Health facilities	Sanitation facilities such as garbage collection stations and public toilets	EUR
	Shared public facilities	Parents' rooms in local elementary schools, open to parents on opening days; public library spaces designed to meet the needs of children	Can

In addition, certain standards are proposed in terms of safety, maintenance and management, children's participation and other operational management and practices (Table 2-8):

1) In terms of safety, the play space is required to have good line of sight penetration, enable adults to effectively supervise children's play behavior, and promote the common use of the play space by different age groups; the community should have good neighborhood relations, and the needs of children's safety should be considered from planning site selection to

planning design, while providing policy and education safeguards.

2) In terms of maintenance and operation management, the management and maintenance personnel are required to have knowledge related to children and regularly maintain the playground and facilities; one of the important elements is that the playground managers are also play facilitators who can guide children to play actively.

(3) Whether it is the planning and design of playgrounds or safety maintenance, all assessment criteria emphasize the important role of children's participation, point out that policies should be provided to guarantee children's participation, and actively organize various community festivals and intergenerational activities to promote children's participation and intergenerational communication.

Table. 2-8 Compilation of guidelines for the maintenance and operation and management of child-friendly community spaces in each country(Source:drawn by author)

Aspect	Key	Specific Contents	Country
Security	Perspective penetration	Construction of the play area should take into account the permeability of the view	UK
	Mixed Age Coexistence	Provide areas where adults can rest and observe their children playing	UK
	Neighborhood surveillance	Should guarantee that occupants can overlook shared spaces between residential buildings and monitor them	UK
	Neighborhood Solidarity	Have someone available to help children if they step out of their homes and are in danger or in danger	UN
	Policy Prevention and Control	Develop policies to prevent and control crimes against children and adolescents	UK
		Keeping children out of traffic	Can
	Site Safety	At the settlement planning level, areas frequented by children and adolescents should be kept away from heavy traffic	UK
		Children's spaces should be kept away from environmentally polluted areas to protect the health of children and their lives	Jan
	Planning and Design	Avoid obstacles and slopes at intersections and corners	UK
		Ensure that children's daily routes are well lit and easy to identify	UK
	Security Education	Develop children's awareness of traffic safety	UK
Maintenance	Control	Improve traffic forms and regulations to ensure that traffic	UK

and Management	measures	slows down in areas frequented by children	
		Have signs to protect children from traffic hazards	UK
		Allow residents to shut down street traffic for street parties to encourage community activities	UK
	Maintenance measures	A department with a regular safety inspection system	Can
		Well maintained play areas with regular health and safety inspections	Can
		Maintenance of playgrounds and play equipment to ensure the safety of preschool children	Can
	Staffing	Staff who understand the growth and developmental stages of children can be trained as play facilitators school maintenance staff to understand the dangers posed by 0/6 year olds playing on school grounds and equipment	Can
Children Participation	Policy	Local policies can ensure that children and parents are involved in the design of the park	Can
		Children can be involved in the planning and design process for neighborhood space development	UK
		Local policies that ensure the participation of children and parents in the design of parks	Can
		Children themselves are given the opportunity to create their own spaces, providing them with the opportunity to learn about place, nature and the earth's environment	Jan
	Cultural	Respecting the culture of the times in which child-friendly cities are built, and inheriting their original local culture	Jan
		Participation of children in community festivals and events	Can
		Intergenerational arts programs and activities	Can
		Respect for cultural diversity and children's participation in or celebration of other cultural or religious festivals and events	UN

Further refining the evaluation points, we can get several key words such as "accessibility, safety, variety, comfort, nature, and participation". In terms of the child-friendliness of the spatial environment, these key points can be borrowed and translated into specific indicators for evaluation.

To sum up, the research on child-friendly community space can be carried out from two aspects: space demand and space assessment, and the summary of research points is shown in Table 2-9.

Table. 2-9 Child-friendly community space research points collation table(Source:drawn by author)

Aspect	Indicator	Sub-Indicator	Specific Content
Space requirements	Game space requirements	Game Time	Children's playtime outside
		Game Space	Children's outing playground
		Game style	Types of children's games
		Game Partners	Type and number of people playing with children, etc.
	Independent Mobility	Independent movement range	The range of activities in which children can travel alone
		Permission level	The extent to which the parents allow the child to travel
		Activity level	The range of activities in which children can actually travel alone
Space Evaluation	Accessibility	Open	The space is designed with openness in mind, with entrances and exits for easy access
		Path access	Children can reach their destination in a short walking time and in a safe walking environment
	Naturalness	Natural Coverage	Children's activity space has some natural space
		Natural accessibility	Children can access the natural space and participate in relevant activities
	Comfort	Appropriate scale of facilities	The facilities used meet the physiological scale of children
		Comfortable environmental elements Visibility	Ventilation, light and natural conditions are comfortable
	Safety	Visibility	The landscape design allows adults to observe children's play behavior well
		Spaciousness	The playground has a certain area to meet children's play needs
		Safety facilities	Safety facilities are set up (such as facilities to separate traffic, lighting facilities, guidance facilities, etc.)
		Diversity of supporting facilities	Medical, health, educational facilities, etc.
		Diversity of	Personal space: a place where children can be alone or free to make noise
			Social space: space to meet children's social needs

Diversity	game space types	such as making friends and chatting
		Physical space: Space where children can engage in more intense activities
		Natural space: a space where children are exposed to more natural elements
	Diverse types of game facilities	Different kinds of play facilities are available
	Diverse functions of game facilities	Adventurous: play facilities that meet children's needs for climbing, exploring, etc.
		Stimulate imagination: game elements can give children and adolescents appropriate imagination space
		Stimulate creativity: play elements allow children to use their creativity
		Promote communication: it can encourage adults to interact and communicate with children and adolescents

2.4 Summary

This chapter presents the development of child-friendly theories at home and abroad, the physical and psychological characteristics of children in different periods, and the requirements of child-friendly construction for community spaces, and summarizes the common construction dimensions and specific construction contents of community public spaces from a child-friendly perspective.

Chapter 3 Case Study of Community Public Space Safety Improvement

3.1 Selection Principle

Child-friendliness aims to protect and promote children's development by providing multidimensional and inclusive services including culture, education, and health in safe and friendly public spaces with children, their guardians, and other family members as service targets. In this chapter, based on the theoretical basis of the classification of the types of community public spaces from a child-friendly perspective and the dimensions of their construction, priority is given to the selection of cases related to the safety of child-friendly public spaces at the community scale in countries with more mature theoretical research, and the selection of relevant cases from the five major aspects of comprehensive policy initiatives and children's participation, travel construction, space construction, activity operation, and cultural creation, etc., and the study of their safety improvement initiatives and strategies in the corresponding aspects, respectively. In this chapter, the principles of case selection are as follows In other words, the cases in this chapter are selected based on three principles: community scale, safety enhancement, and six dimensions.

3.2 Route Construction

3.2.1 Child Safety Program, Delft, Netherlands

The Netherlands is one of the first countries in Europe to focus on spaces for children, and Delft is an outstanding example of a "child-friendly" city in the Netherlands. One of the most important measures of the "Child Safety Plan" implemented in Delft is the establishment of "Child routes", which connects the places where children spend their daily activities, such as homes, schools and parks, through safe paths. In 1986, the city of Delft built a bicycle network covering the entire city, providing ample space for children to move around and safe street space, with clearly marked paths that provide easy and safe access for children to travel, which has significantly increased the amount of daily exercise for local children.

Since 1990, the Netherlands has launched a "child-friendly upgrading program" for urban roads, public places and important public buildings, which includes the following planning measures: First, to control the low speed of motor vehicles in local areas and to increase children's willingness to travel. Secondly, to link up sites with high frequency of children's activities to form children's routes. Third, to maximize space sharing to improve the efficiency of residential road use and achieve the goal of children's activities on the whole road. In 2004,

the Dutch government put into practice the "Children's Safety Enhancement Program", a key measure of which is the construction of children's routes, i.e. linear children's play spaces. The safety of the neighborhood environment is improved through systematic planning of sidewalks and carriageways, safe intersections, etc. By improving the landscape along the streets to enhance the richness of the neighborhood environment, the number of paths preferred by children is increased, and the willingness of children to travel alone is increased(Fig. 3-1).

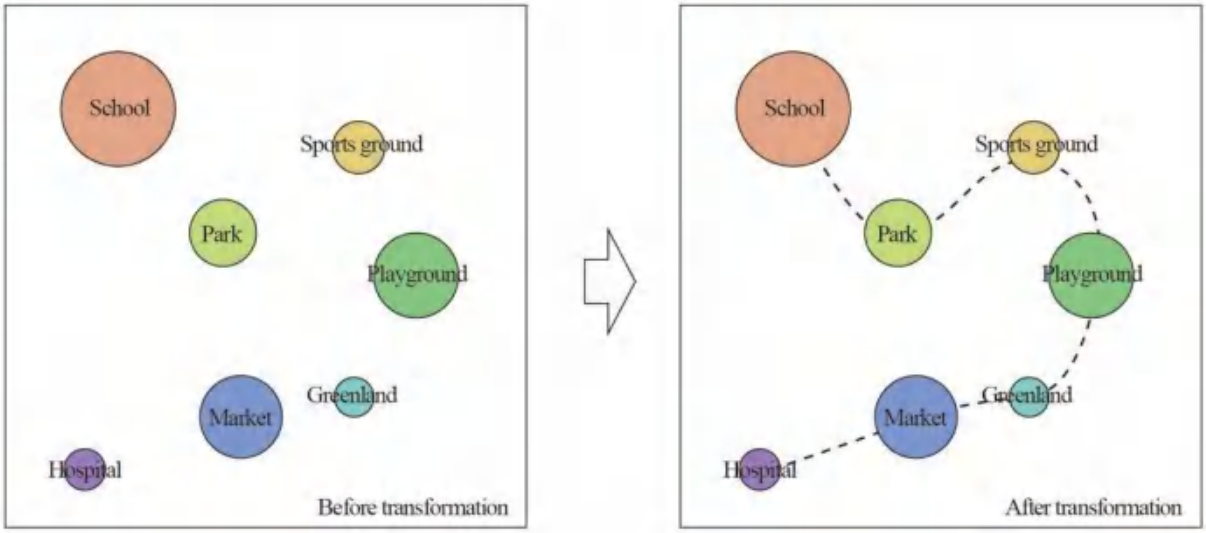


Fig. 3-1 Before and after renovation of the child-friendly path in Delft, the Netherlands(Source:drawn by author)

In August 2005, the International Conference on Children's Streets 2005 was held in Delft, the Netherlands, with 80 participants from 22 countries, including landscape planners, architects, sociologists, dignitaries and parents from all walks of life. In 2006, the government began exploring child-friendly streets measures, focusing on how to balance outdoor activities for children with motorized transportation without increasing the number of motorized vehicles, thereby encouraging adults and children to walk or bike on their daily trips, with the goal of "providing more possibilities for walking, biking and independent outdoor travel for children. The concept of KISS, an overview of "child-friendly" inclusive streets, was developed to provide an objective assessment system for pedestrian and bicycle conversion of neighborhoods and streets. As shown in Table 3-1.

Table. 3-1 Principles of Child Friendly Streets (KISS) assessment in Delft(Source:drawn by author)

Aspect	Contents
Hardware Environment	1. Social environment and road environment can provide sufficient protection measures 2. A good walking environment and a safe walking system 3. An environment suitable for children's bicycle travel and a safe and independent bicycle path system 4. Ensure that children have full freedom of movement on the street, i.e., that children use the entire road surface safely for their activities
Software Environment	4. Complete and varied street furniture 5. 6. A street environment that is attractive to children and offers possibilities for children's play and social activities

In 2008, the City of Delft launched the "Children's Trails" project, which effectively links all the places that children need on a daily basis for safety and recreation, allowing children to play freely in the areas covered by the "Children's Trails" network. Children can play freely in the areas covered by the "children's paths" network. The city of Delft is now improving its network of urban spaces based on neighborhoods to improve the quality of children's outdoor play and ensure children's travel safety.

3.2.2 Woonerven: Stabilized Street Design, Netherlands

The term "Woonerven" originated in the Netherlands and was first coined by Dutch planner Nick de Boer in the 1960s. The term literally means "living yard" or "family area", but in practice it refers to an area where motor vehicles take precedence over bicycles and pedestrians. In the 1960s, Europe was experiencing rapid economic development, with rising personal income levels and rapid expansion of cities, which led to an explosive growth in the number of motor vehicles, but lagging road planning failed to cope with this phenomenon. In this context, de Boer draws inspiration from Buchanan's concepts of "traffic integration" and "traffic stabilization" to create a shared urban street in which cars, pedestrians and bicycles are integrated into one street space and live together peacefully. The concept was first applied in the Netherlands. He first applied the concept to the Dutch cities of Emmerhout and Delft. Specific measures include the removal of continuous curbs on both sides of the street and the use of different colors and textures of pavement materials to distinguish between pedestrian and motor vehicle lanes. These measures put pedestrians and vehicles on the same level, and drivers were forced to slow down and drive carefully because of the mix of pedestrians and

vehicles. This measure allows people to walk, play, and communicate more safely on the street, and allows more space for other functions, such as the placement of street furniture and small spaces for interaction, thus providing more possibilities for the integration of living environment, residential life, and regional transportation[36].

"There is no uniform standard for the construction of Woonerven streets around the world, but a summary of design practices around the world shows that the core concepts include the following:

1. Have a clear entrance

"Woonerven" streets have a clear and obvious sign at the entrance to remind drivers to enter the area and to follow the traffic rules of the area(Fig.3-2).

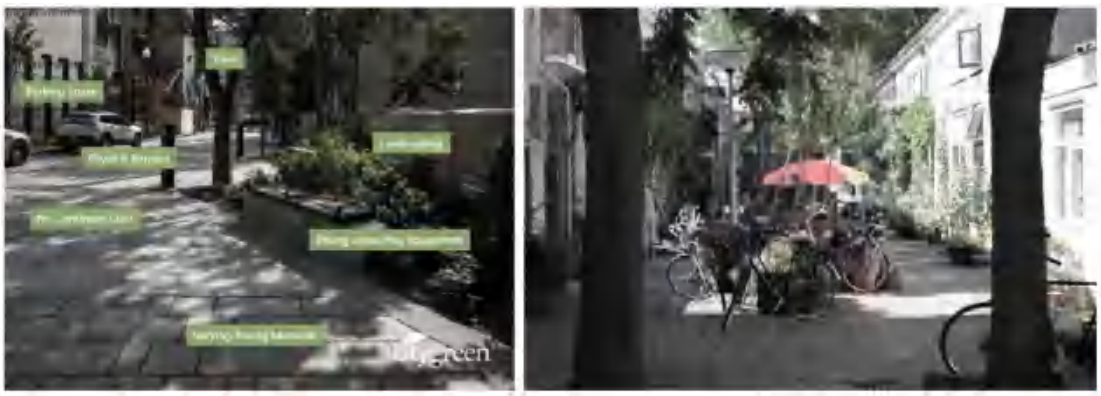


Fig. 3-2 "Woonerven" street design (Source:drawn by author)

2. Elimination of continuous curbs

"Woonerven" streets typically remove the curbs on both sides and use different materials and colors to guide traffic, a move that puts pedestrians and vehicles on the same level and allows drivers to be more careful and cautious in the area, actively reducing their speed. For residents and children, the elimination of curbs is tantamount to expanding their psychological walkable space on the street, allowing them to walk and play freely on the road.

3. Use of traffic calming measures

Physical measures are used to improve street safety, such as adding speed bumps and cushions and increasing the curvature of the street in design, while using street furniture and trees to block the continuous line of sight of drivers, forcing them to slow down and increasing the caution of drivers.

4. Spaced parking areas on both sides of the street

Spaced parking areas allow vehicles to stop filling both sides of the street, leaving space for

pedestrians to move through, while also increasing the openness of their view, making the street feel less like a parking lot.

5. Combine the street with public facilities

Add seats, green landscaping and play facilities to the public space on both sides of the street to encourage residents and children to interact and move around the street.

3.2.3 Other examples of path construction

The Kuperwijk-zuid residential neighborhood in the Netherlands has mostly mid-rise houses in the interior and some low-rise houses in the south side, and the Kuperwijk-zuid neighborhood has established a system of "Kindlint" (children's paths) and open spaces for children's activities, which together form a continuous and safe child-friendly neighborhood. The first aspect is to expand and optimize the public space system for children's activities, and the second aspect is to introduce the concept of "Kindlint"[37], which aims to improve the fun and safety of children's travel and encourage more children to travel and play(Fig.3-3).

Fig. 3-3 Kuperwijk-zuid Plan (Source:drawn by author)

The UK's 'walking buses' create special safe routes for children with an adult escort; a group of children walking to and from school with two or more adults. A series of separate 'stop' spaces for 'walking buses' in cities (locations along the route where children can join the

walking bus), with 'pick-up times', link up special The Walkabus is a series of individual "stops" (locations along the route where children can join the Walkabus) with "pick-up times" to create special child-safe routes. Parents participating in the Walking Bus program volunteered to take turns transporting their children to and from school, with one parent at the front of the line as the "driver" and the other as the "conductor" at the end of the line(Fig.3-4). The other parent acts as a "conductor" at the end of the line to look after the children. This practice has proven to be effective and is now being replicated in the UK. Meanwhile, child-friendly cities in the United States, Australia and New Zealand are beginning to learn from it to ensure that children have a safe route to school.

Fig. 3-4 "Walking Bus" in the UK (Source:https://www.sohu.com/a/557122767_100126192)

The case interpretations of each city show that safety is the primary responsibility of each city in terms of children's travel, and the related measures are based on safety. Therefore, starting from the principle of child-friendly safety and combining the above cases, measures related to building safe paths can be summarized at the levels of walking space, road nodes, traffic organization, and traffic facilities(Table 3-2).

Table. 3-2 Measures related to the route construction (Source:drawn by author)

Space Type	Design Points
Walking Space	Continuous and safe pedestrian network; dedicated right-of-way for children's walking paths; traffic calming design; installation of isolation piers on the side of the walking path near the road; warning signs and regular maintenance of manhole covers; elevation of the walking path at the intersection of motor vehicle entrances and exits; perfect security monitoring facilities
Street Nodes	Pedestrian crossing facilities suitable for children's safety at intersections; expand sidewalks at major intersections to and from school; reduce the turning radius of motor vehicles; shorten the distance for pedestrians to cross the street
Traffic Organization	Improve the mode of public transportation; set up "walking bus" routes within the school district, guided by parent volunteers; harbor parking; organize traffic micro-circulation during peak hours; encourage the use of school playgrounds to build underground parking garages to solve the parking problem; adopt school buses for transportation in conditional school districts
Traffic Facility	Speed limit, set "school area" warning signs; yellow grid no-parking markings at major intersections; temporary parking markings at road tests; intersection signals configured with pedestrian crossing countdown timers; signals to meet children's crossing time requirements during peak hours to and from school

3.3 Space Construction

3.3.1 Transformation of the Poptahof, Netherlands

The Poptahof neighborhood in the northwest corner of Delft, the Netherlands, was built in the 1960s as a densely built, multi-ethnic neighborhood. The neighborhood is surrounded by tram tracks and the city's main roads, and is like an urban "island". The main city streets, shopping malls, and urban infrastructure have had many negative impacts on the neighborhood, such as motorized traffic, chaotic parking, and potential safety threats from strangers, which have posed many safety hazards for children's outdoor activities. As the most active promoter of the "child-friendly city" concept in the Netherlands, the city of Delft established the principle of child-friendly renovation at the beginning of the renovation of the Hofdorp neighborhood in order to solve the traffic problems, optimize the public space and promote the healthy physical and mental development of children. In 2004, the municipality of Delft began a

major renovation of the public space in the residential area.

1.Organize the spatial sequence

By organizing the outdoor spaces in the community, the sequence of public space-semi-public space-private space is created, which can strengthen the residents' sense of belonging and guide children to play safely outside more effectively. The community center park is the center of daily activities for residents in and around the community, where various activities can be held to meet various needs; the street space and green space between houses are key places to enhance neighborhood relations, where children can play under the protection of the "street eye" and neighbors often meet and talk, which improves the safety of children's activities; the entry garden or the entry garden is a space for children to play. The entry garden or entry deck is a relatively private place to meet people's needs for observation, chatting and relaxation(Fig. 3-5).

Fig. 3-5 Poptahof Plan (Source:drawn by author)

2. Expand and optimize community public space

Since the residential buildings in the community are mainly high-rise, the distance between buildings in the community before the renovation has been controlled to 30 meters, but the public space in the community is fragmented and lacks a sense of security due to the chaotic motor road network and monotonous street space in the original residential area. Therefore,

the strategy of optimizing the public space in the community is mainly to renovate the street space and the green space between houses. Based on this, a complete slow walking system and a bicycle network are set up in combination with the roads in the community, thus reducing the hidden dangers caused by traffic. With the integration of inter-residential green space and road space, the public space of the whole community is interwoven into a network, and the whole community becomes a place for children to go out and play. The freedom of children's outdoor activities is greatly increased, and the unobstructed space also provides protection for children's outdoor activities and improves safety.

3. Open natural space

It is the nature of children to love nature, and the construction of children's cognition of the world in contact with the natural environment is an important way for children to grow and develop. At the same time, creating a safe and natural environment in the community also contributes significantly to the quality of the community space. The reconstruction of the central park is the key project of this renovation. The completion of the community park provides a safe corridor for residents and children to connect schools and homes in the community.

4. Entry space and parking space

In order to improve the quality of the community space and ensure the safety of children's travel, it is necessary to plan the parking space within the community in a holistic manner. Before the renovation, vehicles were mainly parked along the streets within the community. This practice not only reduced the efficiency of road traffic and increased traffic hazards, but also encroached on the public space within the community and severed the continuity of the community space.

3.3.2 Pearl District of Portland, USA

The Pearl District of Portland has taken a series of measures in terms of public policies, planning frameworks, action plans, and space creation in the context of the current problems and backgrounds, such as the dramatic increase in the number of families in the area, the high birth rate of children, the failure of children's infrastructure and services to meet the needs of residents, and the calls from various sectors to improve the environment for children's growth, The "Walking Bus", "See and Learn", and "Forest Kindergarten" have also been explored, and

only the space creation is selected for in-depth study and analysis.

Neighborhood space is an important social environment for children's character building. In the Pearl District of Portland, spatial elements such as neighborhood streets, parks, and courtyards were extracted to explore strategies for shaping child-friendly spaces (Fig. 3-6).

1. Street space

Children are often curious to find corners in street space that may become playgrounds, and will move spontaneously and make short stops in safe street space, and individual activities are directional and dispersed. Therefore, in order to add protection to children's travel, we can reduce safety hazards by limiting the speed of vehicles to 20km/s, adding speed bumps and marking signs, etc. We can also form a complete pedestrian network within the community and combine it with the landscape, and lay out parking in places where children's activities are rare.

2. Courtyard space

Due to the limitation of preschool children's ability to move independently over long distances, the courtyard space in the community becomes a place for children's high frequency activities. The layout of the building also has a certain influence on children's activities. The enclosed form is more preferred by children, and also provides more safety and comfort, and can provide children with a sense of security and belonging to the activity space. The "street eye" between neighbors can provide protection for children and create psychological pressure for strangers to enter.

3. Public space system

In order to effectively organize community public space, Pearl District arranges courtyard space and green space in front of houses around the dotted square space to form a multi-level community public space system, and uses spatial corridors to link scattered activity spaces to form a systematic and coherent spatial sequence, so that children can experience a safe, natural and comfortable small environment and enter different types of activity sites such as green space in front of doors, courtyard space, streets and parks.

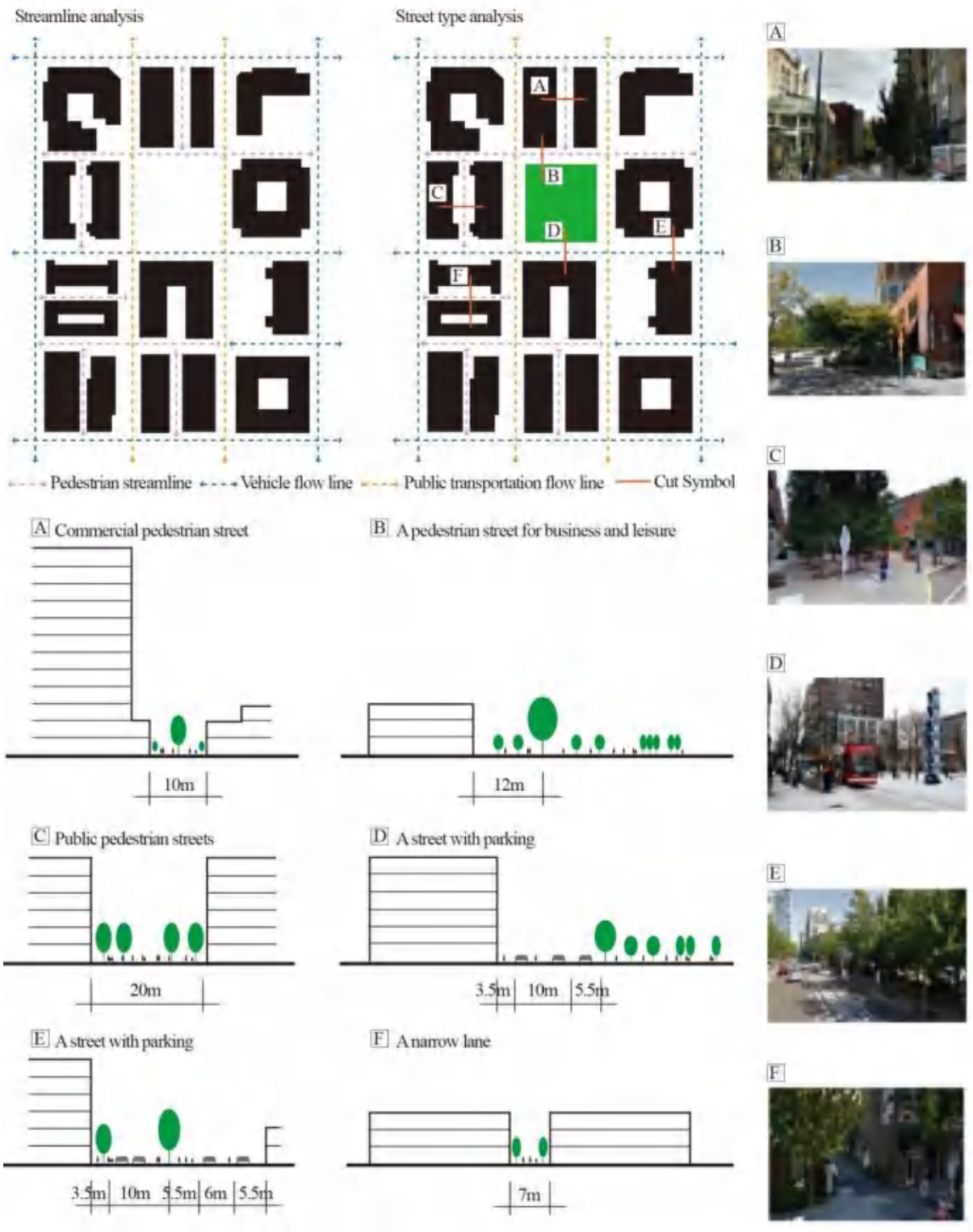


Fig. 3-6 Spatial analysis of streets in Pearl District (Source:drawn by author)

3.3.3 Other examples of space construction

Denver, USA, the first "child-friendly city" in the United States, started a city-wide "Learning Landscapes" project(Fig. 3-7). The city has opened up the school spaces that had lost their

vitality to become an integral part of the city's open space system. Each of these spaces includes the following design elements: community entrances, shaded areas, public gathering areas, natural wildlife parks, outdoor art, multi-purpose sites, hard surface play and educational elements, safe play facilities for participation, and innovative play elements. It not only provides diverse and natural play space for children, but also provides a seeing and learning place for children to know nature and get familiar with it. Multiple learning spaces are gradually forming a network of children's outdoor playgrounds of different scales and levels, which greatly enhance Denver's attractiveness to children and the city's charm.

Fig. 3-7 Denver, USA "Learning Landscapes"(Source: https://www.dcla.net/learning-landscapes)

The experience of Copenhagen, Denmark also shows that point-like children's outdoor play spaces under multiple levels are an effective means to push up the child-friendliness of the city as a whole. After nearly a century of unremitting efforts since its systematic construction began in the early 20th century, Copenhagen's point-like playgrounds have developed into a hierarchical structure system based on residential neighborhood sites, with public sites as the backbone (community children's playgrounds and park green space playgrounds) and institutional-affiliated sites (children's playgrounds in kindergartens, schools, hospitals, churches, etc.) as supplements. The spatial design focuses on attractiveness, adventure and education, and takes into account the integration with the needs of other family members as much as possible, while adopting a natural design approach to emphasize coordination with

the surrounding environment on the one hand, and to provide children with urban spaces in contact with nature on the other.

Similarly to the construction of safe paths, in the construction of safe spaces, each city takes child-friendly conventions as the starting point and proposes different design measures for different space types. Combining the above case contents, we can summarize the public activity space, natural space, street space and so on. Thus, we can get the relevant measures for constructing safe spaces(Table 3-3).

Table. 3-3 Measures related to space construction

Aspect	Design Points
Public Space	Public spaces should be set in areas with concentrated pedestrian flow and "street eyes"; public spaces should be network-like to enhance safety. Enhance the safety, fun, creativity and naturalness of the activity space; introduce children's design creativity into the neighborhood image design; set up a play space close to nature, inspire creativity, and add safe activity facilities.
Nature Space	Create a safe and natural environment in the community, scientifically plan the construction of natural space environment and facilities, and gradually solve the current situation of children's nature deficiency. Provide non-hardened themed walking trails and diverse interactive spaces to suit all ages Accelerate the cooperation between urban parks and primary and secondary schools to make natural spaces a safe corridor between schools and residences.
Street Space	Reduce safety hazards by limiting vehicle speed, adding speed bumps and marking signs, or form complete walking networks within communities and combine them with landscaping, and lay out parking in areas where children have little activity.

3.4 Activity Construction

3.4.1 Park van Eden in Antwerp, Belgium

As cities grow and urban densities increase, resulting in fewer natural environments in urban settings, it is important to consider how children can access natural play environments in urban settings. The City of Antwerp's " Park van Eden" concept is a conscious effort to create opportunities for children to engage with nature, and the city is making a conscious effort to create natural play in schools and public spaces in the community(Fig. 3-8). The program uses natural materials placed in community spaces, such as logs and climbing nets to make tunnels, which stimulate children's imagination and provide them with opportunities to create interesting scenarios and play, in addition to providing them with a natural experience in the community.

Fig. 3-8 Children experience natural materials (Source: https://www.antwerpen.be/info/55a51efdb0a8a7ade38b45d3/park-van-eden-avonturenparcours-in-speelnatuur)

3.4.2 "Toy Boxes", Rotterdam, Netherlands

The City of Rotterdam has placed public "toy boxes" (modified containers filled with toys and play equipment) in public squares or parks and community open spaces to encourage children to play and promote social interaction between parents and parents, children and parents, and children and children in public spaces(Fig. 3-9).

Containers are filled with tricycles, roller skates, go-karts, skateboards, craft materials, etc. where children can rent toys and use them in public squares. The toy boxes are managed by community volunteers (usually parents or grandparents) who look after the equipment and manage the space. Children can collect activity stamps by completing daily activities in the community, such as sweeping floors and watering flowers, and use the stamps to rent special toys from the toy box, which also teaches children about social responsibility.

The "Toy Boxes" program is a simple design intervention that provides a safe space for children and parents to gather and get to know each other, and is especially popular in high-density cities where parents have little private space to store larger toys. In addition to daily activities, volunteers host seasonal community events, such as reading clubs and craft activities. This simple intervention brings children from diverse backgrounds together with their parents to bring joy and life into the community space.

Fig. 3-9 children playing in front of the community toy box

（Source: https://www.pzc.nl/rotterdam/alle-duimdrop-speelcontainers-verdwijnen-uit-wijken-dit-accepteren-we-niet~aae9c90d/）

Table. 3-4 Measures related to activity construction

Aspect	Design Points
Activity Type Selection	1. Proactively meet children's risk-taking mentality and consider how children can get natural play in the urban environment. Use natural elements such as climbing, tree houses and sand pools to satisfy children's curiosity and create controllable risks. 2. Compound a variety of activity types, such as adult and child, play and business, etc.
Activity Space Selection	3.The choice of daily activity sites are mostly chosen in streets and open spaces with rich interfaces to strengthen the daily nature.

3.5 Summary

With the goal of improving the safety of community public spaces and based on the concept of child-friendliness, this chapter summarizes the specific initiatives of each case study in terms of spatial construction, route construction, and activity construction through case studies related to the construction of child-friendly community public spaces around the world, which are important for the proposed strategies in the later sections.

Chapter 4 Research on Liuyun Community from a Child-Friendly Perspective

4.1 Overview of Liuyun Community

4.1.1 Present Elements Analysis

The Liuyun Community is located in the Tianhe District of Guangzhou City, and its location is in a very advantageous condition. Thanks to the development of Guangzhou city and several spatial scale games, the whole Tianhe district has developed at a high speed in recent times(Fig. 4-1).

Fig. 4-1 Location of Liuyun Community (Source:drawn by author)

Guangdong Province, with its sizable population, has always been a vital hub of foreign trade in southern China. During the country's period of reform and opening up, Guangdong Province was also one of the significant commercial ports open to the outside world. As the capital of Guangdong Province, Guangzhou has played an essential role in the economy of the Guangdong-Hong Kong-Macao Greater Bay Area for years, and since ancient times, it has had a rich history of foreign trade and renowned merchant families. Today, Guangzhou is one of the few mega-cities in China with a highly developed technological and economic sector. The GDP output of Tianhe District, which has seen a tremendous economic growth, has been breaking new records every year. Nowadays, Tianhe District, home to the Liuyun Community, has become the most prosperous area in Guangzhou, and the overall magnitude of its business cannot be underestimated.

The rapid development of Tianhe District has been achieved in a relatively short period of time. Initially, it was a suburban area of Guangzhou with barren land and only one airport. However, in preparation for the 6th National Games in 1987, the Guangzhou government constructed a massive new stadium on the city's outskirts. This move brought about significant changes in the area. Later, in 2010, Guangzhou hosted the Asian Games, during which the Tianhe stadium played a crucial role. The city government collaborated with a

design institute to create an urban design plan for Guangzhou's new urban median, which presented another significant opportunity for the development of the Tianhe District. The new urban environment not only boosted Guangzhou's GDP, but also transformed the Liuyun Community into a core area of the city(Fig. 4-2).

Fig. 4-2 Project surrounding analysis (Source:drawn by author)

Located at Tianhe South First Road, connecting Huangpu Avenue West to the south, TIyu West Road to the east and Guangzhou East Railway Station to the north through Tianhe Road, Liuyun Community is located in the core of Tee Mall, at the intersection of Metro Line 1 and Line 3. The site is rich in educational support, in addition to the Tianhe District Liuyun Kindergarten, Children's Welfare Association Kindergarten, Tiyu West Kindergarten, and also the counterpart of Tiyu West Road and Tiyu East Primary School degrees. The Liuyun Community referred to in this article is a neighborhood containing four open residential areas: Liuyun neighborhood, Tiyudong neighborhood, Tiyuxi neighborhood and Yulei neighborhood(Fig. 4-3).

Fig. 4-3 Location of Liuyun Community (Source:drawn by author)

When Liuyun Community was first established, the only available means of public transportation was buses. However, on June 28, 1997, Guangzhou Metro Line 1 was officially opened, greatly improving transportation in the area. Furthermore, the establishment of APM metro line and BRT transportation facilities further enhanced the transportation infrastructure, transforming the Tianhe shopping district into a hub for urban office workers (Fig. 4-4). Currently, the Tianhe Road shopping street attracts an average daily traffic of more than 1.5 million people, making it a prominent traffic core area.

Fig. 4-4 Metro Analysis of Liuyun Community (Source:drawn by author)

Fig. 4-5 Bus Analysis of Liuyun Community (Source:drawn by author)

4.1.2 History and Future Plan from Government

Liuyun Community is among the first open neighborhoods in Guangzhou and has gone through several development stages. Its history can be divided into roughly four stages(Fig. 4-6).

(1) 1980s Sixth National Games period.

The development history of Guangzhou Tianhe District is relatively short and can be traced back to the Sixth National Games held at the Tianhe Sports Center in 1987. To prepare for the games, the Guangzhou government began construction on a 5 square kilometer area near Tianhe Airport in 1984 to build the sports center and other necessary facilities. Liuyun Community was established as a residential area for the athletes participating in the Games, and was named after the Sixth National Games. The community primarily consisted of evenly laid out, multi-story residences of about 8 stories and did not have the commercial functions that exist today. Over the years, Tianhe District underwent a significant transformation from a large agricultural area to a core metropolitan area, with the Tianhe Sports Center now situated in the heart of a modern business district. Liuyun Community has become a valuable real estate resource in the urban core over time.

(2) 1990s period of rapid development of commercial housing.

Liuyun Community became the first in China to implement a pilot housing commercialization reform after the Sixth National Games. Within a few years, the property rights of the Sixth Games District changed from being held by units to individuals. Due to the rise of Tianhe District, the area became a fiercely contested real estate market. Owners of Liuyun Community had already opened smaller stores, attracting commercial funds to the area. In early 1992, real estate entered a golden age, and a development boom rose throughout China. The price of housing soared to a staggering degree, with newspaper statistics indicating that the price per square meter in Liuyun Community in 1992 was 1,800-2,000 yuan, and by 1993, it had rapidly increased to 6,000-7,000 yuan[38], a rate of increase as high as 300%-350%.

(3)2000s government's wavering attitude towards residential conversion to commercial practices.

Over the past decade, the rapid development of the Tianhe District has elevated Liuyun Community to become the city's core, significantly boosting its commercial value and attracting local and foreign investors to convert the ground floors of residential buildings into retail shops. As a result, by the year 2000, the ground floor of the Sixth Games District had

been transformed into a significant commercial space. However, this "housing to business" trend brought about several issues, which intensified the conflicts between residents and commercial tenants. In response, the government launched a 10-year reform process to resolve these issues.

In November 2000, Guangzhou City took the lead by banning "housing to business" in a notice issued by the Municipal Bureau of Industry and Commerce concerning business premises registration. However, in December of the same year, the Bureau of Industry and Commerce issued another document that relaxed the policy. Over the next two years, the government issued two additional policy documents in February 2001 and August 2002[39], further relaxing the policy.

The "Guangzhou Housing Rental Management Regulations" was implemented on May 1, 2005, which prohibited the use of non-commercial rental housing for commercial purposes, officially ending "housing to business". This policy change received significant media attention and sparked discussions among scholars and the community. However, relevant government officials noted the negative impact of the total ban and suggested that further evaluation was necessary, as reported on October 27 of the same year. It was also noted that the ban on residential businesses was unlikely to be eased that year[40].

On October 1, 2007, the "Property Rights Law of the People's Republic of China" came into effect, which requires the majority of owners to agree to "housing to business". In August of the same year, most of the commercial tenants in the Liuyun Community were considered special cases and allowed to continue operating.

In 2009, the Guangzhou Asian Games were approaching, and policies to prepare for the event encountered various obstacles. At the start of the year, the government suggested relaxing the "housing to business" policy, but in May, the Supreme People's Court issued interpretations requiring consent from all building owners for such conversions, further limiting the conditions. By October of the same year, the Guangzhou Municipal Government tentatively approved the "Opinions on the Implementation of the Work of Promoting Employment," resulting in another policy relaxation.

(4) 2010s Guangzhou Asian Games as an opportunity to transform and upgrade the period.

The Sixth Games district, due to Liuyun Community's commercial potential, was a prime area for development. The opportunity for growth became even greater with the 2010 Guangzhou Asian Games, which were hosted in the area's Tianhe Sports Center. As a prominent location on the city's central axis, the district was crucial for showcasing Guangzhou's urban image.

The Tianhe District Government recognized the importance of improving the overall image and began investing over 200 million RMB in August 2009. They renovated Liuyun Er Street, which is closest to the central axis, to look like a European-style commercial pedestrian street, which was used as a model for renovating the district. In a year's time, the residential buildings' exteriors gradually changed to a brick-pink color with a light beige façade, and many buildings' exterior windows were replaced. Downstairs signs were given uniform dimensions, and many buildings along the street had their bottom two floors designed as podiums with corner staircases. In 2018, elevators were added to many of the district's buildings to provide ease of access for the elderly.

The government's policy on "housing to business" showed a trend of gradual relaxation during this period. In June 2015, the State Council issued the "Opinions on Several Policy Measures to Vigorously Promote Mass Entrepreneurship and Innovation", which explicitly supported localities in relaxing restrictions on newly registered business premises based on actual conditions. The release of this central document suggested that the government would continue to adopt a relaxed policy towards "housing to business" for several years.

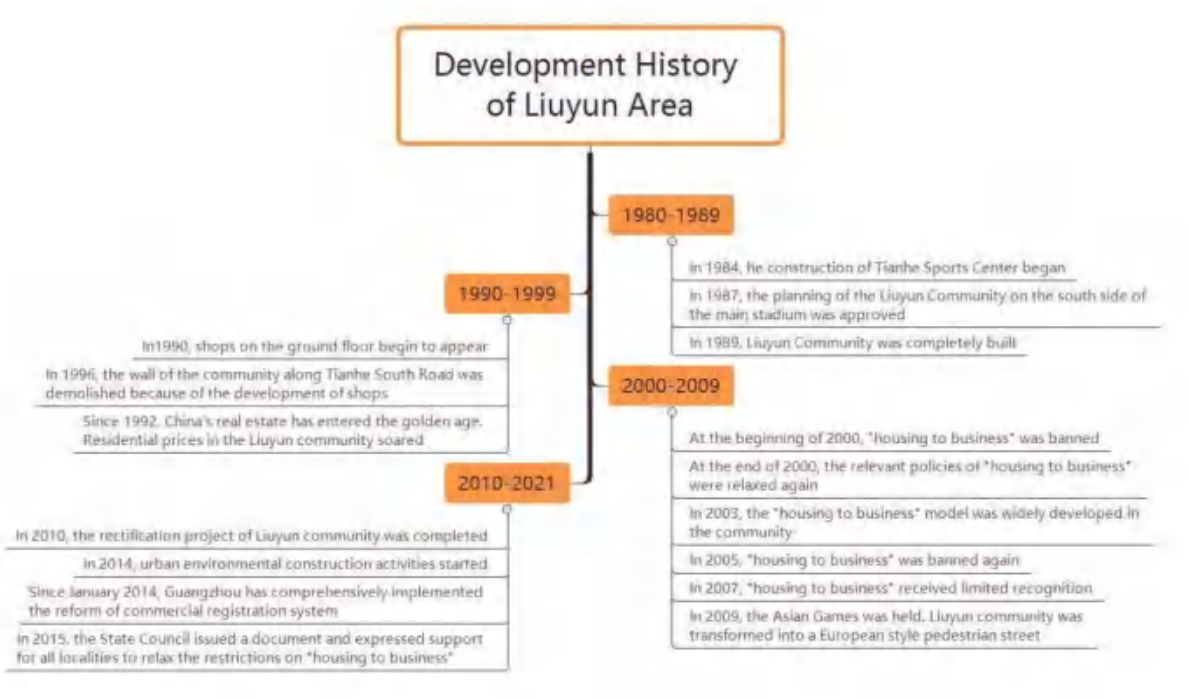


Fig. 4-6 History of Liuyun Community (Source:drawn by author)

4.1.3 Population

Liuyun Community consists of four residential clusters and covers an area of approximately 0.23km^2 . The population density here is high in the city, with an average of 300 households per hectare and a current residential population of 17,618 according to 2014 government data. The overall plot ratio is about 2.6. The commercial function of Liuyun Community attracts a large number of people, resulting in significant foot traffic.

Over the past 30 years, the proportion of occupants has changed considerably, with an increasing percentage of foreign users since 1995. Data from government documents shows that the proportion of foreign users has increased from about 12% in 2000 to 35% in 2010. Tenants make up a significant portion of this population. Due to soaring housing prices, the ratio of tenants to second home buyers who move in has reached more than four times[42] . Most landlords in the community rent their houses to young and middle-aged people who work in the neighborhood and value convenience. According to the author's survey, the majority of tenants who work in the neighborhood have a lease term of less than three years, while a small number of them have a lease term of three to five years.

The current demographic situation has many reasons, but policy and market economy have a dominant influence. Before 1995, housing ownership was managed by the unit, which meant renting was not possible. At that time, the residents in Tianhe District were mainly state-owned enterprise employees. With the introduction of property certificates, individuals gained the right to use their properties as they pleased. Some residents saw the market interest and began to rent or sell their houses when prices were high, while others converted their houses into stores for business or rent, optimistic about the business conditions of the stores on the ground floor. After 2000, the market completely regulated house sales, and "residential to commercial" became a common phenomenon. Government agencies intervened with various decrees, but the unique commercial atmosphere of Liuyun Community made it a popular consumer mecca for nearby citizens, and its opening trend is unstoppable. In the last two years, the upcoming renovation of Liuyun Community has caused the selling price of the area to skyrocket. The selling price of houses rose from 50,000 to 70,000 per square meter in 2019-2020 alone, an increase of about 60 percent[43] (Fig. 4-7).

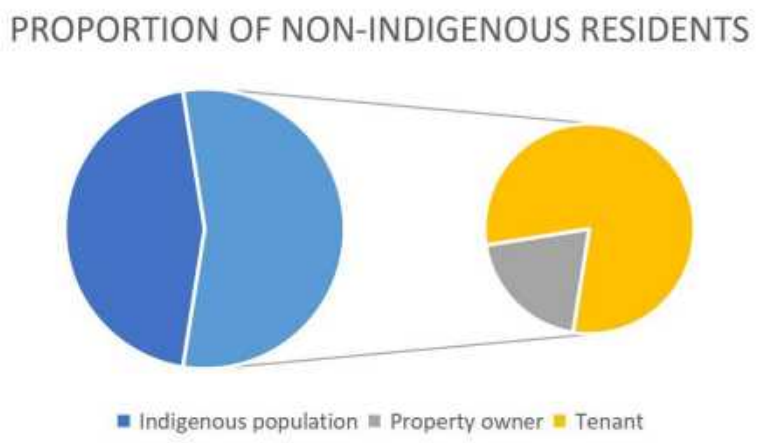


Fig. 4-7 Population Proportion of Liuyun Community (Source:drawn by author based on Government Data)

Looking at the situation from a market economy perspective, it appears to be a win-win situation where the newcomers benefit from a prime location, and the original residents receive rental income. However, the rising number of short-term occupants has created new challenges for the management and daily life of Liuyun Community. As the "residential to commercial" phenomenon initially caused confusion, the property company enlisted the help of a third-party owners' committee. Unfortunately, with the majority of the previous occupants having left, the elderly committee members and new tenants are struggling to fulfill their roles adequately. Therefore, it is important to contemplate how to foster reasonable self-governance within the community and sustainably renovate the public open spaces.

4.2 Analysis of children's behavioral activities in Liuyun Community

4.2.1 Activity Space of High Frequency Use

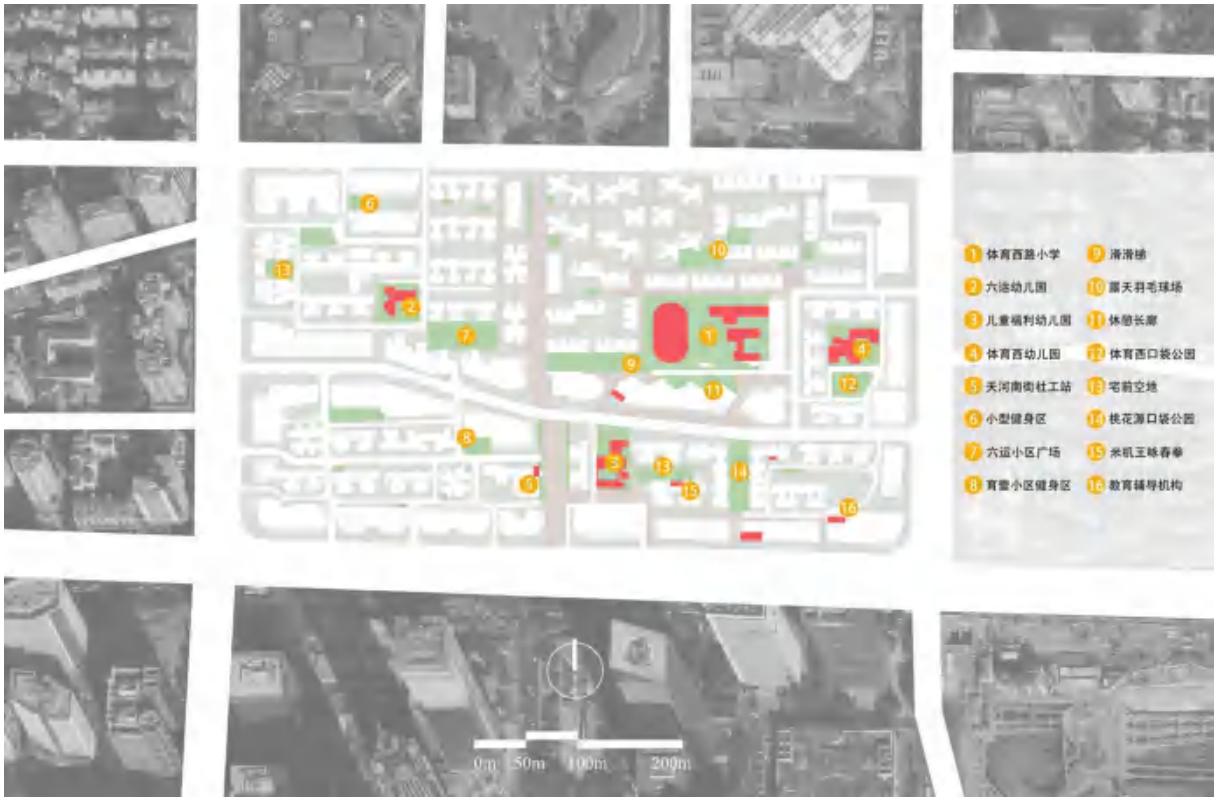


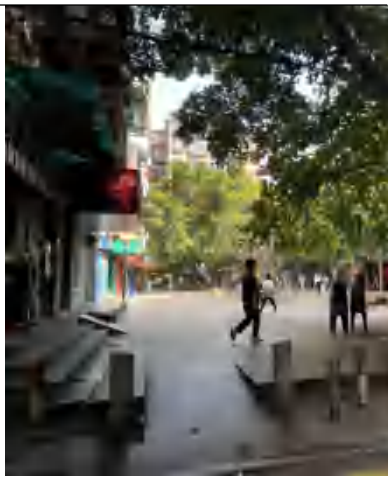
Fig. 4-8 Current location of children's high frequency use of space (Source:drawn by author)

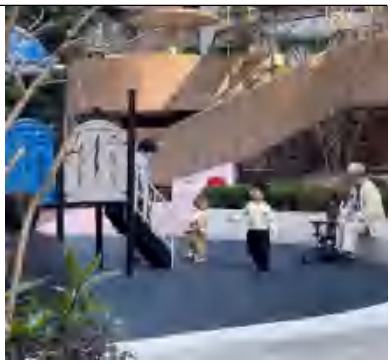
We found that on school days, the most frequent destinations for children in Liuyun Community included kindergartens, schools, department stores, community parks, and childcare classes; on rest days, the most frequent destinations for children were after-school interest classes, Zhengjia Plaza, green parks, and department stores(Fig. 4-8). Through categorization, children's travel destinations can be roughly divided into educational institutions, outdoor playgrounds, medical and health care, and commercial consumption categories. The current situation of collation is shown in Table 4-1.

Therefore, when planning travel routes, we can consider respecting children's intention paths for dense areas and observe their preferred routes, while for more distant areas For more distant areas, the design of the path should be based on accessibility and safety considerations. For example, for educational institutions, the optimization of the surrounding streets should focus on traffic control and other means to improve safety, but for outdoor play areas, the streets should focus on the comfort of children's travel, such as setting up seats every 50-100 meters for children to stay or wait.

Table. 4-1 Current situation of children's high frequency use of playground (Source:drawn by author)

Type	Name	Content	Problem	Photo
Educational Institutions	School	Gathering for chatting, waiting for, and Biking or walking to school	Lack of signage for children, insufficient waiting space, too narrow space for distribution at the school entrance, insufficient fun elements	
	Kindergarten	playing games, or running and playing Waiting	Lack of signage for children, insufficient waiting space, insufficient fun elements	
	After School Interest Classes	Gathering and talking,waiting，Skill training	Used after school and on weekends, scattered	
	Child Care Classes	Playing games, gathering and chatting, Waiting for parents	Only used at noon and after school rush hours, scattered within a five-minute walk around the elementary school	

Outdoor playground	Little Square	Gathering and chatting, playing games, staying and resting	The area of the site is small, non-motorized vehicles are parked indiscriminately, the facilities in the site are not complete and cannot meet the needs of children of different ages, the pavement is dilapidated, the floor tiles are damaged, and there are few resting seats	
	Greenland Plaza	Gathering for snacks, chatting, playing, homework, resting, waiting for parents	The green space is too closed, the enclosure exceeds the height of the children, lack of street furniture for staying and learning	
	Plaza next to West Sports Road Primary School	Gathering and chatting, riding bicycles, roller skating, climbing furniture along the street, waiting and resting, watching the elderly play chess and mahjong, etc,	Scattered play facilities, lack of interesting elements, lack of street furniture for staying and resting	
	Plaza of Yulei District	Gathering and chatting, group games	Lack of facilities for children, lack of street furniture for staying and resting	

	The open space in front of the house near the kindergarten	Using game facilities, running and playing, doing homework	Lack of street furniture for staying and resting, lack of facilities for children to play	
	Community badminton court	Playing badminton, playing house, gathering and chatting	Too single recreational facilities and small site area	
	Playground next to West Sports Road Primary School	Playing slides, gathering and chatting, waiting	Single recreational facilities, small site area, lack of variety in play path design	
Medical and Health	Community health clinic	Getting vaccinations and going to the doctor with an adult	Lack of waiting space, wood or warm colors can be used to reduce children's anxiety	

Commercial Consumer	Dining	Eating and resting alone or in a group	Few seats for resting, lack of barrier-free design, inconvenient to push strollers up and down the steps	
	Department stores, small stores	Shopping alone or in groups, staying and talking, waiting in line	Single type of commercial business along the street, poor transparency of façade	

4.2.2 Children's daily Routes

The travel routes of children on school days and rest days are shown in Fig. 4-9 and Fig. 4-10, and it is found that: on school days, the routes of children are between school, home and the community park, and the routes are concentrated; on rest days, the routes are between home and the nearby tutoring institution and venues outside the community, and the travel routes of children are expanded and more dispersed;

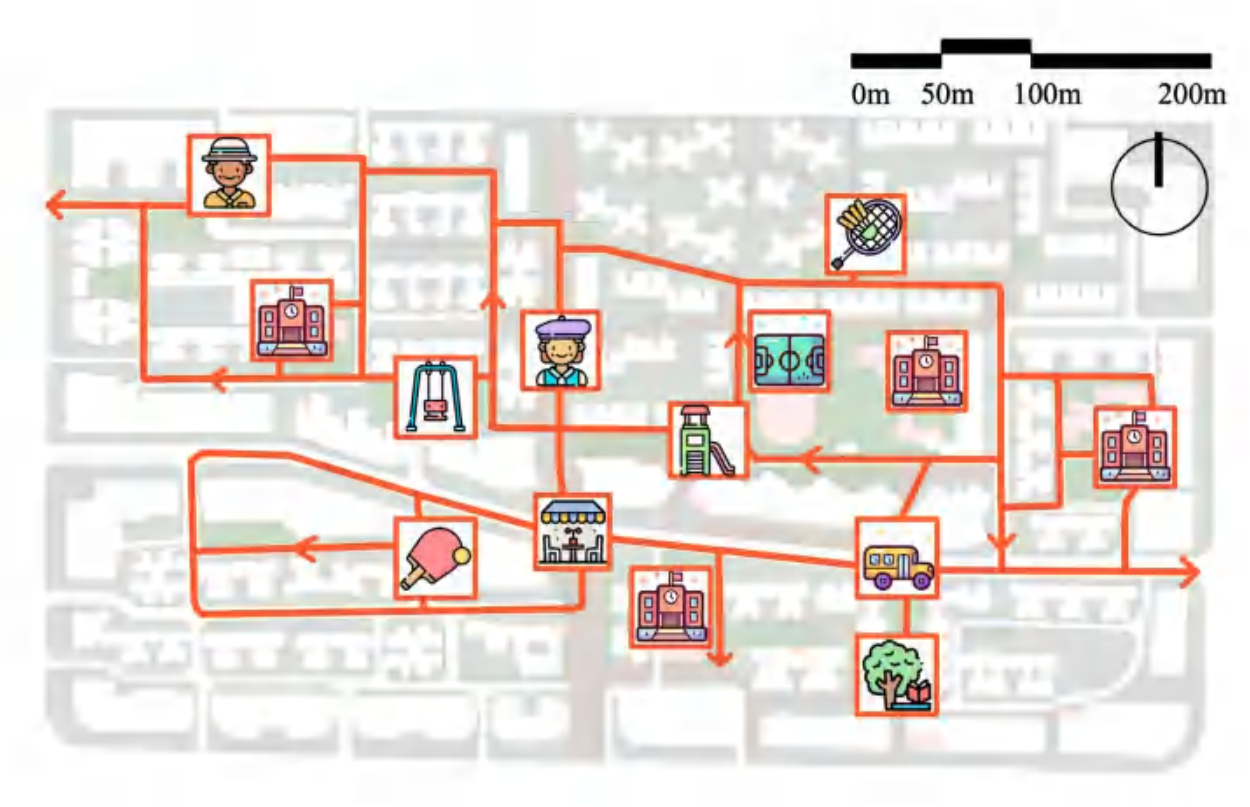


Fig. 4-9 Children's daily routes-school day (Source: Drawn by Author)

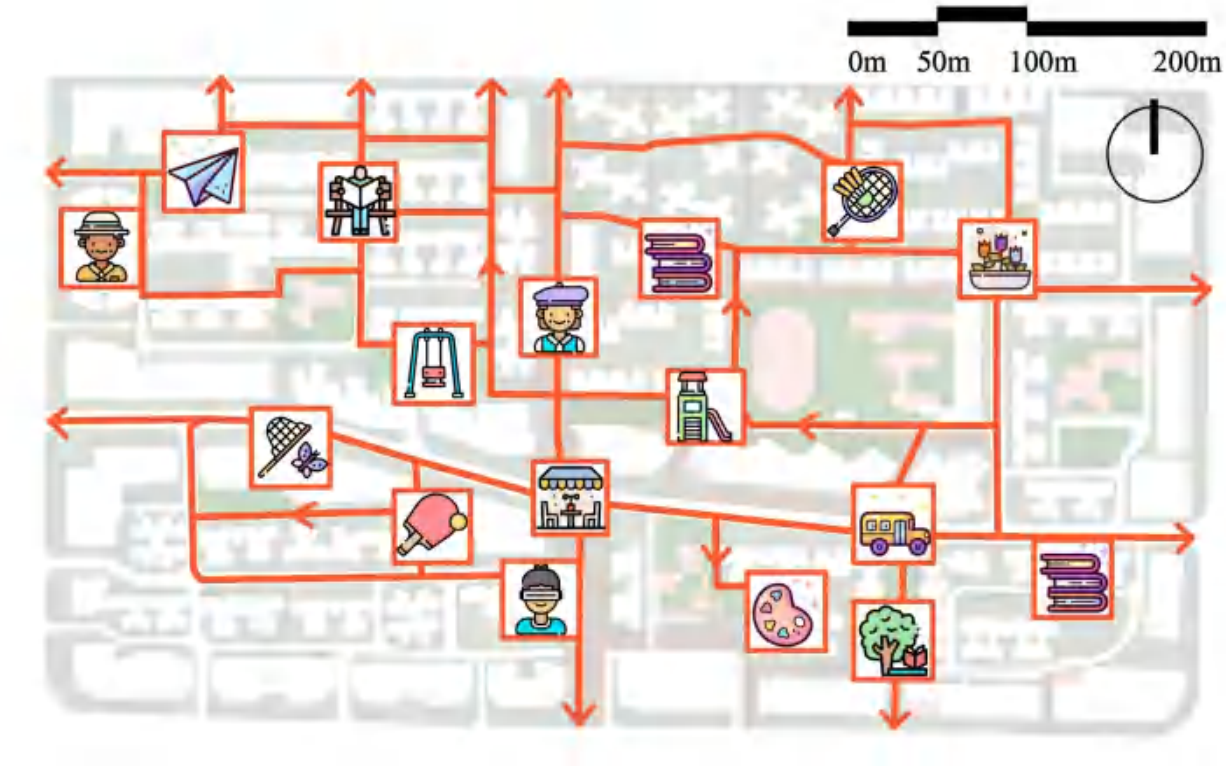


Fig. 4-10 Children's daily routes-weekend (Source: Drawn by Author)

4.2.3 Types and characteristics of children's public space activities

Fig. 4-11 Types of outdoor activities of children (Source: Drawn by Author)

The types of children's activities investigated in this paper are based on Sara Smilansky's 4 forms of play theory, supplemented by reference to Alexandra A's research on the types of activities that occur in children's streets[44] is supplemented by classifying the observed activity behaviors of children into two main categories: play behaviors, non-play behaviors(Fig. 4-11), and subcategorizing them according to the content of the specific

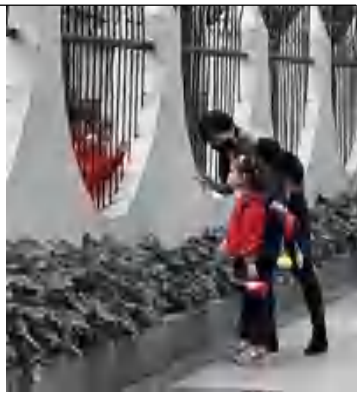
activity occurring as Sport games, functional games, constructive games, imaginative games, rule games, watching behavior, random activities, challenge adventure, rest activities, commercial activities, nature exploration, animal healing and communication behavior, with 13 subcategories(Table 4-2) .

Table. 4-2 Types of outdoor activities of children (Source: Drawn by Author)

Type I	Type II	Description	Activity	Photo
Game behavior	Sports	The child performs a variety of physical activities or participates in sports such as ball games or games of chance through appropriate facilities or equipment	Playing basketball, badminton, scooters, bicycles, jumping rope, jumping and running, etc.	
	Functional Games	Engaging in simple or repetitive muscle movements or playing with an object in a fixed manner, with or without the use of objects, such as running, throwing an object back and forth several times, playing with an object in a fixed manner, etc.	Chasing back and forth, playing with fallen leaves, branches and stones on the ground, playing with seesaws, slides, bubble blowers, rocking chairs, gym equipment, toys, swings, rails, talking with partners, playing in pairs, etc.	

	Constructive Games	Purposefully constructing or making something, such as purposefully playing with blocks, shaping sand, playing with clay, and reorganizing materials on the floor	Play with sand, clay, building blocks	
	Imaginative Games	Role-play or transformation involving imaginative processes such as play house	Playing house, pretend gun battle	
	Rule games	Games with certain rules, which may be set by the children themselves or may be rules that have already been formed and which the children must accept and follow in order to engage in such games, such as hide-and-seek, eagle-catching chicks, etc.	Sandbag throwing, playing cards, hide-and-seek, playing UNO	
Non-gaming behavior	Watching Behavior	Watching others play, but not participating in the game themselves.	Observing other people's games, observing basketball on the court	

	Random activities	To engage in random and casual activities without any purpose	Hanging out, dancing with hands, spinning, waiting on the sidelines, picking plants with hands	
	Challenge Adventure	It is a kind of behavior to know one's courage, endurance, and ignore the rules, such as climbing the railing, sliding down the ramp over the railing, etc.	Climbing chairs, climbing trees, walking on the edge, sliding down ramps, reversing up slides, climbing singles, climbing railings, standing up on swings	
	Rest activities	Behavior necessary to meet the needs of bodily functions such as resting, eating, reading, etc.	Watching, sitting still, eating, doing homework	

	Commercial activities	Behaviors resulting from commercial activities, such as buying and manipulating goods	Shopping	
	Nature Exploration	Children getting close to nature, exploring, observing, studying plants or cultivating plants	Touching rocky soil, smelling plants, observing plants, watering plants	
	Animal Healing	Children get close to animals such as kittens and puppies and communicate and play with them	Petting kittens, playing with puppies	
	Communication Behavior	Behaviors such as talking and shouting	Shouting, talking, whispering, arguing	

4.3 Research on public space in Liuyun Community from a child-friendly perspective

4.3.1 Space Construction

Table. 4-3 Types of outdoor public space in the Liuyun community (Source: Drawn by Author)

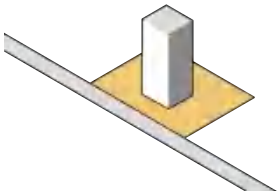
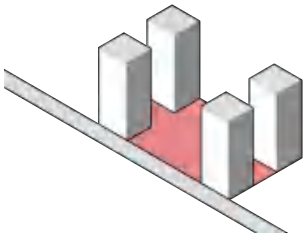
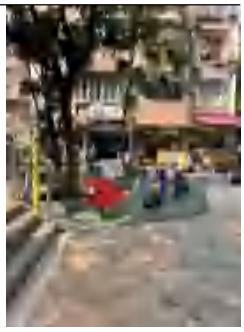
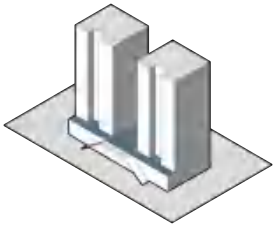
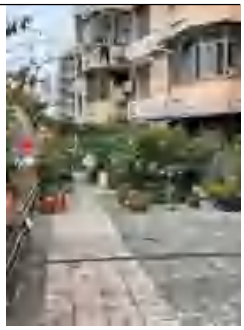
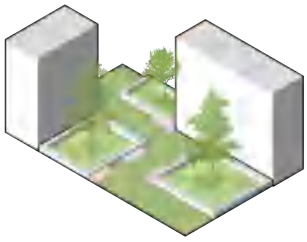
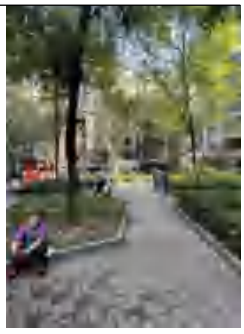
Type	Usage Status	Activity Mode	Photo
 Street side clearing	This type has wide distribution and small area, prone to occasional activities of children but lack of maintenance and inadequate facilities	Playing badminton, playing with scooters, jumping rope, jumping and running	
 Enclosed vacant space	This type is large and regular in scope, and is a gathering place for children and their guardians, but lacks variety of facilities and resting seats.	Chasing back and forth, playing with slides, playing with exercise equipment, playing with toys, playing with swings, talking with partners	
 Podium roof	The ground floor of this type is basically commercial, with more open space and independent greenery for residents, but lack of infrastructure.	Playing cards, hide-and-seek, playing UNO, observing plants, watering plants	
 green space	This type has high natural coverage, but does not have interactive properties and lacks resting seats.	Wandering, picking plants, resting, chatting with partners	

Fig. 4-12 Distribution map of public space types (Source: Drawn by Author)

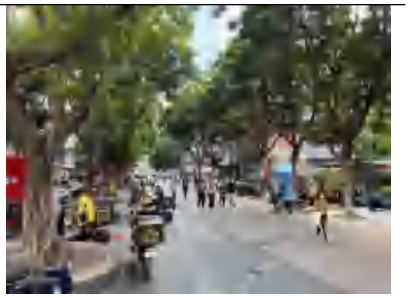
As shown in Table 4-3, the outdoor public spaces in the Liuyun community can be divided into four types, Street side clearing, Enclosed vacant space, Podium roof, and green space, which carry different patterns of children's activities. The distribution of these types within the community is shown in Fig. 4-12, with Street side clearing being the most numerous and Enclosed vacant space and green space being less numerous.

4.3.2 Route Construction

(1) Types and characteristics of street space

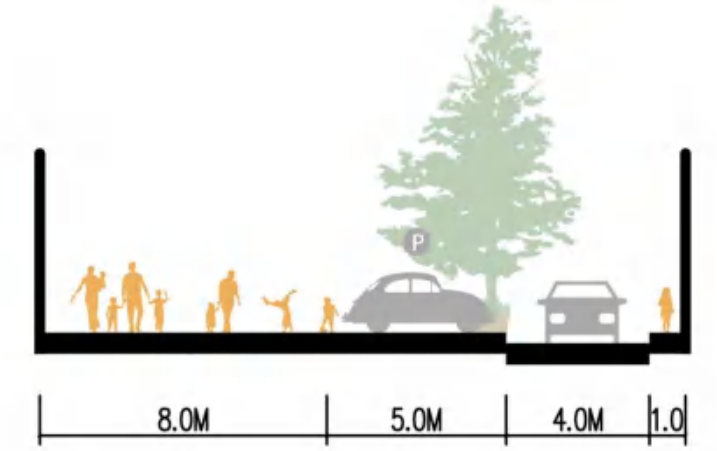
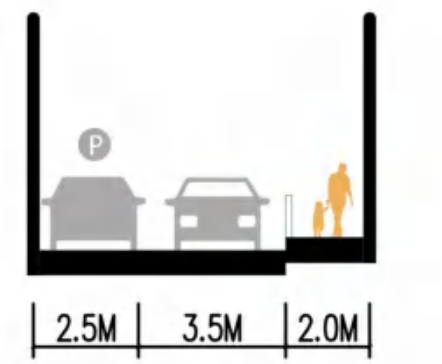
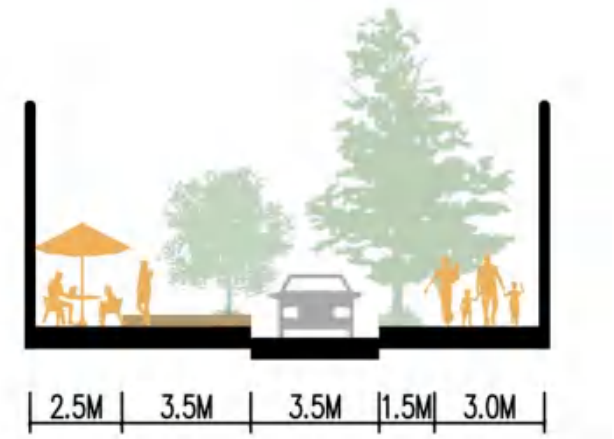
Children's activities on the street are not only influenced by the function of the buildings and ground floor use along the street, but also related to the spatial and functional structure of the neighborhood. Therefore, the same road, despite the same grading, should also change its cross-sectional design as it traverses different functional areas. Taking into account the interaction along the street, street space landscape features and traffic functions, we can classify the streets of Liuyun Community into five major types: traffic streets, life service streets, landscape and leisure streets, commercial streets and comprehensive streets according to the classification standard of Shanghai Street Design Guidelines(Table.4-4).

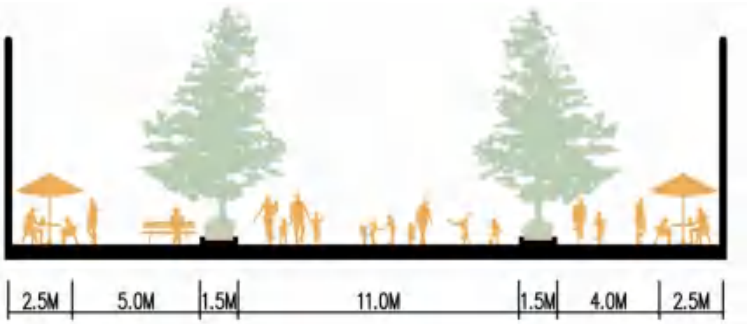
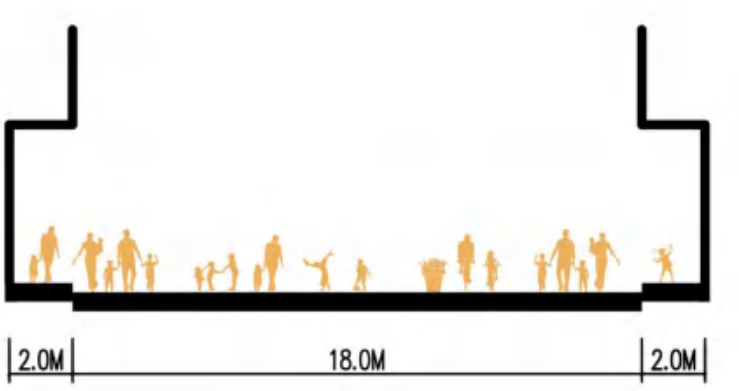
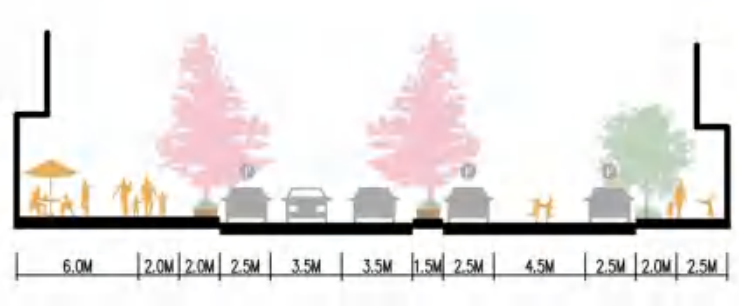
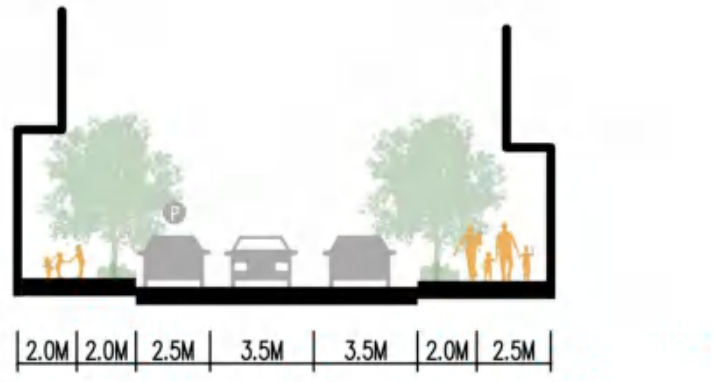
Table. 4-4 Street types in Liuyun Community (Source: Drawn by Author)

Type	Description	Photo
Traffic-oriented street	Emphasis on traffic characteristics as the main factor, non-open street interface along the line is dominant, and the speed of traffic is high	
Live and leisure street	Commercial and public service facilities, including convenience stores, barber stores, small and medium-sized retail and restaurants, are mainly provided for local residents along the streets.	
Landscape and leisure street	There are parks, green areas and other open spaces along the streets with concentrated leisure facilities	
Commercial street	Streets with commercial service facilities mainly for restaurants and retail, with certain service level and business characteristics	
Comprehensive street	Street function type and interface type with two or more types of characteristics, supporting a variety of mixed street services	

(2) High frequency use of street cross-sections

Table. 4-5 Sections of street in Liuyun community (Source: Drawn by Author)

Type	Name	Section
Live and leisure street	Tianhe South Community Street（Close to Tiyu West Road Primary School）	
	Liuyun 1st Street（Close to Liuyun Kindergarten）	
	Yulei Community Street	

Landscape and leisure street	Tianhe South Pedestrian Street （Southern Section）	
Commercial street	Tianhe South Pedestrian Street （Northern Section）	
Comprehensive street	Tiyu West heng Road （special）	
	Tiyu West heng Road （regular）	

(3) Analysis of traffic flow and children's behavior on high-frequency streets

Except for Sports West Cross Street (urban bypass), which has the main traffic function, and Tianhenan Pedestrian Street, which is mainly a commercial street, the other streets in the area have the main function of living and interacting with each other, and the traffic function is supplementary, and are generally narrow and pedestrian-oriented.

The motor vehicle flow, non-motor vehicle flow and pedestrian flow of the main streets in the study area were counted every 5 minutes during school hours and non-school hours, respectively, and were obtained as shown in Tables 4-6:

Table. 4-6 vehicle volumes and pedestrian volumes statistics

Road	Motor vehicle flow		Non-motorized traffic		People flow		Child Behavior
	School hours	Non-school hours	School hours	Non-school hours	School hours	Non-school hours	
Tiyuxi West Road	39	28	83	64	179	25	Vehicle traffic, children playing along the street
Tianhe South Pedestrian Street	0	0	75	53	198	141	Passing to and from school, stopping and playing
Liuyun 1st Street	3	1	17	12	87	63	Kindergarten children passing to and from school, stopping and playing, parents waiting
Liuyun 3rd Street	0	0	77	30	105	47	Shopping and playing in stores
Yulei Community Street	0	0	18	6	45	20	Elementary school children passing to and from school, chatting and playing, parents waiting
Tianhe South Community Street	0	0	47	6	326	46	Large activity during school hours, mostly passing, accompanied by short stops

4.3.3 Acitivity Construction

Guangzhou Tianhe South Street Social Work Service Station (Family Integrated Service

Centre) is a professional social work service platform built by the government through the purchase of services, established in July 2012 with an area of 650 square metres. Based on the needs of the residents in the district, the station provides remedial, preventive and developmental professional social work services by relying on the professional advantages of social work and applying the professional approach of social work.

Since January 2019, the Kai Chi Social Work Centre has been in operation to better serve the social groups in need with the service mode of "social worker + volunteer". Under the leadership of Party building, six comprehensive services are provided to residents in the district, including Party building services, employment services, youth, family, elderly and special services.

From January to April, the Tianhe South Street Social Work Station organised a total of 94 activities for community residents, volunteers, children under 12 years of age, families of families with severe disabilities, general and special youths, elderly people, groups in need, party organisations, enterprises and workers in the district, and so on. The number of activities is gradually increasing. Among them, there are 30 family and youth service activities (pictured), accounting for about one-third of the total activities(Fig.4-13).

Fig. 4-13 Activities around family and youth (Source:drawn by author)

In addition to research, regular visits and family support, the activities for children and young people up to the age of 12 are centred on special festivals, crafts, sports and skills training, as described below (Table 4-7).

Table. 4-7 Community related activities for children from January to April (Source:drawn by author)

Events Name	**Time**	**Overview of activities**	**Events Object**	**Recruiting Number of people**	**Events Location**
Mindfulness Backyard Workshop	Mid-month	Provide psychological support and emotional counselling for carers of	Families of families with severe	6-12 people	Social Work Stations

		families.	disabilities in the district		
Visits, electric visits	Monthly	Volunteers are organised to make regular telephonic visits and visits to families in need in the community .	Families in need in the area	Several	Community
You and Me - Spring Flower Cutting Activity	14 January, 15:00-17:00	Young people from the community were organised to join in the Chinese New Year activities.	Special Youth in the Community	10-20 people	Social Work Stations
Play with You - Children's Board Game Group	Under 2.1/2.2/2.3 15:00-16:30	Experience the world of board games, teamwork and improve interpersonal skills.	Jurisdiction Children aged 6-12 years	12 people	Social Work Stations
Lantern Festival Activities	2.4 14:30-17:30 pm	The festival was a fun celebration of the Lantern Festival with riddles, crafts and interactive games.	Households in the area	Not limited	Social Work Stations
Research	February	Design and implement services for the new year according to the needs.	Families in the area	Not limited	Tianhe South Street Jurisdiction
"Youth Table Games Competition	25 February, 15:00-17:00	Develop mind and use strategies to win games, enrich after-school life.	General youth in the jurisdiction	10-20 people	Social Work Stations
Running with passion and youth - Fun Games	18 February, 15:00-17:00	Experience the fun of teamwork in sports, fun games take you to sweat, release youthful energy.	Special young people in the area	10-30 people	Social Work Stations
Children's street dance work you	4 March/18 March 14:30-16:00	Tapping into children's physical potential, developing a basic sense of rhythm.	Children aged 9-12 years old in the district	12 people	Social Work Stations
Children's Ball	Every	Volunteers from the	Children aged		Social Work

Building Workshop	Saturday from 4 March 14:30-16:00	Collegiate Ball Building Association teach, exercise physical fitness, learn ball building skills.	6-12 years old in the district		Stations
Ukulele Workshop for Children	Every Saturday from 4 March 14:30-16:00	A small ukulele lesson is available for beginners, with one session per week.	Children aged 6-12 years old in the district		Social Work Stations
You and Me - "Crafty Block Flower" Youth Craft Activity	18 March, 15:00-17:00	By making block flowers, we help to promote more community involvement among young people in the community.	Special youth in the community	10-30 people	Social Work Stations
Community research activities for young journalists	11 March, 14:00-17:00	Recruiting young people from the community to participate in the community activities of the young journalists.	Community Youth	10-15 people	Social Work Stations
Working Together for Happiness - Tianrong Secondary School Volunteer Service Special Programme Group 1	7/14/21/28 March 16:00-17:00	Students will be led by social workers or volunteers in the planning and practical participation of volunteer services, and will be able to practise their various skills in volunteering.	Community Youth	10-20 people	Social Work Stations
"Arbor Day Theme Activity "Planting Spring Trees - Enjoying Green Fun	20 March	Activities such as environmental education and DIY hand bouquets were led by university volunteers.	Children aged 6-12 years old in the district	10-20 people	Social Work Stations
Friendship -	1/15/29	The youth in difficulty	Special Youth	10-30	Social Work

"Home of Love" Special Education Counselling Programme	April 15:00-17:00	are given hands-on practice to promote their socialisation and to help them improve their emotional management skills.	in the Community	people	Stations
Working Together for Happiness - Tianrong Secondary School Volunteer Service Special Programme Group 2	4/11/18/25 April 16:00-17:00	The social worker brothers and sisters will lead the youngsters to understand the process of volunteering, plan the volunteering programme and practice the volunteering activities.	General youth in the community	10-20 people	Social Work Stations
Starry Dream Senior Service - Youth Volunteering Workshop	8/22 April 15:00-17:00	To enhance young people's ability to volunteer for the elderly by taking them on outings to visit and accompany them.	General youth in the community	10-20 people	Social Work Stations
Workshops for Future Young Journalists	April 1/8/15/22 from 14:30-17:00	The young journalists were led by university volunteers to report on the beauty around them through interviews.	General youth in the community	20 people	Social Work Stations

Through on-site research, interview surveys and official access to event information, it is possible to conclude that the community has several problems with the construction of event operations.

（1）Due to the lack of outdoor space, more than 90% of the children's activities organised by the community are held in the social work stations, so the activities usually have a capacity of only 20 participants and are limited in the way they are conducted.

（2）The activities are aimed at residents and families in the community, with the minimum age being 6 years old, and no recreational training activities have been carried out in collaboration with the relevant units for children aged 3-6 years in the district.

（3）Apart from the children, most of the participants were university volunteers or young

social workers, and little consideration was given in the planning of the activities to the interaction of children of different ages and intergenerational activities.

（4）The activities are not comprehensive and mostly consist of educational promotion, handicrafts and skills development, but not in outdoor literacy, pro-nature exploration and science awareness.

4.3.4 Policy Construction

The highest graded road within the design area of the Liuyun Subdivision is Sports West Cross Street, an approximately 650m long east-west community slip road. The conventional section of the road slab is 9.5m wide and contains a 2.5m wide on-street parking space and a 7m wide single lane in both directions. The street connects to Sports Road West on the left and Sports Road East on the right and carries the main traffic function of the study area. There are no corresponding speed limits or warning signs for children crossing the street along the street.

In terms of hardware configuration, there is a mini fire station in the community of Tianhe South Street Sports West. In terms of ideological propaganda, the community linked up with Lam Wo Fire and Rescue Station in April to conduct fire safety training for social workers and residents. Firstly, we explained the knowledge about fire safety, including understanding fire fighting equipment, how to prevent fire, means of escape from fire and good tips for fire fighting. Secondly, the steps and methods of using fire extinguishers and filtered fire breathing apparatus were explained in detail, and doubts were answered. Finally, the Fire and Rescue Station led residents to conduct fire drills outdoors so that they could further master the use of fire extinguishers and techniques as well as understand the precautions in the process of using them through practice (Fig. 4-14).

Fig. 4-14 Indoor lectures and outdoor drills on fire safety

（Source: https://mp.weixin.qq.com/s/dv_8jeHTuMn8x2UZG8Gxuw）

4.3.5 Neighborhood Culture Construction

The setting up of community events is important for enhancing community cohesion and

communication among residents. For this purpose, communities often organise various activities in conjunction with traditional holidays, such as the Chinese New Year and Lantern Festival, thereby motivating residents to participate and increasing interpersonal interaction and neighbourly support. These events usually include celebrations, cultural performances, interactive activities and so on, and are very rich and varied(Fig. 4-15).

In addition, the community also conducts detailed research to understand residents' suggestions and requests for activities to be carried out, and organises targeted activities, such as biscuit baking. These activities meet the needs of residents of different ages and interests, and also help them to get to know each other better.

Recently, the community has also launched activities between the youth and the elderly, setting up youth volunteering workshops to encourage intergenerational exchanges. Through outings to visit the elderly and accompany them in recreational activities, we help young people integrate into the community and promote mutual understanding and communication between generations, while also enabling them to learn more knowledge and skills.

Fig. 4-15 International Day for Protecting Consumers' Rights themed events on site

（Source: https://mp.weixin.qq.com/s/HBr8KI6G55AtTDJzFv-RgQ）

4.4 Summary

This chapter conducts a comprehensive research on Liuyun Community. Three main aspects Liuyun Community were studied, including the general community situation, the analysis of children's behavioural activities in the community and the details of the construction of the dimensions of the community's public space.

Chapter 5 Evaluation of Public Space in Liuyun Community Under Child-friendly Evaluation Criteria

5.1 Evaluation Framework

The child-friendly evaluation is divided into two parts: indicator evaluation and user evaluation. The evaluation of indicators adopts the AHP method to construct the evaluation criteria of child-friendly community public space indicators and to score them. The user evaluation uses questionnaires and interviews to survey children and parents in Liuyun Community to obtain their evaluation and demand expectations of the public space in Liuyun Community from a child-friendly perspective(Fig.5-1).

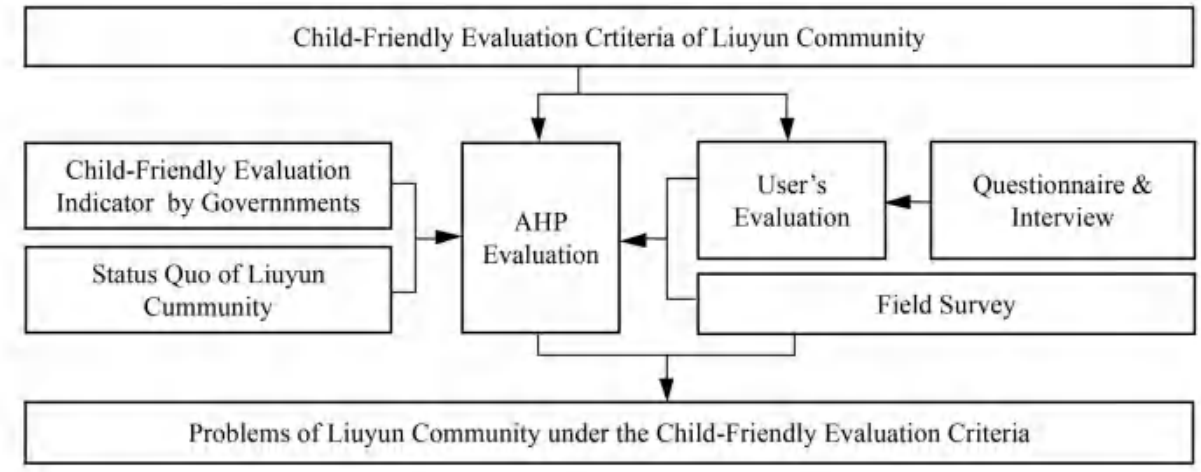


Fig. 5-1 Evaluation Framework (Source: Drawn by Author)

5.2 Child-friendly Indicator Evaluation Construction

5.2.1 Construction Process

The evaluation of child-friendly community public space contains many elements, and the needs of different groups are involved and interrelated. Therefore, it needs to be studied and analyzed in a scientific and rational quantitative way to assist in analyzing the problematic areas of the site. The hierarchical analysis (AHP) method is a systematic and convenient way to measure the overall evaluation problems that are difficult to quantify or have multiple levels and interlocking indicators, and to calculate the weight values of each evaluation index factor based on the data from research, scoring, and judgment, and then to rank them, and finally to arrive at a reasonable comprehensive analysis of the data by means of fuzzy numerical measurement. Therefore, it is the ideal choice for evaluating the child-friendliness of community public spaces(Fig.5-2).

The method is a systematic hierarchy of complex objects, which is decomposed into target, criterion and several indicator layers, and grouped according to the interrelationship, logic and

affiliation of the indicator factors, forming a multi-level and progressive structure. After that, the experts score the indicators at each level by two-by-two comparison, and quantify the importance difference between each indicator by numbers, and finally calculate the eigenvalue and eigenvector to obtain the weight value of each indicator factor (Research and application of AHP-based fuzzy comprehensive evaluation method[45] (Fig.5-3).

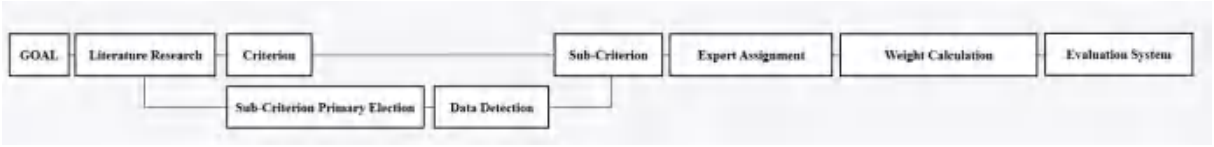


Fig. 5-2 AHP Process (Source: Drawn by Author)

(1) Determination of Criterion and Sub-Criterion: 1 primary selection through policy papers and other materials, 2 selection based on evaluation of primary selection factors by survey respondents such as experts in the field of children, scholars and experts engaged in the field of architectural planning, students, children and parents residing in Liuyun Community;
(2) Determination of Criterion weights: two-by-two judgment matrix, experts and parents fill in the judgment matrix to determine the weight of each factor
(3) Evaluation Results: the situation of each factor is controlled by grading, and the results of multiplying the average score of the factor and its weight are obtained, and the evaluation results of each standard layer are finally obtained after linear weighting.

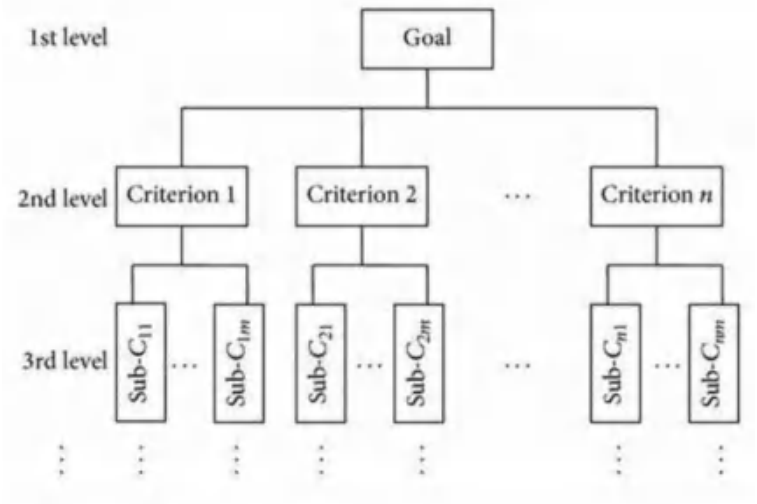


Fig. 5-3 AHP Framework (Source: Drawn by Author)

5.2.2 Criterion

According to the evaluation criteria of community public space indicators from the child-friendly perspective of each country in Chapter 2, diversity, accessibility, safety, comfort, naturalness and participation are selected as the criterion in this paper.

5.2.3 Sub-Criterion

1. Primary selection.

The authors collected information from the theoretical studies mentioned in the previous section, and came up with the following evaluation factors for child-friendly community public spaces. Combined with the actual situation of the research in Liuyun Community, the factors that were not suitable for our national conditions were filtered and those that were not consistent with the theme of this thesis were deleted. 37 evaluation factors were finally selected and categorized according to the evaluation criterion layers identified above(Table.5-1).

Table. 5-1 Primary selection of Sub-Criterion (Source: Drawn by Author)

Criterion	Sub-Criterion
Diversity	1. Spatial diversity: The space is diverse and rich in form, size, and static and dynamic attributes, allowing for different amounts and types of activities to occur 2. Variety of activities: Spatial elements encourage and stimulate a variety of children's play, including social and physical play, formal and informal play 3. Variety of ages: public spaces allow children and adults of all ages to gather for activities 4. Variety of facilities: Different kinds of play facilities are available 5. Cultural diversity: Respect for cultural diversity, with cultural or festivals and events in which children participate
Accessibility	6. Balanced spatial distribution 7. No need to cross complicated traffic environments such as urban arteries 8. There are paths and signage systems for children only 9. Roads and spaces with barrier-free design 10. Short walking time 11. Space entrance is eye-catching and easy to enter
Safety	12. Space safety: children's activity space without sharp edges and angles, with elastic protection layer to prevent fall damage 13. Space boundary: the space has a certain boundary, and vehicles cannot enter directly 14. Visual penetration: The play space has good visual penetration, which enables adults to effectively supervise children's play behavior. 15. Neighborhood surveillance: residents should be able to overlook the shared space between residential buildings and monitor them 16. Mixed-age coexistence: provide places where adults can rest and observe their children at play

	17. Neighborhood solidarity: If children are out of the house and in danger or in danger, someone will be there to help them 18. Site safety: keep the site away from traffic and keep the area frequented by children and youth away from heavy traffic 19. Path safety: to ensure that children's daily routes have easy to identify, to ensure the safety of children signs 20. Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.) 21. Surrounding environment: There are no toxic and harmful stimulating substances or pollution sources around 22. Medical configuration: there are clinics, hospitals, etc., with emergency care facilities 23. Management and operation: management and maintenance personnel should have knowledge related to children, regular maintenance of the playground and facilities 24. Policies and education: policies and education are also provided to improve children's safety awareness
Comfort	25. Adequate space and facilities for rest and play 26. Space and facilities conform to children's physiological scale 27. Good lighting and ventilation conditions, with shade in summer 28. There are seats for parents to rest 29. Spatial elements such as colors and shapes are in line with children's psychological characteristics 30. A certain division between the activity area and rest area in the space 31. Adequate toilets, trash cans, etc. 32. Space and facilities are regularly cleaned by maintenance staff
Naturalness	33. Provide a variety of opportunities for sensory stimulation of nature, from the natural environment around them to the natural environment, and provide spatial conditions for activities, such as vegetation, sand, water and other natural elements 34. Children can enter the community garden and participate in nature-related activities such as planting, caring for and picking flowers and vegetables 35. Plants change significantly from season to season
Participation	36. Children can participate in the planning and design process of neighborhood space development 37. The community actively organizes various community festivals and intergenerational activities to promote children's participation and intergenerational communication

2. Selection

In order to further ensure the necessity and operability of the evaluation factors, the selection of evaluation factors is required. The selection was carried out by means of a questionnaire. Among them, using the 5-point Likert quantification method, respondents were required to quantify the importance of 37 pre-selected evaluation factors, namely: very important (5), relatively important (4), average (3), relatively unimportant (2), and very unimportant (1).

The selection questionnaire was based on the content of the pre-selected evaluation factors, and the respondents were asked to rate the importance of each evaluation factor. The author compiled the valid questionnaires and calculated the results. There were four categories of respondents: experts in the field of children, academic experts working in the field of architectural planning, students, and parents of children who usually live in Liuyun Community. A total of 197 questionnaires were distributed and 176valid questionnaires were recovered, with a valid recovery rate of 89.34%(Table.5-2).

Table. 5-2 Interviewees (Source: Drawn by Author)

Interviewees	**Experts in the field of children**	**Academic experts in the field of planning**	**Students in the field of planning**	**Children and parents in communities**	**Total**
Quantity distributed	5	12	60	120	197
Number of recycling	5	12	58	101	176
Recycling rate	100.00%	100.00%	96.67%	84.17%	89.34 %

Selection Sub-Criteria: There are two data criteria set for this selection, i.e., mean and coefficient of variation. Among them, the Coefficient of Variation, which is the absolute value reflecting the degree of dispersion of the data, is the standard deviation/mean value, i.e:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \mu)^2}{n}}$$

In order to ensure that the selected evaluation factors can truly reflect the results of multiple questionnaires, the criteria for the selection of evaluation factors were determined through a comprehensive study of the literature of several experts and scholars: (i) the mean value ⩾

3.5; and (ii) the coefficient of variation < 0.25.

The following are some of the data processing procedures:

准则层	样本数据	均值	标准差	变异系数
多样性	4, 4, 5, 4, 4, 3, 3, 4, 4, 5, 4, 5, 4, 4, 4, 4, 4, 5, 3, 5, 3, 5, 5, 3, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 3, 4, 4, 4, 2, 5, 4, 5, 3, 4, 5, 5, 4, 4, 4, 4, 3, 5, 4, 4, 3, 4, 4, 5, 5, 3, 4, 4, 4, 5, 4, 4, 5, 5, 4, 4, 4, 4, 3, 4, 4, 4, 4, 4, 4, 5, 5, 5, 5, 5, 4, 4, 5, 4, 4, 3, 5, 4, 4, 4, 5, 4, 3, 4, 4, 3, 4, 4, 3, 4, 5, 4, 3, 4, 4, 5, 3, 3, 4, 3, 4, 3, 5, 3, 5, 5, 4, 5, 5, 3, 5, 2, 3, 3, 3, 4, 5, 5, 5, 4, 3, 3, 5, 5, 4, 3, 4, 5, 3, 4, 3, 5, 4, 5, 4, 4, 5, 4, 5, 4, 3, 3, 4, 3, 4, 3, 4, 4, 4, 4, 4, 4, 3, 4, 5, 3, 3, 4, 5	4	0.7251	0.180749701
	3, 4, 4, 3, 4, 4, 3, 3, 4, 3, 3, 4, 5, 3, 4, 4, 3, 5, 4, 4, 4, 4, 3, 5, 3, 3, 3, 3, 4, 5, 5, 4, 5, 5, 4, 5, 4, 4, 4, 5, 3, 4, 5, 3, 3, 4, 5, 4, 4, 4, 5, 4, 3, 5, 3, 4, 4, 5, 3, 3, 4, 5, 5, 4, 4, 5, 4, 3, 3, 5, 4, 4, 4, 3, 5, 5, 3, 3, 3, 4, 5, 3, 5, 5, 3, 4, 5, 4, 5, 3, 3, 4, 3, 3, 4, 3, 5, 4, 4, 5, 3, 3, 4, 4, 4, 4, 4, 4, 4, 3, 3, 5, 4, 4, 4, 5, 4, 4, 5, 4, 4, 4, 4, 4, 3, 5, 3, 3, 3, 4, 3, 3, 3, 4, 4, 5, 5, 5, 3, 5, 4, 4, 4, 4, 4, 5, 4, 3, 5, 4, 3, 4, 4, 3, 3, 4, 4, 4, 5, 4, 3, 4, 5, 4, 4, 3, 4, 5, 4, 4, 5, 4, 5, 3, 5, 3	3.9432	0.7385	0.187274553
	4, 3, 4, 3, 3, 4, 4, 5, 3, 4, 3, 5, 2, 3, 3, 4, 2, 3, 5, 3, 4, 2, 4, 3, 3, 3, 3, 3, 4, 5, 5, 5, 3, 5, 2, 4, 4, 2, 2, 4, 4, 4, 3, 5, 4, 3, 3, 4, 2, 4, 4, 2, 4, 4, 4, 4, 3, 3, 4, 5, 4, 4, 2, 5, 3, 5, 3, 2, 4, 3, 3, 3, 3, 3, 3, 4, 4, 4, 3, 4, 4, 4, 3, 3, 3, 3, 5, 5, 4, 4, 4, 4, 4, 5, 4, 3, 2, 2, 5, 3, 4, 2, 3, 4, 4, 3, 3, 3, 4, 4, 4, 4, 5, 4, 3, 2, 2, 3, 4, 2, 3, 5, 3, 3, 4, 4, 3, 2, 4, 3, 3, 3, 3, 3, 3, 3, 4, 4, 5, 3, 3, 4, 3, 3, 3, 2, 2, 4, 5, 4, 5, 5, 4, 2, 2, 3, 4, 4, 4, 2, 3, 5, 2, 3, 5, 4, 2, 4, 3, 2, 4, 5, 4, 5, 5, 3	3.5114	0.9133	0.260101762
	3, 4, 3, 3, 4, 5, 3, 3, 5, 5, 3, 5, 4, 4, 4, 5, 3, 3, 4, 4, 3, 2, 5, 2, 4, 3, 3, 3, 4, 4, 3, 3, 3, 3, 3, 3, 4, 3, 3, 4, 3, 3, 3, 3, 4, 5, 4, 3, 3, 4, 5, 4, 4, 3, 3, 4, 3, 4, 4, 5, 4, 3, 2, 4, 2, 4, 3, 4, 2, 4, 5, 2, 4, 4, 3, 3, 4, 3, 4, 3, 4, 4, 4, 4, 5, 4, 5, 3, 3, 4, 4, 4, 4, 3, 3, 3, 4, 5, 2, 2, 5, 5, 5, 4, 4, 3, 3, 3, 4, 4, 4, 3, 5, 3, 2, 4, 5, 4, 3, 3, 4, 3, 3, 5, 3, 5, 3, 3, 4, 3, 4, 4, 3, 5, 3, 4, 4, 3, 3, 2, 4, 2, 2, 3, 3, 3, 5, 3, 4, 3, 5, 3, 3, 3, 3, 4, 4, 5, 3, 3, 3, 5, 4, 3, 3, 3, 3, 4, 4, 4, 3, 5, 3, 5, 4, 4	3.5909	0.83	0.231128278
	4, 2, 4, 3, 5, 3, 2, 2, 2, 3, 4, 5, 4, 3, 4, 4, 4, 3, 3, 3, 4, 3, 4, 2, 3, 2, 4, 4, 3, 4, 2, 4, 4, 2, 4, 4, 5, 2, 5, 2, 4, 4, 3, 2, 4, 3, 2, 4, 3, 4, 3, 4, 3, 3, 3, 3, 4, 4, 5, 3, 3, 5, 4, 2, 4, 3, 3, 4, 4, 3, 3, 5, 2, 4, 3, 4, 2, 4, 4, 4, 2, 2, 4, 5, 3, 3, 2, 3, 4, 2, 3, 3, 4, 5, 4, 4, 3, 4, 5, 3, 4, 3, 2, 2, 4, 3, 4, 4, 5, 3, 4, 3, 4, 3, 4, 4, 4, 4, 3, 5, 2, 5, 3, 3, 4, 5, 4, 4, 3, 2, 2, 5, 3, 5, 4, 4, 3, 5, 3, 3, 3, 5, 2, 3, 3, 2, 2, 4, 2, 4, 4, 3, 5, 5, 3, 5, 5, 5, 2, 5, 5, 2, 5, 5, 5, 2, 3, 3, 2, 4, 3, 2, 5, 2, 3, 4	3.4716	0.9852	0.28378814
可达性	3, 2, 4, 2, 2, 4, 3, 4, 4, 4, 3, 3, 3, 2, 3, 4, 3, 4, 3, 3, 2, 4, 2, 4, 4, 4, 4, 5, 3, 4, 2, 3, 3, 4, 4, 4, 3, 3, 3, 4, 3, 3, 3, 4, 4, 3, 3, 2, 4, 5, 3, 4, 4, 3, 3, 3, 3, 3, 5, 3, 3, 4, 2, 3, 2, 3, 2, 4, 3, 2, 4, 4, 4, 3, 4, 3, 2, 3, 2, 4, 2, 2, 3, 3, 3, 3, 3, 2, 1, 3, 2, 3, 3, 3, 1, 3, 2, 3, 3, 5, 4, 2, 3, 2, 2, 3, 2, 3, 4, 3, 3, 4, 3, 3, 3, 3, 4, 3, 3, 3, 1, 3, 3, 2, 3, 2, 4, 2, 4, 4, 3, 3, 2, 3, 3, 3, 2, 2, 3, 4, 2, 4, 3, 3, 4, 2, 3, 3, 2, 2, 2, 3, 3, 3, 2, 3, 3, 4, 3, 4, 4, 3, 2, 3, 4, 3, 3, 4, 2, 3, 2, 3, 3, 3, 4, 4	3.0568	0.798	0.261046912
	3, 3, 4, 4, 3, 4, 4, 4, 5, 3, 4, 4, 5, 4, 4, 4, 3, 3, 3, 3, 5, 5, 5, 5, 4, 4, 4, 3, 3, 5, 4, 4, 5, 2, 4, 4, 3, 4, 4, 3, 3, 4, 3, 2, 5, 5, 4, 3, 5, 5, 3, 5, 3, 4, 3, 4, 3, 4, 4, 5, 4, 3, 4, 5, 2, 4, 4, 3, 4, 5, 4, 4, 4, 4, 4, 4, 4, 3, 4, 3, 4, 4, 3, 4, 5, 5, 4, 5, 4, 4, 3, 4, 3, 4, 3, 5, 5, 3, 4, 3, 4, 4, 5, 5, 5, 4, 3, 4, 2, 4, 4, 3, 5, 4, 3, 4, 3, 4, 4, 4, 4, 4, 5, 5, 2, 5, 4, 3, 4, 3, 5, 4, 5, 3, 4, 4, 5, 4, 5, 4, 5, 5, 4, 4, 3, 4, 4, 3, 3, 4, 4, 5, 5, 5, 5, 4, 3, 4, 4, 4, 4, 5, 3, 4, 5, 3, 3, 4, 4, 5, 5, 5, 3, 5, 3, 5	3.9432	0.7908	0.20054137
	4, 3, 4, 3, 4, 3, 3, 3, 4, 3, 3, 3, 4, 3, 3, 4, 3, 3, 3, 3, 3, 4, 4, 4, 5, 4, 3, 3, 4, 5, 4, 3, 4, 3, 4, 3, 4, 3, 5, 4, 4, 2, 4, 4, 4, 3, 4, 3, 5, 5, 3, 3, 3, 3, 4, 4, 3, 4, 3, 4, 5, 2, 3, 3, 4, 3, 3, 4, 3, 3, 3, 4, 3, 4, 3, 4, 3, 4, 4, 4, 3, 3, 4, 3, 4, 3, 3, 3, 5, 3, 3, 4, 3, 3, 5, 3, 3, 3, 5, 3, 3, 3, 4, 4, 4, 4, 4, 4, 3, 3, 3, 3, 4, 3, 3, 5, 3, 4, 3, 5, 4, 4, 3, 3, 3, 4, 3, 3, 3, 4, 4, 3, 3, 4, 3, 3, 3, 5, 4, 3, 4, 4, 3, 4, 5, 4, 3, 4, 4, 4, 4, 4, 4, 4, 3, 3, 4, 3, 4, 4, 3, 4, 3, 3, 4, 4, 3, 4, 4, 3, 4, 4, 3, 4, 3, 4	3.5625	0.6384	0.179188005
	3, 3, 2, 2, 3, 3, 2, 2, 2, 3, 3, 2, 4, 3, 2, 2, 4, 2, 2, 3, 3, 3, 3, 2, 3, 3, 3, 2, 4, 3, 3, 3, 3, 4, 3, 4, 4, 3, 3, 3, 2, 4, 4, 2, 4, 3, 2, 2, 3, 3, 3, 4, 3, 4, 4, 3, 3, 2, 4, 3, 2, 3, 3, 4, 2, 3, 4, 4, 3, 3, 4, 4, 4, 4, 4, 2, 3, 4, 3, 2, 4, 4, 4, 2, 2, 4, 3, 3, 3, 3, 3, 2, 2, 3, 3, 3, 2, 3, 3, 3, 2, 2, 3, 2, 3, 4, 3, 3, 4, 3, 2, 4, 4, 4, 3, 3, 4, 4, 3, 3, 4, 3, 3, 3, 3, 3, 4, 4, 2, 2, 3, 4, 2, 3, 4, 3, 3, 3, 2, 3, 2, 2, 3, 2, 2, 3, 3, 3, 4, 4, 3, 3, 4, 3, 3, 4, 4, 3, 2, 4, 3, 3, 3, 3, 4, 3, 2, 4, 4, 3, 2, 2, 3, 4, 3	2.9773	0.7997	0.268590756
	4, 3, 3, 3, 4, 3, 3, 4, 4, 5, 4, 4, 3, 4, 3, 3, 3, 4, 3, 3, 3, 4, 4, 3, 3, 5, 3, 3, 4, 4, 4, 1, 4, 4, 4, 4, 3, 4, 4, 3, 4, 3, 3, 4, 3, 4, 4, 4, 4, 3, 4, 4, 5, 3, 4, 3, 4, 3, 4, 3, 3, 4, 3, 4, 4, 3, 3, 4, 4, 3, 4, 3, 3, 3, 3, 3, 3, 4, 3, 5, 3, 4, 3, 3, 3, 4, 4, 3, 3, 5, 4, 3, 4, 3, 3, 4, 4, 4, 3, 3, 4, 3, 5, 4, 4, 4, 4, 3, 3, 4, 3, 4, 4, 4, 3, 1, 4, 4, 3, 3, 5, 3, 3, 4, 4, 3, 4, 4, 3, 4, 3, 3, 4, 4, 3, 3, 4, 4, 5, 3, 3, 4, 3, 4, 3, 3, 4, 4, 3, 3, 4, 4, 3, 3, 4, 4, 3, 4, 4, 3, 4, 4, 4, 3, 4, 4, 3, 3, 4, 4, 3, 4, 3, 4, 4, 4	3.5568	0.6389	0.179625249
	3, 1, 3, 2, 4, 4, 3, 3, 4, 2, 3, 2, 3, 4, 2, 3, 3, 3, 4, 5, 3, 4, 3, 4, 2, 3, 3, 4, 3, 3, 3, 4, 2, 3, 3, 4, 4, 4, 3, 3, 3, 2, 3, 4, 4, 3, 3, 5, 4, 3, 4, 3, 3, 5, 4, 3, 3, 4, 3, 4, 4, 3, 3, 4, 2, 4, 5, 3, 5, 2, 3, 3, 3, 3, 2, 3, 4, 3, 5, 2, 3, 3, 3, 4, 5, 3, 2, 3, 2, 3, 4, 4, 3, 2, 3, 3, 4, 3, 3, 4, 3, 2, 4, 3, 4, 4, 3, 4, 2, 2, 3, 3, 3, 3, 4, 4, 3, 2, 3, 1, 2, 3, 3, 3, 4, 4, 3, 3, 3, 2, 4, 3, 3, 3, 4, 3, 4, 2, 2, 2, 2, 2, 2, 3, 2, 4, 3, 3, 4, 3, 4, 3, 2, 4, 3, 3, 4, 2, 3, 3, 3, 2, 3, 3, 4, 4, 2, 2, 4, 2, 3, 3, 4, 3, 4, 2	3.142	0.8122	0.258505404

Fig. 5-4 Part of the data processing process (Source: Drawn by Author)

Selection results: ①Means: The mean values of evaluation factors with serial numbers 5, 6, 9,

11, 28, 30, 31 and 35 in the factor layer are lower than 3.5, which means that the evaluation concentration of these evaluation factors is not high, i.e., these evaluation factors are not important enough by themselves and are considered to be eliminated. (2) Coefficient of variation: The coefficients of variation of evaluation factors with serial numbers 3, 5, 6, 9, 11, 28, 30, and 35 in the factor layer are greater than 0.25, which indicates that the respondents' evaluation results of the above evaluation factors are too discrete and divergent, and should be considered for elimination. The remaining 28 evaluation factors passed the test after elimination(Table.5-3).

Table. 5-3 Sub-Criterion Scoring (Source: Drawn by Author)

	Criterion	Sub-Criterion	Mean value	CV	Result
1	Diversity	Spatial diversity: The space is diverse and rich in form, size, and static and dynamic attributes, allowing for different amounts and types of activities to occur	4.00	0.18	reserve
2		Activities diversity: Spatial elements encourage and stimulate a variety of children's play, including social and physical play, formal and informal play	3.94	0.19	reserve
3		Age diversity: public spaces allow Children and adults of all ages to gather for activities	3.51	0.26	remove
4		Facilities diversity: Different kinds of play facilities are available	3.59	0.23	reserve
5		Cultural diversity: Respect for cultural diversity, with cultural or festivals and events in which children participate Balanced spatial distribution	3.47	0.28	remove
6	Accessibility	Balanced spatial distribution	3.06	0.26	remove
7		No need to cross complicated traffic environments such as urban arteries	3.94	0.20	reserve
8		There are paths and signage systems for children only	3.56	0.18	reserve
9		Roads and spaces with barrier-free design	2.98	0.27	remove
10		Short walking time	3.56	0.18	reserve
11		Space entrance is eye-catching and easy to enter	3.14	0.26	remove
12	Safety	Space safety: children's activity space without sharp edges and angles, with elastic protection layer to prevent fall damage	3.97	0.19	reserve
13		Space boundary: the space has a certain boundary, and vehicles cannot enter directly	4.18	0.16	reserve

14		Visual penetration: The play space has good visual penetration, which enables adults to effectively supervise children's play behavior.	3.85	0.17	reserve
15		Neighborhood surveillance: residents should be able to overlook the shared space between residential buildings and monitor them	3.47	0.18	reserve
16		Mixed-age coexistence: provide places where adults can rest and observe their children at play	4.13	0.16	reserve
17		Neighborhood solidarity: If children are out of the house and in danger or in danger, someone will be there to help them	3.99	0.18	reserve
18		Site safety: keep the site away from traffic and keep the area frequented by children and youth away from heavy traffic	4.46	0.12	reserve
19		Path safety: to ensure that children's daily routes have easy to identify, to ensure the safety of children signs	4.52	0.12	reserve
20		Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)	4.47	0.11	reserve
21		Surrounding environment: There are no toxic and harmful stimulating substances or pollution sources around	3.94	0.19	reserve
22		Medical configuration: there are clinics, hospitals, etc., with emergency care facilities	4.49	0.12	reserve
23		Management and operation: management and maintenance personnel should have knowledge related to children, regular maintenance of the playground and facilities	3.95	0.20	reserve
24		Policies and education: policies and education are also provided to improve children's safety awareness	3.95	0.19	reserve
25	Comfort	Adequate space and facilities for rest and play	3.80	0.18	reserve
26		Space and facilities conform to children's physiological scale	3.99	0.17	reserve
27		Good lighting and ventilation conditions, with shade in summer	3.59	0.17	reserve
28		There are seats for parents to rest	3.49	0.19	remove
29		Spatial elements such as colors and shapes are in line with children's psychological characteristics	3.58	0.25	reserve

30		A certain division between the activity area and rest area in the space	2.86	0.30	remove
31		There are enough toilets, trash cans, etc.	3.49	0.19	remove
32		Space and facilities are regularly cleaned by maintenance staff	4.32	0.15	reserve
33	Natural	Provide a variety of opportunities for sensory stimulation of nature, from the natural environment around them to the natural environment, and provide spatial conditions for activities, such as vegetation, sand, water and other natural elements	3.98	0.20	reserve
34		Children can enter the community garden and participate in nature-related activities such as planting, caring for and picking flowers and vegetables	3.86	0.20	reserve
35		Plants change significantly from season to season	3.01	0.22	remove
36	Participation	Children can participate in the planning and design process of neighborhood space development	4.03	0.18	reserve
37		The community actively organizes various community festivals and intergenerational activities to promote children's participation and intergenerational communication	3.66	0.21	reserve

According to the content of the criterion layer of the evaluation system determined above, the 28 selection evaluation factors determined by the questionnaire survey were combined and integrated in a proximate manner, and the following 24 evaluation factors in the factor layer of the evaluation system were finally determined(Table.5-4).

Table. 5-4 Final Sub-Criterion (Source: Drawn by Author)

	Criterion	**Sub-Criterion**
1	Diversity	Spatial diversity: The space is rich in variety of forms, sizes, and dynamic and static properties
2		Activitydiversity: the space allows and stimulates a variety of children's activities
3		Facilitiy Diversity: different kinds of play facilities are available
4	Accesibility	Walking time: short walking time
5		Walking environment: no need to cross city arteries and other complex traffic environments
6		Walking route: there are paths and signage systems exclusive to children
7	Safety	Space safety: children's activity space without sharp edges and angles, with a flexible protective layer

8		Boundary safety: the space has a certain boundary, and vehicles cannot enter directly
9		Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources
10		Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)
11		Surveillance safety: children's activity space has a good line of sight penetration and parental observation area
12		Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety
13		Configuration safety: there are clinics, hospitals, etc., and emergency care facilities
14		Operation safety: Management and maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities
15		Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents
16		Policy and education: Policy and education are also provided to enhance children's safety awareness
17	Comfort	Adequate and good quality space and facilities for recreation and play
18		Adequate and good quality of supporting facilities (toilets, trash cans, etc.)
19		Space, facilities, colors and elements conform to children's physiological scale and psychological characteristics
20		Good lighting, ventilation and natural conditions
21	Naturalness	Space natural coverage situation
22		Children can contact nature and participate in nature-related activities
23	Participation	Children can participate in the planning and design process of neighborhood space development
24		The community actively organizes activities to promote children's participation and intergenerational communication

5.2.3 Sub-Criterion Weights

After constructing the index ladder hierarchy model, experts are required to compare and rate each element in the index and criterion levels, and then construct a judgment matrix based on the given scores to finally determine the weight value of each element in its level.

(1) Constructing a two-by-two judgment matrix

The expert evaluation scores are substituted into the hierarchical analysis equation to calculate their mean values as the final statistical results. The judgment matrix is a two-by-two

comparison of each indicator in the same hierarchy, comparing its relative to another indicator importance. The relative importance is usually quantified by the number 1 to 9 and its reciprocal(Table.5-5).

Table. 5-5 Score and its Meaning (Source: Drawn by Author)

Score	Meaning
1	two factors are of equal
3	i is slightly more important than j
5	i is significantly more important than j
7	i is strongly more important than j
9	i is extremely more important than j
1/3	j is slightly more important than i
1/5	j is significantly more important than i
1/7	j is strongly more important than i
1/9	j is more extremely important than i
2,4,6,8,1/2,1/4,1/6,1/8	the middle value of the above adjacent judgments

（2）Experts fill in the judgment matrix

In order to ensure the objectivity and accuracy of the scoring, 20 experts from different fields were invited to make a two-by-two factor comparison assignment for the weighting of this evaluation system, all of whom have lived or studied in Guangzhou for a longer period of time and have a deeper understanding of Liuyun Community.

Table. 5-6 Experts basic information and number of people (Source: Drawn by Author)

	Field of study	Academic qualifications	Number of people
Students	Urban Planning and Design	M.S., Ph.D.	3
	Architectural Design	M.S., Ph.D.	3
High school teachers	Urban Planning and Design	Ph.D.	3
	Architectural Design	Ph.D.	3
Children's industry practitioners	Children's Education	M.S., Ph.D.	4
Designers	Urban Planning and Design	B.S., M.S.	2
	Architectural Design	B.S., M.S.	2

Among them, there are 6 master and doctoral students engaged in planning and architecture,

6 university teachers engaged in planning and architecture, 4 practitioners in children's industry, and 4 designers in urban planning and design(Table.5-6).

（3）Weighting calculation

After the judgment matrix is completed, the judgment matrix needs to be calculated to find the weights of B1, B 2, B 3...Bn with respect to A. The characteristic equation of the matrix is established by linear algebra:

$$W=\lambda \max W$$

where λ max is the maximum eigenroot of the matrix, W is the eigenvector of the matrix corresponding to the maximum eigenroot, and its components are the corresponding weights(Table.5-7).

Table. 5-7 Calculation method of AHP hierarchical analysis (Source: Drawn by Author)

	Product of elements in each row	**nth root of the product $\overline{W}$n**	**$\overline{W}$n's Weight vector**
B_1	$B_{11} \times B_{12} \times B_{13} \times ... \times B_{1n}$	$\overline{W}_1=\sqrt[n]{B11 \times B12 \times B13 \times \ldots \times B1n}$	$W_1=\overline{W}_1/WP$
B_2	$B_{21} \times B_{22} \times B_{23} \times ... \times B_{2n}$	$\overline{W}_2=\sqrt[n]{B21 \times B22 \times B23 \times \ldots \times B2n}$	$W_2=\overline{W}_2/WP$
B_3	$B_{31} \times B_{32} \times B_{33} \times ... \times B_{3n}$	$\overline{W}_3=\sqrt[n]{B31 \times B32 \times B33 \times \ldots \times B3n}$	$W_3=\overline{W}_3/WP$
...	...	...	...
B_n	$B_{n1} \times B_{n2} \times B_{n3} \times ... \times B_{nn}$	$\overline{W}_n=\sqrt[n]{Bn1 \times Bn2 \times Bn3 \times \ldots \times Bnn}$	$W_n=\overline{W}_n/WP$
	Total	$WP=\sum_{i=1}^{n} \overline{W}i$	$\sum_{i=1}^{n} W1=1$
	$\lambda\ max$	$\Lambda\ max=\frac{1}{n}\sum_{i=1}^{n} \frac{BW}{Wi}$	

（4）Consistency testing

Due to the complexity of the actual objective things, there may still be a certain deviation in the judgment matrix obtained from the calculation, and if If this deviation is too large, wrong logical results will be obtained, for example, B1 is more important than B2, B2 is more important than B3, while B This is obviously a self-contradictory conclusion, which will lead to a serious error in the final evaluation result. Therefore Therefore, it is necessary to conduct consistency test on the judgment matrix, and only when the judgment matrix passes the consistency test, the weights obtained Only when the judgment matrix passes the consistency test, the weighting result is true.

First, the consistency index CI is calculated, and the maximum value of the corresponding λ max eigenvalue (n is the order of the discriminant matrix A) is used to obtain the high-

precision CI by the power multiplication method, i.e.

$$CI=\frac{\lambda max-n}{n-1}$$

At the same time, the average random consistency index RI is introduced to eliminate the influence of the order of CI in the power multiplication method. The RI values of each order are shown in Table5-8.

Table. 5-8 Average Random Consistency Index (Source: Drawn by Author)

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.14	1.45

Finally, the consistency ratio CR is calculated, i.e:：

$$CR=\frac{CI}{RI}$$

When CR < 0.10, the judgment matrix is considered to have strong consistency and is acceptable; when CR ⩾ 0.10, the judgment matrix should be modified until CR < 0.10.

Fig. 5-5 Part of the data processing process（a）

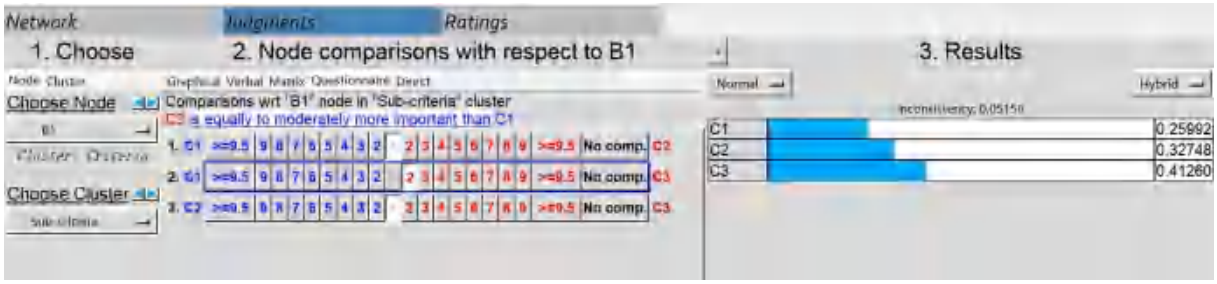


Fig.5-5 Part of the data processing process（b）

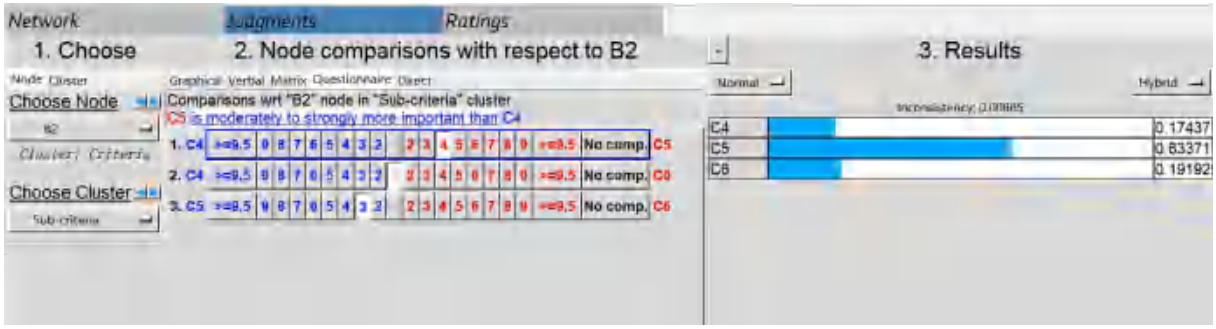


Fig.5-5 Part of the data processing process （c）

Fig.5-5 Part of the data processing process（d）

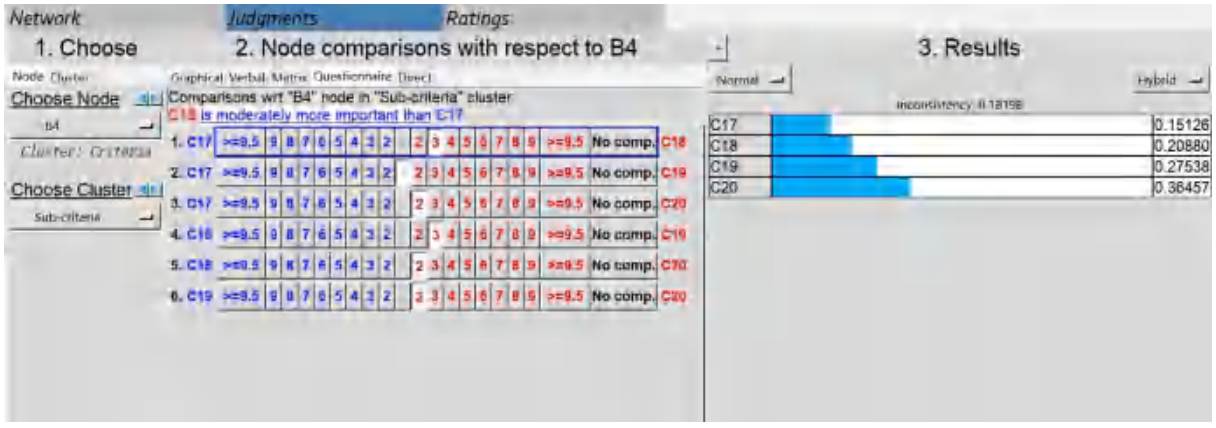


Fig.5-5 Part of the data processing process（e）B4 CR before adjustment 0.181

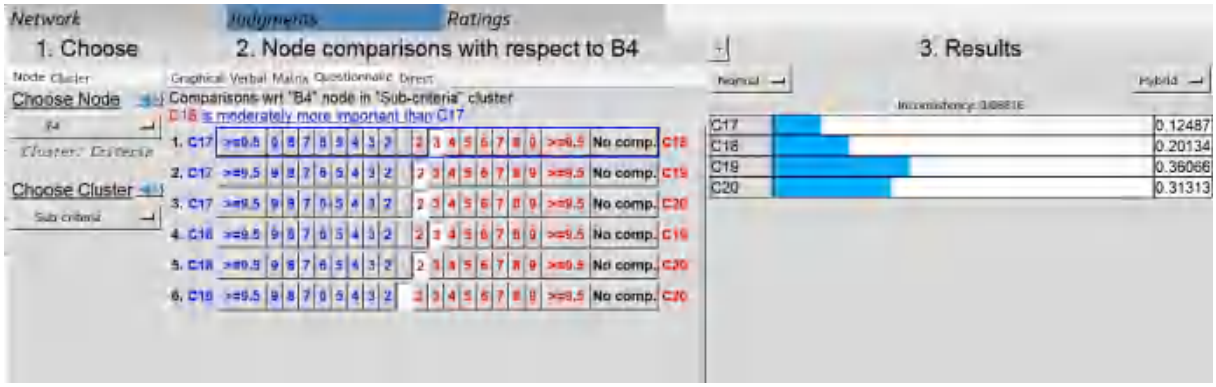


Fig.5-5 Part of the data processing process（f）B4 CR after adjustment 0.088

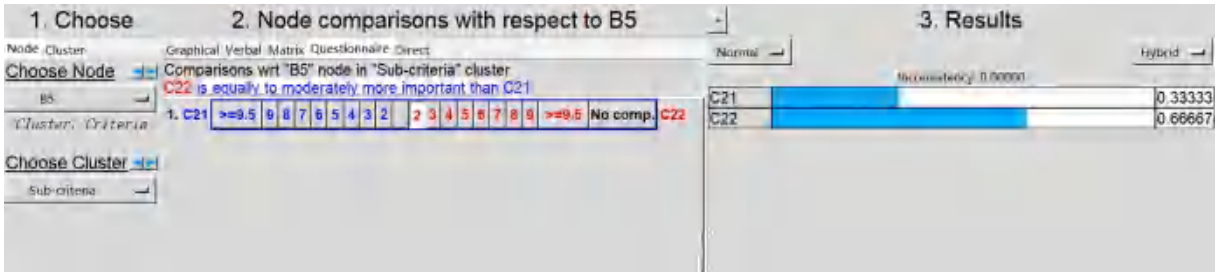


Fig.5-5 Part of the data processing process（g）

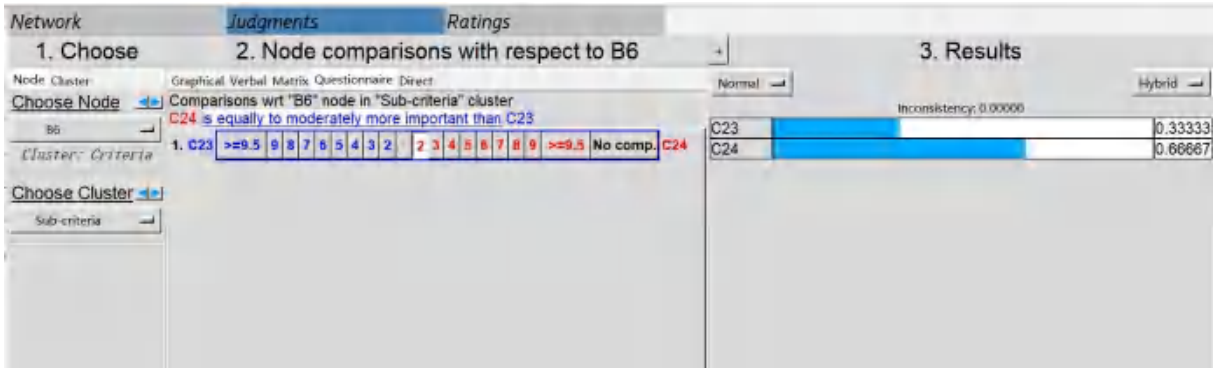


Fig.5-5 Part of the data processing process（h） (Source: Drawn by Author)

（5）Results and analysis of absolute weights

The absolute weight refers to the weight of each factor relative to the total target layer, and for the convenience of data statistics and result calculation, the absolute weight is included in the evaluation system. The absolute weight of the indicator factor in the factor layer = the relative weight of the indicator factor × the absolute coefficient of the standard layer, and the results are shown in the table below:

Table. 5-9 Weights of Criterion and Sub-Criterion (Source: Drawn by Author)

Goal（A）	Criterion(B)	Absolute Weight (Wj)	Sub-Criterion(C)	Absolute Weight (Wj)
A Evaluation of the child-friendliness of public spaces in Liuyun Community	B1 Diversity	0.0592	C1 Spatial diversity: The space is rich in variety of forms, sizes, and dynamic and static properties	0.0129
			C2 Activity diversity: the space allows and stimulates a variety of children's activities	0.0186
			C3 Facilitiy Diversity: different kinds of play facilities are available	0.0277
	B2 Accesibility	0.1130	C4 Walking time: short walking time	0.0195
			C5 Walking environment: no need to cross city arteries and other complex traffic environments	0.0714
			C6 Walking route: there are paths and signage systems exclusive to children	0.0221
	B3 Safety	0.4524	C7 Space safety: children's activity space without sharp edges and angles, with a flexible protective layer	0.0497
			C8 Boundary safety: the space has a certain boundary, and vehicles cannot enter directly	0.0764
			C9 Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources	0.0650
			C10 Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)	0.0524
			C11 Surveillance safety: children's activity space has a good line of sight penetration and parental observation area	0.0713
			C12 Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety	0.0395
			C13 Configuration safety: there are clinics, hospitals, etc., and emergency care facilities	0.0412
			C14 Operation safety: Management and	0.0324

			maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities	
			C15 Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents	0.0378
			C16 Policy and education: Policy and education are also provided to enhance children's safety awareness	0.0262
	B4 Comfort	0.1263	C17 Adequate and good quality space and facilities for recreation and play	0.0168
			C18 Adequate and good quality of supporting facilities (toilets, trash cans, etc.)	0.0251
			C19 Space, facilities, colors and elements conform to children's physiological scale and psychological characteristics	0.0452
			C20 Good lighting, ventilation and natural conditions	0.0392
	B5 Naturalness	0.1071	C21 Space natural coverage situation	0.0362
			C22 Children can contact nature and participate in nature-related activities	0.0709
	B6 Participation	0.1420	C23 Children can participate in the planning and design process of neighborhood space development	0.0467
			C24 The community actively organizes activities to promote children's participation and intergenerational communication	0.0952

It is obvious that the weight of B3 safety in the standard layer is much higher than other indicators, and the second weight is B6 participation. Safety is the most important criterion for evaluating the child-friendliness of public spaces, as safety is the first criterion for children's activities in public spaces, both for guardians and children themselves. The top five factors were C24 Community Activities for Child Participation, C8 Boundary Safety, C5 Pedestrian Environment, C11 Surveillance Safety, and C22 Extent of Children's Access to Nature Activities.

5.2.4 Scoring Criteria

Table. 5-10 C1、C2、C3 Scoring Criteria (Source: Drawn by Author)

Criterion	Method	Evaluation Criteria andScore				
		5	4	3	2	1
C1	Subjective evaluation	Very rich	Relatively rich	Fair	Not rich	Very not rich
C2	Subjective evaluation	Very rich	Relatively rich	Fair	Not rich	Very not rich
C3	Objective evaluation	Very rich	Relatively rich	Fair	Not rich	Very not rich

Table. 5-11 C4、C5、C6 Scoring Criteria (Source: Drawn by Author)

Criterion	Method	Evaluation Criteria andScore				
		5	4	3	2	1
C4	Objective Evaluation	Less than 5 minutes	5~10 minutes	10~15 minutes	15~20 minutes	20 minutes or more
C5	Objective Evaluation	Not at all	Relatively needed	Fair	More needed	All needed
C6	Objective Evaluation	Very obvious	Relatively obvious	Fair	Not obvious	Very inconspicuous

Table. 5-12 C7-C16 Scoring Criteria (Source: Drawn by Author)

Criterion	Method	Evaluation Criteria andScore				
		5	4	3	2	1
C7	Objective Evaluation	Fully implemented	Basically implemented	Generally	Rarely implemented	Completely unimplemented
C8	Objective Evaluation	Fully implemented	Basically implemented	Generally	Rarely implemented	Completely unimplemented
C9	Objective Evaluation	Fully implemented	Basically implemented	Generally	Rarely implemented	Completely unimplemented
C1	Subjective evaluation	Fully implemented	Basically implemented	Generally	Rarely implemented	Completely unimplemented
C11	Subjective evaluation	Fully implemented	Basically implemented	Generally	Rarely implemented	Completely unimplemented
C12	Objective Evaluation	Fully implemented	Basically implemented	Generally	Rarely implemented	Completely unimplemented
C13	Objective	Fully	Basically	Generally	Rarely	Completely

	Evaluation	implemented	implemented		implemented	unimplemented
C14	Subjective evaluation	Fully implemented	Basically implemented	Generally	Rarely implemented	Completely unimplemented
C15	Subjective evaluation	Fully implemented	Basically implemented	Generally	Rarely implemented	Completely unimplemented
C16	Subjective evaluation	Fully implemented	Basically implemented	Generally	Rarely implemented	Completely unimplemented

Table. 5-13 C17、C18、C19、C20 Scoring Criteria (Source: Drawn by Author)

Criterion	**Method**	**Evaluation Criteria andScore**				
		5	**4**	**3**	**2**	**1**
C17	Subjective evaluation	Satisfied	Relatively Satisfied	Fair	Not very satisfied	Unsatisfied
C18	Objective Evaluation	Fully adequate	Basically adequate	Fairly adequate	Not quite adequate	Very inadequate
C19	Subjective evaluation	Satisfied	Relatively Satisfied	Fair	Not very satisfied	Unsatisfied
C20	Subjective evaluation	Good	Relatively good	Fair	Poor	Bad

Table. 5-14 C21、C22 Scoring Criteria (Source: Drawn by Author)

Criterion	**Method**	**Evaluation Criteria andScore**				
		5	**4**	**3**	**2**	**1**
C21	Subjective evaluation	High	Relatively High	Fair	Relatively Low	Low
C22	Subjective evaluation	High	Relatively High	Fair	Relatively Low	Low

Table. 5-15 C23、C24 Scoring Criteria (Source: Drawn by Author)

Criterion	**Method**	**Evaluation Criteria andScore**				
		5	**4**	**3**	**2**	**1**
C23	Subjective evaluation	Often involved	Relatively more involved	Fair	Less involved	Never involved
C24	Subjective evaluation	Often involved	Relatively more involved	Fair	Less involved	Never involved

5.2.5 Evaluation Results Calculation

The evaluation results are calculated by means of linear weighted sum, and the specific steps are: multiplying the standardized values of each evaluation factor with the corresponding weights, and then adding the sums to obtain the final evaluation results.

$$CFI=\sum_{i=1}^{n} Wj \cdot Fi$$

$$Fi=\sum_{i=1}^{n} \frac{Vi}{Nq}$$

The CFI is the Child-Friendly Index (CFI), which is the final result of the evaluation, reflecting the three status levels of child-friendliness, fair-friendliness and unfriendliness of the public space in the settlement, corresponding to three score ranges of 4-5, 2-4 and 0-2 respectively.

Wj represents the weight of each evaluation factor in the overall target level. Fi represents the score of each indicator obtained after processing, according to which the Fi value can accurately identify the weaknesses of the community public space for child-friendly growth. Nq is the number of valid samples from the questionnaire.

5.3 Child-Friendly Evaluation and Analysis of Liuyun Community

Through field research, interviews and questionnaires, we evaluate the current situation of public space on the basis of the basic information and data, and analyze the problems and reasons according to the evaluation results.

5.3.1 Data Source

The evaluation data were obtained from field surveys, interview records and questionnaires.

Field survey: The survey points were used to observe and record the various types of public spaces in the selected settlements, to understand the distribution of public spaces, play facilities and the number of surveillance, and to summarize the specific situation and characteristics of children's activities in public spaces.

Interviews: Interviews were conducted with the property owners and doormen of the selected residential areas to determine the age of construction, the number of existing residents, and the number of existing children, etc. Random interviews were conducted with children aged 4-12 and their guardians about the use of public spaces in the residential areas and children's needs for public spaces in the residential areas.

Questionnaire survey: On February 18, 20 and 22, 2022, questionnaires were administered to

some children and their guardians in the selected settlements, covering children of different ages and genders between 0 and 15 years old. Children aged 7-15 were asked to fill in the questionnaire by themselves, while children aged 0-6 were asked to fill in the questionnaire by their guardians(Fig.5-6). A total of 200 questionnaires were distributed, 182 questionnaires were collected, and 167 questionnaires were valid.

Fig. 5-6 Collection of questionnaires (Source: Photoed by Author)

5.3.2 Data Processing and Results

According to the results of field research, ten evaluation factors C3, C4, C5, C6, C7, C8, C9, C12, C13, C18 were scored by the author corresponding to the rating scale; the rest were scored according to the results of the questionnaire survey, in accordance with the calculation method in Chapter 4, Subsection 5, to obtain the scores of questionnaire survey-type index factors, and the specific results are shown in the following table.

Table. 5-16 Child friendliness Evaluation Results of Liuyun Community (Source: Drawn by Author)

Criterion(B)	Sub-Criterion(C)	Absolute Weight (Wj)	Score（Fi）	Wj·Fi	Data Source
B1 Diversity	C1 Spatial diversity: The space is rich in variety of forms, sizes, and dynamic and static properties	0.0129	2.8	0.0361	Questionnaire
	C2 Activity diversity: the space allows and stimulates a variety of children's activities	0.0186	2.6	0.0484	Questionnaire
	C3 Facilitiy Diversity: different kinds of play facilities are available	0.0277	1.5	0.0416	Field Research
B2 Accesibility	C4 Walking time: short walking time	0.0195	4.5	0.0878	Field Research
	C5 Walking environment: no need to cross city arteries and other complex traffic environments	0.0714	4.7	0.3356	Field Research
	C6 Walking route: there are paths and signage systems exclusive to children	0.0221	2.6	0.0575	Field Research
B3 Safety	C7 Space safety: children's activity space without sharp edges and angles, with a flexible protective layer	0.0497	1.6	0.0795	Field Research
	C8 Boundary safety: the space has a certain boundary, and vehicles cannot enter directly	0.0764	1.0	0.0764	Field Research
	C9 Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources	0.0650	1.4	0.0910	Field Research
	C10 Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)	0.0524	1.5	0.0786	Questionnaire
	C11 Surveillance safety: children's activity space has a good line of sight penetration and parental observation area	0.0713	1.0	0.0713	Questionnaire
	C12 Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety	0.0395	2.5	0.0988	Field Research
	C13 Configuration safety: there are clinics,	0.0412	2.6	0.1071	Field

	hospitals, etc., and emergency care facilities				Research
	C14 Operation safety: Management and maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities	0.0324	3.1	0.1004	Questionnaire
	C15 Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents	0.0378	2.8	0.1058	Questionnaire
	C16 Policy and education: Policy and education are also provided to enhance children's safety awareness	0.0262	3.6	0.0943	Questionnaire
B4 Comfort	C17 Adequate and good quality space and facilities for recreation and play	0.0168	3.1	0.0521	Questionnaire
	C18 Adequate and good quality of supporting facilities (toilets, trash cans, etc.)	0.0251	2.9	0.0728	Field Research
	C19 Space, facilities, colors and elements conform to children's physiological scale and psychological characteristics	0.0452	2.3	0.1040	Questionnaire
	C20 Good lighting, ventilation and natural conditions	0.0392	4.1	0.1607	Questionnaire
B5 Naturalness	C21 Space natural coverage situation	0.0362	3.2	0.1158	Questionnaire
	C22 Children can contact nature and participate in nature-related activities	0.0709	2.8	0.1985	Questionnaire
B6 Participation	C23 Children can participate in the planning and design process of neighborhood space development	0.0467	1.1	0.0514	Questionnaire
	C24 The community actively organizes activities to promote children's participation and intergenerational communication	0.0952	2.5	0.2380	Questionnaire

According to the calculation method of CFI, the CFI (Child-Friendliness Index) of the overall public space in Liuyun Community was 2.5035, and the child-friendliness of the public space was low, of which the results of the scores of the seven standard layers are shown in Table 5-17. Among them, the scores from highest to lowest are: accessibility, comfort, naturalness, diversity, participation and safety.

Table. 5-17 Child friendliness Evaluation Results of Liuyun Community (Source: Drawn by Author)

Criterion	Diversity	Accesibility	Safety	Comfort	Naturalness	Participation	Total
Full marks	0.2960	0.5650	2.2620	0.6315	0.5355	0.7100	5
Score	0.1260	0.4808	0.9033	0.3896	0.3144	0.2894	2.5035
Score rate	42.57%	85.10%	39.93%	61.69%	58.71%	40.76%	50.07%
CFI				2.5035			

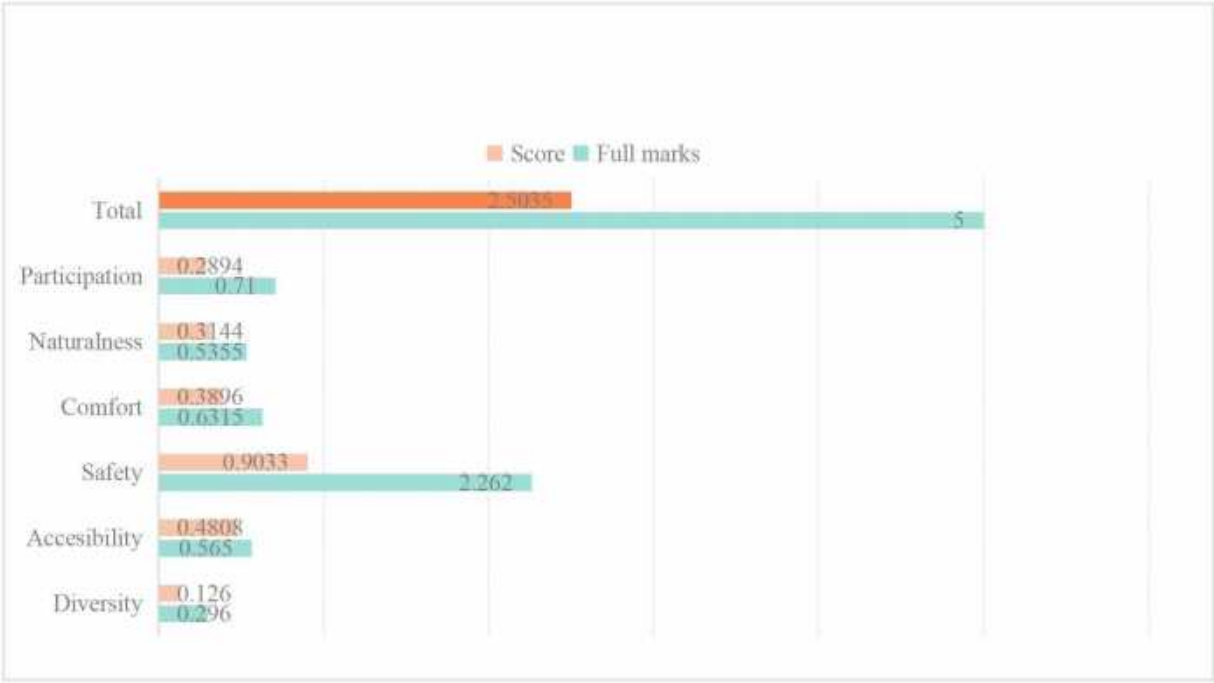


Fig. 5-7 Evaluation Results of Liuyun Community (Source: Drawn by Author)

5.4 Public Space Issues under Child-Friendly Evaluation

Of the 200 questionnaires distributed, 105 were directional questionnaires, which were administered to respondents in different types of public spaces and streets, indicating that the 22 scoring items, with the exception of participatory, were based on a selected category of places in Liuyun Community , and that actual photographs were taken to identify the target group. There were seven categories of participatory questionnaires, namely Enclosed vacant space, green space, Street side clearing, Podium roof, Live and leisure street, Commercial street and Comprehensive street. The high frequency locations for the design of children's activities in the community were covered, with the following scores(Table.5-18):

Table. 5-18 CFI for different spaces and street types in Liuyun Community(Source: Drawn by Author)

Criterion (B)	Sub-Criterion (C)	Enclosed vacant space	green space	Street side clearing	Podium roof	Live and leisure street	Commercial street	Comprehensive street
B1	C1	0.0400	0.0413	0.0335	0.0335	0.0335	0.0361	0.0426
	C2	0.0651	0.0446	0.0558	0.0539	0.0521	0.0502	0.0484
	C3	0.0859	0.0471	0.0526	0.0443	0.0582	0.0499	0.0526
B2	C4	0.0878	0.0761	0.0917	0.0741	0.0975	0.0956	0.0936
	C5	0.3284	0.2999	0.3427	0.2927	0.3570	0.3356	0.3499
	C6	0.0619	0.0641	0.0597	0.0287	0.0398	0.0486	0.0508
B3	C7	0.1192	0.1044	0.1249	0.0547	0.0994	0.0596	0.1243
	C8	0.1657	0.3056	0.1624	0.2368	0.0770	0.1604	0.0764
	C9	0.1362	0.2010	0.0650	0.1365	0.1150	0.1755	0.1460
	C10	0.0650	0.0791	0.0815	0.0524	0.1258	0.0576	0.1310
	C11	0.0735	0.0713	0.0884	0.1569	0.0870	0.1640	0.0998
	C12	0.1041	0.0869	0.0524	0.0869	0.0435	0.0474	0.0435
	C13	0.1277	0.1071	0.1542	0.1154	0.1566	0.0906	0.1301
	C14	0.0551	0.0389	0.0593	0.0778	0.0880	0.1199	0.0518
	C15	0.1285	0.0869	0.1399	0.1096	0.1102	0.0794	0.1172
	C16	0.0707	0.0419	0.1022	0.1048	0.1022	0.1074	0.0855
B4	C17	0.0722	0.0353	0.0605	0.0370	0.0538	0.0521	0.0470
	C18	0.0753	0.0653	0.0602	0.0377	0.0628	0.0904	0.0879
	C19	0.1175	0.1266	0.0994	0.0949	0.1401	0.0859	0.0814
	C20	0.1529	0.1960	0.1254	0.1921	0.1490	0.1764	0.1646
B5	C21	0.1050	0.1810	0.0905	0.1484	0.1158	0.0796	0.1376
	C22	0.2340	0.3191	0.1489	0.2765	0.1560	0.1276	0.2269

The scores for specific types were overwhelmingly higher than the neighbourhood average, confirming that these high frequency activity spaces are favoured by children and their guardians precisely because they are more child-friendly. Nevertheless, safety remains the most pressing issue for all sites, followed by diversity and naturalness(Fig. 5-8).

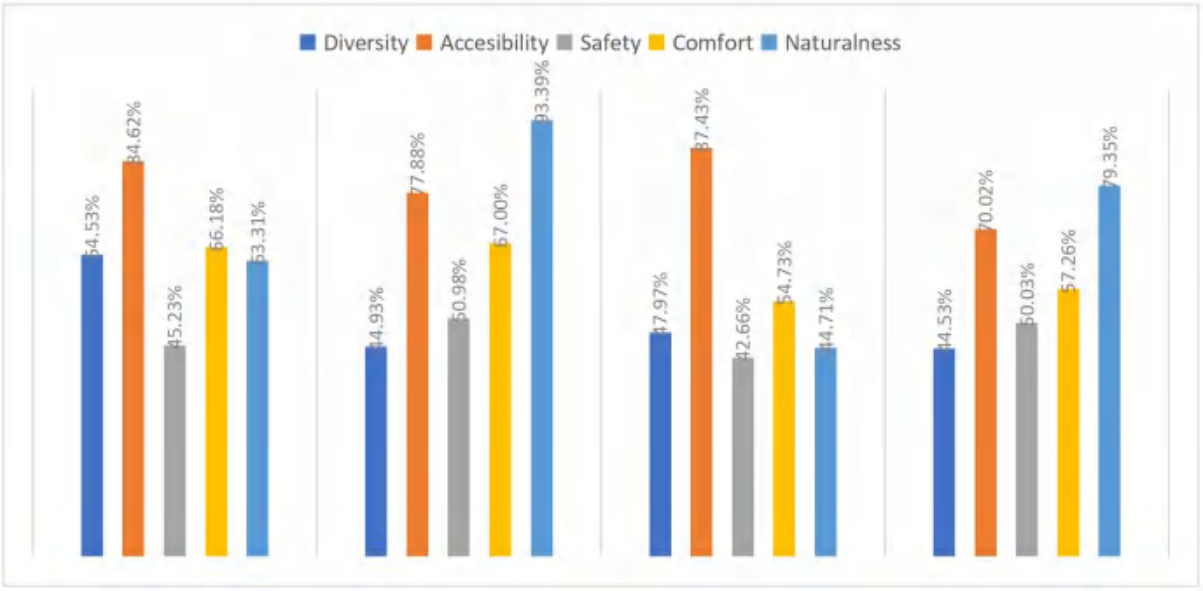
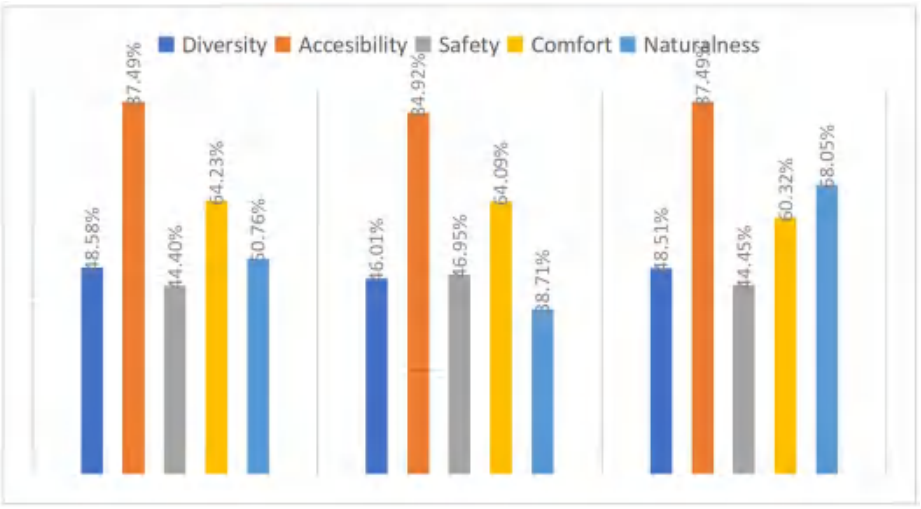


Fig. 5-8 Score rate for different spaces and street types in Liuyun Community(Source: Drawn by Author)（a）

Enclosed vacant space green space Street side clearing Podium roof



Live and leisure street Commercial street Comprehensive street

Fig. 5-8 Score rate for different spaces and street types in Liuyun Community(Source: Drawn by Author)（b）

(Source: Drawn by Author)

The evaluation results show that the three lowest scores for the evaluation indicator factors for safety in each space and street type are:

(1) Enclosed vacant space: C14 Operation safety, C10 Facility safety, C11Surveillance safety;

(2) green space: C14 Operation safety, C16 Policy and education, C11Surveillance safety;

(3) Street side clearing: C12 Route safety, C14 Operation safety, C9 Site safety;

(4) Podium roof: C10 Facility safety, C7 Space safety, C9 Site safety;

(5) Live and leisure street: C12 Route safety, C8 Boundary safety, C11Surveillance safety;

(6) Commercial street: C12 Route safety, C10 Facility safety, C7 Space safety;

(7) Comprehensive street: C12 Route safety, C14 Operation safety, C8 Boundary safety.

These impact factors, ranked from lowest to highest, represent the priority of that type of solution to the security class and can also be summarised in the following way, which will guide the design of the subsequent transformation(Table.5-19).

Table. 5-19 Prioritisation of security issues in different situations(Source: Drawn by Author)

Safety issues	Enclosed vacant space	green space	Street side clearing	Podium roof	Live and leisure street	Commercial street	Comprehensive street
C7 Space safety	○	◎	○	●	○	●	○
C8 Boundary safety	◎		◎		●	◎	●
C9 Site safety	◎		●	◎	○		○
C10 Facility safety	●	◎	○	●	○	●	○
C11Surveillance safety	●	●	◎		◎	○	◎
C12 Route safety	◎	○	●	○	●	●	●
C13Configuration safety				○		○	
C14Operation safety	●	●	●	○	○		◎
C15Neighborhood safety		○				○	
C16 Policy and education		●	○				○

○Some safety issues ◎More safety issues exist ● Most serious issues

5.5 Summary

This chapter proposes an evaluation of the child-friendliness of the public space in Liuyun Community, based on the relevant research and grounded theory in the previous section. Based on the relevant literature, combined with the opinions of experts and scholars and the results of questionnaires, it is determined that the AHP analysis method is used to construct

the index evaluation system.

Firstly, 37 evaluation factors were selected by combining the actual research situation in Liuyun Community and the six indicators of the criterion level identified in Chapter 2, and the 24 evaluation factors of the sub-criteria level were selected by means of a questionnaire.

Secondly, experts from different fields were invited to fill in the judgment matrix, and the absolute weights of each evaluation criterion and evaluation factor were determined through consistency testing, among which the evaluation criteria with the highest weights were safety, participation and comfort. The three-tier evaluation system of child-friendliness evaluation was then constructed, with detailed descriptions of the evaluation basis and methods for each factor, and the calculation and analysis methods for the evaluation results were clarified. The CFI was proposed as a child-friendliness index for public spaces in settlements to reflect the child-friendliness of public spaces in community

Finally, the child friendliness index for each indicator factor in Liuyun Community is derived from the objective scores of the field research and the subjective scores of the questionnaire survey. Through the scores and influence factor scores, the design strategy of safety-led, diversity, accessibility, nature, comfort and participation is clarified, and which safety issues should be addressed first in each type of public space and street.

Chapter 6 Public Space Renewal Strategies in Liuyun Community from Child-Friendly Perspective

6.1 Principles

Based on the previous theoretical research and actual research and evaluation, this chapter takes the current situation of public space development in Liuyun Community as the starting point and elaborates on the principles of public space renewal in Liuyun Community from the perspective of child-friendliness, in order to guide the renewal strategy of public space in Liuyun Community under child-friendly evaluation.

According to the previous research and evaluation, Liuyun Community has the lowest safety score under the child-friendly evaluation criteria, and its public space has more serious safety-related problems. Therefore, this strategy will take the safety enhancement as the leading principle, and elaborate the safety enhancement strategies from five aspects: space construction, path construction, activity construction, policy construction and culture construction, while taking into account diversity, accessibility, naturalness, comfort and participation(Fig. 6-1).

Fig. 6-1 Renewal Principles (Source:drawn by author)

6.1.1 Safety-led

Safety in community public spaces is the most basic requirement and the most important

principle, and is currently the most problematic aspect of Liuyun Community under the child-friendly evaluation. The safety of a site and travel routes determines whether parents allow children to use the community public space or allow children to travel independently. Also among the characteristics of children's activities are randomness and self-centeredness, and children are more curious than adults, especially about the unknown, and these characteristics can make children extra vulnerable and much less able to perceive danger than adults. Therefore, ensuring the safety of children's activities in public spaces is the primary principle of child-friendly public spaces. By improving spatial safety, path safety, activity safety, and policy and cultural safety, we create a positive and favorable community environment and atmosphere, and improve the safety of community public spaces from the physical environment to the social environment in a comprehensive manner.

6.1.2 Diversity, accessibility, naturalness, comfort and participation

According to the theoretical basis of the previous article and the practice of various countries based on child-friendly theory, diversity, accessibility, naturalness, comfort and participation are also important principles for the renewal and enhancement of child-friendly community public spaces.

Children are more sensitive to outdoor spaces than adults and less tolerant of harsh environments. Comfort is also an important principle when designing child-friendly community public spaces. The physical environment not only affects the quality of children's activities, but can even cause physical health problems. Spatial comfort also includes psychological comfort. The psychological comfort of open space is mainly reflected in the sense of belonging to the space, the privacy of the space and the satisfaction of children's interaction needs. Only in a relaxed and comfortable environment can children move around without any worries.

The diversity of community public space includes the diversity of space, i.e., the diversity of space form, size, dynamic and static properties, the diversity of activities and the diversity of facility types. Children are curious, and a diverse and interesting environment is more likely to stimulate their interest in public activities and enhance the attractiveness of outdoor activities for children.

Accessibility is the main factor that influences children's use of community space. Accessibility refers to the degree of spatial obstruction when children use community spaces. There are many factors that affect accessibility, such as the safety of roads, the proximity of

activities to home, and the presence of special landmarks.

The naturalness of a child-friendly community public space refers to the coverage of natural space in the children's activity space and the nature-related activities that children can participate in. Moderate exposure to natural space is not only beneficial to children's physical growth, but also stimulates their sense of adventure, hands-on skills, and many other skills that cannot be developed in man-made spaces.

"The Child Friendly Cities Initiative (CFCI) clearly states that child participation is the foundation of "child friendly" cities, and that society can only listen to children if they have a voice. A city is "child-friendly" when children have the right to participate in its construction. Children's needs for space are different from those of adults, and they see and understand the world from a different perspective. Children are the only ones who know children best, so by involving children in the design of urban spaces and making full use of their design skills and imagination, we can create open spaces in residential areas that meet children's needs. Children's participation can stimulate children's enthusiasm for activities in open spaces, strengthen children's cognition and experience of open spaces, and help cultivate children's sense of belonging to residential neighborhoods.

6.2 Renewal Strategies

6.2.1 Space Construction Strategies

Redistributing and Systematizing

Children's activities in the community require a safe and continuous spatial network that includes indoor and outdoor spaces. A continuous children's activity space system not only provides children with a safe activity site, but also enables children to play in the space with a greater sense of spatial domain, establishing their sense of belonging and improving their psychological security. Most of the existing settlements have limited space, and children's activity spaces are mostly characterized by one large space, with the rest of the spaces being marginalized and fragmented, and each space is relatively independent and unorganized. Therefore, the existing inefficient and fragmented children's public spaces need to be optimally integrated and redistributed according to the different needs of children of all ages, and through the reorganization of spatial resources, a complete sequence of children's activity public space system with a sense of domain and security should be realized.

1. System

Studies based on the spatial extent of children's activities have found that children's activity

distances increase with age, expanding from next to their homes in infancy to entire neighborhoods and then to city parks.

Children between the ages of 2 and 4 can generally only observe activities in a five-minute living area in the community with their parents leading them from 0-100 meters;

Whereas children who are slightly older and under the age of 12 have the ability to play with their peers in areas such as parks and sports fields, and generally move around the ten-minute living area at a distance of about 0-300 meters;

If children are older and have the need to go to school, their while usual activity range and distance may be around 0-1000 meters, and some even break the distance of fifteen minutes living circle.

Therefore, when redistributing and systematizing the public space for children in the community, we should consider the appropriate distance and time for children of different ages, consider the layout of the activity space according to the maximum activity range of children, and combine natural elements and site topography from the perspective of children's preference for colors, materials and planting levels to create a safe, convenient and high quality public space for children in the community. As preschool children are not capable of independent long-distance activities, convenient proximity courtyard space and space in front of the house should focus on the activity needs of children of this age group; public space between groups is the activity space accessible to most children and should focus on the activity needs of children of multiple ages; public space at the residential level should give due consideration to the activity needs of children.

According to the difference in the frequency of children's activities in different levels of public space and the distribution characteristics of public space, they are divided into three levels: pre-home level, group level and residential level, which correspond to different activity frequencies and public space levels.

The public space in pre-house is the first level, which refers to the space around the residential building, with the largest number of spaces, the smallest scale and high activity frequency of children. These spaces are generally frequented by younger children. In the design, attention should be paid to safety issues, low plants to ensure the permeability of the view and reduce the oppressive feeling of the space for children.

The group-level public space is the second level, which is a faceted space formed by the enclosed residential buildings, with a service radius of 100 meters, a large number of spaces, a small scale, and a high frequency of children's activities. It can be equipped with children's activity facilities to provide activity places for older children.

The third level of public space is the residential level, with a service radius of 300 meters, a small number of spaces, a large scale, and a relatively low frequency of children's activities. The users of this type of space are not only children, but it is still necessary to ensure that it is child-friendly and reduce the possible negative impact on children(Fig. 6-2).

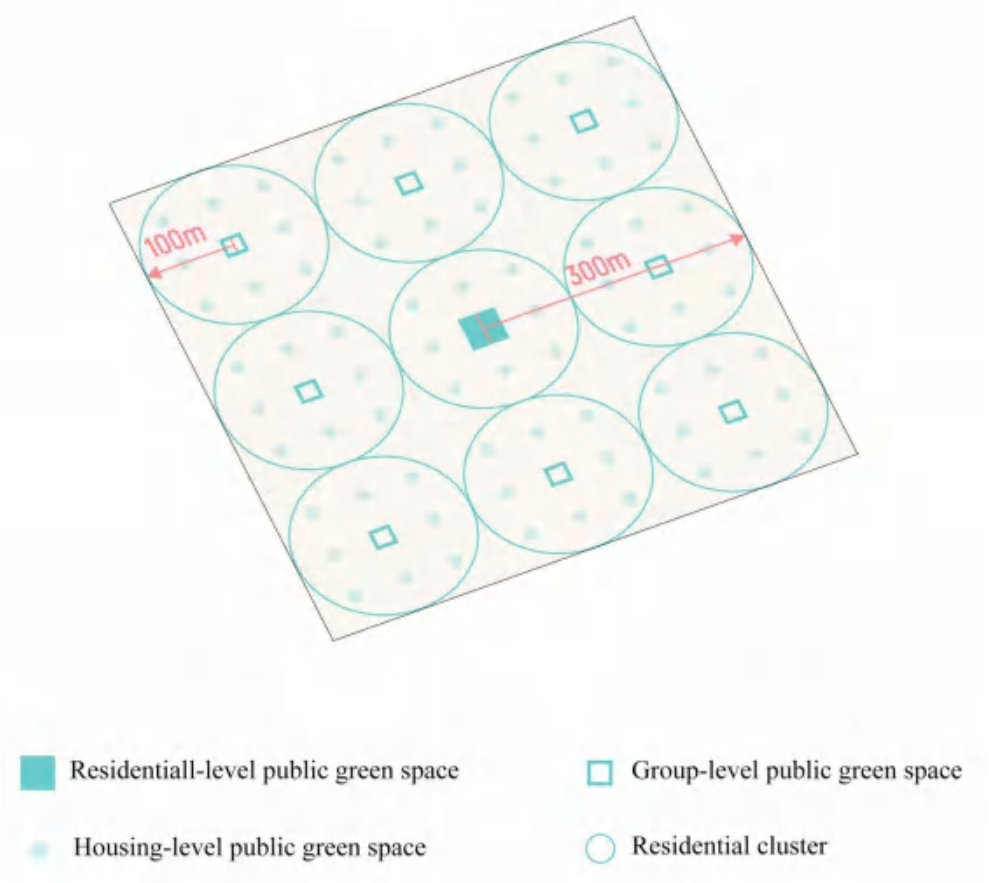


Fig. 6-2 Distribution of public space at different levels (Source:drawn by author)

2. Area

According to the service targets, quantity and frequency of use of children's activity spaces at each level, the corresponding scale requirements are set.

Among them, the public space in pre-house level in the community is the site for frequent activities of younger children, and should be set in a larger number scattered inside the community as a small-scale play space, corresponding mainly to the land between houses, podium roofs, etc. The space scale can range from 10 square meters to dozens of square meters, depending on the conditions;

Group-level public space is the activity site for most mixed-age children, with a larger number of spaces, corresponding mainly to small-scale outdoor activity green areas, small squares enclosed by buildings and other sites within the community, whose area should not be less

than 100 square meters, and can be chosen for the central location of the community to facilitate easy access for all children in the community;

The public space at the residential level should give due consideration to the needs of children's activities, and the corresponding spaces are mainly residential level central squares, central gardens, activity centers, etc., with a scale of 150 ㎡ and above(Table. 6-1).

Table. 6-1 Community Public Space in different level (Source:drawn by author)

Public Space System	Pre-house Level	Group-level	Residential level
Space Scale	10-100 ㎡	100-150 ㎡	150 ㎡ and above
Type	Inter-house land, podium roof	Outdoor activity green space, building enclosure square	Plazas, activity centers, etc.
Distance from home	close	middle	far

Visualizing and Monitoring

There are also potential unsafe factors in residential spaces, such as closed spaces, corners with obstructed views, and internal traffic hazards. In addition to avoiding roads with high traffic flow and parking lot entrances and exits, the location and design of children's activity spaces should also take into account the problem of permeability, the absence of tall trees and architectural dead ends to ensure that children's activities are within the sight of their guardians. In the design of public spaces for children in the community, the selection of the location of the space, the design of the line of sight for adult monitoring, and the layout of monitoring facilities to eliminate the lack of safety supervision of the space can improve the sense of security of children in the space and reduce the danger brought by strangers to children.

1. The location of the space to form a "street eye" passive supervision

Jane Jacobs believes that good street dynamics can provide the necessary surveillance and protection for children's activities[46]Street eyes" in residential neighborhoods are a safety measure for children's activities. A vibrant residential neighborhood provides a good atmosphere for residents, promotes outdoor activities, and provides supervision for children in the activity space. When choosing the location of children's activity spaces, it is important to ensure that the public space for children's activities has a good line of sight penetration, so that children's activities are within the monitoring range, which allows adults to effectively supervise children's play behavior, avoid visual dead spots, and ensure the safety of children. At a younger age, children are more often led by their guardians to play outside, so good

spatial penetration can make it easier for parents to supervise and use the eyes of pedestrians to observe children in the neighborhood, which can reduce the danger of children playing in the neighborhood and form a "passive supervision".

Common types of public space in residential areas are: open space in front of houses, open space surrounded by residential buildings, open space along the roadside, and community green space(Fig. 6-3). In addition, the "Design Guidelines for Micro-renovation of Older Neighborhoods in Guangzhou" encourages the use of rooftop space for renovation. Rooftop gardens can not only solve the problem of insufficient public space in existing communities, but their excellent location is closely linked to residential houses, which can provide parents with a better surveillance environment and form a safe and controllable public activity space for children. In an accessible rooftop space, the roof space can be used as a drying space and a sports space for residents, and it can also be used to grow vegetables and fruits to become a small urban farming garden, forming a composite place and a natural "monitoring coverage area", and at the same time, it can provide a different kind of educational space and activity space for children. Therefore, when redistributing the space for children's activities, we should give priority to spaces with good visual penetration, such as the rooftops of podiums, open spaces enclosed by residential buildings, open spaces between groups, streets with active interfaces or open spaces in front of public buildings.

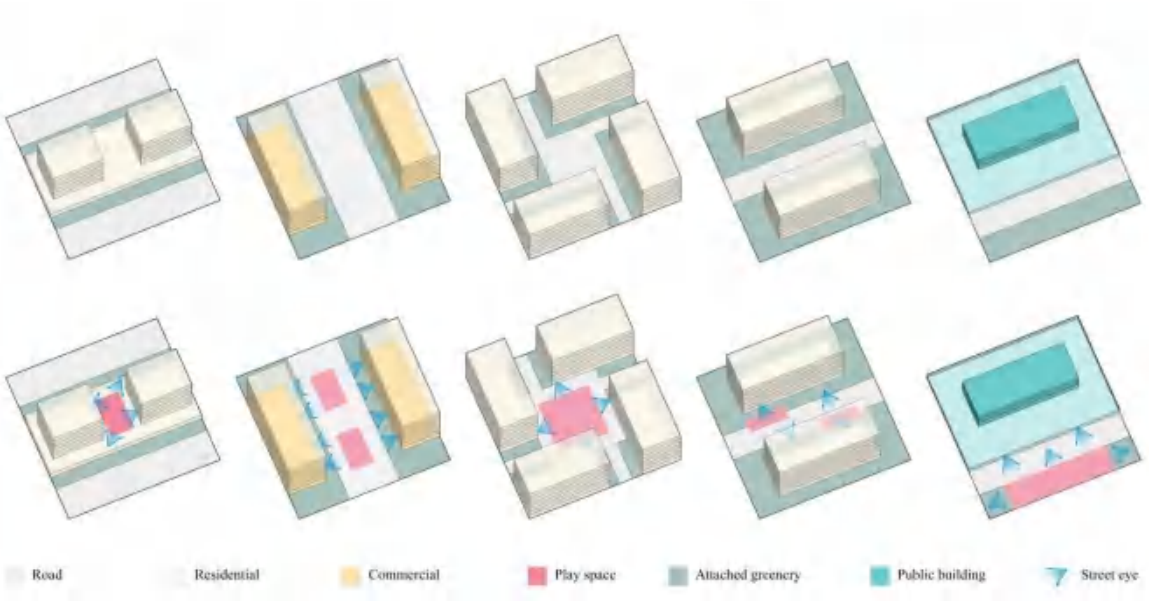


Fig. 6-3 Types of relationship between community public space and children's activity space distribution (Source:drawn by author)

2. Compound activity spaces for the elderly and children to form effective supervision

The elderly and children belong to the socially disadvantaged group, and they have a great

degree of similarity in terms of location, frequency and time of space use. Compared with the busy young and middle-aged population, children and the elderly use the public space in the residential area more frequently. Second, in China, intergenerational childcare is also very common. In the daily childcare process, the elderly are often passive, with activity behaviors and routes changing with the children, and rarely have the opportunity to enjoy themselves at the same time. Based on the above activity rules of the elderly and children and the actual situation in China, when designing and laying out the children's activity space, the children's activity space and the elderly resting space are combined to provide the elderly with a space for rest and play, while also ensuring that they can effectively watch over the children and see the children's activities in real time, so that the old and young groups can use the public space together.

Compound old and young activity space means that in the same public space, the different activity needs of children and the elderly can be met at the same time, i.e. the interactive shared space has multiple functions and facilities to meet the differentiated needs of both groups, while avoiding line of sight obstruction and ensuring the normal care of children by the elderly.

In terms of spatial layout, the composite old and young activity space has the following three layout methods.

The first is the extended functional compound, where the old and young activity spaces are directly joined together in an extended and mutually permeable space, which is mainly applicable to the surrounding sites where there is no carriageway, without considering the safety hazards brought by the surrounding motor traffic.

The second is the enclosed functional compound, children are suitable to be arranged inside the space because of the randomness of their activities. Older people in the outer activities, children in the inner activities, space is surrounded by the type, mainly applicable to the site surrounded by the carriageway.

The third is the semi-enclosed functional compound, which can ensure that children have a complete activity space, and at the same time, within the line of sight of the elderly space activities, so that the elderly activity site to achieve comprehensive monitoring of children's activity site(Fig. 6-4).

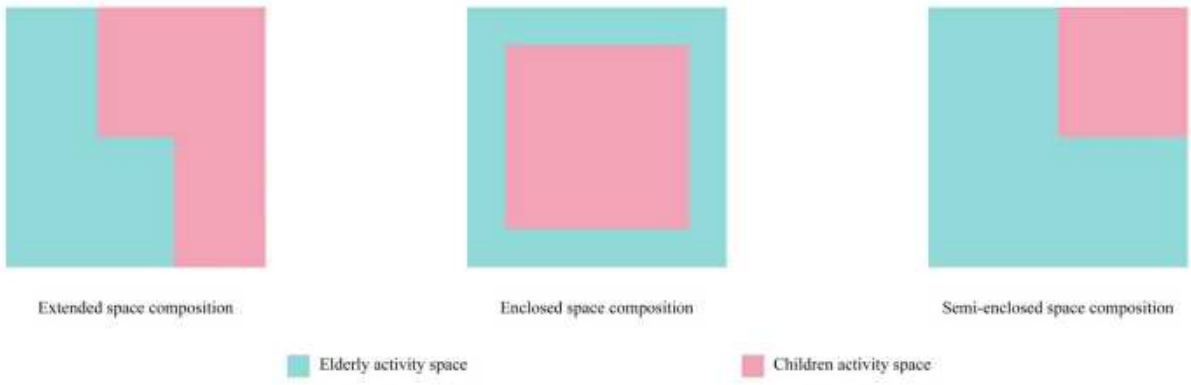


Fig. 6-4 Three layout of the old and children’s activity space (Source:drawn by author)

3. Layout of monitoring equipment network to form active monitoring

In addition to the above two types of artificially formed monitoring, the monitoring of children's activity sites also needs to achieve full coverage of monitoring equipment. Improve the monitoring system in the residential area and add electronic monitoring facilities in the main public space to play the role of warning, supervision and management.

In terms of the layout of monitoring points: first, the entrances and exits of the activity venue must be laid out with monitoring points to achieve clear images of any incoming and outgoing people, vehicles, objects and other targets. Secondly, in the venue important facilities, stairs and other parts of the distribution of monitoring points, forming a full-coverage monitoring of key areas. Finally, for monitoring dead ends and other areas, according to the actual situation, choose the type of camera to fill the point to ensure multiple captures of moving targets.

In the selection of the location of the pole: 1. The distance between the pole point and the pole point is in principle not more than 300 m. 2. In principle, the location of the pole from the monitoring target area of the nearest distance of not less than 5 meters, the farthest distance shall not be greater than 50 meters, so as to ensure that the monitoring screen can contain more valuable information. 3. In the vicinity of a light source, give priority to the use of light sources. But pay attention to the installation position of the camera should be in the direction of the light. 4. Try to avoid installation in places with high contrast, if you must install then consider: ① open exposure compensation (the effect is not obvious); ② the use of fill light; ③ set the camera in the underground channel outside the entrance and exit; ④ set in the channel by a little. 5. Pole position as far as possible to avoid green trees or have other obscuring objects, if you must install it to consider Avoid trees, other shading objects, but also for the future growth of trees to leave space(Fig. 6-5).

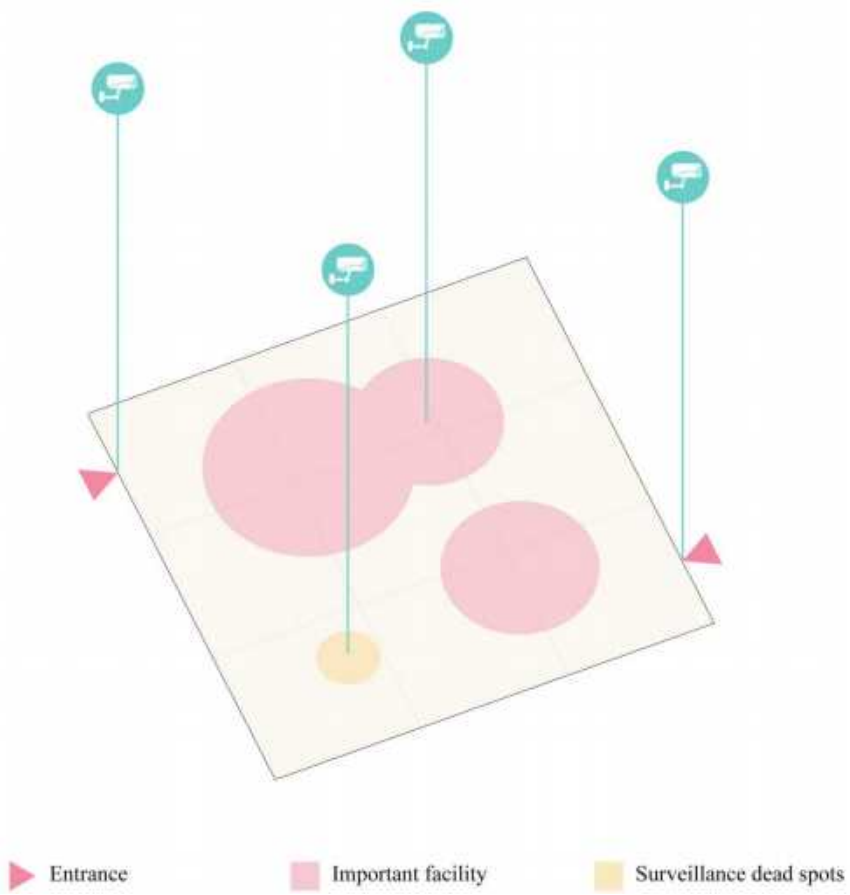


Fig. 6-5 Monitoring layout location (Source:drawn by author)

Bordering and Zoning

1. Boundary

Traffic speed in the community is generally slow, but for the open six-unit community and the now increasingly developed take-out industry, fast-moving take-out workers' electric vehicles also have certain safety risks for children's activity space. Therefore, the public space for children's activities should have certain boundaries to reduce the influence of the outside environment on the children's activity area, improve the safety of children's activities, and also help to form children's sense of domain for space and enhance their sense of psychological security.

Common public spaces for children's activities can have boundaries in the form of plants, maintenance, height differences, seating facilities, etc. as their activity space.

Plant greening: Children's activity sites can use plant greening, flower beds and tree ponds as the boundaries of the site. In the selection of plants, choose non-toxic, thornless low shrub greening, the height should be effective in limiting children to cross, but do not block the sight of parents watching children. At the same time, shrubs can also be trimmed into the

shape that children like, and business cards introducing their species can be added to each different kind of greenery, which can invariably educate children about science and increase their interest in plants and nature.

Height difference: Children's activity sites can use height difference to clarify the boundaries of the activity site, and appropriately raise the public space for children's activities to give a reminder to electric vehicles and other pedestrians to prevent the entry of vehicles and other means of transportation. The height difference should not exceed 0.1 meters, and should be set up to remind the ground paving eye-catching; when the height difference exceeds 0.1 meters, the facility should be steps or fences to achieve the division of space. At the same time, attention should be paid to the height of the height difference and the handling of the interface to avoid psychological oppression and safety hazards to children's daily walking. Barrier-free facilities and channels should also be set up at the height difference.

Seating facilities: Children's activity site can use seats, stone piers and other facilities as its boundary, while playing a division of space can also provide parents with a place to rest and monitoring. The setting of seats should pay attention to the distance between each other, should be controlled within 2m to control the entry of vehicles and ensure the scale of pedestrian traffic.

Maintenance facilities: The most direct way to set boundaries for children's activity sites is to set up maintenance, such as fences and railings. The fence should not be set too high, and can be left with inward sight space by opening holes, shaped treatment, etc. At the same time, it can be combined with children's activity facilities and educational propaganda, and set some interesting small objects to create a child-friendly and attractive interface. Through the design of the painting content, children can be given more fresh knowledge outside the classroom in a subtle way. The fence as the boundary of the activity site should be more than 1.1m, while the design of the railing should take into account the scale of children's bodies, and the distance between the vertical bars should not be larger than 0.11m to avoid accidents caused by children sticking their heads or other parts of their bodies into the gap of the railing due to curiosity(Fig. 6-6).

Fig. 6-6 Boundary of children's activity site (Source:drawn by author)

2. Zoning

Due to the different age and cognition of children, their preference for activities and the properties of space movement are different, so the internal space is flexibly and appropriately partitioned and combined to make each activity area clear to meet the different spatial needs of children. Consider the partitioning and combination of different spaces, such as the combination of age-specific and mixed-age spaces, the combination of main children's activity space and adult accompanying space, the combination of children's activity space and rest space, and the combination of nature and activity space for the internal partitioning of space, and need to pay attention to the setting of a 1.5m buffer zone between dynamic and static activity areas(Fig. 6-7).

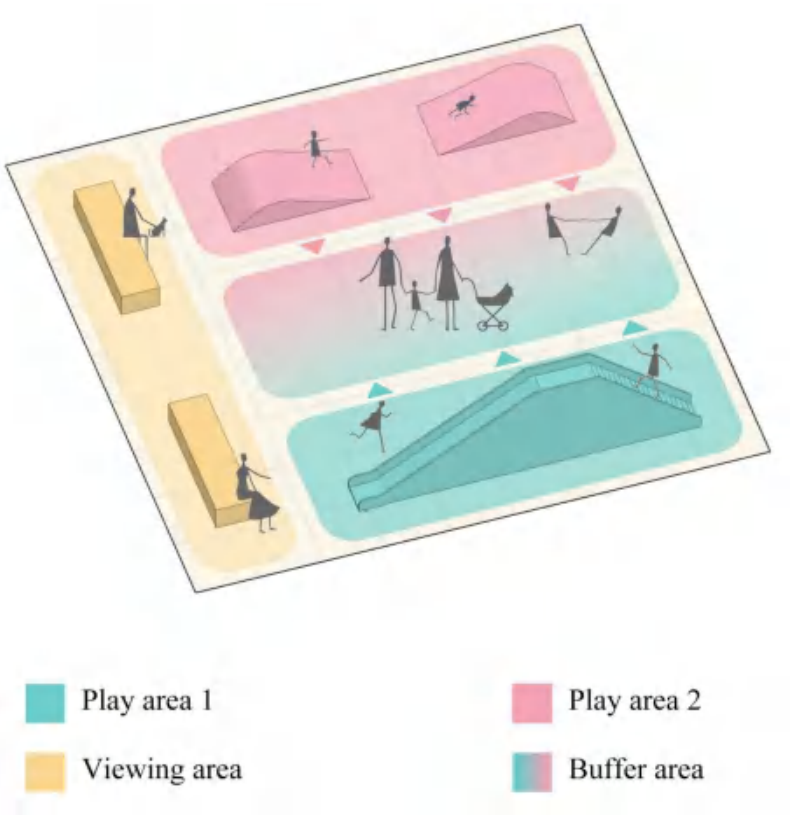


Fig. 6-7 Zoning of children's activity site (Source:drawn by author)

According to the previous theoretical study, children like to interact with their peers and attach to their parents, and moderate attachment can train children's independence and make them feel more at ease with independent activities and other psychological characteristics of children.

Children like to imitate at the early stage of their growth, learning new skills, expressions and behaviors through imitation, and they will follow the crowd because of their incomplete knowledge of things.

Therefore, the optimization of community public space should take into account the arrangement of activity space for children of different ages.

Children often run outside the play space to play, so a certain safe buffer space can be set around the play space to prevent children from running into the motorway and causing safety hazards. At the same time, a buffer space of at least 1.5m should be set between the static and dynamic activities of children(Fig. 6-8).

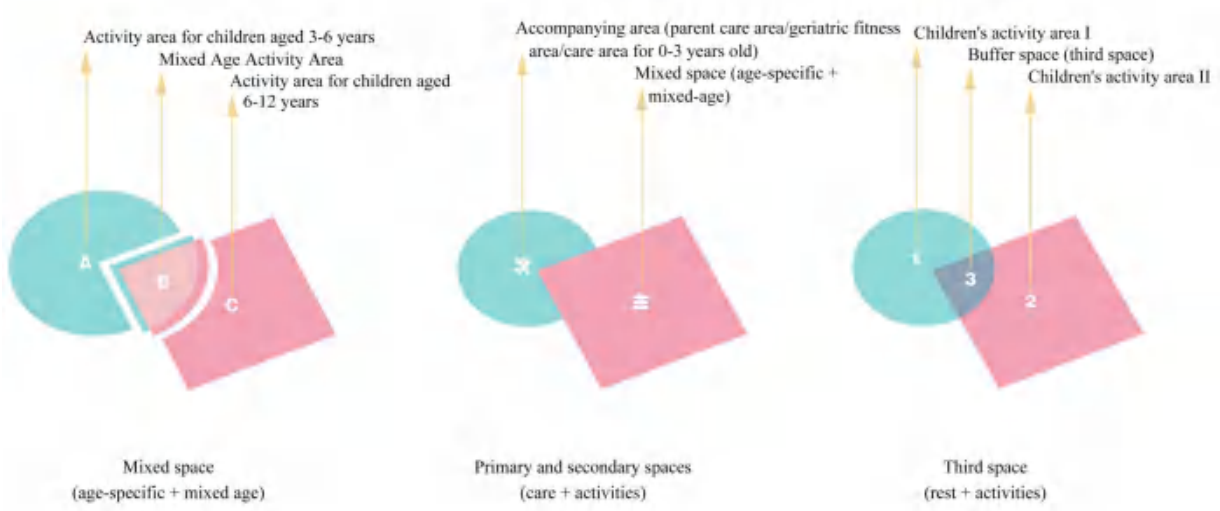


Fig. 6-8 Zoning of children's activity site (Source:drawn by author)

Optimizing and Controlling

There are also certain dangers inside the public space for children's activities. The scale of the space, the type of facilities, the choice of paving materials, the configuration of plants and other aspects can all have safety problems. However, the public space should not be made uniformly uninteresting and bland to avoid some dangers. Children have a natural psychological need to try danger and excitement, and an overly boring environment will often make children feel bored and want to try some risky behavior. However, because children's mental development is still immature and their perception of danger is low, they may cause serious harm to themselves when they engage in risky activities. Therefore, in addition to the spatial scale, activity facilities, paving materials and plant configurations that meet the physical and mental characteristics of children, the design of community public space should also appropriately select some challenging activity facilities for children to carry out safe and controlled risky activities to avoid uncontrollable risky behaviors by children themselves, the key is to make the risk controlled or acceptable. At the same time, regular safety assessment and maintenance of children's activity facilities to ensure the safety of the facilities in the process of long-term use by children.

1. Spatial proportion and scale

When planning and designing public spaces for children in the community, the spatial organization, scale and layout of facilities in the space should take into account the physiological scale and psychological tolerance of children, and avoid using adult scale for construction. Children's line of sight should be within a 60° angle. The length to width ratio of the activity site should be controlled at 2.5:1~4:1. The design of private small space at such

scale can meet the needs of children to be alone or communicate with others. On the contrary, spaces with a length-to-width ratio of more than 5:1 tend to reduce the comfort of children's activities. Space planning from 95 cm height is conducive to children gaining a strong sense of security and belonging. At the same time, the detailed design of the guide facilities, the selection of play facilities, seating facilities, outdoor stair treads and handrail height should also pay attention to the grasp of children's scale(Fig. 6-9).

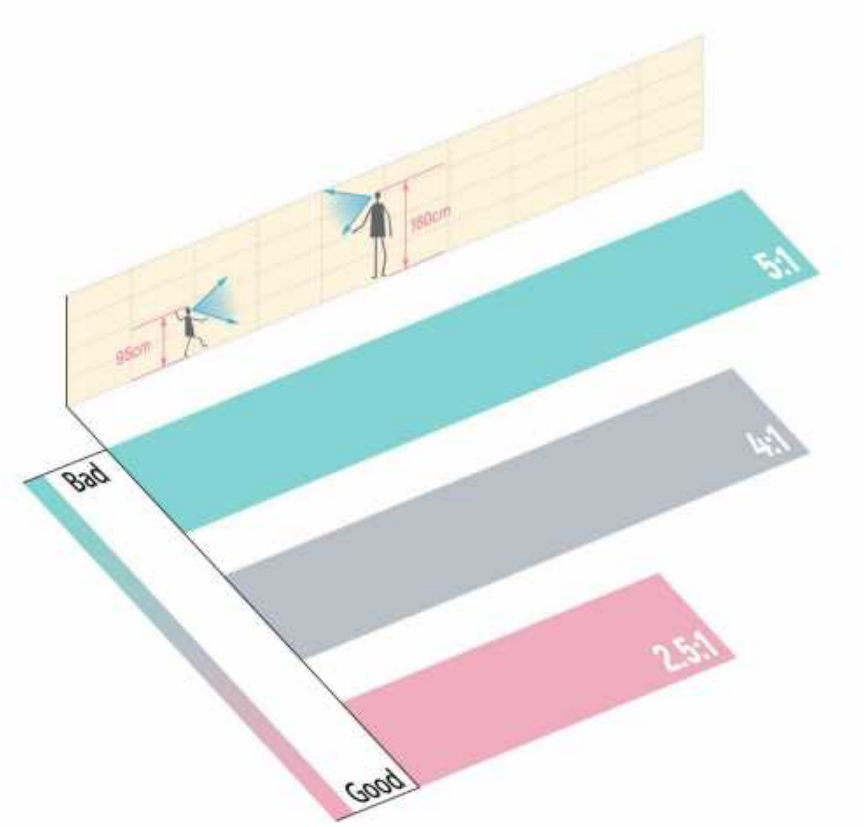


Fig. 6-9 Activity field length to width ratio and children's line of sight (Source:drawn by author)

2. Configuration of activity facilities

Children's needs for games are different, and the configuration of activity facilities in public space needs to take into account the needs of children of different ages. At the same time, we should use playground facilities with high safety factor and pay attention to the daily maintenance of playground facilities to avoid accidents. The combination of children's activities, children's companion activities, parent-child activities and other activities should be fully considered in the division of the site, and the respective activities should be divided into clear areas accordingly.

Specifically, 0-3 years old children's activity ability is relatively weak, need such as sand pool, rocking car, slide and other relatively low and simple facilities.

3-6 years old children's activity ability increased, can be slightly larger scale activities, can be configured such as swings, climbing frame, seesaw and other facilities.

6-12 years old children's independent activity ability is strong, the public space can be configured with large combination slide, climbing wall, balance beam, etc. The public space can be equipped with a large combination slide, climbing wall, balance beam, etc., or only an open space or green space for children's imagination and creativity to carry out free activities or free creation(Table. 6-2).

Table. 6-2 Activity facility for different age children (Source:drawn by author)

Age	Facility	Design Points
0-3	Sandpit	The scale is generally 10-20 square meters, sand pit in the placement of play equipment to be appropriately increased to ensure that the basic activities of children space
	Slides	The slide consists of climbing section, platform section and sliding section, climbing ladder frame inclination of about 70 °, 40 cm wide, with handrail rails on both sides, rest platform around the 80 cm protective rails, both sides of the straight edge of 18 cm, so dry children's feet brake. Slides under the laying of not less than 3cm of rubber mat or 40cm of sand, to prevent children from falling injured
3-6	Swings	Swings are generally 2.5m high, the surrounding guardrail height 60cm, the ground needs to set up a drainage system and laying flexible materials
	Seesaw	The general width is 1.8m, the length is 3.6m, the center axis is 45cm high, the end of the old tires and other equipment placed as a buffer pad
	Rock Climbing	The standard size of climbing frame is 2.5*2.5m, multiple groups of lattice frame can form a climbing maze, and flexible materials need to be paved under the frame
6-12	Skatepark	The skateboard field is a special site, which should be separated by green planting and railings equal to other leisure areas. Fixed practice apparatus should be set up in the field, and sufficient safety distance should be reserved for skating and running
	Labyrinth	The labyrinth is composed of shrubs from the wall or a solid wall. Wall height is generally between 0.9-1.5m, in order to block the children's line of sight shall prevail, the ground to gravel, pebbles, etc. paving
	Game wall	The height of the wall is below 1.2m for children to cross or ride. The wall can be appropriately open holes for children to cross and peer to generate interest in play, the wall should be painted patterns are not easy to fade
Others		Various types of seats, weather shelters, hand washing pools, garbage cans, lockers, etc.

In addition, the site should also provide a variety of seats, weather shelves, washbasins, garbage cans, lockers and other facilities, and reserved for strollers, children's bicycles,

scooters, etc. to meet the needs of children accompanying leisure, care for children. Finally, in the children's activity facilities, try to choose curved, harmless, also for the protection of children.

3. Natural elements

The introduction of natural elements helps to satisfy children's curiosity and adventurous spirit. The risk control of facilities and sites related to natural elements to provide children with adventure within a controlled range is another form of safety assurance. In terms of plant elements, facilities can be combined with tree pools for climbing frames and tree houses, but care should be taken in the selection of plants. In addition to the traditional ornamental landscape plant mix, children's public spaces in the community can also introduce edible fruit trees and health plants to enrich the variety and level of landscape plants and enhance interactivity. However, care should be taken to avoid choosing plants with poisonous thorns and allergic hazards, such as poisonous oleander and redbud, thorny acacia and rose, irritating poplar and willow. Shrubs should replace trees, and trees should be non-toxic, low branched and strong, easy for children to climb upside down, while sand pits and other protective materials should be provided under the trees. In terms of water elements, public spaces with children's activities should not use deep pools as landscape nodes or play facilities, or do protective measures around deep pools(Fig. 6-10).

Fig. 6-10 Natural elements（Source: Pictures from Internet）

4. Paving materials

Another design approach to ensure the safety of children's activities is the choice of paving materials, children are prone to fall when playing, chasing and playing, different materials of ground paving can bring different protective effects. Concrete floor anti-slip wear resistance is better, but the texture is hard, children are easily injured after a fall; ordinary tile floor aesthetics is better, but wear resistance and slip resistance are poor, once the ground has water is very dangerous; plastic and other soft paving materials have better wear resistance and slip resistance, even if children fall can provide a certain buffer, and color options, low cost

paving, is the children's activity area floor paving Ideal material. Therefore, children's activities in public space as far as possible to use rubber, pine filling materials, turf and other flexible soft paving materials to avoid serious tripping accidents(Fig. 6-11).

Fig. 6-11 Paving materials（Source: Pictures from Internet）

5. Node marking

The play space can also increase the naturalness and identifiability of the activity space by setting iconic landscapes, such as big trees, small hills, big platforms or sculptures, etc. This is conducive to the formation of a clear orientation of the space in children's minds, enhancing the identification of the space and enhancing children's sense of security(Fig. 6-12).

Fig. 6-12 Node marking（Source: Pictures from Internet）

6.2.2 Route Construction Strategies

Specializing and Netting

1.Coverage

Establishing a child-friendly community public space system requires the establishment of exclusive routes for children to ensure the safety of children's travel. The paths that are used more frequently by children are selected in a larger area, and the places for children's daily activities, including residences, schools and children's activity sites, are linked together to maximize the needs of children's activities in the residential neighborhoods, and finally a safe, continuous, interesting and walkable community public space system is established.

As children are the main users, the planning of children's routes must be carried out under the

premise of ensuring children's participation. Children have difficulty expressing themselves clearly due to their cognitive immaturity, so designers can obtain a map of children's daily behaviors in the community through games, interviews, and field observations. The children's behavior map contains children's behavior in different spaces, children's evaluation of the space, and children's daily routes(Fig. 6-13). The designer establishes a system of children's routes through the judgment of children's perspective, and optimizes and enhances the related spaces to delineate independent and continuous walking and riding spaces for children.

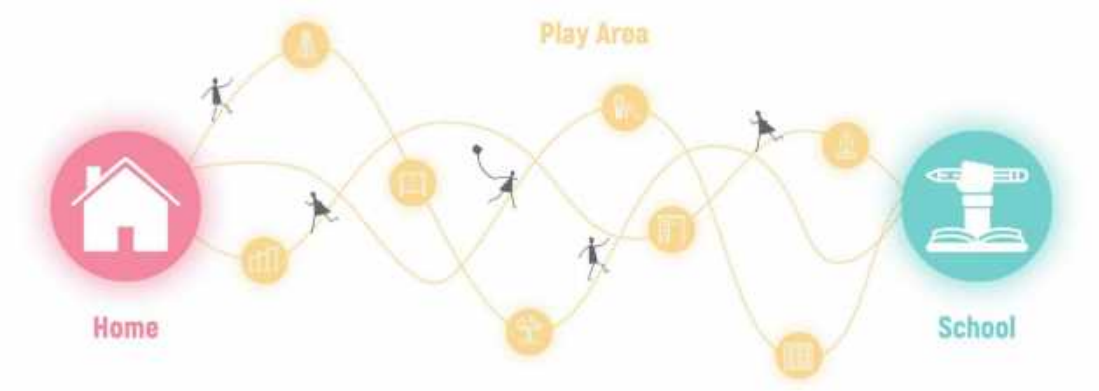


Fig. 6-13 Children's routes（Source: Drawn by Author）

2. Size and location

Children's routes need to be planned with complete and continuous bicycle paths and children's walking paths, and distinguished by obvious colors or paving materials. The width of bike lanes should be no less than 1.5 meters for one-way travel and no less than 2.5 meters for two-way travel. In the case of adequate street scale, bicycle lanes should be arranged on both sides. When the conditions are limited, it can be arranged on one side, but the minimum width should meet the requirements of two-way driving. At the same time, bicycle parking space and shared bicycle stations need to be set up in conjunction with travel destinations and departure points(Fig. 6-14).

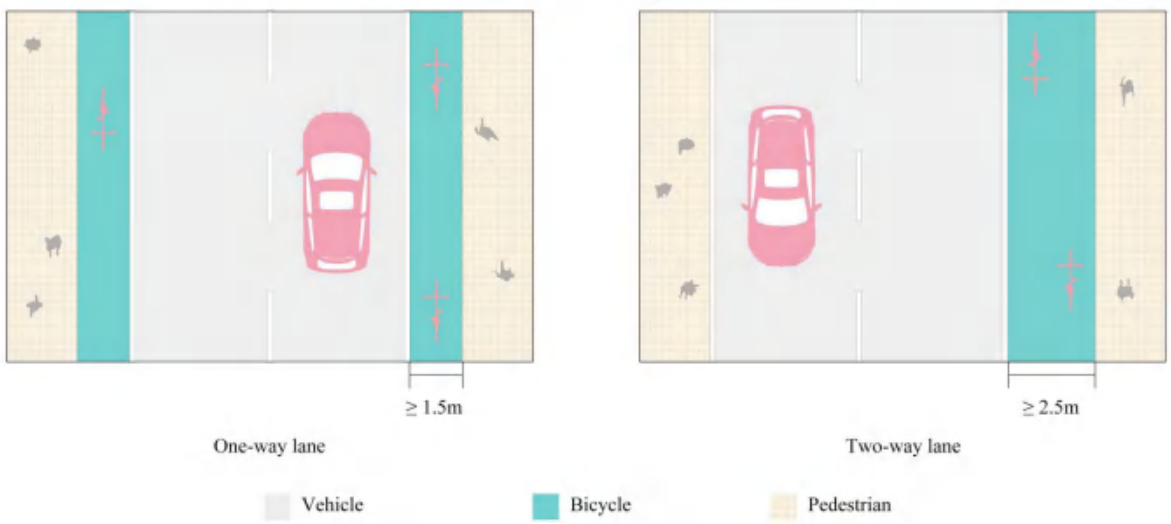


Fig. 6-14 Bicycle Lane (Source:drawn by author)

Based on the physiological and behavioral characteristics of children described in the previous section, children's walking paths should be no less than 1.5 meters to ensure adequate scale for children and parents or children walking side by side in pairs. When conditions permit, it is advisable to increase the width of the walking path to meet the needs of children gathering to interact and play.

The interior of Liuyun Community is dominated by commercial-type roads and life-type roads.

①Commercial street-type roads with urban traffic attributes should fully guarantee the safety of pedestrian paths when setting up children's routes, and protective measures such as green belts can be set up between the carriageway and the sidewalk. Children's exclusive path can be located between the front area of the building and the walking space, the overall street space from the inside to the outside are the front area of the building, children's walkway, walking space, green facilities belt and non-motorized lanes, motor vehicle lanes. If space conditions allow, it is appropriate to set up areas for children to rest and stay at intervals of 50-100 meters(Fig. 6-15).

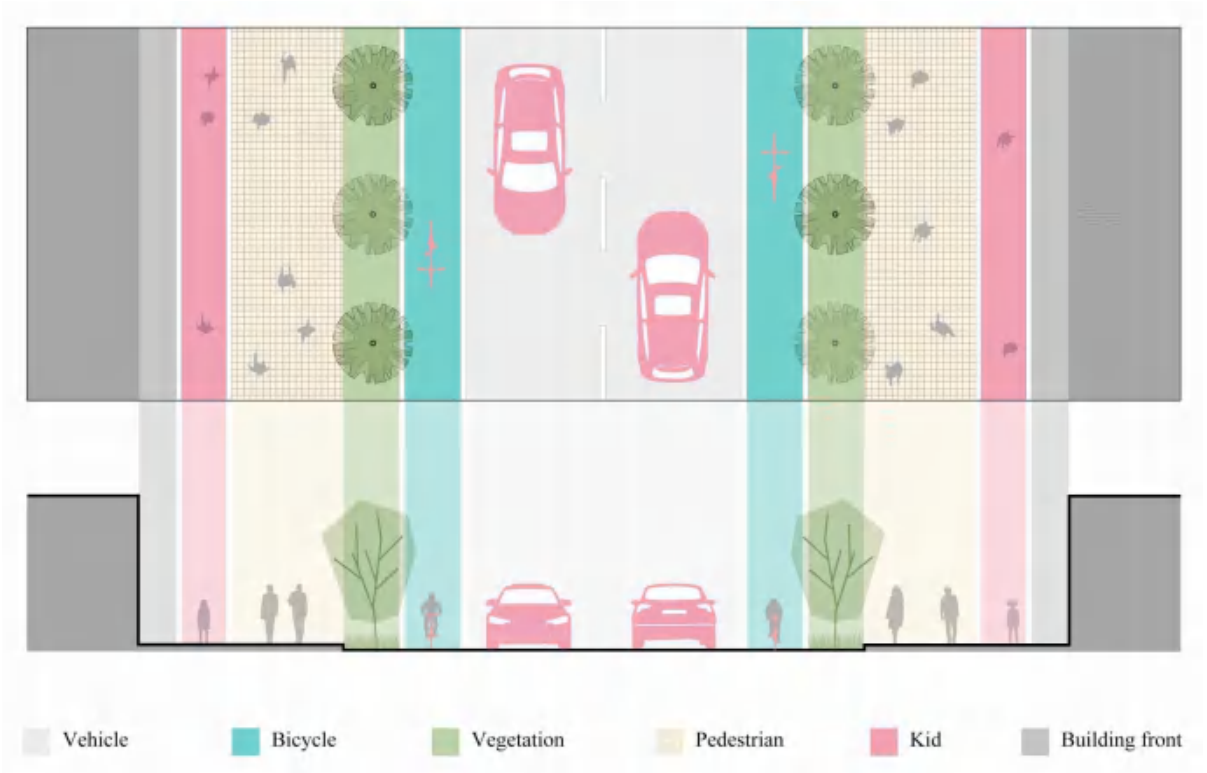


Fig. 6-15 Children Route on commercial street (Source:drawn by author)

②A shared urban street can be created where cars, pedestrians and bicycles are integrated into a single street space and live together peacefully. Remove continuous curbs on both sides of the street and use different colors and textures of pavement materials to distinguish between pedestrian and motor vehicle lanes. These initiatives put pedestrians and vehicles on the same level, and drivers are forced to slow down and drive carefully as people and vehicles mix. This measure allows people to walk, play, and communicate more safely on the street, and also allows more space to expand other functions, such as placing public facilities on the street and adding small spaces for interaction, thus providing more possibilities to integrate the living environment, residents' lives, and regional transportation. When installing shared streets, a clear entrance sign should be installed to remind drivers to enter the area and to follow the traffic regulations of the area. At the same time, physical means should be used to improve the safety of the street, such as adding speed bumps and cushions and increasing the curvature of the street in the design, while using street furniture and trees to block the continuous view of drivers, forcing them to slow down and increase their caution in driving(Fig. 6-16).

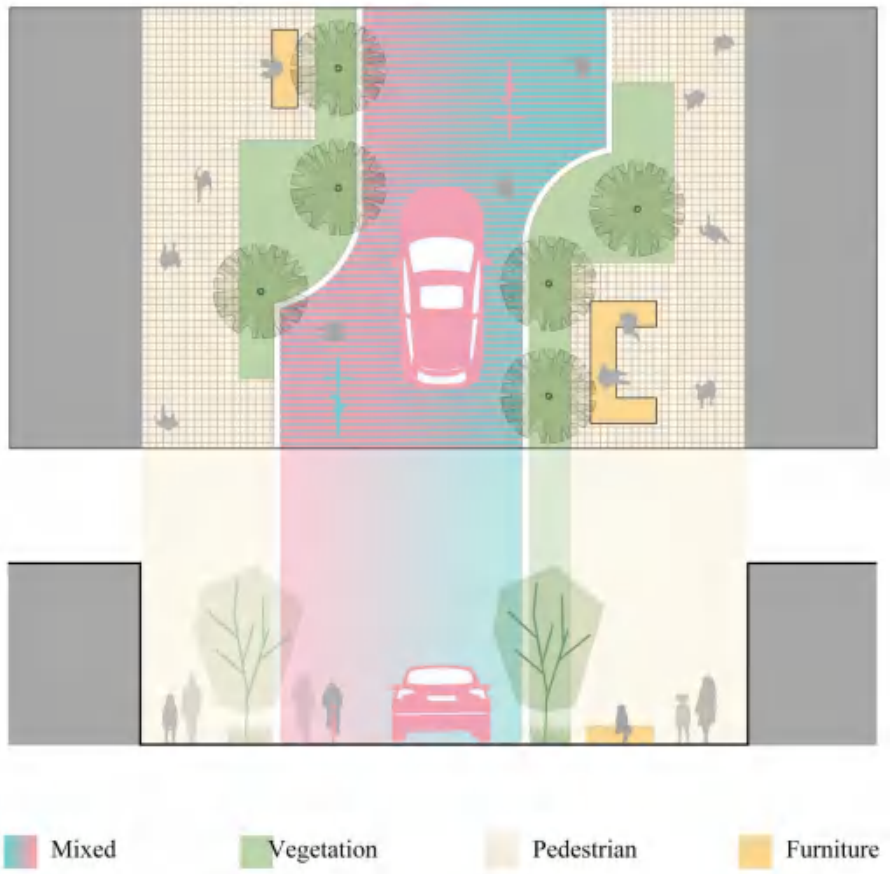


Fig. 6-16 Children Route on living street (Source:drawn by author)

Signing

A special signage system is needed for children's routes. This includes signs for adults and drivers as well as child-oriented signage systems, such as path ground signs, activity space node signs, route guidance signs, colorful street crossing signs, etc., to guide children's travel, improve their sense of direction and psychological safety, and reduce the possibility of getting lost.

1. Child-friendly travel signs for adults and drivers

The signage system for adults and drivers needs to be set up with eye-catching colors and signs near the crosswalk and children's activity destinations, such as watch out for children signs, speed limit signs and slow down signs to warn drivers of the speed limit, and watch out for children passing and avoid them. Also pay attention to the density and spacing of the installation(Fig. 6-17).

Fig. 6-17 Child-friendly travel signs for adults and drivers (Source:drawn by author)

2. Child-friendly travel signs for children

The child-oriented signage system includes pavement and signage for children to guide them on their travels. First of all, the signage system should be interesting and should fully consider the psychological characteristics and aesthetic interests of children, which can attract children to use and encourage them to travel; secondly, children's sense of orientation is poor and their actions are uncertain, so the signage system can also regulate children's route to a certain extent and reduce the possibility of children getting lost(Fig. 6-18).

The pavement of the road should have obvious recognizability, such as color, material and other differences. There is a clear distinction from other roads through special road forms, such as children's coloring, interesting shapes, or the use of plastic pavement, which is distinguishable from the car road and has a soft texture that can guarantee children's safety. By using children's favorite cartoon forms and bright colors, the guidance of children can be enhanced, and children can clearly distinguish the direction of the road or the type of space(Fig. 6-19)..

The signage system is essential in the planning of child-friendly spaces because it can indicate the direction and help children connect various spaces in the community. Therefore, the plan is to set up signs at important spatial nodes in the city that meet the scale of children's vision and are distinguished by different color zones. Considering children's limited cognitive ability of words, the signage pattern should be as readable and recognizable as possible, so that children can recognize it. In addition to the regular route guidance, the content of the guide can also be implanted with popular science content, such as traffic safety knowledge,

compliance with traffic rules, etc., so that children can understand traffic safety knowledge faster, comply with traffic rules, and cultivate children's spatial sense and ability to remember the path from childhood Finally, the height of the signage system should also be in line with the children's scale, the guide facilities should be in line with the height of children, generally 95cm high.

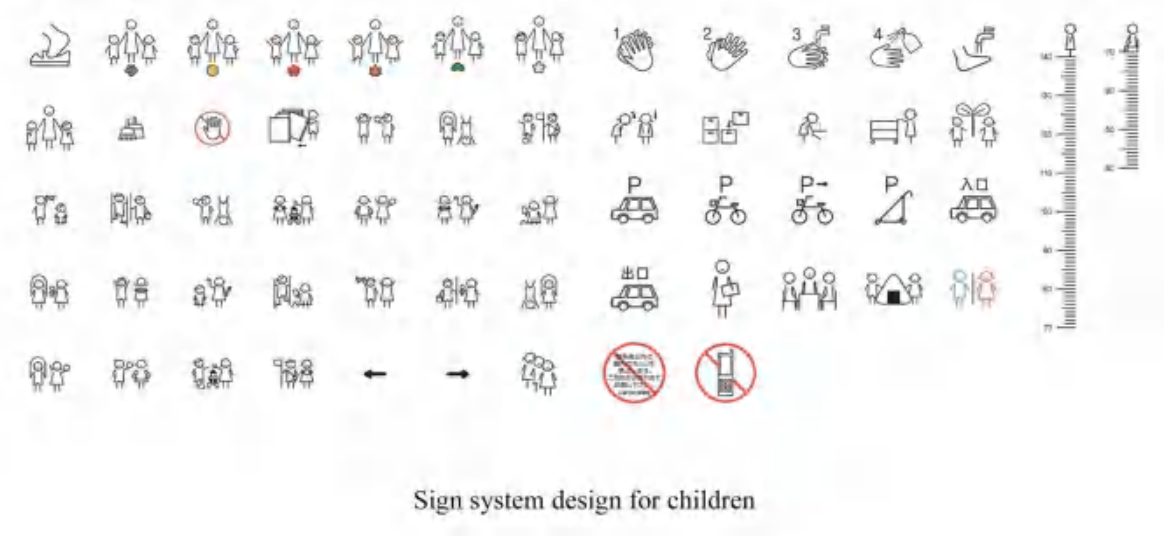


Fig. 6-18 Child-friendly travel signs for children (Source:drawn by author)

Fig. 6-19 Child-friendly travel pavement (Source:drawn by author)

Upgrading and Elaborating

Optimize and enhance the environment of children's routes, combine children's interaction, psychological feelings, guardrail facilities, scale safety, etc. to optimize the design of children's paths in different levels of urban streets. We will explore the design of intersections, safety islands, space protection, and parking belts in child-friendly paths to optimize the design of children's paths.

1. Intersection design

For the streets with high pedestrian flow, we should consider the children's pace, extend the green signal duration appropriately, adopt the way of increasing a small amount of sidewalk

height to ensure the continuity of the walking path, and adopt the zigzag folded crosswalk pavement to divert the flow of people on both sides of the street, so as to effectively reduce the crowding of people crossing the street and the collision that may occur when meeting. In addition, through ground markings, pavement and sidewalk continuous paving, reasonable control of curb radius and other measures, can also prompt motor vehicles to avoid pedestrians, to ensure the safety of children's passage(Fig. 6-20).

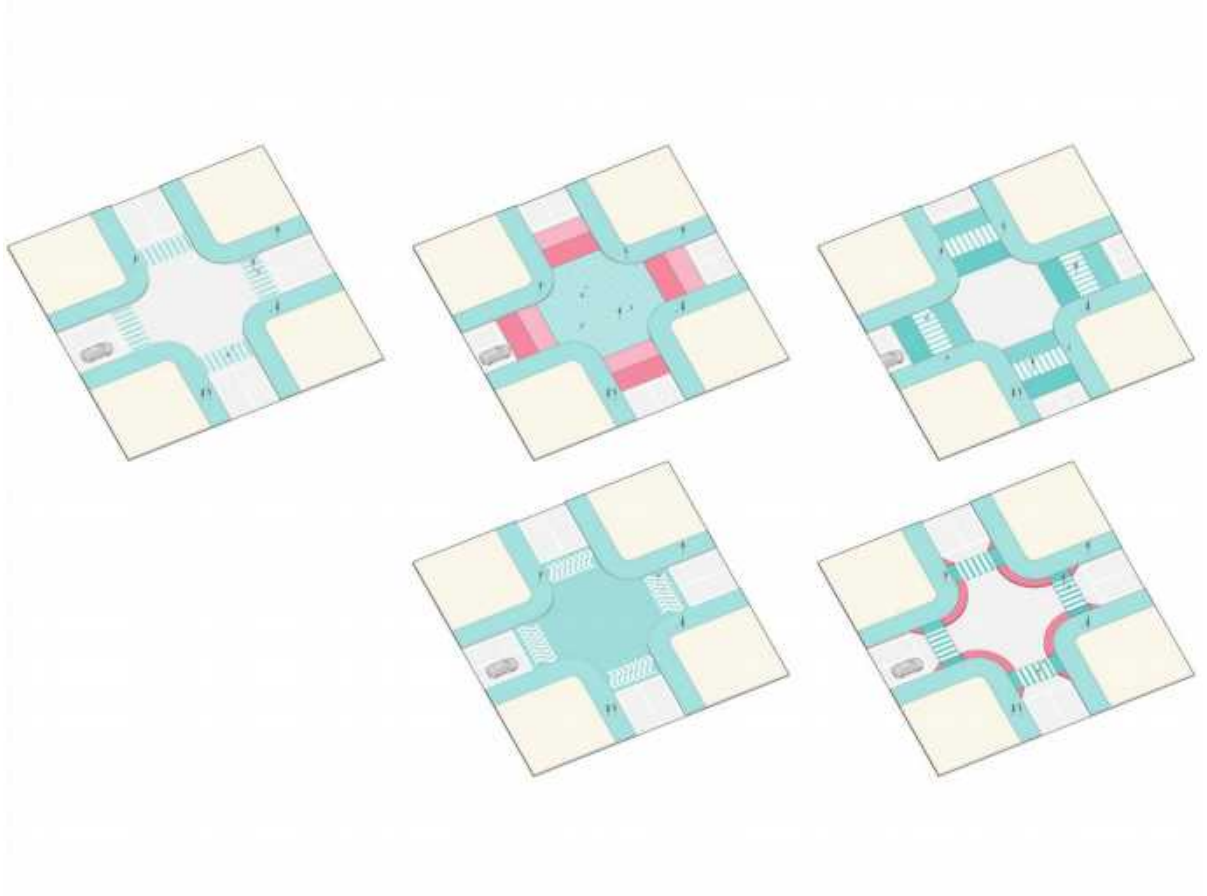


Fig. 6-20 Intersection design (Source:drawn by author)

2. Safety island design

Safety island design. The design of street intersections in children's routes should reserve sufficient space and ensure a clear view of the surrounding area for children to wait and observe vehicles. For streets with high traffic flow or wide motorway, according to the "Urban Road Intersection Design Code (CJJ 152-2010)", "when the length of the pedestrian crossing is greater than 16m, a safety island should be set up in the middle of the road to give them space to wait safely. And children due to the smaller body scale, so when considering the setting of the safety island can be set to reduce the length of the "code" to set, so that children can have sufficient time to safely cross the street. In addition, for the road width is larger, the road condition is more complex streets, can be set up more three-dimensional traffic, so that

children can be more comfortable, convenient through the street.

3. Space protection design

Children's exclusive path and the play space along it should have certain spatial protection measures to achieve the protection and separation of children's right-of-way. The most effective measure for right-of-way separation is physical separation. When child-friendly walking paths are adjacent to non-motorized paths or motorized paths, separation stakes, green belts, and ground height differences should be used to clearly delineate the right-of-way to ensure children's travel safety. The widest applicability is segregation through sign lines, including delineation, coloring, changing paving and other ways(Fig. 6-21).

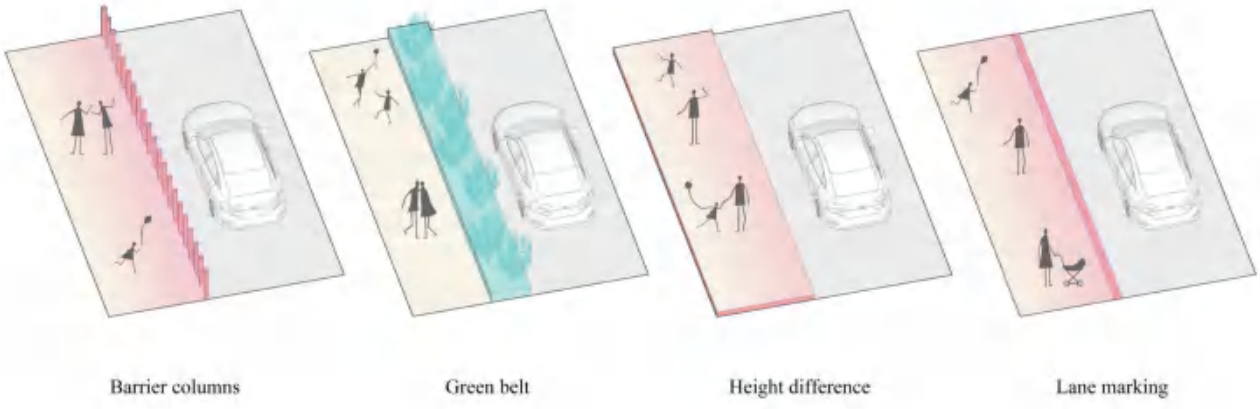


Fig. 6-21 Space protection design (Source:drawn by author)

4. Parking zone setting

Communities set up centralized parking lots, partial parking and flexible parking to meet the demand for non-motorized parking while ensuring the safety of children's travel. Communities with underground space conditions, set up centralized parking areas in the underground, and pay attention to the parking lot entrances and exits should be set far away from the children's activities in the community, such as set in the periphery of the community, this approach can maximize the safety of children traveling in the community, to create the most suitable place for human interaction(Fig. 6-22). For communities that still have external parking needs, partial parking strips and flexible parking can be installed. For streets near children's main destinations, temporary parking can be set up and the number of vehicles parked can be reduced by charging; for commercial streets outside the community, parking strips can be set up carefully under the condition of ensuring the smooth passage of space to avoid affecting the continuity of children's walking space. The length of the parking strip should not exceed 30 meters, because it will block pedestrians and children from crossing the

road, but should be set at a certain distance, such as 30 meters, for pedestrians to cross the road, and emphasize this safe passage through greenery or other isolation measures. It is advisable to use raised walkways for separation, and it is not easy to arrange parking strips on both sides(Fig. 6-23).

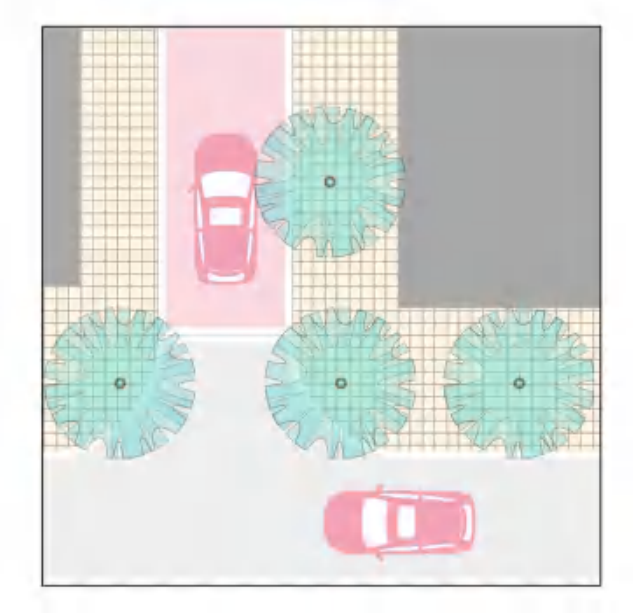


Fig. 6-22 Underground Parking (Source:drawn by author)

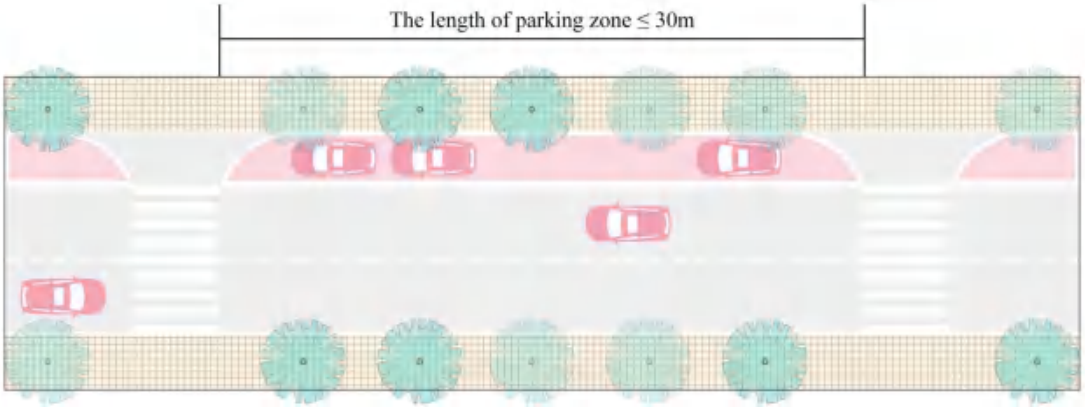


Fig. 6-23 Side Parking (Source:drawn by author)

5. Speed control facilities

Speed control can be achieved by increasing the road no parking instructions and speed limit deceleration signs, installing speed bumps and other traffic stabilization measures to reduce vehicle speed, setting up road safety islands, cross-sectional design, barrier-free and other physical transformation measures, pedestrian crossing signal facilities, to achieve effective vehicle deceleration, so that the speed of vehicles in the school district is controlled to 30km/h or less, to improve the safety of children's travel accessibility(Fig. 6-24).

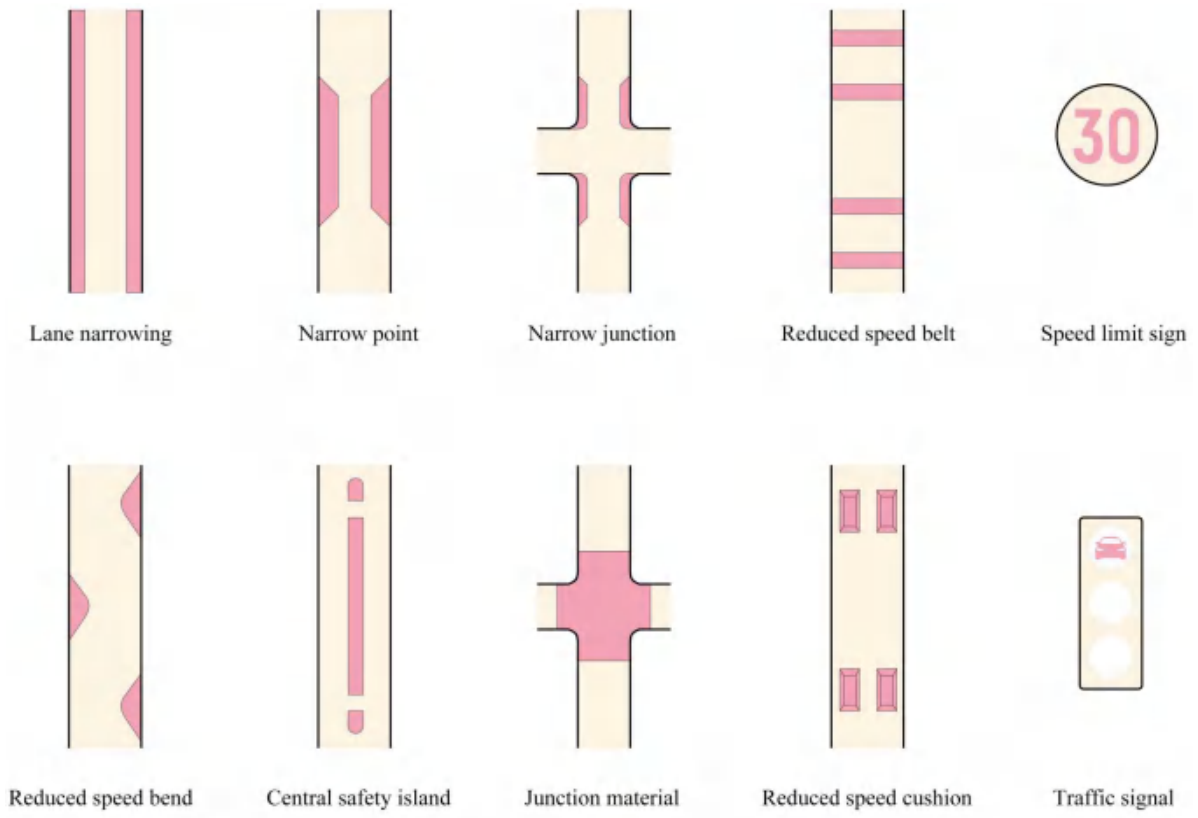


Fig. 6-24 Speed control facilities (Source:drawn by author)

6.2.3 Activity Construction Strategies

In the construction of activities for child-friendly community public spaces, activities can be divided into daily activities and event-based activities. Daily activities are usually activities that occur in the community in daily life, such as daily games, community maintenance activities, and triggered commercial activities, etc. Event activities are activities held on specific holidays or community-specific days, such as activities held in the community for Children's Day and community harvest festivals. In the triggering and guiding of daily activities, certain designs can be made by combining children's routes and activity spaces to attract children to occur here and create energetic paths and spaces to enhance the liveliness of spaces and paths to form passive surveillance for children, and also to improve children's psychological security. In the event activities, it is appropriate to take into account the interaction and communication between children of different ages, as well as intergenerational interaction activities, forming a relationship of mixed-age activities.

Activating and Extending

In her book "Death and Life in America's Great Cities," Jane Jacobs describes how removing

children from active city streets to general parks, residential areas, and specialized playgrounds will expose urban children to another kind of abuse, namely, the inability to seek help from adults in a timely manner when in danger. At the same time, based on children's cognitive behavior and needs, children are able to learn the basic knowledge of urban life from the various behaviors and pedestrians on the streets. Such street experience and life knowledge cannot simply be learned from school or home, for example, children can observe commercial activities and have a more specific knowledge of commercial behavior, thus promoting the learning of general social knowledge and increasing the sense of belonging and safety in the community . Therefore, in the guidance of children's daily activities, we can revitalize children's routes and spaces by increasing spatial extension, creating active street facades, and compounding street functions, so that they can become places where daily activities take place.

1. Increase the spatial extension

Extending children's paths and activity spaces to adjacent areas for holding and operating daily children's community activities makes the streets more active and interactive. It can make full use of the unused area and also increase the attention of passers-by to the street, creating surveillance of children's activities. The outlying spaces include microspaces generated by building retreats on the street, privately owned internal public passageways, and also some public facilities such as school playgrounds, museums, libraries, etc. Owners are also encouraged to remove fences and walls from local areas of buildings with public attributes on the ground floor and open the internal areas to children's activity facilities throughout the day. When the street space is limited, the roadside facility zone can be used to form a multifunctional zone, such as planting street trees with non-motorized parking or combining with commercial to form open space.

On the premise of not affecting the smooth flow of the passage area, urban furniture as well as street-side plazas and green areas can be set up to form resting nodes according to the main destinations of children's trips and areas where they often stay such as small stores and bus stops. On the one hand, it provides convenience and activity space for stores, pedestrians, and children, and on the other hand, it provides a place for pedestrians to stop and rest, reduces the frequency of pedestrian movement, and uses pedestrians' eyes to observe children moving around the neighborhood, which can reduce the danger of children playing in the neighborhood. These stopping spaces should support both formal and informal activities and promote mutual communication between children and caregivers. The width of the resting nodes should be 2 meters or more and the length should be 5 meters or more. Commercial

activities along the street or daily activities for children along the street are allowed, and can be paired with educational outreach and interactive daily activities for children(Fig. 6-25).

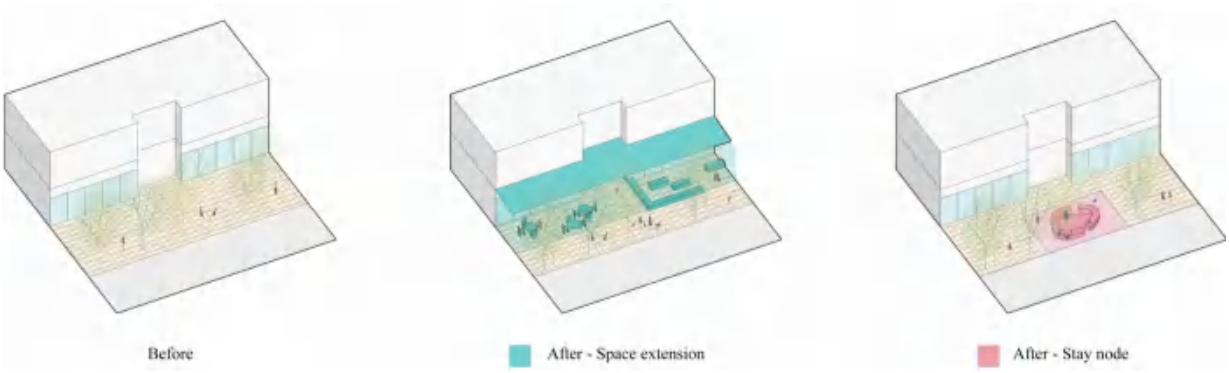


Fig. 6-25 Spatial Extension (Source:drawn by author)

2. Create active street facades

Active but not overcrowded streets are often safer than isolated and cold streets. Increasing the variety of building functions around the street or ensuring the street is active can greatly enhance social surveillance. Creating a vibrant street façade can be done mainly by compounding the functions of the businesses along the street and improving the transparency of the façade to enhance the use of the street and the visual penetration.

Encourage compound land use along children's paths, improve the diversity of ground floor businesses, mix and match commercial retail, restaurants, culture, community services and other businesses to increase activity intensity; regulate the height, style and number of entrances of building facades along streets; improve the transparency of ground floor building facades, for commercial streets the minimum transparency of the first floor street wall interface should reach more than 60% of the total area, and encourage the installation of display windows; For living service streets the minimum transparency of the first floor street wall should reach more than 30% of the total interface(Fig. 6-26).

Fig. 6-26. Active Street Facades (Source:drawn by author)

Mixing and Compositing

Community activity planning should take into account the communication and interaction of children of different ages, and intergenerational interaction activities. Children of different ages, children and the elderly can form harmonious relationships of mutual help and assistance. Such mixed-age activities help to form a mutually supervised relationship in daily life and provide a certain sense of security for children's daily sexual activities.

Educating and Proposing

To create a child-friendly community, we should adhere to the concept of "child-first development", start from the perspective of children, take children's needs as the guide, and aim for better growth of children, improve the policy system for children, optimize public

services for children, strengthen the protection of children's rights, expand the space for children's growth, improve the environment for children's development, and comprehensively guarantee children's survival, development, protection and participation, To improve the policy system for children, optimize public services for children, strengthen the protection of children's rights, expand the space for children's growth, improve the environment for children's development, and fully guarantee children's rights to survival, development, protection and participation. To deepen the construction of "child-friendly communities" and actively build a high-quality, scientific and open cultural environment for children. We promote child-friendly community building and child safety through knowledge dissemination, such as raising awareness of traffic safety and regulating safe travel behavior through schools and kindergartens. Through various ways such as classroom questions, story introduction, propaganda films, children's songs, pictures, games and situational performances, children are guided to understand basic traffic safety knowledge and good habits for civilized travel. It also infiltrates all these knowledge into our daily life.

6.2.4 Policy Construction Strategies

Policy and Administrating

1. Graded speed limit in different levels of roads

In order to ensure the safety of children's travel, the first thing to do is to minimize the harm of motor vehicles to children, so the speed of the vehicle should be effectively controlled. Relevant research shows that the braking distance of a motor vehicle with a speed of 15km/h is 5 meters, which means that the motor vehicle will still slide forward 5 meters after braking. When the speed is 30km/h, the braking distance of a motor vehicle is 13 meters. Therefore, when a child encounters a motor vehicle traveling at 30km/h, the evasion time is much less than that of a motor vehicle traveling at 15km/h.

In areas with dense residential neighborhoods in Liuyun Community, control the streets around key areas, especially at dense intersections, by changing the location of facility strips and parking strips, adopting horizontal line offset methods to limit motor vehicle traffic, establishing pedestrian-led pedestrian streets or adopting shared street models. The speed limit for motor vehicles should not exceed 10-15km/h to provide a safe travel environment for children. For roads that assume part of the urban traffic function such as Sports West Cross Street, the maximum speed should be limited to 30km/h(Fig. 6-27).

Fig. 6-27 Graded speed limit (Source:drawn by author)

2. Street use time-of-day management

Restrict vehicle access to children's primary routes to and from school during peak hours, for example, to return road space to children. Restricting vehicle access during a certain time period can be regulated by mandatory regulations, with advance notice at intersections of prohibited road sections with warning signs, speed limit strips, and other facilities, or timely feedback to vehicle drivers via a network data platform of prohibited road sections. Appropriately extend the signal at intersections when children pass to and from school, leaving sufficient time for children to cross the road. Intersections around schools should be widened to allow space for pedestrians to stay, so that there is no congestion even when a large number of children exit the school at the same time during school hours. For conflicts between pedestrians and freight traffic on the streets in the community, it is important to regulate unloading facilities and time guidance to avoid occupying sidewalks during high activity hours, and to organize freight traffic in the early morning hours and late at night.

Preventing

Strengthen the handling of unexpected emergency time. Promote the implementation of the main responsibility for the safety of child-intensive places and industry supervision, develop and improve the safety system and emergency plans, strengthen the safety of hidden dangers

and disposal, pay attention to the psychological health of the people in the place, and effectively prevent and respond to the risk of various types of safety accidents. Prevent the occurrence of aggregated infectious diseases. Places involving food supply to ensure food safety. Strengthen disaster prevention and mitigation safety education to enhance children's awareness of disaster prevention and mitigation and their ability to save themselves and help each other. Stockpile important emergency supplies geared toward children's needs. The relevant emergency response plan can then effectively govern and divert the problem after an accident occurs to reduce the impact on the wider area, etc.

6.2.5 Neighborhood Culture Construction Strategies

Part of the problem of community safety, reduced independence for children, and parental restrictions is the weakening of the sense of community. Some studies have shown that increasing access control is not a strong contributor to improving safety, but rather a fundamental and important part of increasing children's independence. In early unitary communities, residents were colleagues and neighbors and knew each other, resulting in a strong sense of community and a strong sense of community safety. In contrast, the six-unit community is a mixed commercial and residential open community, with a high turnover rate and a mix of residents in the community, changing from a small society of acquaintances to a small society of strangers. The most fundamental and effective measure is to improve the sense of community through the construction of community neighborhood culture to enhance parents' positive perception of neighborhood safety and sense of community belonging in the community public space, improve trust, enhance the sense of security, and reduce the restrictions on children's independent activities.

According to the standards of the "Child-Friendly Community Construction Standards" issued by the China Association for Community Development, cultural construction in the community should be carried out. The main purpose of the cultural construction is to popularize the concept of child-friendliness among residents through various channels, combine the local culture of the community, and improve the mechanism to support the development of child-friendly cultural activities.

The construction of community neighborhood culture and sense of community in Liuyun Community can be done by improving the community operation mode, optimizing the service orientation, improving the basic services, extending other services by integrating community resources, carrying out various service activities, allowing children to participate more in

social parent-child activities organized by the community, promoting the exchange of children within the community and also promoting the exchange between parents, transforming the stranger society into the acquaintance society, building community It also facilitates communication among parents, transforms the community from a society of strangers to a society of acquaintances, builds a community of mutual help among small families, leads to a change in parents' behavior and thinking, allows children to move freely and independently in a safe and secure community public space, satisfies children's need to find playmates in the community, and builds a sense of identity between neighbors and children.

6.3 Summary

This chapter first combines the theoretical study of the previous chapter with the actual situation of the community and proposes design principles, and then proposes strategies to improve the safety of child-friendly community public space based on the characteristics of children's behavior and evaluation indexes and the design concept of this chapter from the aspects of spatial construction, path construction, activity construction, institutional construction and cultural construction respectively, and devotes to creating the safety of child-friendly community public space from different dimensions.

Chapter 7 Public Space Design for Safety Enhancement in Liuyun Community from a Child-Friendly Perspective

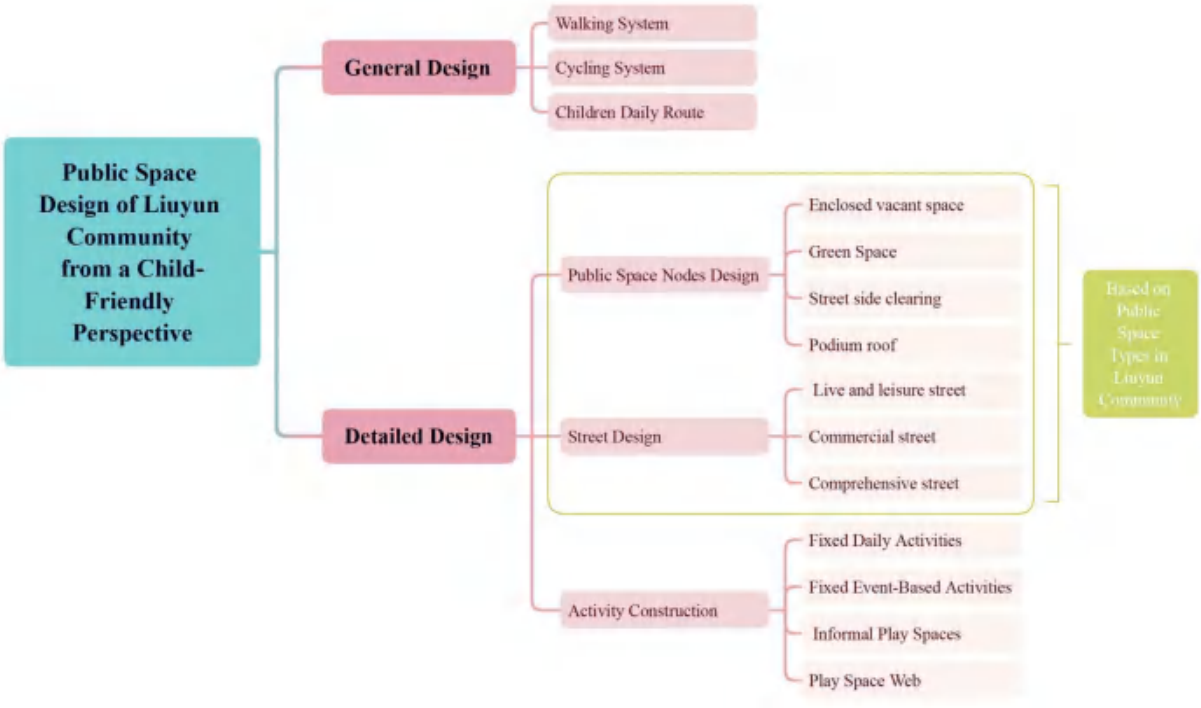


Fig. 7-1 Framework of chapter 7 (Source:drawn by author)

7.1 General Design

7.1.1 Walking Network

Establishing a complete and comprehensive pedestrian network is essential for creating a child-friendly community, as most children rely on walking for daily transportation and recreation. Due to their age, physical condition, and the safety requirements of their parents, walking is the predominant mode of transportation for children. A complete pedestrian network ensures they can safely and easily access their everyday destinations. Moreover, for children who lack access to high-quality activity spaces such as playgrounds and community squares nearby, the streets become important places for entertainment and social interaction. Therefore, when planning a community pedestrian network, it is necessary to consider the needs of children. The pedestrian network should be designed to connect children's activity and service locations, such as parks, schools, libraries, and playgrounds, to provide more opportunities for recreation and learning.

The current layout of urban pedestrian spaces primarily considers the width of the central carriageway. Typically, pedestrian spaces on both sides of high-end urban roads are appropriately wide and well-equipped. However, pedestrian spaces are narrower and less

developed for roads with higher pedestrian traffic within communities. Therefore, when optimizing pedestrian networks, it is crucial to first consider the function and grade of the street to meet the walking needs of children. For instance, shared street formats are more practical for streets outside communities with lower vehicular traffic. In contrast, pedestrian streets with street furniture incorporated can be used for internal community streets to enhance comfort. In summary, a comprehensive pedestrian network system should rationalize the walking pattern of streets according to street types, ensuring safety and continuity of children's walking trips. Additionally, it should seek suitable street locations and integrate street furniture to offer resting and interactive spaces, improving the comfort of walking experiences.

To ensure the safety of pedestrians, it is necessary to take measures to reduce the speed of motor vehicles. One effective measure is to install speed bumps or humps. Speed bumps are commonly used in residential areas and are designed to force drivers to slow down to prevent accidents. Speed humps are wider and flatter than speed bumps and are generally used on main roads. In addition, roundabouts, chicanes, and narrowed lanes can also be effective in slowing down vehicles. These measures not only reduce the risk of accidents but also make the streets safer and more comfortable for pedestrians.

Tiyu West Heng Road is a two-way bike lane urban branch road. The original road did not allocate a specific width for non-motorized vehicles, leading to safety concerns as many electric bikes ride quickly on the lane. It fails to meet practical needs and requires urgent optimization and transformation. Meanwhile, research on the site reveals that Tiyu West Heng Road, although the highest-ranked road within the design range, has relatively low traffic volume. Its north side is occupied by the Ti Yu Xi Road Primary School and Tianhe District Tiyu West Kindergarten, while its south side houses the Tianhe District Children's Welfare Institute Kindergarten and Tianhe Nan Social Work Service Station. Therefore, Tiyu West Heng Road is one of the high-frequency routes for children to commute to school within the community. Furthermore, due to the high number of shops on both sides of the section near the Tianhe Nan Walking Street, it attracts a large number of pedestrians. Therefore, it would be very suitable to transform it into a shared comprehensive street (Fig.7-2).

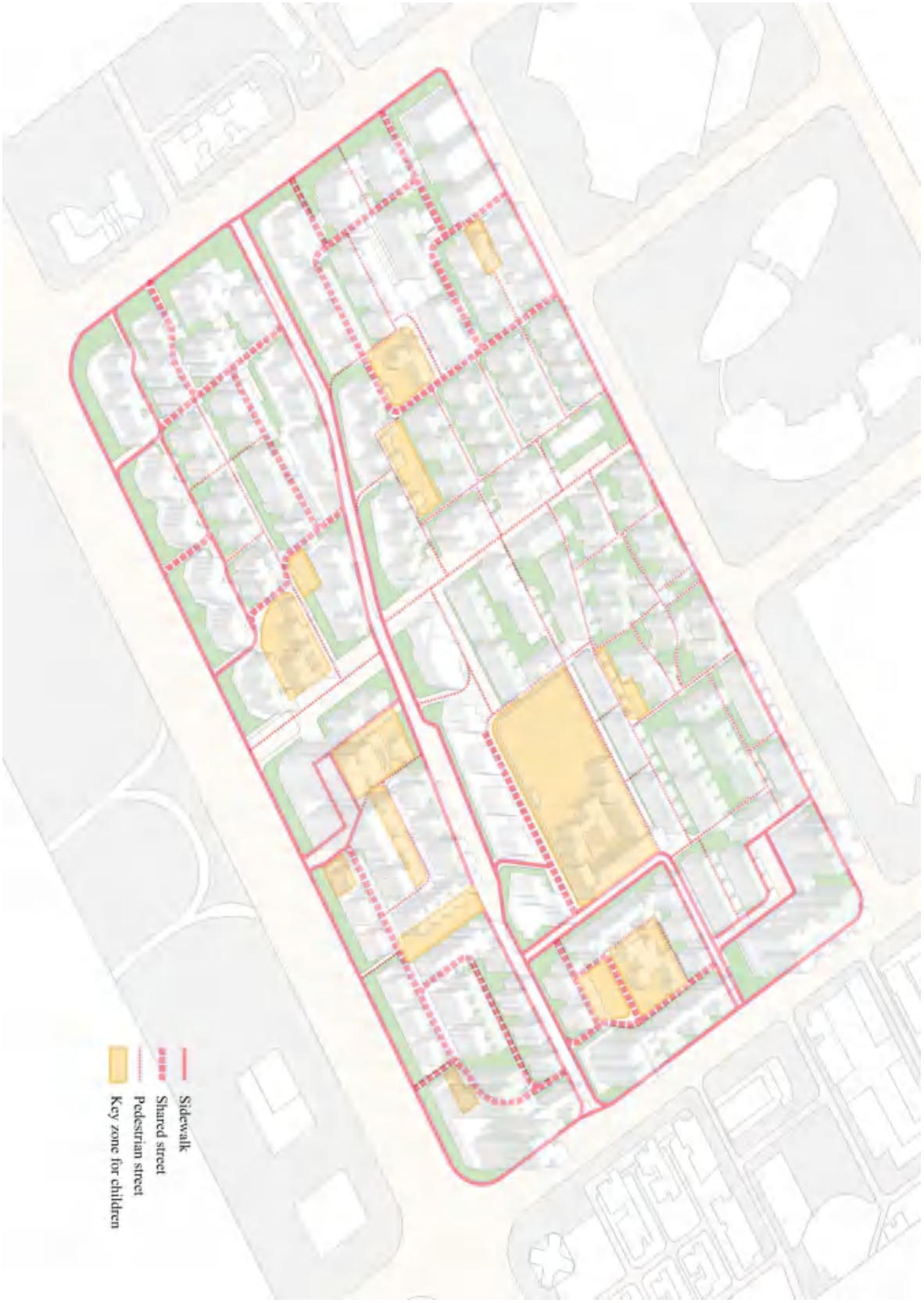


Fig. 7-2 Walking Network (Source:drawn by author)

7.1.2 Cycling Network

Children as young as 6 years old can safely ride bicycles with adult supervision, but starting at age 13, the frequency of bicycle use increases significantly. Therefore, a complete network of bicycle infrastructure that covers both inside and outside the community is essential. This network should include considerations such as the number, width, and cross-section of bike lanes, the type of lane dividers used, the placement of bike stations and parking, and signage. All of these factors should be carefully considered to meet the needs of children of all ages.

For streets outside the community, separated bike lanes with physical barriers should be installed to protect children and caregivers from motor vehicle traffic. The type of separation and the number of bike lanes can be determined by the width of the road. Since cycling presents a much lower potential threat to pedestrians than motor vehicles, community streets that prohibit motor vehicle traffic can be mixed-use, or "bicycle streets." Different paving materials can be used to distinguish the road space, eliminating the need for physical separation.

Bike share stations should be located near all major destinations in the community, such as schools, parks, and community centers. In addition, different types of bicycles, such as cargo bikes with child seats, should be installed to provide cycling options for caregivers with young children.

Inside the community, with the exception of a few main roads used by motor vehicles, the roads are generally shared by pedestrians and non-motorized vehicles. Occasionally, motor vehicles may illegally transport goods, but this is not a significant problem. The roads inside the community should be upgraded as a whole to become shared streets, with children's activity facilities and play areas installed to increase the amount of space available for children on the streets. The shared street form is suitable for transformation because nearby Liuyun 1st Street and the community roads in front of the Tiyu West Road Primary School have a small amount of motor traffic, allowing pedestrians, bicycles, and a small number of motor vehicles to travel at low speeds.

Roads with large widths and high pedestrian traffic demands in the pedestrian zone are suitable for transformation into slow roads, allowing children to freely use the full width of the road for activities. Tianhe South Pedestrian Street has sufficient width and a rich distribution of commercial businesses on both sides, making it suitable for a combination of walking and cycling by using the form of a "bicycle street"(Fig.7-3).

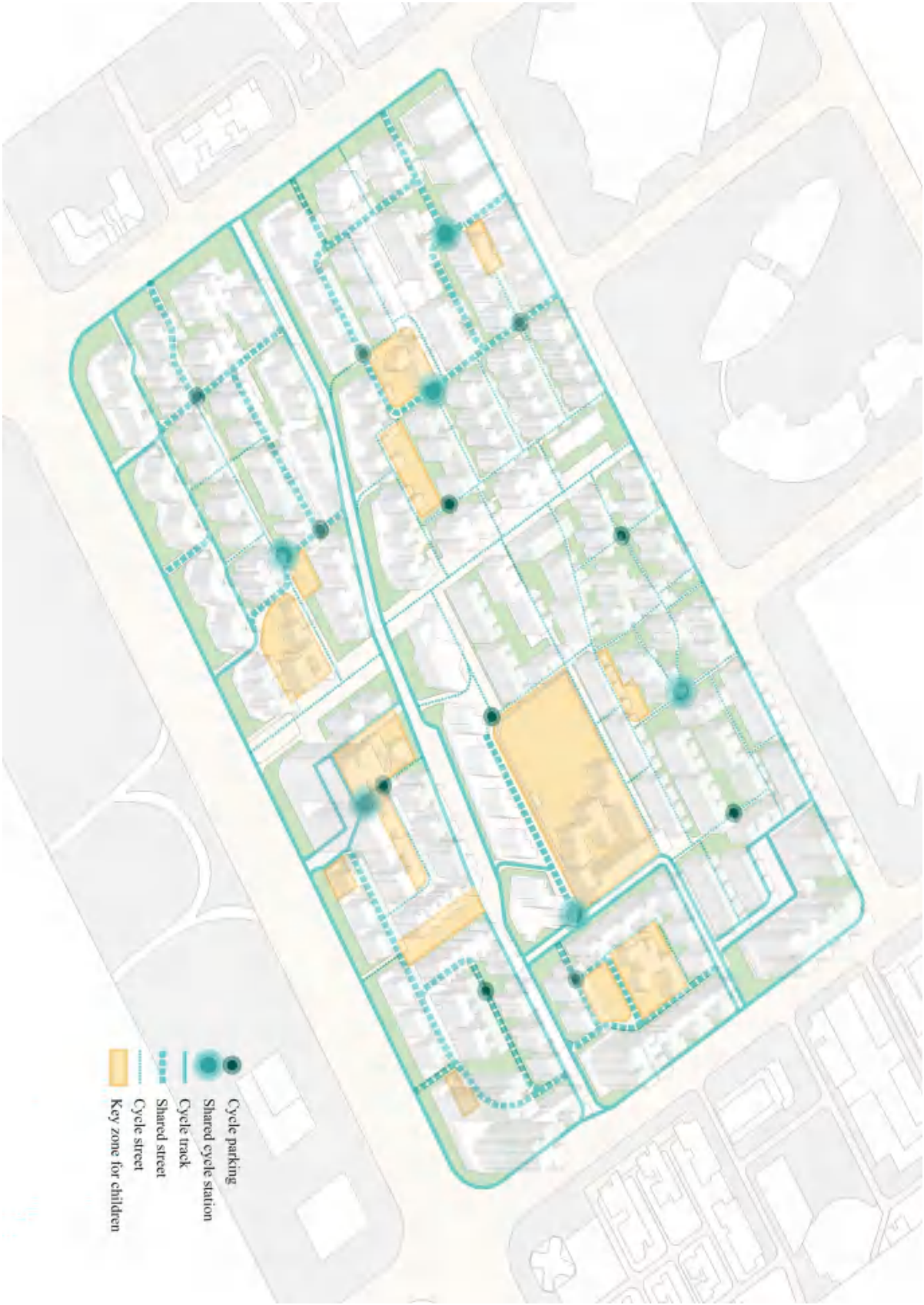


Fig. 7-3 Cycling Network (Source:drawn by author)

7.1.3 Children's daily travel path

To ensure safe and independent travel for children along streets connecting their everyday places like homes, schools, and green spaces, the Children's Daily Travel Path should link these places logically. This enables spontaneous play and chance encounters within the neighbourhood, which benefits children's intellectual and physical development. Given the differences between children's and adults' travel habits, the key step in designing the Children's Daily Travel Path is to involve children, using their daily travel maps and the frequency of street use(Fig.7-4, 7-5).

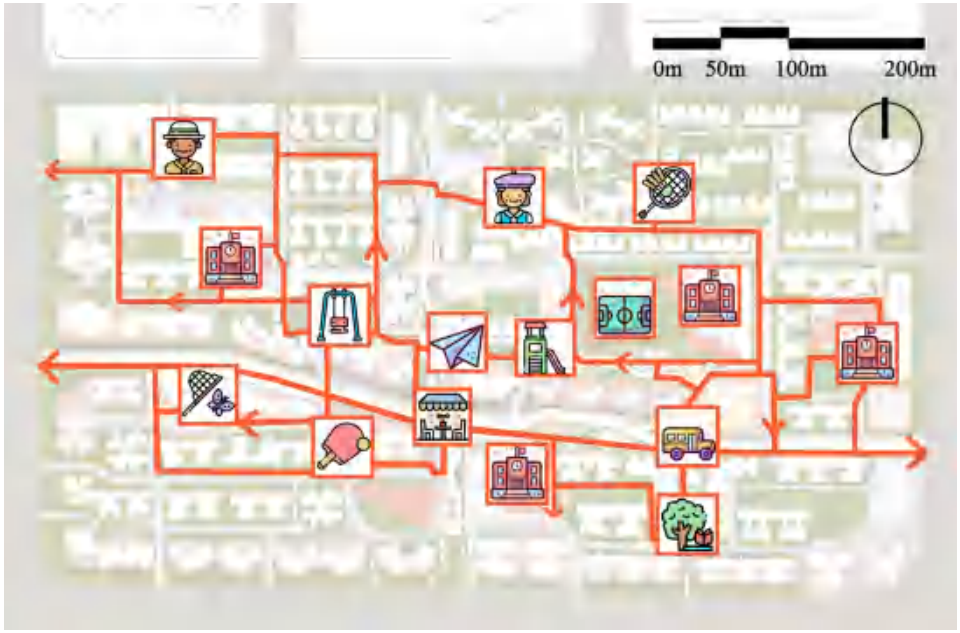


Fig. 7-4 Children's daily routes-school day (Source: Drawn by Author)

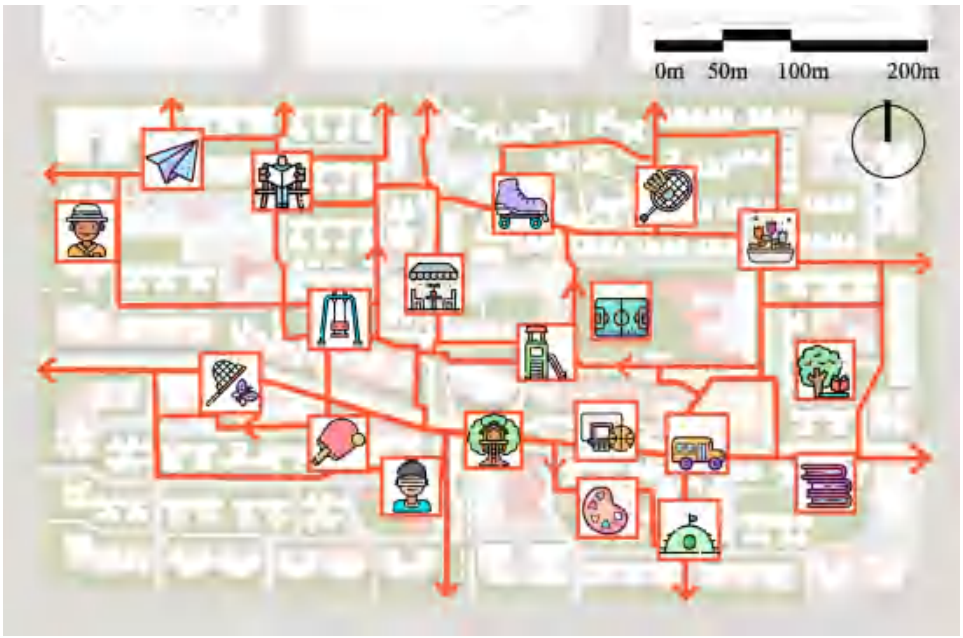


Fig. 7-5 Children's daily routes-weekend (Source: Drawn by Author)

7.1.4 Master plan

Fig. 7-6 Master plan (Source:drawn by author)

7.2 Detailed Design of Public Space Nodes

Fig. 7-7 Detailed Design in Liuyun community (Source:drawn by author)

7.2.1 Public Space Node 1: Enclosed vacant space

Location

The site is located inside the Liuyun neighborhood on the southeast side of the study design area. It belongs to the central square enclosed by buildings, which is one of the important activity sites for the elderly and children in the community. The central pedestrian street is on the east side, the kindergarten is on the northwest corner, and most of the one-story interface on the north and southwest side of the site are food and beverage stores. The first floor interface on the southeast side is residential and surrounding greenery. There are two groups of large banyan trees in the site, which are proposed to be designed and retained in combination with facilities for children and the elderly.

Fig. 7-8 Location (Source:drawn by author)

Daily activities and facilities

There are gazebos and playground facilities in the current site. The elderly mostly concentrate on playing cards and chess in the pavilion or waiting for the children of kindergarten to finish school. On the east side, there are facilities for children to play and there are children playing here.

Safety issues

1. The activity areas for children and the elderly inside the venue are too separated, with

children mostly concentrated in the east side area to play and the elderly mostly concentrated in the pavilion on the west side to play cards, chat or play chess. The overly separated activity area makes the elderly activity area without a good view, which is not conducive to the formation of good monitoring of children's activities.

2. The children's activity area lacks space for adults to rest, which is not good for supervising children's activities. At present, there are several tree pools in the middle of the site, where parents can rest and observe children's activities at the same time. However, this area is still far away from the children's facilities area, and there are trees and other facilities in between.

3. There is a garbage collection site on the south side near the children's facility area, which leads to a large odor in the children's activity area, which is not good for children's health.

4. There are more food and beverage stores on both sides of the site, so there are more take-away workers in this area at the restaurant. The speed of take-away workers riding electric bikes is high, and the activity site does not have a clear boundary to prevent electric bikes from passing through, which will pose a certain threat to children's activities and lead to safety problems.

5. The children's activity area has single facilities and old equipment. The children's activity area on the east side of the site has only one slide combination and is divided by a railing. However, there is a single type, and the railing is broken in several places, which is a major safety hazard. The internal paving of the children's activity site is hard paving, which can easily lead to safety problems when children fall.

6. Failure to make good use of natural elements to form interesting and controllable activity elements. There are two tall trees in the site, but the current situation is only a simple landscape facility, which cannot be used to meet the children's spirit of adventure and curiosity.

Tree in the Site

Function: Lanscape
Users: The aged
Activity: Rest, Chat

Safety Problem

There are several trees in the entrance on both sides of the site and in the site that deserve to be kept, which are only used as landscape elements at present and only some people rest here. It supposed to be better utilized.

Pavilion

Activity: Chess, Cards, Chat, Rest
User: The Aged

Safety Problem

The pavilion here is an activity area for the elderly, where many elderly people take a break to play chess and cards, but it is too separated from the children's activity area to form a good monitoring function.

Garbage Station

Activity: Garbage Collecting
User: Resident

Safety Problem

Adjacent to the children's activity area is the community garbage collection station. Here the air quality is poor, there is a larger odor. It is supposed that they be disposed of places, away from playground.

Tree Pools

Activity: Rest, Chat
User: The Aged

Safety Problem

Between the old people's activity area and the children's activity area are several tree pools, where more people have a rest or chat. However,it is too far from children playground, so there is no good view to detect children's activities.

Children Playground

Activity: Games, Slide
User: Children

Safety Problem

The children's playground is located at the entrance of one side of the site, with a large height difference. There's a railing around the perimeter, but it's broken. The facilities inside the site are simple, the floor is hard.

Boundary

Activity: Riding, Delivery, Walking
User: Take-out Works

Safety Problem

The first floor of the surrounding buildings are mostly restaurants, and the boundary between the activity area and the traffic area is not clear. There are more delivery people riding electric bikes through nearby.

Fig. 7-9 Safety issues (Source:drawn by author)

Generating steps and strategies

Redistributing and Visualizing

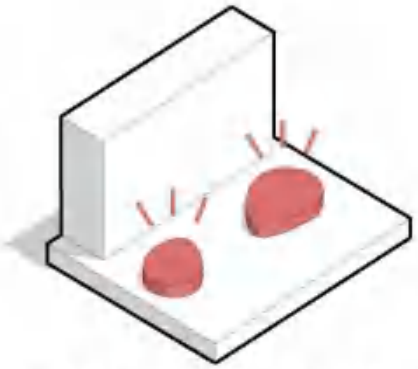
The original site is too separate for the elderly and children areas, which is not conducive to the formation of monitoring. At the same time, there is a lack of resting and shade places for parents near the children's area to supervise children's activities. In the generation of the program, firstly, the elderly activity area is linearized across the site to form a semi-encircled structure for the children's activity area to achieve a comprehensive visualization state, while also providing parents with supervision and rest areas. Secondly, the activity space is three-dimensionally treated to further expand the space and at the same time, the children's activities can be better monitored comprehensively.

Bordering and Zoning

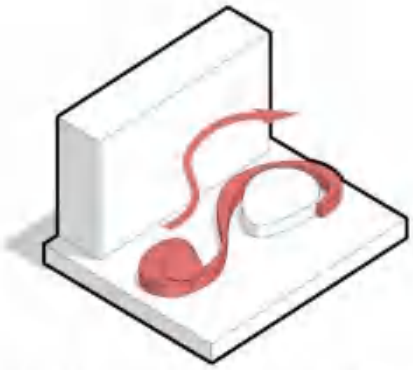
The current site boundary is unclear, and there are many take-away boys walking through. Therefore, in the scheme generation, paving, vegetation and facilities were used to separate the activity areas and clarify the boundaries of the site.

Controlling and Elastifying

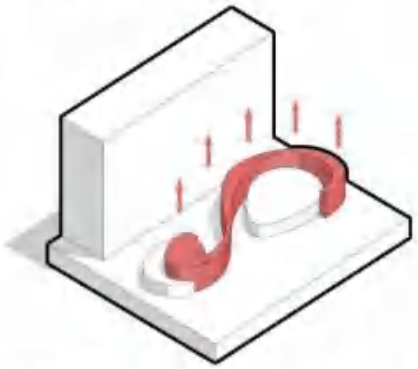
The current site has a single children's facility and broken guardrails, and also fails to make good use of natural elements to form interesting and controllable activity elements. In the scheme generation, we combine the trees in the site to form interesting and controllable natural activity areas, use the current trees to form climbing facilities, slides and other adventurous activity areas, and set up sand pits and other protective materials under the trees. At the same time, the safety elements such as paving and guardrails of children's facilities and sites are enriched and improved to form a safe, diverse and controllable children's activity site.



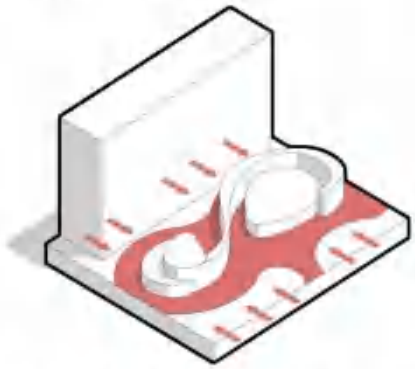
STEP 1: The original area for children and the elderly is very separate, which is not conducive to the monitoring of children's activities.



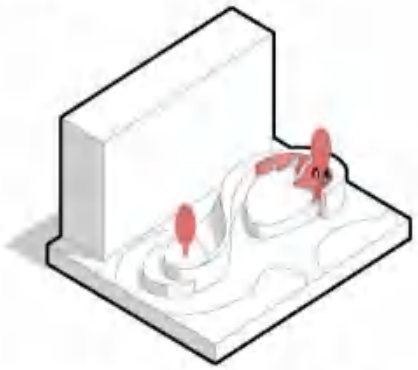
STEP 2: The activity space for the elderly is linearized, so that it runs through the whole site, forming a semi-enclosed space for the children's activity space.



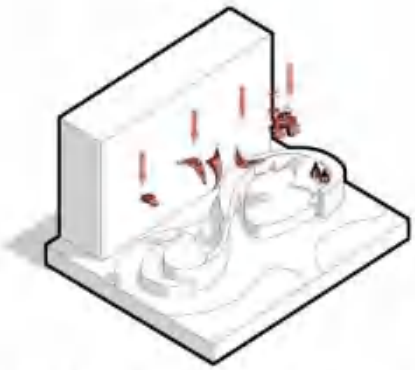
STEP 3: The activity space of the elderly can be further three-dimensional processed, the space types can be enriched, the activity area can be expanded, and the activities of children can be further comprehensively monitored.



STEP 4: Define the boundary between the activity area and the passing area in the site, and divide the site with paved ground, plants, height difference and facilities, which separating the fast take-out workers from the moving children.



STEP 5: Large trees worth preserving are used to set up natural activity areas and climbing facilities for children, proactively providing controllable dangers and satisfying children's desire for adventure.



STEP 6: Further optimize the children's activity facilities in the site, enrich the types of facilities, meet the needs of children's activities and ensure their safety.

Fig. 7-10 Strategy Application (Source:drawn by author)

Fig. 7-11 Axonometric View (Source:drawn by author)

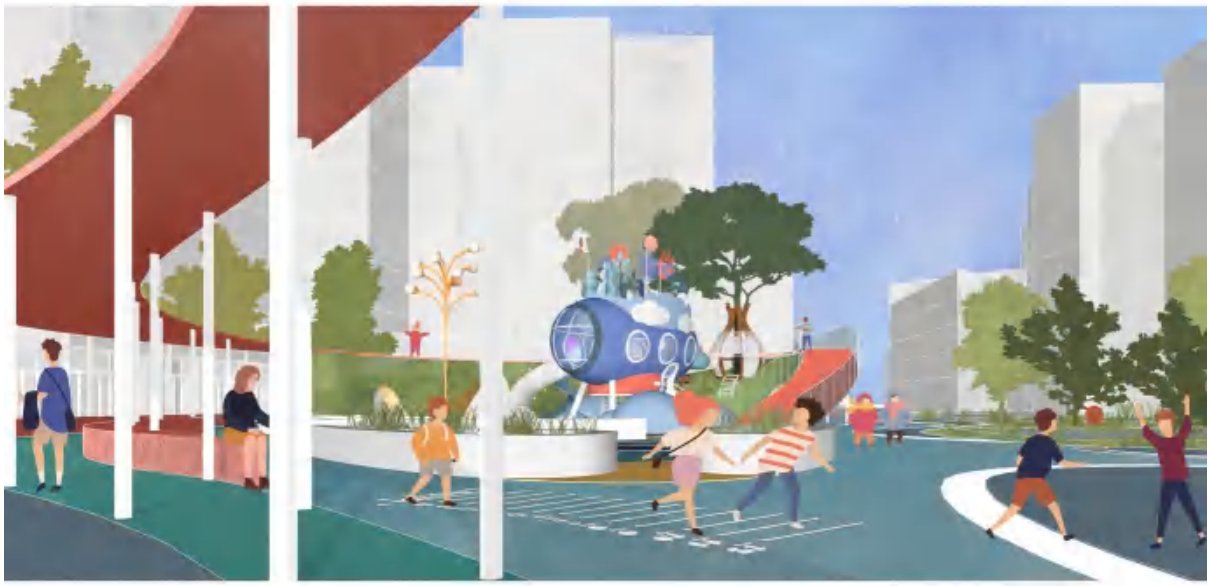


Fig. 7-12 Perspective view (Source:drawn by author)

Fig. 7-13 Perspective view (Source:drawn by author)

7.2.2 Public Space Node 2: Green Space

Location

The site is located in the southeastern part of the study design area, south of Sports West Cross Street, and is a community garden between two clusters. The overall external connection is high, but the green space is too closed. The main businesses on the east and west sides of the site are bars, izakayas and some retail stores, and the overall activity varies greatly with time, being relatively cold during the day and more active at night because of the bar street and izakayas. The north side of the site is the sports west cross street with high traffic flow, and the south side has some teaching and support institutions.

Fig. 7-14 Location (Source:drawn by author)

Daily activities and facilities

Inside the current site, there is a north entrance square with hard paved floor and no activity facilities. There is a community green space in the center, with continuous stone altar and some seats around, with poor internal connection. There are more children chatting, perfecting and even writing homework on the flower bed stones after school. Or some children stay in the street space, and the children's play space overlaps with the traffic space of the passing take-away.

Safety enhancement issues:

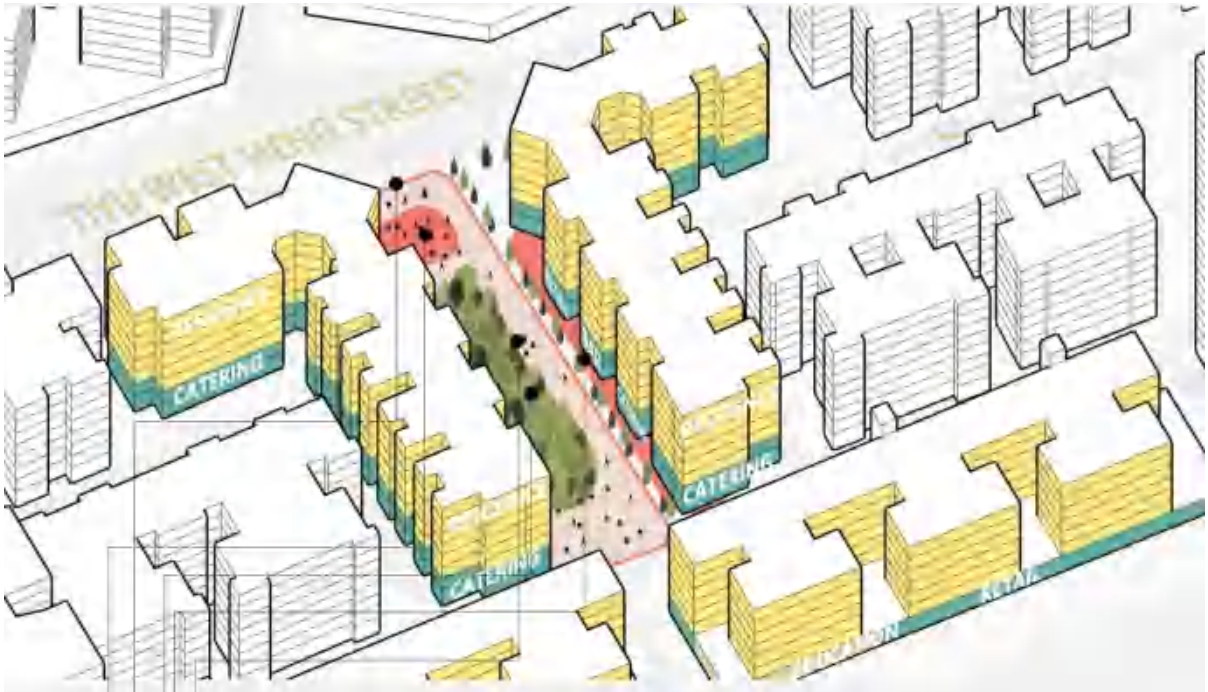
1. The entrance on the north side of the site is connected to the city road intersection, with a large traffic flow. But there is a lack of signs and exclusive paths for children to travel. In addition, there is a lack of buffer area or clear boundary between the activity site and the traffic space. This is a major safety hazard during children's activities.

2. The entrance plaza is the only centralized activity space in the site, and the pavement is hard pavement, which does not provide an effective cushioning effect when children fall. And there is no activity facility in the site, children can only sit on the edge of the stone for activities.

3. The interface around the site is dominated by izakaya and bars, and the decoration style results in low transparency and poor interaction with the outside world. The single type of business also brings the problem of uneven distribution of vitality in time, which is not conducive to the formation of street eyes.

4. The central green space is poorly connected to the outside world, mostly bounded by stone altars and lacking the necessary entrance. As well, the internal activity facilities of the green space are lacking and in a single form, which is not very attractive to children.

5. The site is surrounded by schools and educational and auxiliary institutions, so there are more children passing through or moving around the site. However, due to the lack of activity areas and facilities inside the site, most children choose to stay near the roadside, flowerbeds or tree ponds, or even do their homework. The overlap between the activity area and the traffic area is a great danger for children's safety.



Junction of the Site

Function: Road Crossing
Users: Pedestrian

Safety Problem

The two urban roads intersecting the entrance and exit of the site have a large traffic flow, but lack children's signs and child-only paths. There is lack of buffer area from the traffic space directly into the children's activity space.

Entrance Square

Activity: Games, Chat, Rest
User: Children

Safety Problem

The entrance square, as the only hard paved space inside the site, has a high degree of external connection. But it lacks facilities to play and rest. In addition, the pavement is hard, which is not conducive to the safety of children's activities.

Street Interface

Function: Catering, Retail, Bar
User: Consumer

Safety Problem

The surrounding businesses are mostly bar streets and izakaya, and the transparency of the interface is very low. And because the business is too single, the daytime activity is low, not conducive to the formation of street eyes.

Central Garden

Activity: Rest, Chat,Walk
User: Resident

Safety Problem

At the center of the site is a central garden shaped like a strip, but surrounded by a continuous stone altar. Its borders are stiff and lack access to play. At the same time, the interior of the garden has a single function.

Roadside

Activity: Games, Rest, Homework
User: Children

Safety Problem

Due to the lack of activity areas in the central garden and surrounding facilities, many children choose to use the roadside flower beds to play games, rest, or even do homework. There is no clear boundary with take-out workers, which is very dangerous.

Fig. 7-15 Safety issues (Source:drawn by author)

Steps and strategies

Redistributing and Visualizing

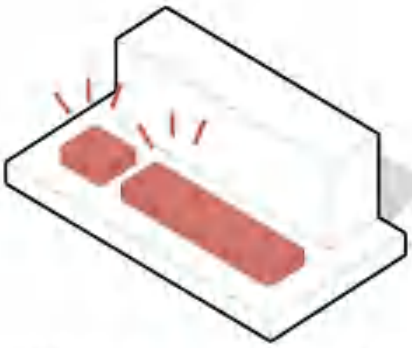
The internal space of the original site is divided into a hard plaza at the entrance and a central community green space. There was a lack of space for children's activities. In the scheme generation, the children's activity area is redistributed from the boundary between the green space and the road to the center of the green space, forming a natural elastic boundary barrier with the green space. At the same time, the diversity of businesses on the ground floor is increased to change the temporal activity difference caused by a single business; and the transparency of the interface is increased to encourage the installation of display windows and resting facilities to improve the connection between the inside and outside, and to provide space for parents to monitor children's activities.

Bordering and Zoning

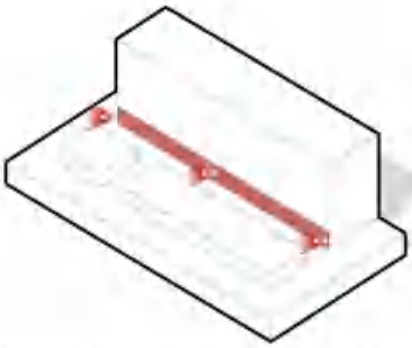
The children's activity area is located in the center of the green space, with greenery as a flexible boundary to separate the take-out boy route from the children's activity area. No site entrances are provided on the south and north sides where they connect with urban traffic. Children's crossing paths and signs are set on the north side. At the same time, the interior of the site is set with the zoning of children's needs to form a dynamic and static partitioned activity area. In the internal partitioning, the dynamic activity area for children is placed in the middle, and the adult fitness area and rest area (also for children's homework) are set up on both sides near the intersection.

Controlling and Elastifying

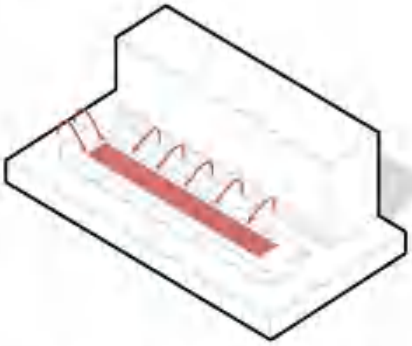
Children's facilities are controlled inside the green space, improving the safety elements such as paving and guardrails for children's facilities and the site, and at the same time, forming an interesting and controllable natural activity area by combining with the greening of the site boundary, and setting sand pits and other protective materials under the trees.



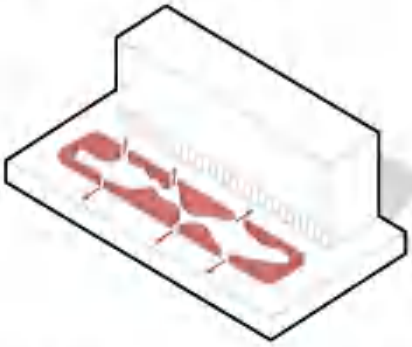
STEP 1: The original activity space of the site is divided into the entrance square and the central garden. The entrance square is hard paved, and there are no recreation facilities. The central garden is too closed to be used. Children can only move on the roadside.



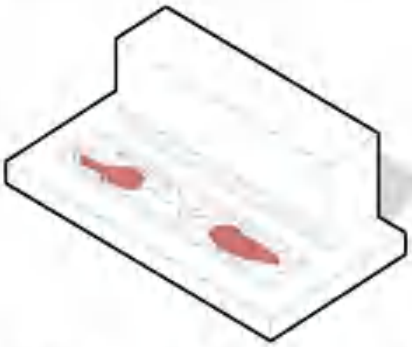
STEP 2: Improve the diversity of the bottom business forms to hange the difference of time activity caused by a single business form, improve the transparency of the interface, encourage the setting of display windows and rest facilities to form street eyes.



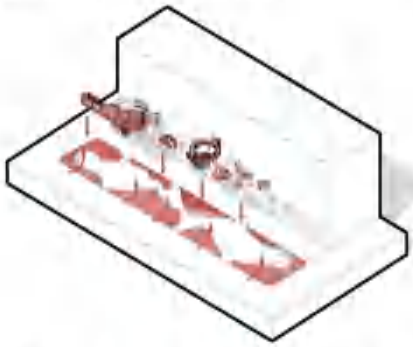
STEP 3: The children's activity area is redistributed from the boundary between the green space and the road to the center of the green space, forming a natural elastic boundary barrier to separate the delivery route from the children's activity area.



STEP 4: The entrances and exits of the site should be set according to the traffic conditions. The south and north sides should not be opened, and the entrances and exits should be set in the east and west directions. At the same time, children's crossing roads and signs are set on the north side.



STEP 5: According to the needs of children, the inside of the site is set up to form the activity area of dynamic and dynamic zone. The children's activity area with large amount of dynamic activities is placed in the middle, and the two sides close to the intersection are respectively set up adult fitness area and rest area.



STEP 6: Combined with children's activity facilities, the slope is set up to create a rich and interesting natural terrain to meet children's adventurous spirit. At the same time, the internal facilities of the site are optimized, and rich and sufficient play and rest facilities are placed.

Fig. 7-16 Strategy Application (Source:drawn by author)

Axonometric View

Fig. 7-17 Axonometric View (Source:drawn by author)

Fig. 7-18 Perspective view (Source:drawn by author)

Fig. 7-19 Perspective view (Source:drawn by author)

7.2.3 Public Space Node 3: Street side clearing

Location

The site is located on the north side of the elementary school and is a corner vacant lot formed by a building bump, and the site is fragmented and fragmented. The site is fragmented and fragmented. There is a blockage of view due to the building concavity. Most of the businesses on the first floor of the buildings on the north side of the site are boutiques and restaurants.

Daily activities and facilities

There is a badminton court and some basic fitness facilities in the site, but the equipment is relatively old and the road surface is uneven.

Fig. 7-20 Location (Source:drawn by author)

Safety issues

1. The original site has a badminton court and basic fitness facilities. However, due to the lack of space, there are often children moving around on the roadside, which is a major safety hazard. During the interview, we learned that children also want to add another badminton court to solve the problem of waiting too long.

2. The complete open spaces around the perimeter are all corner open spaces formed by building concavities, which are more fragmented and fragmented from each other and do not have good continuity.

3. The corner space has the problem of sight line obstruction caused by the building concave and convex, which is not conducive to the supervision of children's activities by parents.

4. The first floor of the buildings around the site are mostly boutiques and restaurants, and there are some commercial outfits, but they are obviously separated from the activity space and cannot form a good compound and surveillance.

5. Although the street here is a street where motor vehicles are prohibited, there are a large number of take-away workers quickly crossing due to the presence of surrounding restaurants, which is not conducive to the safety of children's activities.

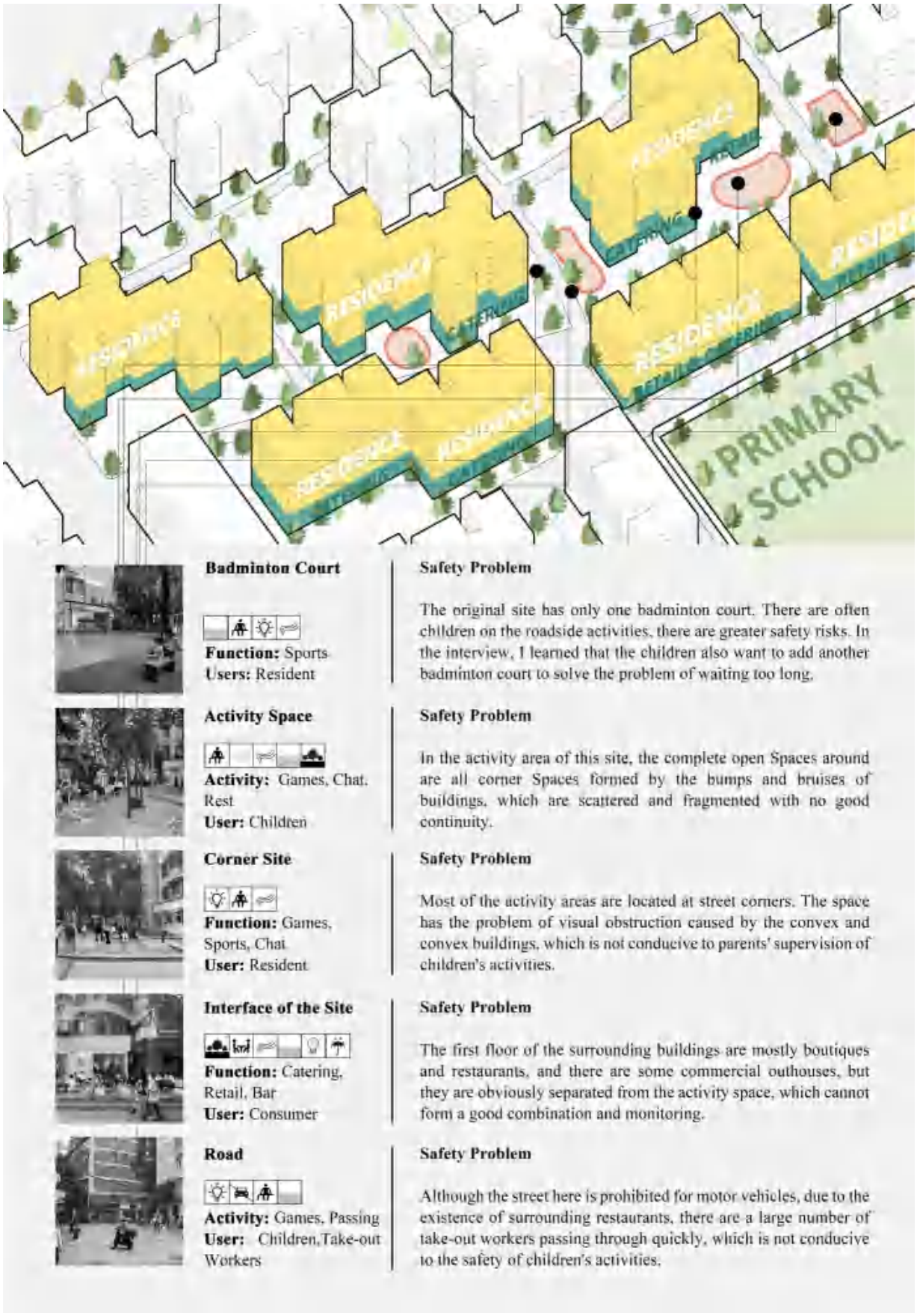


Fig. 7-21 Safety issues (Source:drawn by author)

Steps and Strategies:

Redistributing and Visualizing

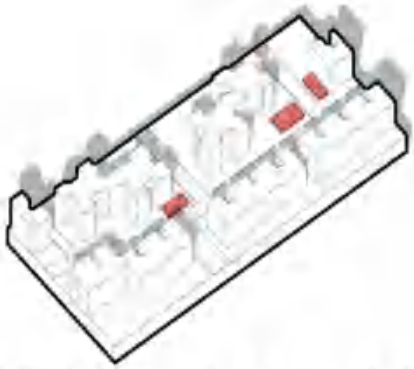
Using street space and other corner spaces, we integrate fragmented spaces and connect activity spaces to form a complete and continuous community public space. The corner space inevitably has some problems of visual obstruction due to the concave and convex buildings. By eliminating the visual dead space through greening and other means, we can redefine the activity space. The transparency of the interface is improved, and the installation of display windows and resting facilities is encouraged, combined with commercial outstands that can be monitored by parents.

Bordering and Zoning

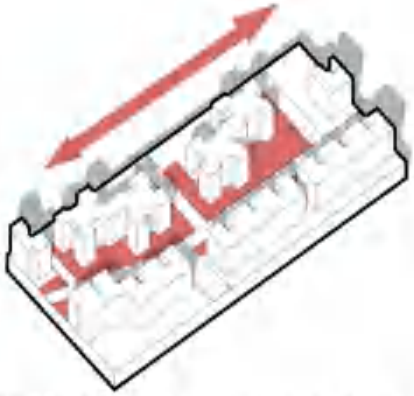
Define the space boundary through spatial elements and so on, bend the traffic space to control the speed of non-motorized vehicles, separate the traffic and activity areas, and form boundaries and zoning.

Controlling and Elastifying

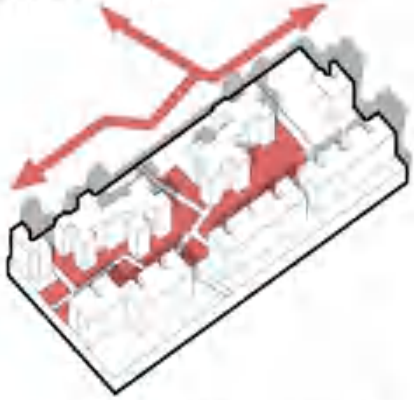
The current ground is uneven and the court facilities are old. Optimize the internal safety of the site, put in facilities, and enrich the site.



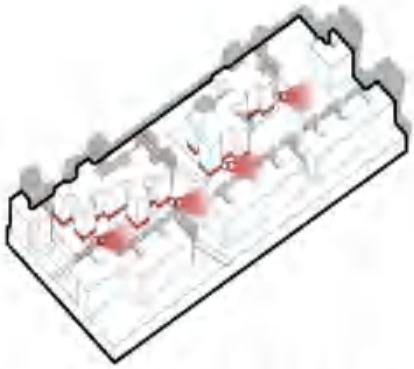
STEP 1: The original site has a badminton court and basic fitness facilities, which are distributed in the corner space, scattered and fragmented between each other, without good continuity.



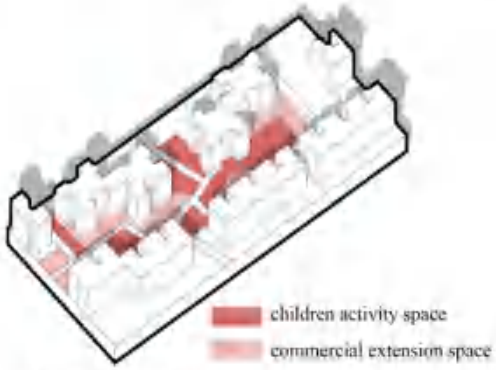
STEP 2: The street space and other corner Spaces are used to integrate scattered and fragmented Spaces and connect activity Spaces to form a complete and continuous community public space.



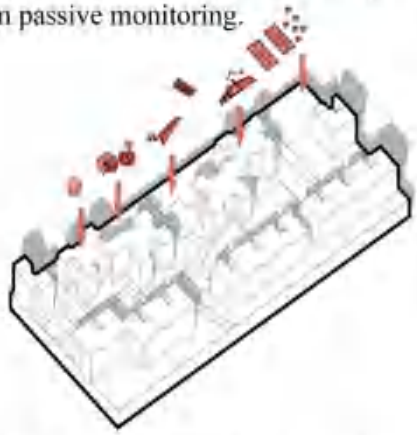
STEP 3: The site is closed to motor vehicles, but some takeaways still ride through it. By bending the road, the speed is further controlled to ensure the safety of children's activities.



STEP 4: The corner space has some problems of obstructing the sight line due to the building. Improve a layer of interface transparency, especially corner space, to form passive monitoring.



STEP 5: Further compound commercial extension space and children's activity space. Provide a safe and friendly environment for children's activities by encouraging display Windows and commercial pendants .



STEP 6: The internal safety of the site should be further optimized, the ground should be levelled, activities and rest facilities should be placed according to the functions of each space.

Fig. 7-22 Strategy Application (Source:drawn by author)

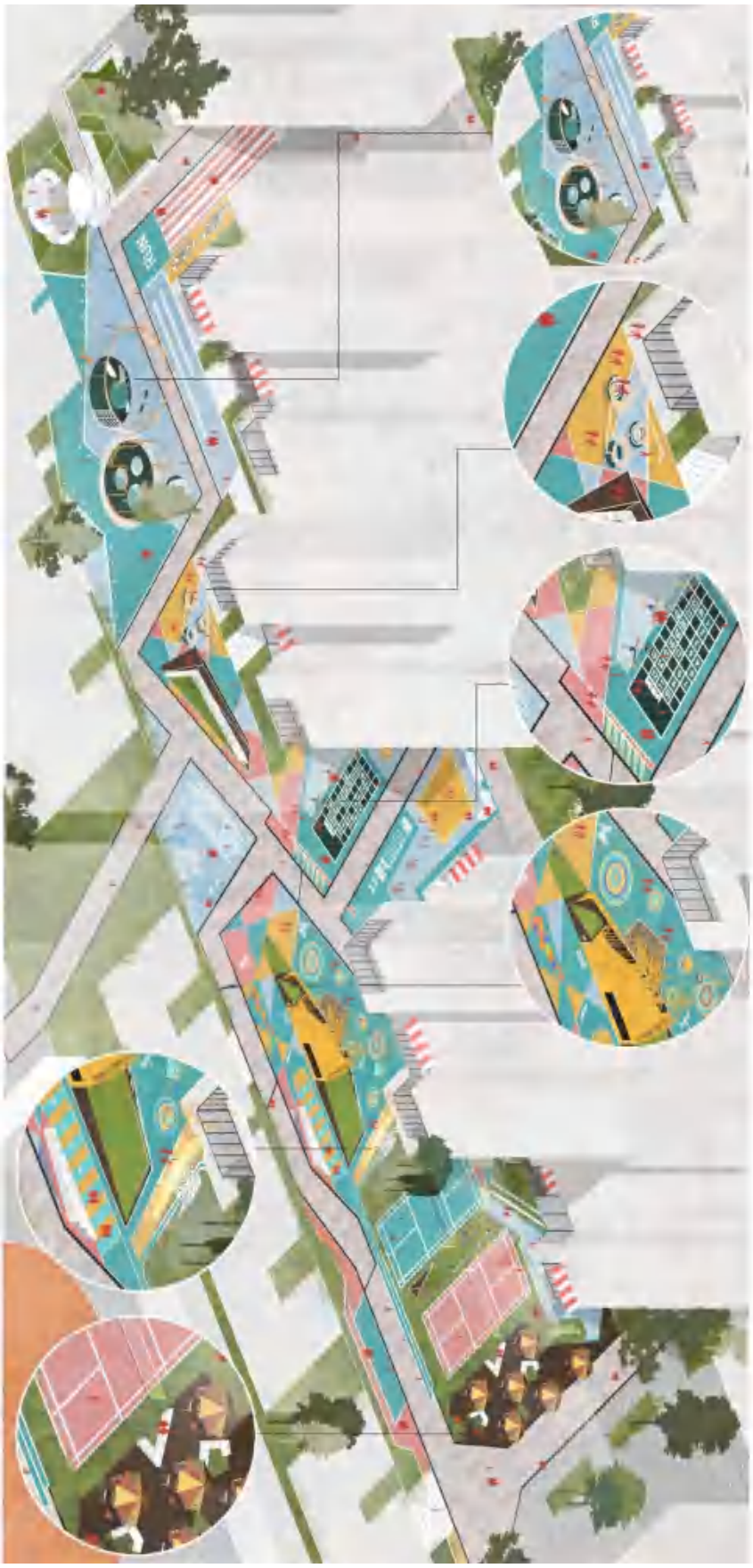


Fig. 7-23 Axonometric View (Source:drawn by author)

Fig. 7-24 Perspective view (Source:drawn by author)

Fig. 7-25 Perspective view (Source:drawn by author)

7.2.4 Public Space Node 4: Podium roof

Location

The site is located on the roof of the podium of the building on the south side of Sports West Cross Street, inside the Yulei district, and access requires passing through the district gate and the first floor of external stairs. The site is within the visible range between the residences, and both sides are residential buildings with high security. The current situation is that the roof is empty and the utilization rate is low. Downstairs there is a small open space formed by the concavity of the building, which is the original site for children's activities. The downstairs site is located at the east side of the parking lot at the entrance of the district, and the northern interface is the back door of the restaurant and small stores with very low activity, often occupied by parking, the ground is uneven and lacks facilities. The street downstairs is narrow and occupied by parking, with basically no more expandable space on either side. Children cannot move around in close proximity. Expanding the unused space in the podium is a good way to solve the problem of lack of space for children's activities in this area.

Fig. 7-26 Location(Source:drawn by author)

Daily activities and facilities:

There is a small piece of open space downstairs with uneven ground and no facilities. There are no facilities in the rooftop site, but there is a demand for them.

Safety issues:

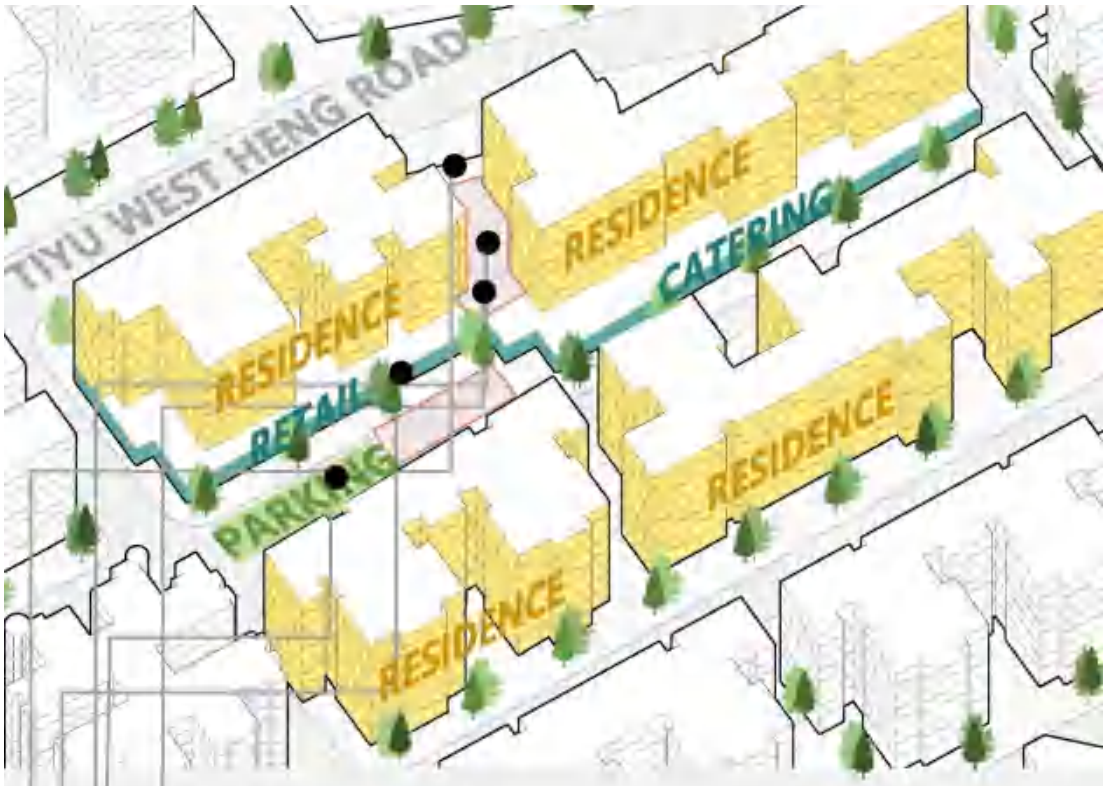
1. Downstairs activity space is insufficient, the street is narrow and it is difficult to continue to expand.

2. More parking around the downstairs activity space, more negative space interface, mostly restaurant back kitchen and small stores with low activity, poor security.

3. The roof space is bounded by the outer wall of the residence and the roof podium railing, but the podium railing should pay attention to the scale of children's safety.

4. The roof space child-friendly space and facility elements are insufficient. The ground is uneven, there are no night lighting facilities, no shade and green space.

5. The rooftop space is currently in an unused state. If it is transformed into a child-friendly public space, attention should be paid to the compounding of functions and proper zoning, such as adding a family drying area or planting area to form a compound of applicable people and functions, so as to enhance the liveliness and safety of the space.



Downstairs Space

Activity: Sports,Games
Users: Children

Safety Problem

The original activity space is located in an empty space downstairs, but the activity space downstairs is insufficient, the facilities are single, the street is narrow, and it is difficult to continue to expand.

Interface of the Space

Function: Parking, Retail
User: Children

Safety Problem

There are lots of parking spaces around the downstairs activity space, and the space interface is relatively negative. Most of them are restaurant kitchens and small shops with low activity, so the security is poor.

Boundary of the Site

Function: Wall, Handrail
User: Resident

Safety Problem

The boundary of the roof space is not clear. The roof space is bounded by the outer wall of the residence and the roof apron railing, but the apron railing should pay attention to the scale of children's safety.

Facility in the Site

Function: Lighting, Shading, Planting
User: Resident

Safety Problem

Insufficient child-friendly space and amenities in roof space. The uneven floor of the roof space, no night lighting facilities, no shade and green space, is not conducive to the safety of children's activities.

Function Zones

Activity: Games, Airing
User: Resident

Safety Problem

If the roof space is transformed into a child-friendly public space, attention should be paid to the combination of functions and appropriate partitions, to form the combination of suitable people and functions, so as to improve the vitality and safety of the space.

Fig. 7-27 Safety issues (Source:drawn by author)

Steps and Strategies

Redistributing and Visualizing

The original activity space was located downstairs in the hard open space, which was not enough activity space and poor visibility. Redistributing the children's activity space to the roof of the podium so that it is within the visibility of the residence.

Bordering and Zoning

The boundaries of the children's activity space were clearly defined in the form of external walls, stairs, fence railings and paving, while the height of the fence on the roof podium was noted to ensure children's safety. The space is reasonably zoned to meet the different needs of children's activities. Combining the applicable population of the roof space, the space is further compounded to enhance the space

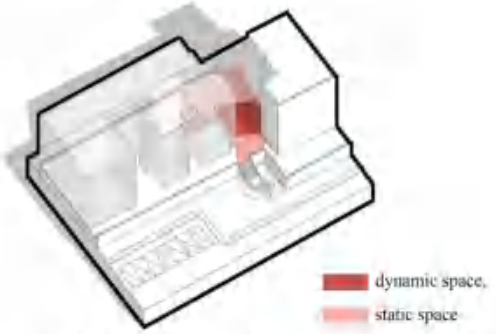
Controlling and Elastifying

The current roof has uneven ground, no lighting facilities at night, no shade and greenery. Optimize the roof facilities and environment, add lighting and greenery, and install facilities according to the functional zoning.

STEP 1: The original activity space of the site is located next to the parking lot, and the space interface is relatively negative, with insufficient space and low safety. And the street is narrow, difficult to expand the activity space.

STEP 2: The podium roof space is currently in the unused state, the space security is high, and located in the visual range of residential buildings. Reallocate the children's play space to the podium roof.

STEP 3: The boundary of children's activity space is clearly defined by external walls, stairs, fence railings and paving. At the same time, the roof podium should pay attention to the height of the wall to ensure the safety of children.



STEP 4: Partition the space properly. The area near the border is set as a static activity area, and the central area is a dynamic activity area to further ensure the safety of children's activities.

STEP 5: Further compound space functions, into the residential drying area, children's planting area and other functions, so that the roof platform suitable for more types of people, stronger vitality.

STEP 6: Optimize the roof space. Smooth the roof floor to make it elastic and secure. According to the function of each space into the corresponding activity facilities, making the roof space more comfortable and safe.

Fig. 7-28 Strategy Application (Drawn by Author)

Fig. 7-29 Axonometric View (Source:drawn by author)

Fig. 7-30 Perspective view (Source:drawn by author)

Fig. 7-31 Perspective view (Source:drawn by author)

7.3 Detailed Design of Streets

7.3.1 Live and leisure street

Location: The street is located within the Tiyu West community on the southeast side of the study design area and is part of the street near the destination, which is a necessary route for students and parents to travel to and from school. To the north of the street is the Tiyu West Primary School, to the south the ground floor interface is mostly restaurants, education and training, retail of daily necessities, mini-markets and other public services for the convenience of local residents, to the west it is divided into two strands of roads running to the central pedestrian street, and to the east are residential buildings with commercial retail, coffee and leisure on the ground floor.

Fig. 7-32 Location (Source:drawn by author)

Daily activities and facilities: The current site has six large banyan trees with a certain number of parking spaces and two rows of uncovered resting stone benches planned between the tree ponds. During peak school hours, security personnel circle a temporary buffer zone in the street by means of a removable fence, and guardians are mostly concentrated at the tree pond and stone benches to wait for the extremely high flow of people.

Safety issues:

1. The planned parking spaces between the tree ponds encroach on normal walking space, children are not given sufficient space to explore and play freely and routes are unsafe. The lack of bicycle parking facilities leads to a significant reduction in children's interest and the likelihood of carers choosing bicycles as a means of transport.

2. The number of resting benches is small and too scattered, and only the scale of adults is considered. The absence of a canopy leaves children and parents without a suitable space to rest their feet during rainy days, and the resting area is often blocked from view by tall banyan trees and parked cars, lacking good visual penetration for parents to monitor children's related activities.

3. There is not enough space to congregate and disperse in front of the school and parents often encroach on the street's vehicular space during drop-off and pick-up times in order to wait for their children to be released from school. Multiple modes of transport such as bicycles, electric bikes and cars further add to the chaos on the roads during this time.

4. Due to the limited space on the pavement, the pavement on the side of the street close to the school is less than 1m wide and cannot accommodate the conversation and chasing activities of the students. In addition, occasional random obstacles such as street lights, utility poles and rubbish bins are placed on the road, making it a safety hazard for children and caretakers to walk on the driveway.

5. There is a serious shortage of sports grounds in the Liuyun community, and the school's enclosed playground is a waste of public education resources by shutting out children and community residents on double holidays, statutory holidays and during the summer and winter holidays. The school fence and walls are too dull and ordinary, not interesting and active enough.

6. The ground floor shop fronts around the school are in poor condition and the floor coverings are mostly in a state of disrepair. There is a community waste collection site on the west side of the street where the junction branches off, resulting in a large odour from children's activity areas such as the sunken slide above it, which is not conducive to children's

health while also causing pollution to parts of the street.

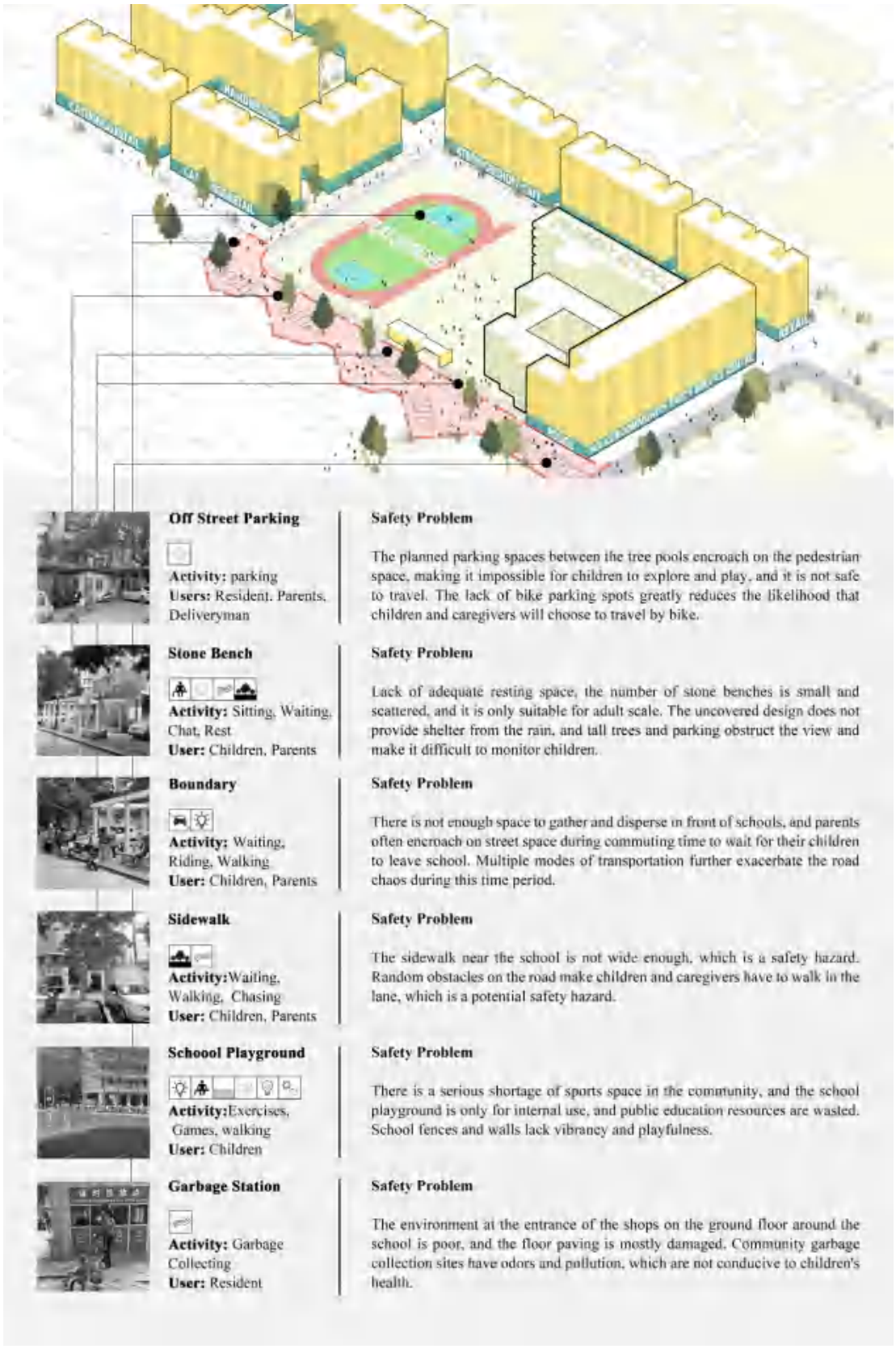


Fig. 7-33 Safety enhancements for Live and leisure street（Drawn by author）

Generating steps and strategies:

Specializing and Netting

The street is a road used more frequently by children and should be optimised in the first instance to create a children-only route in order to guarantee the safety of children travelling and to avoid conflicts between pedestrians and vehicles.

I. Reconfigure the space in front of the school. Transform school frontage roads into shared streets, limiting the right of way for motor vehicles; keep pedestrians and vehicles on the same level and encourage cycling and walking through these streets by removing parking spaces and continuous kerbs on both sides of the street, using different coloured and textured pavement materials to differentiate between pedestrian and motor vehicle lanes, etc.

II. Expand pedestrian areas with activity areas. Install parent waiting areas and use and street greenery to block continuous sight lines for motorists and further force them to slow down their vehicles.

III. Establish designated drop-off and pick-up zones at specific times to control traffic flow through traffic control while allowing emergency vehicles to pass.

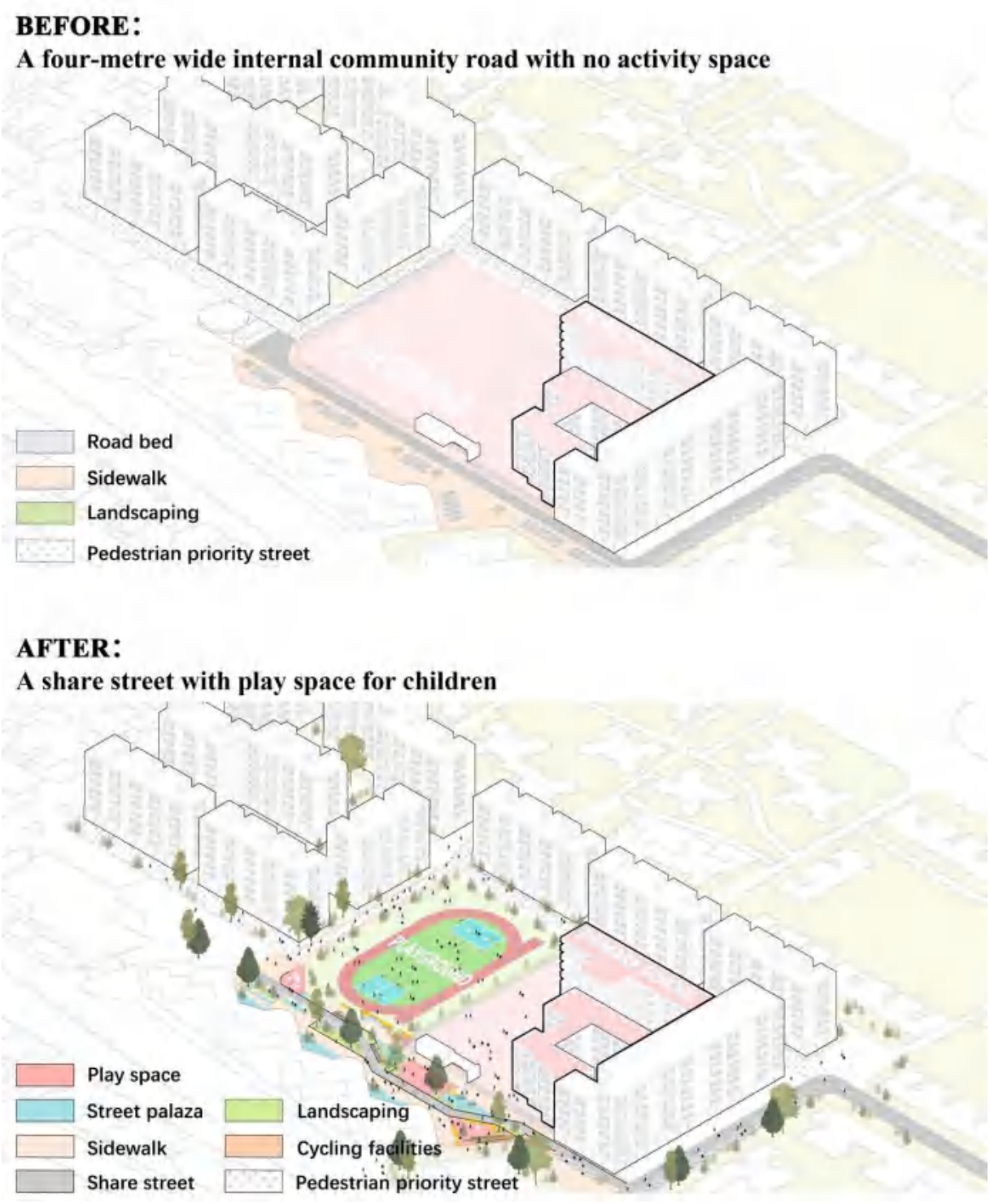


Fig. 7-34 Turning the internal community street into a share street(Drawn by author）

Signing

Eye-catching colourful children's signs and slow-down signs, aimed at adults and drivers, warn drivers to avoid children. Pavement in different colours and materials, interesting shapes,

or in plastic to distinguish it from the carriageway and with a soft texture to keep children safe.

Activating and Extending

The original site lacked children's facilities and waiting facilities for parents, and the towering fence confined the vitality of the playground and created a cramped pedestrian pathway. Therefore, the scheme was developed to redistribute the public space by removing part of the fence built by the school and extending part of the school grounds into the public realm of the street and the nearby entrances and exits, opening up the school sports grounds to the community and increasing the effective use of educational resources.

Redistributing and Visualizing

By optimising the design of the small spaces along the exclusive route for children and the open space of the playground, the layout of small play facilities and characteristic leisure seats, taking into account the special needs of the neighbourhood residents, children and students, provides children with the opportunity to learn through play, provides a comfortable shared resting space for children and parents, and improves the safety monitoring rate of children's activities.

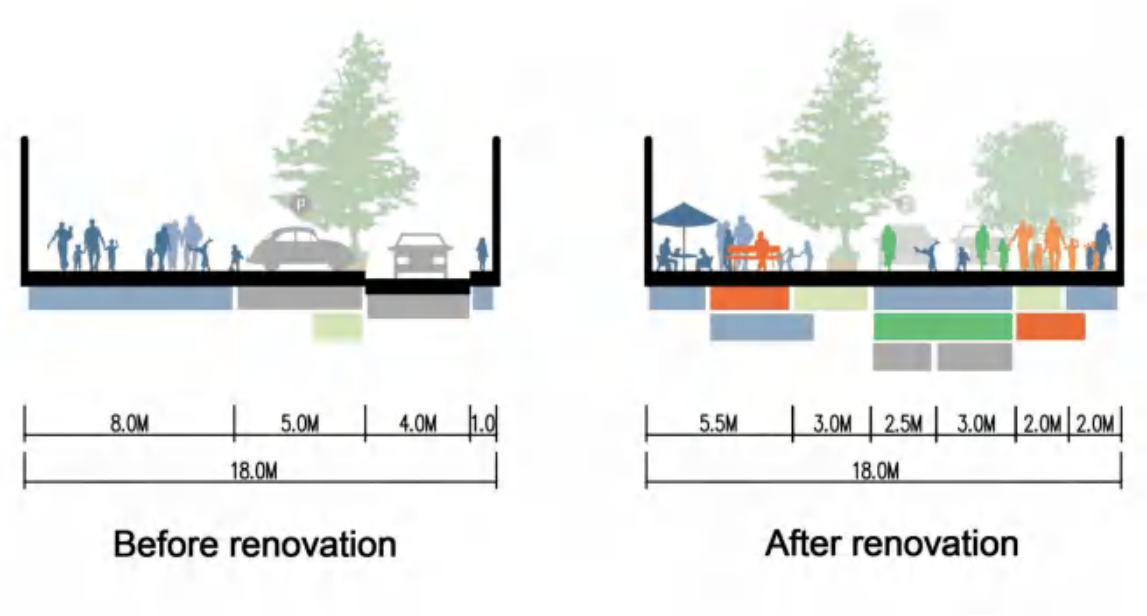
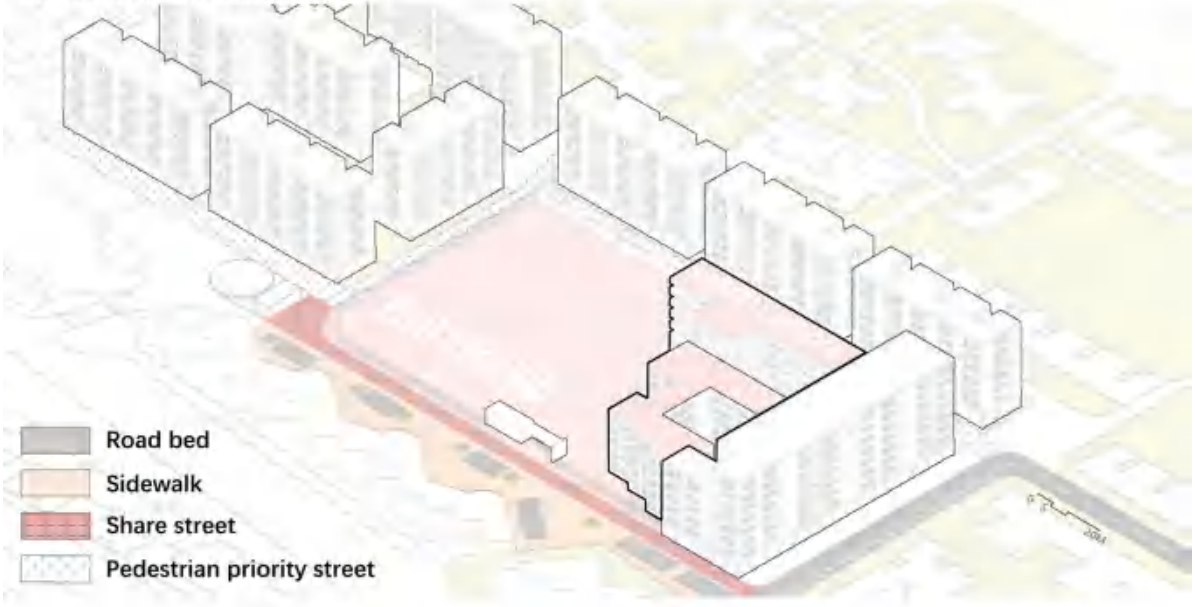


Fig. 7-35 Section of Living Street before and after renovation (Drawn by author)

STEP 1：Adopt share street model

Remove existing parking spaces and continuous kerbs on both sides of the street, use different coloured and textured pavement materials to differentiate between pedestrian and motor vehicle lanes etc., and convert the mixed pedestrian and vehicular areas into shared streets.



STEP 2：Provide buffer zone for school

The location of the tree pond is used to offset the original street horizontally and enclose the school entrance staging area at a suitable location, which can cater for children waiting for their carers and playing with their peers after school.

Fig. 7-36 The renovation process of Live and leisure street (Drawn by author)

STEP 3： Extending child-related functions

Removing some of the fences established by the school and opening up the school sports grounds to the community to improve the effective utilisation of educational resources. Secondly, the functions of the ground floor living commercial and the street are combined to provide a comfortable shared open space for children and parents.

STEP 4： Optimise space for street activities

The optimised design of the small spaces along the exclusive children's travel paths and the open space of the playground, with the layout of small play equipment and characteristic leisure seating, provides children with the opportunity to learn through play.

Fig. 7-37 The renovation process of Live and leisure street (Drawn by author)

Fig. 7-38 Live and leisure street optimization plan（Drawn by author）

Fig. 7-39 Perspective view of Live and leisure street: Buffer zone in front of the school（Drawn by author）

Fig. 7-40 Perspective view of Live and leisure street: Public sports resources open to the community（Drawn by author）

7.3.2 Commercial street

Location: The street is located in the central part of the study design area and is a central pedestrian street with a flat and open surface. It is an essential route for students and parents to access public transport stops such as the metro and buses during school hours, and is also a densely populated section for pedestrians during non-school hours. The north side of the street runs through the large shopping areas of Ti mall and Zhengjia Plaza, while the south side is connected to MalloftheWorld through an underground passage, with residential buildings with ground floor shops on the east and west sides.

Fig. 7-41 Location (Source:drawn by author)

Daily activities and facilities: The current site has a green tree pond of around 32 metres and several large banyan trees with a small number of stone benches and other seating underneath. There is a long stained glass roofed non-motorised parking area and a sunken circular slide facility on the path leading to the primary school, with parents mostly standing or sitting on seats in the outside swing area of the business to supervise their children's play.

Safety enhancement issues:

1. There is a height difference between the front areas of the ground floor shops on both sides

of the street and the wide 18 metre pedestrian pavement, resulting in difficult access for younger children, people with limited legs and wheelchair and pram users, increasing the complexity of the pedestrian environment.

2. The pedestrian street is flanked by a large number of food and drink outlets and therefore attracts a large number of takeaway riders to take orders. These takeaway riders ride their electric bikes at a very high speed, but the area lacks clear boundaries to restrict the passage of electric bikes, and there are no marked no-passing areas, which would disrupt the continuity of the walking experience, as well as posing a potential threat to children's movement and lack of safety boundary restrictions.

3. The lack of child-specific route construction and corresponding crossing signs does not allow for a safe, continuous and interesting linkage of high-frequency children's activity areas with schools and residences. The lack of bicycle parking areas significantly reduces the public transport options for children, carers and visitors to cycle to and from school or on trips.

4. Lack of abundant street furniture and safety features, especially illuminated street lights. The lack of adult resting spaces next to spaces where children often move around does not allow for good supervision of children's activities. Additional activity areas should be properly installed and night lighting should be secured to use the eyes of pedestrians to observe children's activities and reduce the danger of children playing in the neighbourhood.

5. The façade along the street lacks vitality, the function of the businesses along the street is single, and the actual utilization rate of the street space is low. Urban furniture, as well as street squares and green spaces, should be installed according to the main destinations of pedestrian trips and areas where they often stay, to form resting nodes, without affecting the smooth flow of the passing area.

6. There are some tall trees within the site and these natural elements offer potential opportunities to create interesting and manageable activity elements. However, at present these natural elements are seen as mere landscape features that do not provide well for shaded public spaces and are not fully utilised to satisfy children's sense of adventure and curiosity.

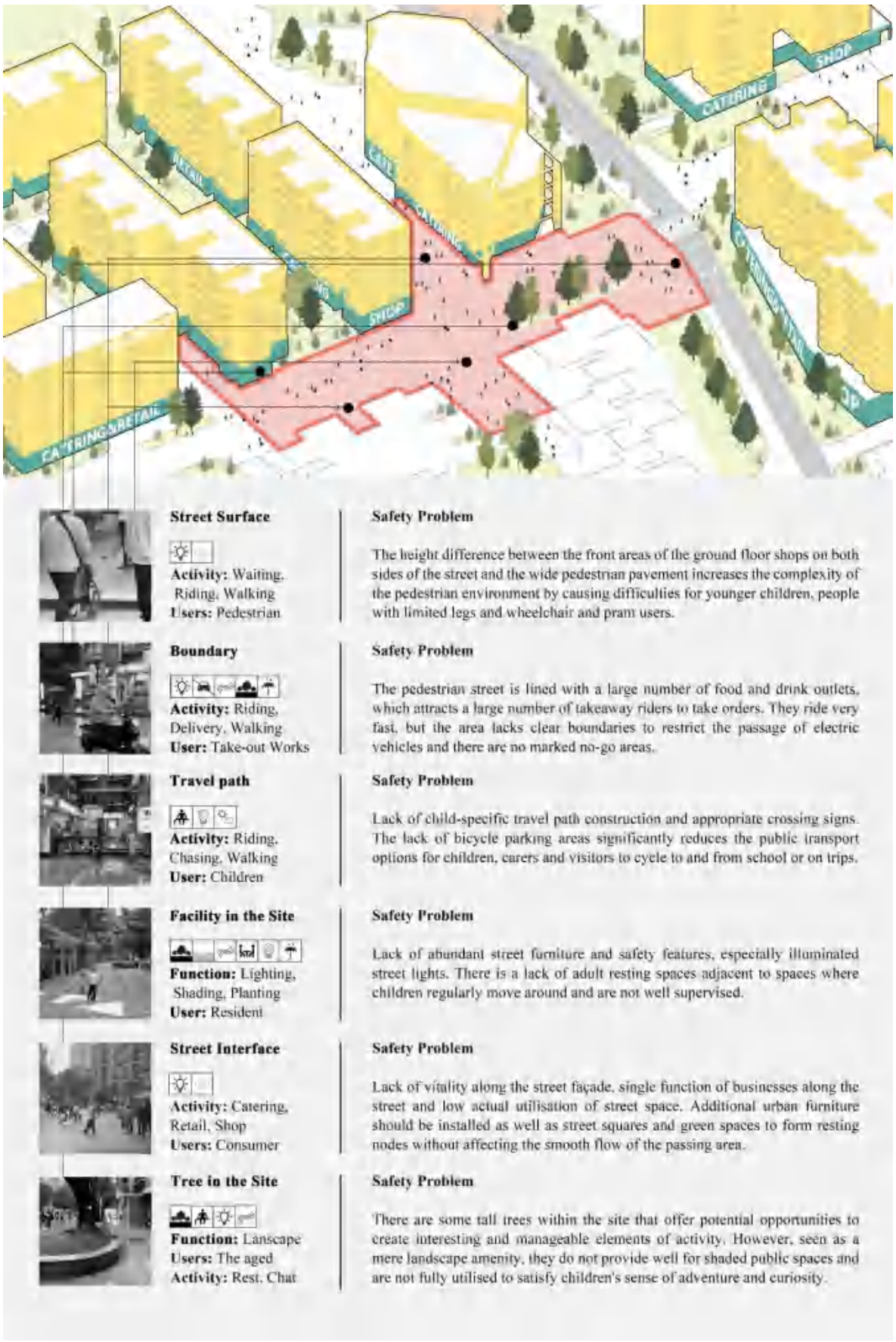


Fig. 7-42 Safety enhancements for Tianhe south pedestrian street（Drawn by author）

Generating steps and strategies:

Specializing and Netting

The northern section of the Tianhe South pedestrian street is often a destination for different groups of people due to its strong commercial nature. Therefore, when optimising the commercial pedestrian street, the needs of a wider range of people, including children, needed to be taken into account in the design.

I. Accessibility, elimination of existing height differences and street levelling to provide a more humane travel environment for younger children, people with limited legs and wheelchair and pram users.

II. Replace the paving materials on the streets and create exclusive paths for children to travel in order to ensure their safety and avoid conflicts with other vehicles.

III. Change the existing mixed pedestrian and vehicular area to a pedestrian-only street with pedestrian-only lanes on both sides, allowing pedestrians to visually identify the pedestrian priority area by changing the width of the entrances, pavement materials and vertical elements (e.g. bollards).

Signing

Interesting elements such as coloured zebra crossings and painted signs on the ground are used to enhance signage and interest. For example, 'coloured footprints' are designed specifically for children to guide them in identifying the direction of the road and the type of space, as well as to enhance guidance and safety for children.

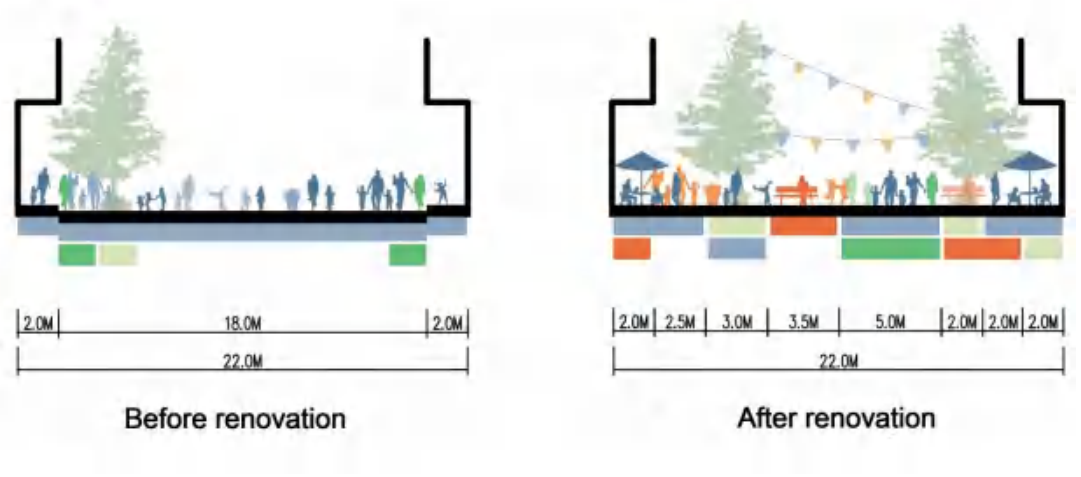


Fig. 7-43 Section of Tianhe south pedestrian street before and after renovation (Drawn by author)

Activating and Extending

I. Widen the local pavement to maintain the continuity and smoothness of the pedestrian space, and as the buildings on both sides of the street are mainly small restaurants and shops, it is necessary to enhance the use of the street and the visual penetration of the street by compounding the functions of the businesses along the street and enhancing the transparency of the façade to create an active façade along the street and maintain the uninterrupted flow of the circulation area. In addition, the ground floor frontage should be dominated by display and sales windows, which can be 0.5-1m wide. Also, the front area for outdoor displays and outdoor dining should be 1.5-2 metres wide to improve accessibility.

II. Combine small micro-spaces and green space along exclusive routes for children, encourage land compounding and transform suitable locations on the street into children's activity areas.

Bordering and Zoning

The children's playgrounds are bounded by seating, stone piers and tree ponds, which divide the space and provide a place for parents to rest and monitor.

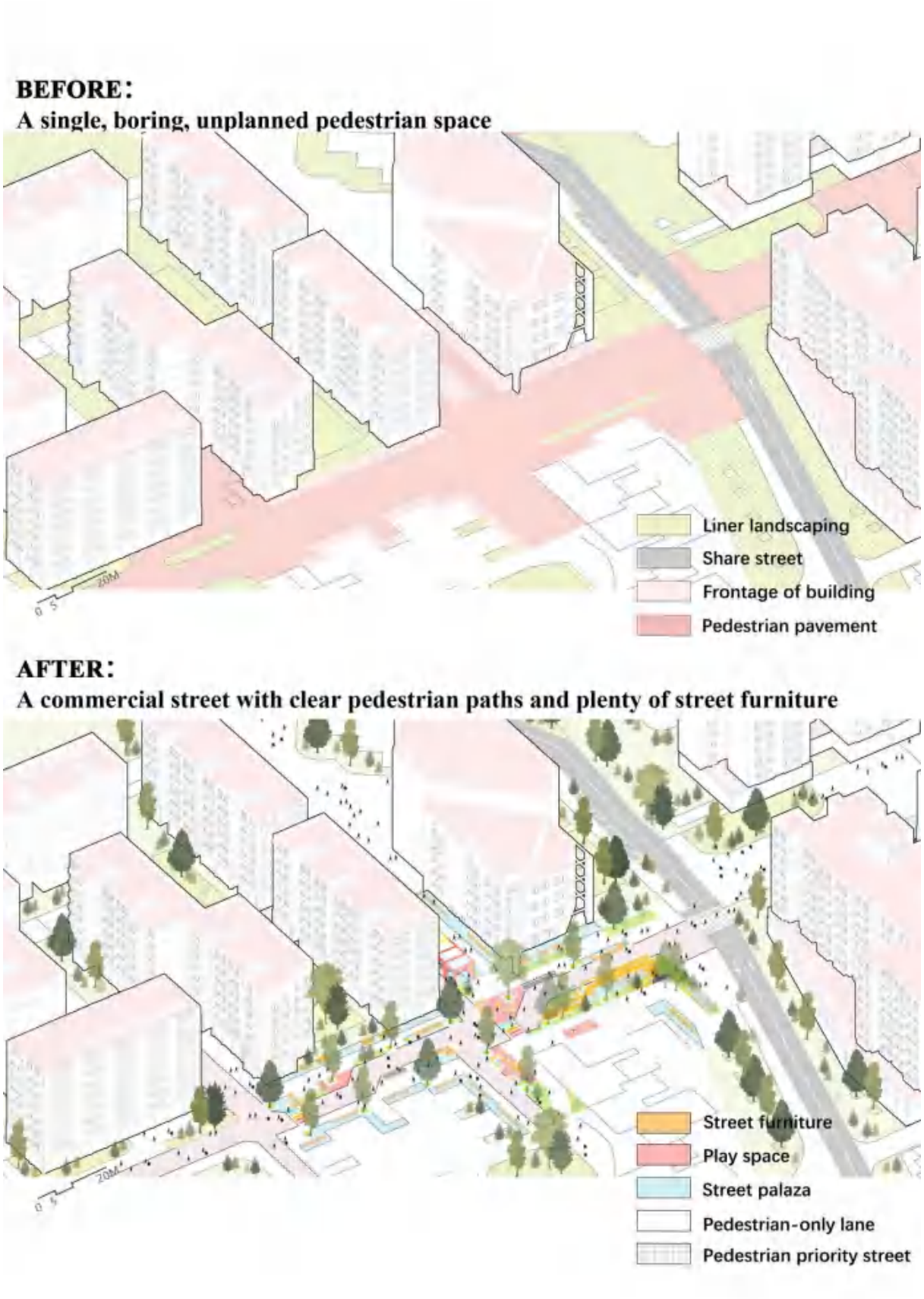


Fig. 7-44 Turning a boring pedestrian street into a mixed-use commercial street (Drawn by author）

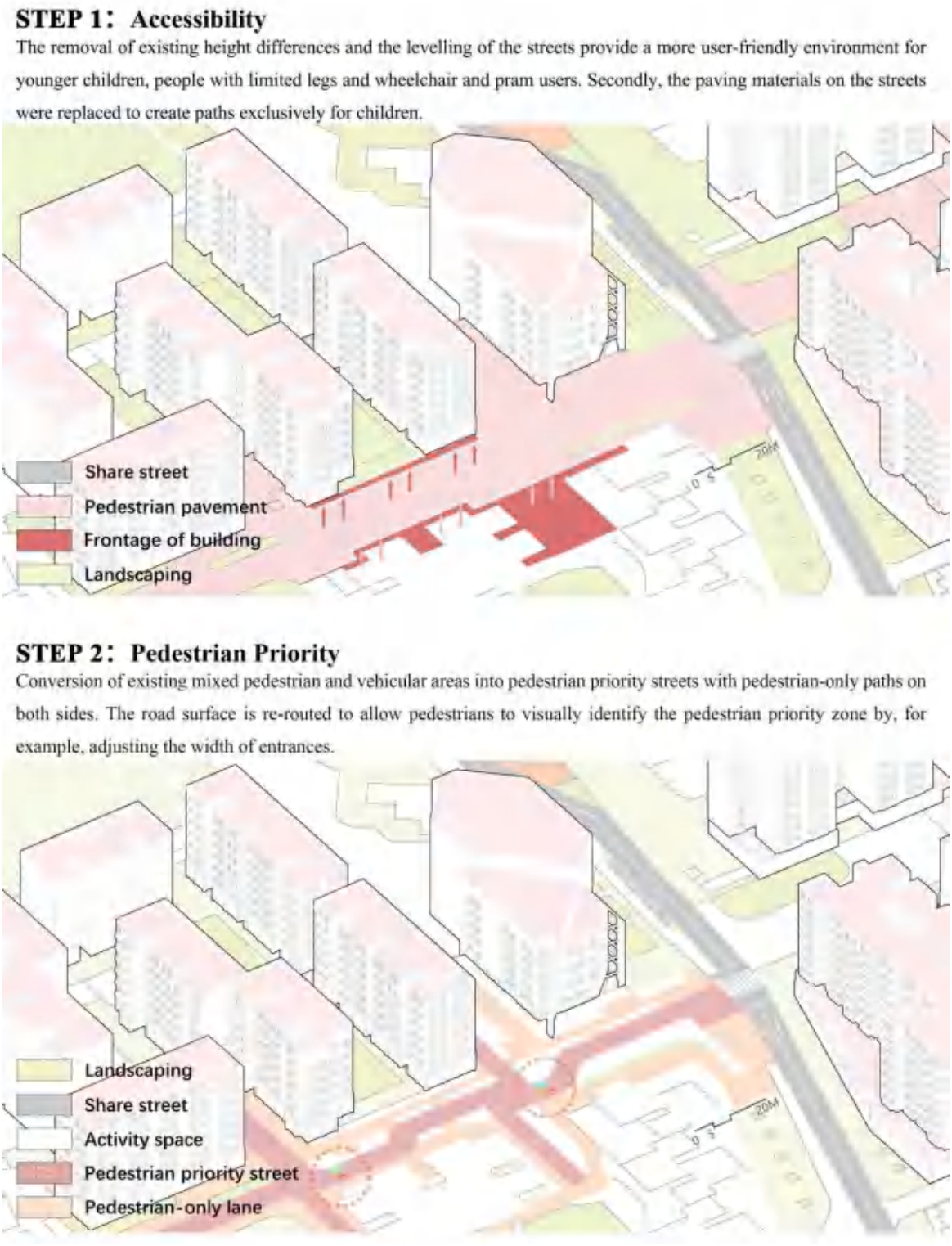


Fig. 7-45 The renovation process of Tianhe south pedestrian street (Drawn by author)

STEP 3： Rationalise the planning of amenity zones

As the continuity of the pedestrian space is often interrupted by randomly parked bicycles and catering furniture, dedicated furniture display areas and non-motorised parking areas need to be provided to maintain an uninterrupted flow of circulation areas.

STEP 4： Insert children's activity space along the street

Playable commercial streets can compensate for the lack of public space for community activities. In the placement of children's activity areas, facilities such as seating, stone piers and tree ponds are used as their boundaries, providing a place for parents to rest and monitor.

Fig. 7-46 The renovation process of Tianhe south pedestrian street (Drawn by author)

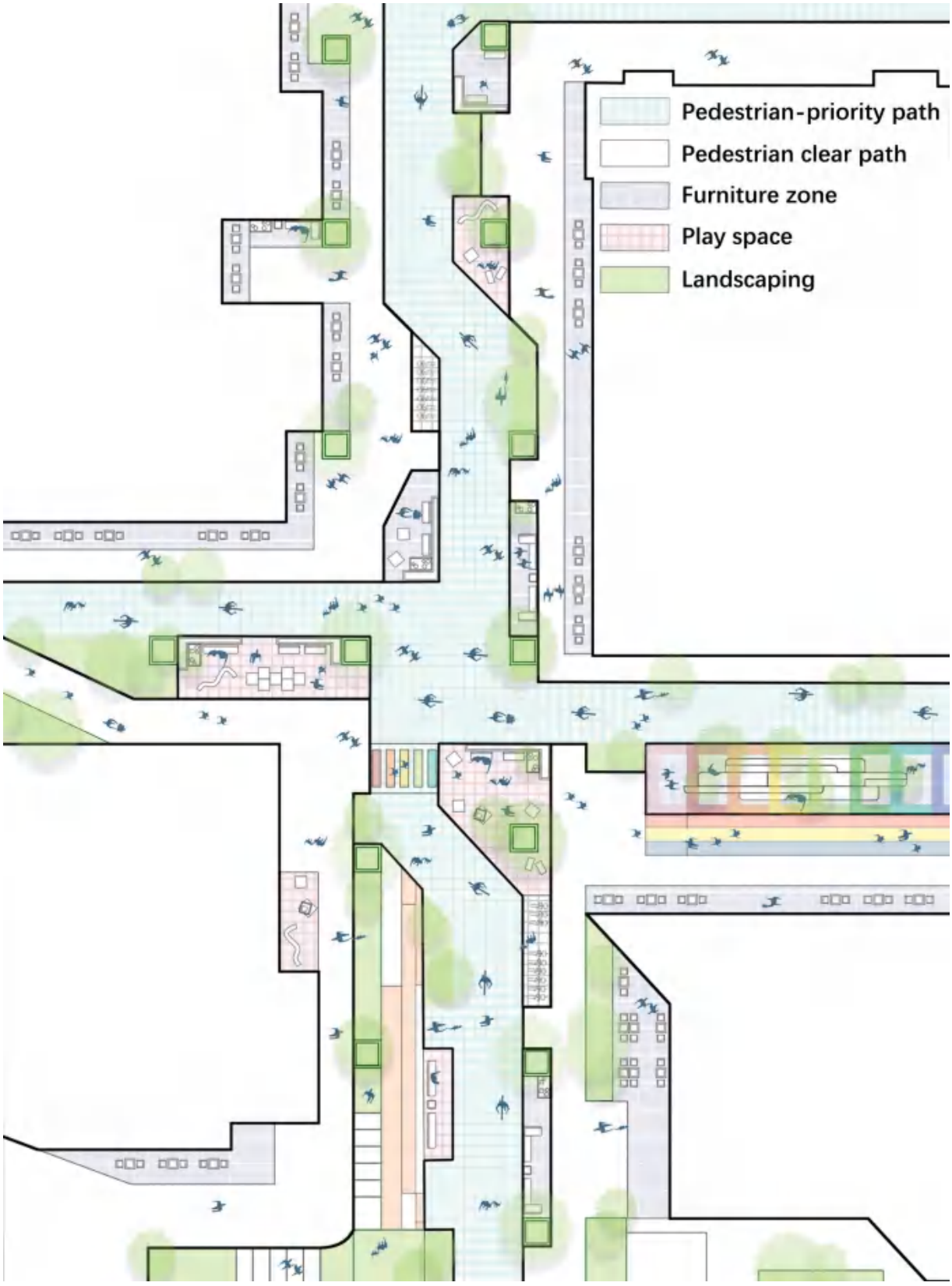


Fig. 7-47 Tianhe south pedestrian street optimization plan（Drawn by author）

Fig. 7-48 Perspective view of Tianhe south pedestrian street: Clear distinction between pedestrians-priority and pedestrian-only（Drawn by author）

Fig. 7-49 Perspective view of Tianhe south pedestrian street: Modification of non-motorised parking area and inclusion of children's play elements（Drawn by author）

7.3.3 Comprehensive street

Location: The street is located within the Tiyu West community on the south-eastern side of the study design area and has both commercial and landscape typologies to support a diverse mix of street services. To the north of the street are a small number of offices and a large number of residential buildings with commercial catering at the bottom, linked by paths to the Tiyu West Primary School and the Tianhe District Tiyu West Kindergarten. To the south of the street are public services such as the Taohuayuan public green space, new daily retail, educational tutoring and catering facilities for local residents, connected by pathways to the Tianhe District Children's Welfare Association Kindergarten and the Tianhenan Social Work Service Station. The street connects to Tiyu Road West on the left and Tiyu Road East on the right, taking on the main traffic function of the study area.

Fig. 7-50 Location (Source:drawn by author)

Daily activities and facilities: The current site has a 2.5 metre wide on-street parking plan and an extended 9.5 metre wide bilateral parking strip, separated by a footpath with a tree pond, but which does not contain any child and adult friendly leisure and activity facilities. During the peak school hours, there is a significant number of pedestrians crossing the street,

parents waiting at the curb for school to be dismissed and some children playing freely in the park or outside the shops.

Safety issues:

1. There is a 2.5m wide by 650m long on-street parking strip within the street and the existing access for pedestrians to cross the road is well over 30m apart. The excessively long parking area blocks pedestrians and children from crossing the road and affects the continuity and safety of the children's walking space.

2. There are a high number of food and beverage outlets on both sides of the street and therefore a high number of takeaway riders are active in this area. The speed of the takeaway riders on their electric bikes is high and the street does not have clear boundaries to stop electric bikes from crossing or speed warnings or lane demarcation, which can pose some threat to children's activities and lead to safety concerns.

3. The street continues to have a large number of pedestrians and children crossing it at all times of the day, except during peak school hours. The pavements are blocked and encroached upon by on-street parking and illegally parked vehicles, the design of the street crossings is confusing and the lack of warning signs or colour paving for children crossing the street poses a major safety hazard.

4. Compact pedestrian space on one side of the street without adequate buffer space for getting to and from school. The spaces for adults to rest within the street do not have good views and do not allow for good supervision of children's activities. With the exception of the open space in front of the kindergarten house and the peach blossom garden, the street space only serves a passing function and few children stay to play or rest.

5. There is a lack of exclusive pathways for children to travel, and an extreme lack of play facilities for children and rest facilities for parents. There is a particular lack of activity areas set up for the elderly, and due to the specific nature of parents' work, more than 80% of children are transported by their grandparents, and physical interactive spaces for intergenerational communication are urgently needed.

6. The natural elements are not well utilised to create interesting and manageable activity elements. There is a full row of taller trees on the south side of the street and taller greenery in front of the shops and houses, but in its current state it is a mere landscape amenity that is not utilised to satisfy children's sense of adventure and curiosity.

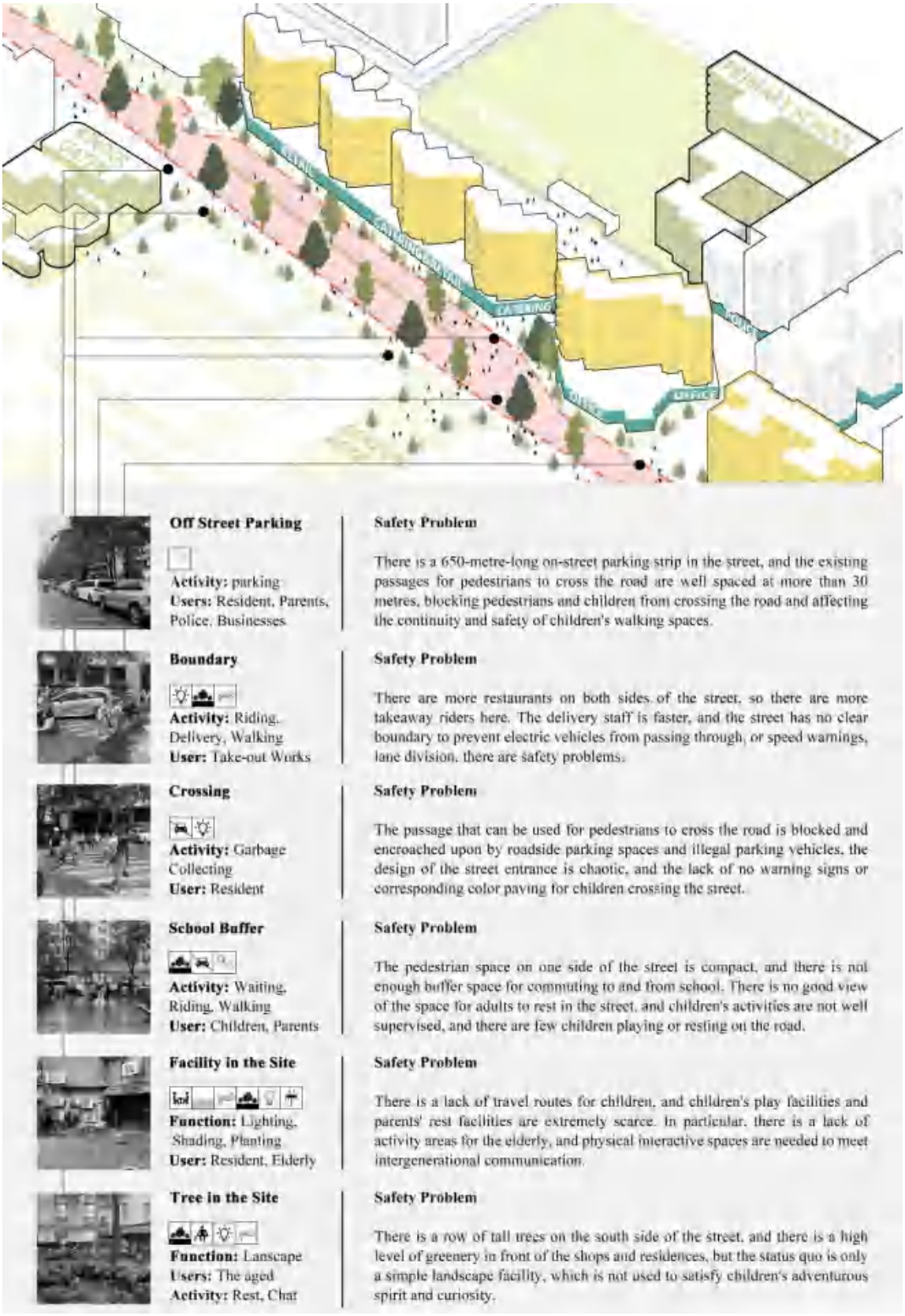


Fig. 7-51 Safety enhancements for Tiyu West Heng Road（Drawn by author）

Generating steps and strategies:

Specializing and Netting

Creating a child-friendly community public space system requires the creation of child-specific routes to ensure safe travel for children.

Ⅰ. By optimising high-frequency use streets and linking together places where children spend their daily activities, including homes, schools and children's activity areas, a safe, continuous, fun and walkable community public space system can be ultimately created.

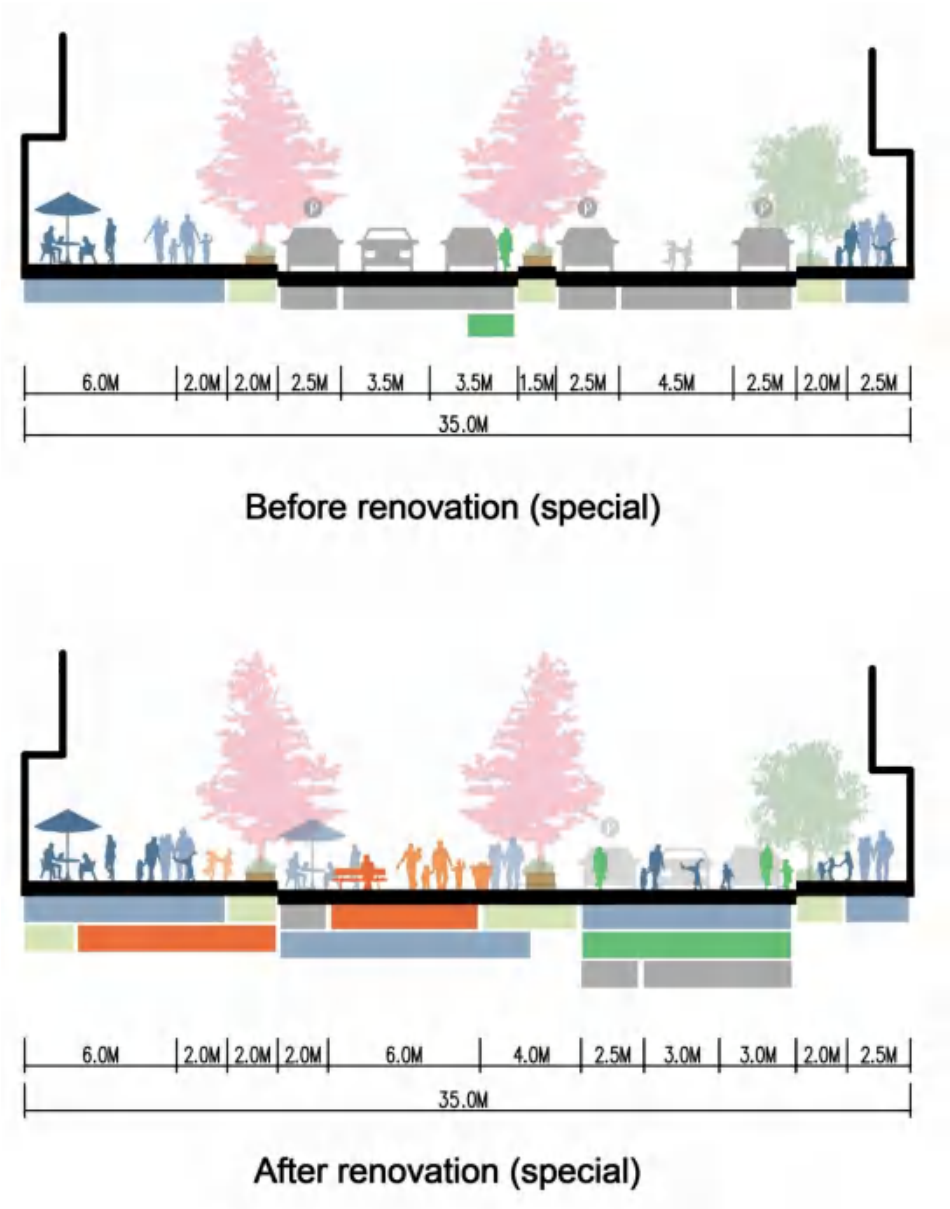


Fig. 7-52 Section of Tiyu West Heng Road before and after renovation I (Drawn by author)

Ⅱ. A rational allocation of rights of way is carried out, the original entire uninterrupted parking strip is eliminated, the paving material on the street is replaced, a shared street is

created using horizontal offsets in the location of parking spaces and tree ponds, and a 10 km/h speed limit is imposed on motor vehicles.

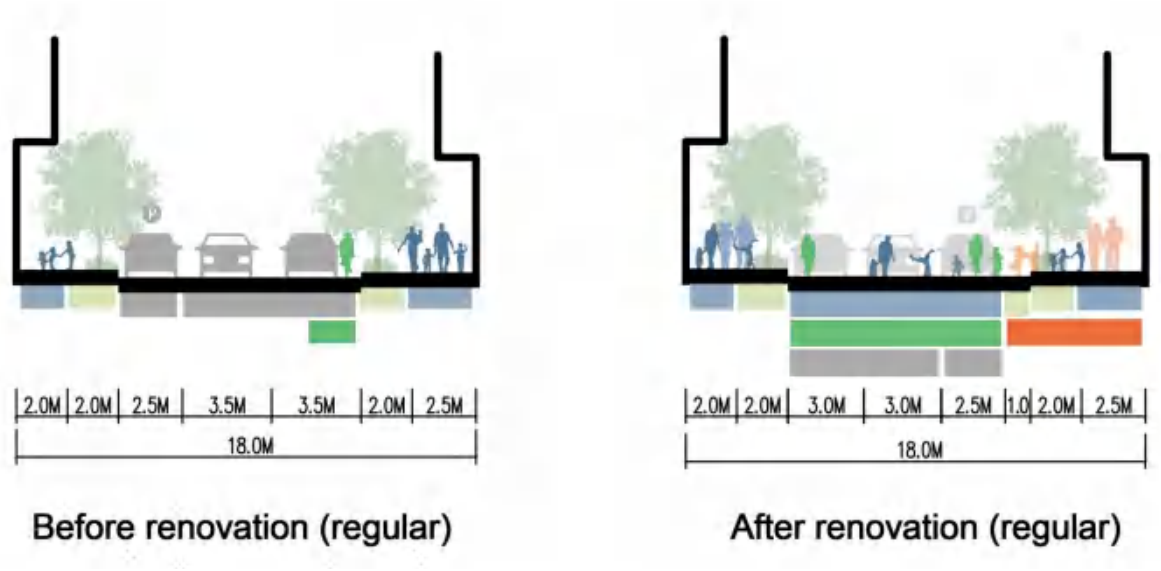


Fig. 7-53 Section of Tiyu West Heng Road before and after renovation II (Drawn by author)

Signing

Improvements should be made to the current situation where the crossings are obscured, confusingly designed and without warning signs.

Ⅰ. A signage system for adults and drivers needs to be put in place with eye-catching colours and signs near crossings and children's destinations, such as look out for children signs, speed limit signs and slow down signs, to warn drivers of the speed limit and to watch out for children passing and avoid them.

Ⅱ. Coloured zebra crossings and signage systems with directional signs are used to help connect children to various spaces in the community.

Redistributing and Visualizing

The redistribution of fragmented and marginalised public space, combined with the small and micro spaces along the exclusive routes for children and the open space of the playground, optimises the design by taking into account the special needs of the surrounding residents as well as children and students, laying out small play facilities and characteristic leisure seats, providing a comfortable shared open space for children and parents (especially the elderly),

enhancing inter-generational interaction activities and improving the activities of children Safety monitoring rate.

Fig. 7-54 Release the space encroached by long parking strips to the public (Drawn by author）

Upgrading and Elaborating

To optimise and enhance the environment for children's routes, the design of junctions should take into account children's walking speed and lengthen the duration of green signal passage

as appropriate, while adding vertical deflections such as raised crossings and speed bumps at the intersections of Sports West Cross Road and other streets to reduce the speed of oncoming motor vehicles to ensure the continuity of the walking path.

Fig. 7-55 Tiyu West Heng Road optimization plan（Drawn by author）

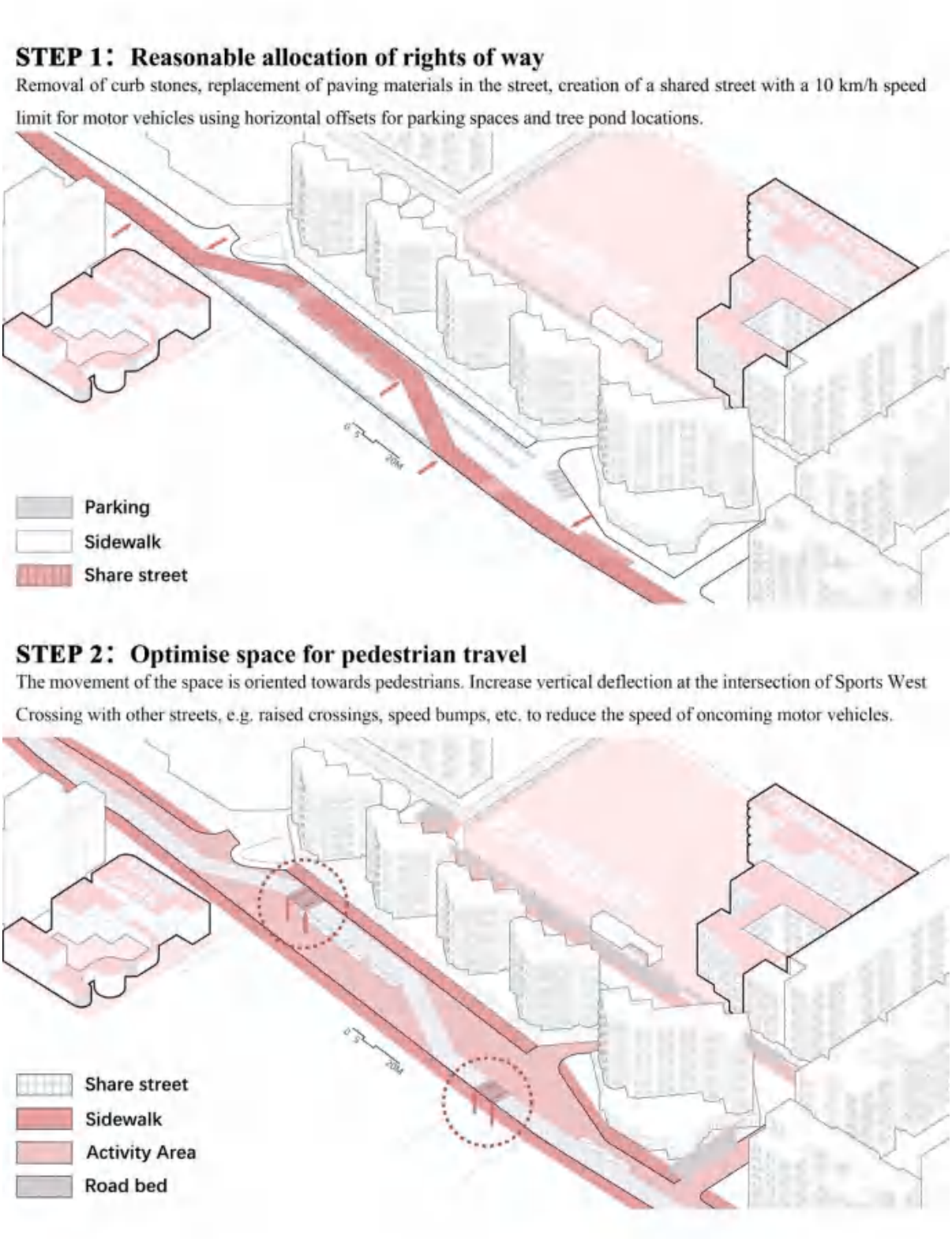


Fig. 7-56 The renovation process of Tiyu West Heng Road (Drawn by author)

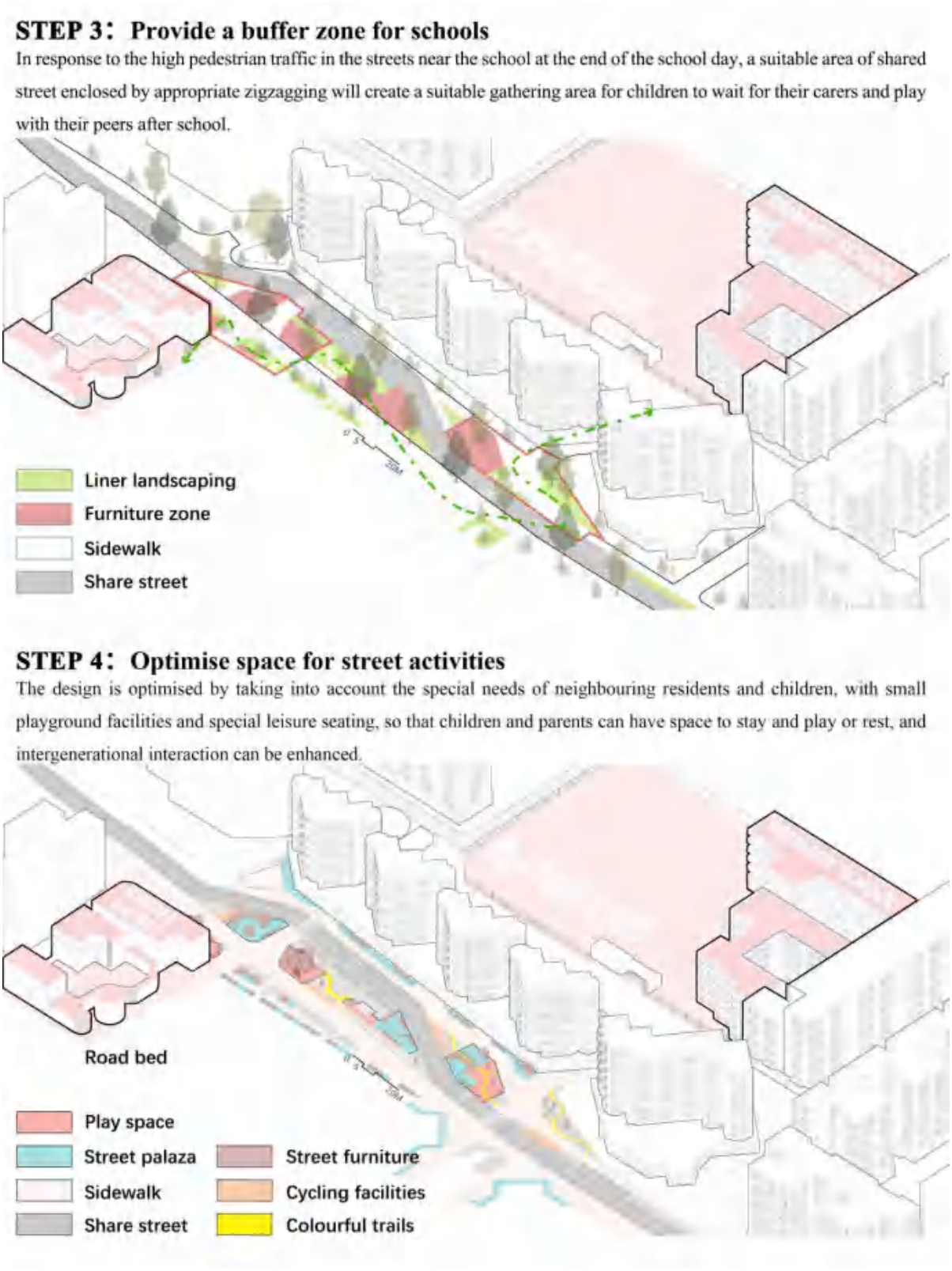


Fig. 7-57 The renovation process of Tiyu West Heng Road (Drawn by author)

Fig. 7-58 Perspective view of Tiyu West Heng Road: Extension of commercial space and installation of street furniture（Drawn by author）

Fig. 7-59 Perspective view of Tiyu West Heng Road: A pre-kindergarten buffer zone with a variety of recreational elements for children（Drawn by author）

7.4 Detailed Design of Activity Construction

7.4.1 Value of Activity and Community Games

Driven by their innate curiosity and desire for exploration, games help children understand and control their behavior, spark their imagination, and develop cognitive, emotional, and social skills. Whether alone or with others, in the outdoors or in virtual worlds, playing games can aid children's growth. For instance, holding a tea party with imaginary friends can foster original thinking, while building a "playhouse" castle outdoors can develop spatial visualization skills and serve as a crucial foundation for learning math.

Most parents recognize that play is crucial in making their children happy, expressing themselves, and mastering skills.

95% of parents agree that play promotes skill development (National Geographic).

96% of parents believe that play has educational value for their children (IKEA).

98% of parents say they believe play can help children fully realize their potential (DiG).

7.4.2 The Silent but Urgent Game Crisis in Liuyun Community

Although participation in games is critical in early personal development, children's game time and space are continuously squeezed. As rapid urbanization and disruptive technology reshape our lives and work, life pressure increases, and schedules become increasingly packed. Parents and children rarely enjoy leisurely family time in their busy lives, and "home" is becoming a space filled with multitasking. Children face greater pressure at school, focusing all their attention on exams. The reduction of community play spaces and parents' safety concerns further decrease children's opportunities for outdoor play. Facing a rapidly changing and challenging future, reducing children's opportunities for game play will hinder the cultivation of the diverse skills needed for the future.

According to additional research from the Liuyun Community Children's Friendliness Evaluation Questionnaire and in-depth interviews with parents, children, and community workers, children and families desire more opportunities for game play in their lives, but it is

becoming increasingly challenging to find time for it. 92% of children say they want more games in their lives, particularly more diverse and rich entertainment facilities. 93% of children say playing makes them feel happier, and more than one-fifth of children say they are "too busy" to have time to play.

Fig. 7-60 How often children go out to play in the survey questionnaire(Source:drawn by author)

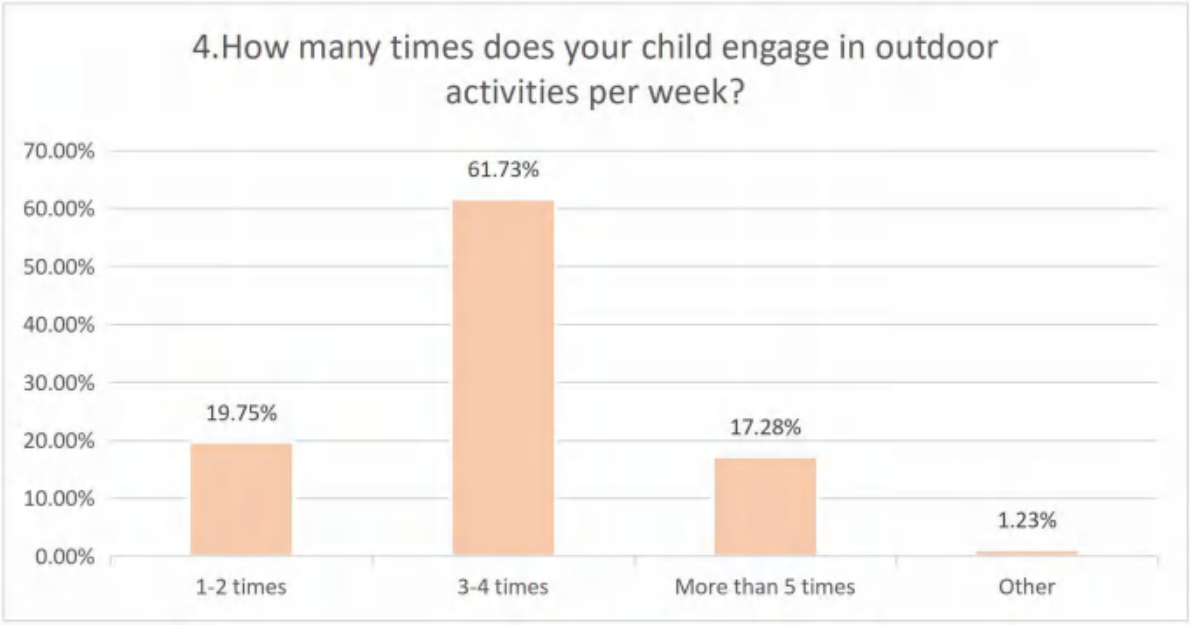


Fig. 7-61 Number of times children went out to play per week in the survey questionnaire

(Source:drawn by author)

In the lives of children today, it is particularly difficult to find time for outdoor play. 70.37%

of children spend less than an hour playing outdoors each day, and 19.75% of children play outdoors less than three times a week (Fig.7-61). Many children are enrolled in structured, pre-planned indoor activities at professional daycare centers or training classes after school (Fig.7-62).

Fig. 7-62 After school training classes(Source:photoed by author)

Parents' time is also increasingly tight. Many people mention that anxiety and stress are reducing the amount of quality family game time. When attention is constantly divided by life and work, parents find it difficult to be in the mood to play games. Many children also feel that playing games together is not a top priority for their parents. 81% of children wish their parents could play with them more, while 49% of parents feel that they don't spend enough time playing with their children.

Entertainment methods in families, schools, and communities are all affected by the wider structural changes in our way of life. In order to truly build child-friendly communities, according to Article 31 of the United Nations Convention on the Rights of the Child, all children have the right to "rest and leisure, to engage in play and recreational activities appropriate to the age of the child." Addressing and solving the problem of children's play deficiencies in community life is crucial, including over-scheduled activities, disappearing community spaces, safety hazards, and insufficient play in school life.

7.4.3 Fixed Daily Activities

In the process of physical transformation of public spaces and streets, some spaces have been designated as fixed and friendly venues, and three large daily activity venues have been created in the community through specific operational techniques of Activating and Extending and Mixing and Compositing.

Fig. 7-63 Fixed Daily Activities (Source:drawn by author)

1. Inter-generational Games

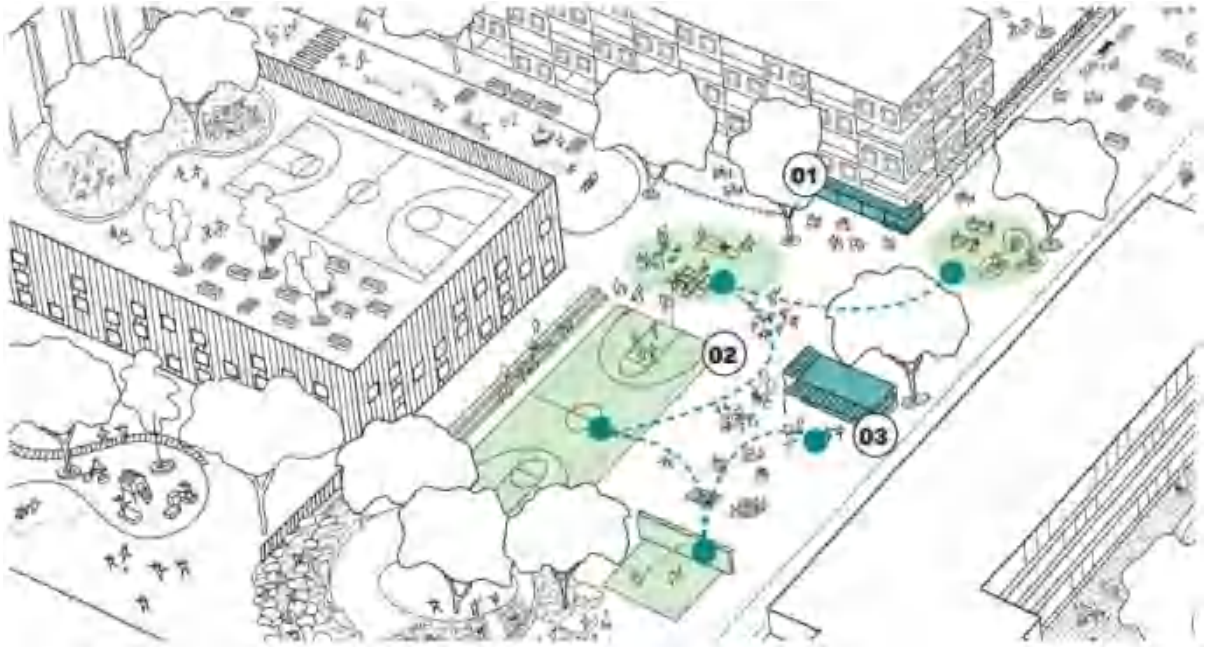


Fig. 7-64 Inter-generational Games (Source:drawn by author)

① There is direct visual connectivity between nearby shops and facilities and recreational spaces; ② The children's play area is adjacent to the rest area of young and old adults;③Adjacent shaded rest areas.

The Housing Development Board of Singapore believes that providing opportunities for residents of different ages and abilities to play together is an important aspect of social cohesion and integration in high-density residential areas. Almost every housing unit group has The Three-Generation Playspaces, providing fitness equipment for the elderly, gaming areas for the young, and adjacent open playgrounds for children. This enables residents to engage in activities together and feel part of a larger community.

The renovation of Public Space Node 1 focuses on creating activity spaces for children while providing recreational areas for the elderly, which not only strengthens the sense of responsibility of young residents but also expresses empathy for the needs of others. In-depth interviews with a interviewed couple of parents reflected: "If you provide a comfortable area for the elderly to exercise next to the children's play area, it will reduce complaints from older residents about noise."

2. School as community heart

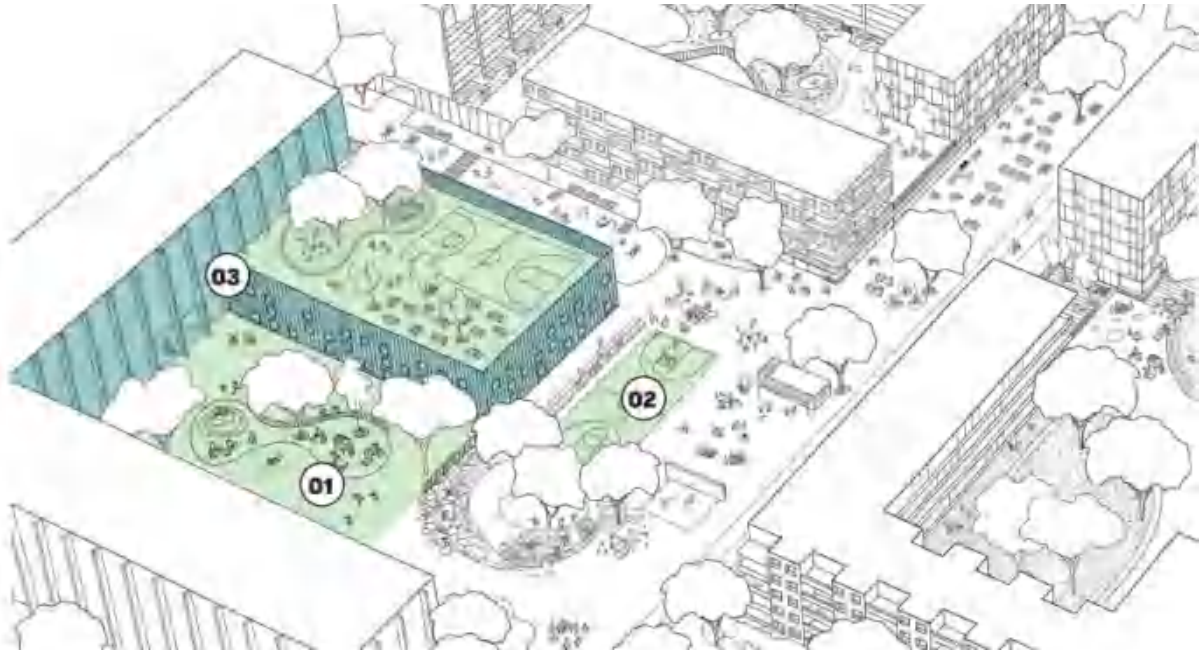


Fig. 7-65 School as community heart (Source:drawn by author)

① School yard open to the public after school hours ； ②Facilities such as sports courts shared by school & community；③Shared indoor facilities accessible to the public

In high-density communities, from both a spatial and social perspective, schools provide an important asset for community use. Campuses can provide much-needed open play spaces after school hours, and the buildings themselves can serve as a hub for the local community.

While we may not be able to emulate the Fiep Westendorp Community School in Amsterdam, which was designed from the outset as part of a large, multi-purpose block that includes community meeting areas and spaces for activities, we can still open up the playground and other sports equipment to community members after school hours. These shared facilities are located near the entrance of the school, making it convenient for community members to use them after school hours and allowing more of the school's private areas to remain secure.

This is a positive operation, with the school becoming the heart of the community, providing children with a sense of pride and belonging. Residents feel that the school is a community treasure, and they share a common sense of responsibility.

3. Narure play

Fig. 7-66 Narure play (Source:drawn by author)

①Playful natural elements within the landscape such as logs, rocks, sand and water can create a stimulating and engaging space for children ②Direct visibility to adjacent amenity for passive surveillance

For Public Space Node 2, the redesign of the green space drew inspiration from the Park van Eden in Antwerp, Belgium, which was analyzed in detail in the case study section of chapter three.

Although the Liuyun Community has a decent amount of green coverage, it lacks child-friendly natural elements. Given the high-density nature of the community, we still need to consider how to create equally rich play memories for children in a natural environment. In addition to providing simple ways to stimulate imagination, discovering symbolic natural game objects ensures that children feel they can play freely in public spaces.

7.4.4 Fixed Event-Based Activities

Concerns over stranger danger, pollution, road traffic, bullying, and implicit hazards to the environment can all impact the number of children playing outdoors. 20% of children worry about getting hurt while playing outside, 22% of 7-12 year olds are prohibited from playing alone outside, 79% of parents worry about traffic endangering their children, and 69% of parents worry about the safety of play equipment. More than half of the surveyed parents say that despite their desire for their children to play outside, safety concerns remain(Fig. 7-67)..

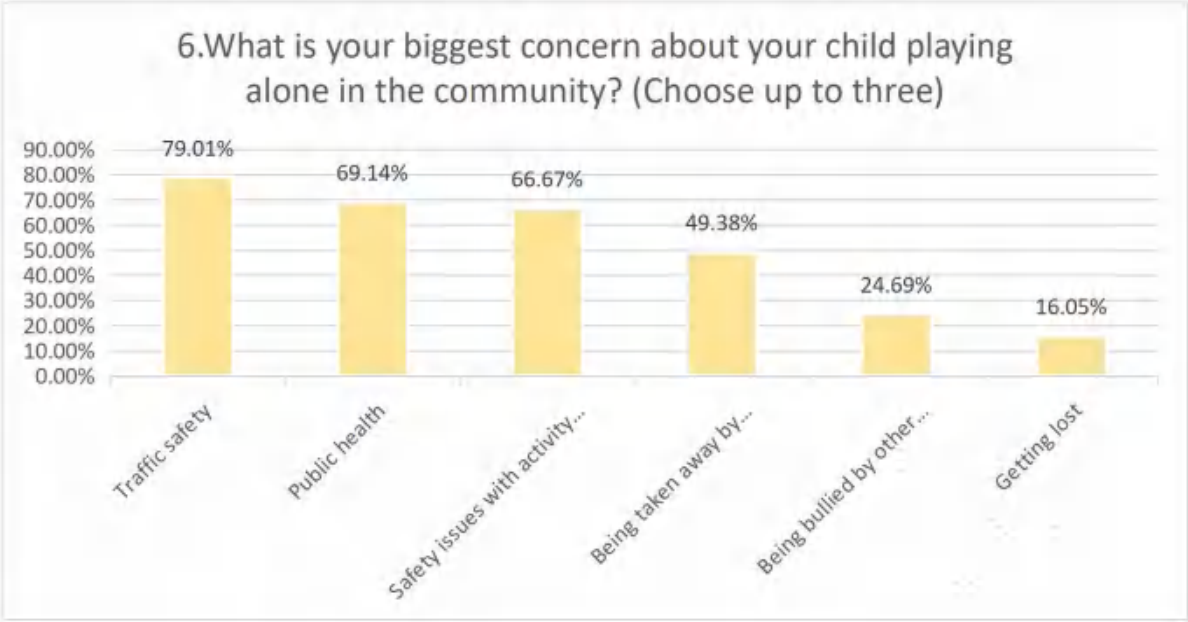


Fig. 7-67 The biggest concerns of parents in the survey questionnaire (Source:drawn by author)

Playing is increasingly becoming an indoor activity, with parents often attributing their preference to unpredictable weather and lack of time to take their children to "play destinations." As such, planning fixed spaces in the community to meet the play needs of children and parents can minimize the time spent outdoors and address parents' concerns through child-friendly routes.

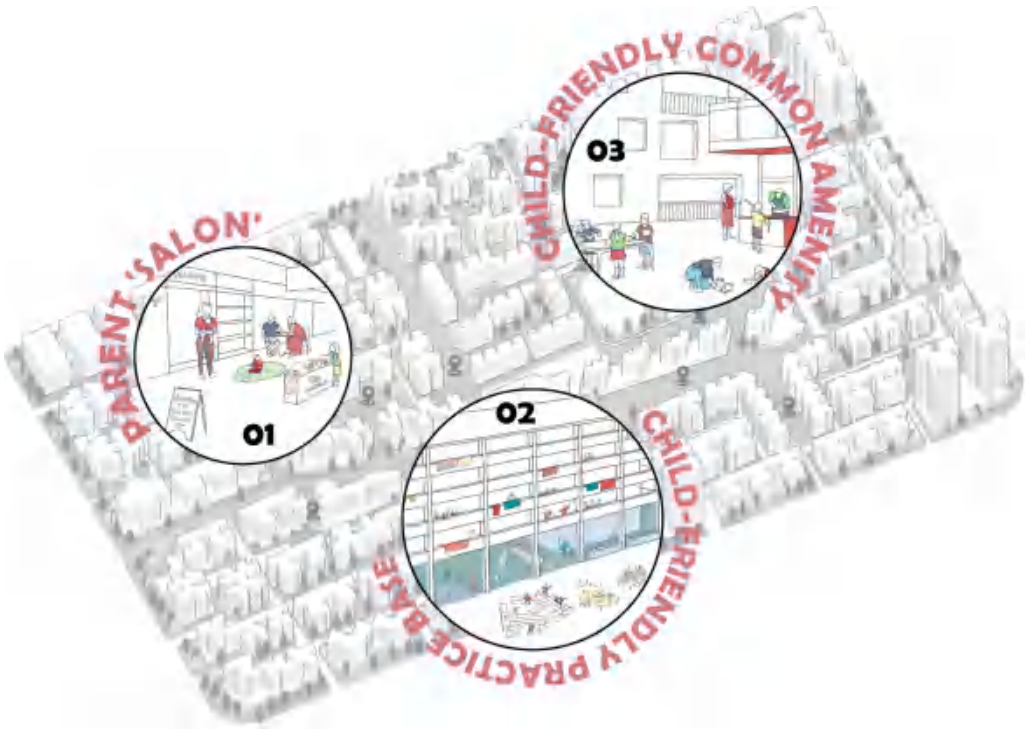


Fig. 7-68 Fixed Event-Based Activities (Source:drawn by author)

1. Parent 'Salon'

Fig. 7-69 Parent 'Salon' (Source:drawn by author)

Most people would probably agree with the African proverb that says, "It takes a whole village to raise a child." In order to ensure that caregivers feel connected and supported in their community or "village," spatial rules must be established to facilitate social support and

communication.

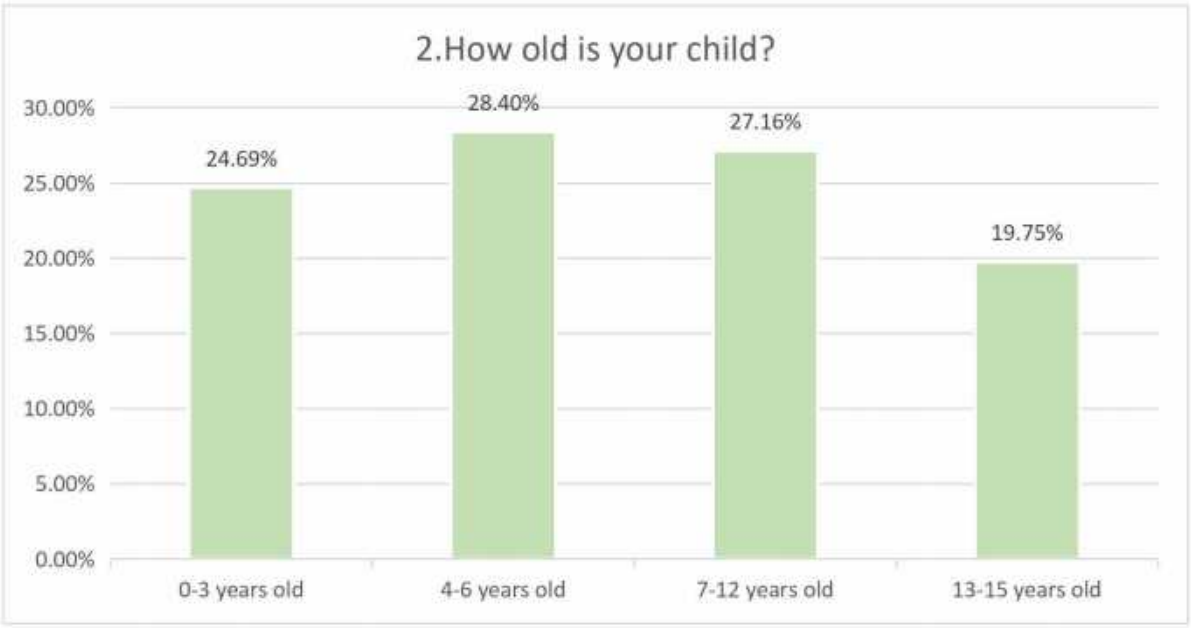


Fig. 7-70 The age composition of the children in the research questionnaire (Source:drawn by author)

Among the effective survey respondents in the Liuyun community, more than half are infants, toddlers, and preschoolers aged 0-6 (Fig.7-70), and the community has almost no activity planning for this age group (detailed in Chapter 4, Community Activity Operation Dimension Survey), which exacerbates the parenting pressure on parents.

The community can learn from the Bouken Tamago Care Salon in the Kokubunji community of Tokyo to provide a space where parents can gather together, chat, and play with their babies. In addition to basic facilities, the salon should also be equipped with support personnel and a visiting consultant who is responsible for answering any questions parents may have in a relaxed environment.

The parent salon in the Liuyun community should be located along the Tianhe South Pedestrian Street within reach of the children's path to ensure accessibility and safety visibility. It can be led by the Tianhe South Street Social Work Service Station, and funding can be sought from the local government and relevant agencies or from corporations for event sponsorship to ensure that the parent salon can serve all families in the community free of charge.

2. Child-Friendly Practice Base

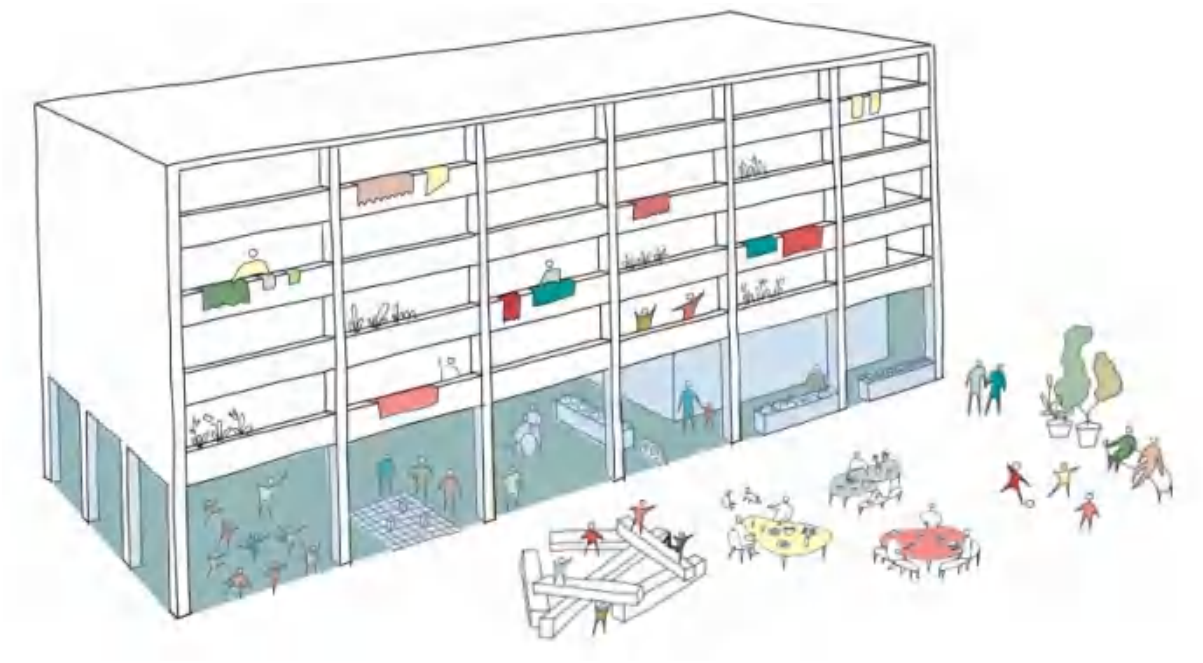


Fig. 7-71 Child-Friendly Practice Base (Source:drawn by author)

Fig. 7-72 Simihehe International Food Anchor Base

（https://mp.weixin.qq.com/s/E35TJVrGUC9QxcxcFStiRg）

Although the number of activities for children and teenagers in the community has increased after the pandemic, the audience for these activities still tends to focus on only one age group of children, with little involvement of interaction between children of different age groups and

communication between children and parents.

The International Food Anchor Base of the Hangzhou Child-Friendly Practice Base provides a valuable reference for optimizing the food production activities in the Liuyun community, using the PBL project-based learning method(Fig.7-71). "Food Anchor PBL" classes are offered at the community center, along with "Family PBL Project-based Learning to Inspire Children's Inner Drive" classes for parents. These activities expand the audience from adults to children and provide rich learning experiences that not only enhance children's problem-solving abilities, but also focus on the "urgent and difficult problems" of family education for parents, guiding them on how to educate their children and create a positive family atmosphere(Fig.7-72).

3. Communal maker-space

Fig. 7-73 Communal maker-space (Source:drawn by author)

When we talk about a recreational space, we often think of a space that can accommodate a variety of entertainment activities. However, in high-density residential areas, home space is often very limited, and providing a positively creative public activity space can provide much-needed convenience for children and parents.

The amazing number of businesses and diverse business types in the Liuyun community is conducive to creating a Guangzhou version of The Play Depot, establishing a maker space that encourages community residents (including shop operators) to gather, entertain, share, and stimulate innovative thinking. By attracting artists in the community to conduct short-term residencies, it seeks to find a connection between art and play, which enables them to discover fun intervention measures and activities to enhance their connection with the community.

Although this space is focused on providing fun play space for children, any member of the community, regardless of age, is welcome to come here. Retired residents can serve as volunteers in the maker space, making toys or furniture for children to use, and promoting intergenerational communication within the community.

7.4.5 Informal Play Spaces

From the perspective of integrated cognitive science, in the built environment of child-friendly communities, learning and play are integrated activities that are multi-sensory, emotional, and based on activity trajectories. Therefore, learning and play cannot be separated. "Non-traditional play spaces," such as community spaces, public spaces, or urban roads, squares, commercial venues, and even other people who play with children at the same time (peers, parents, and people around them), should be encouraged and developed into the overall environment of children's lives.

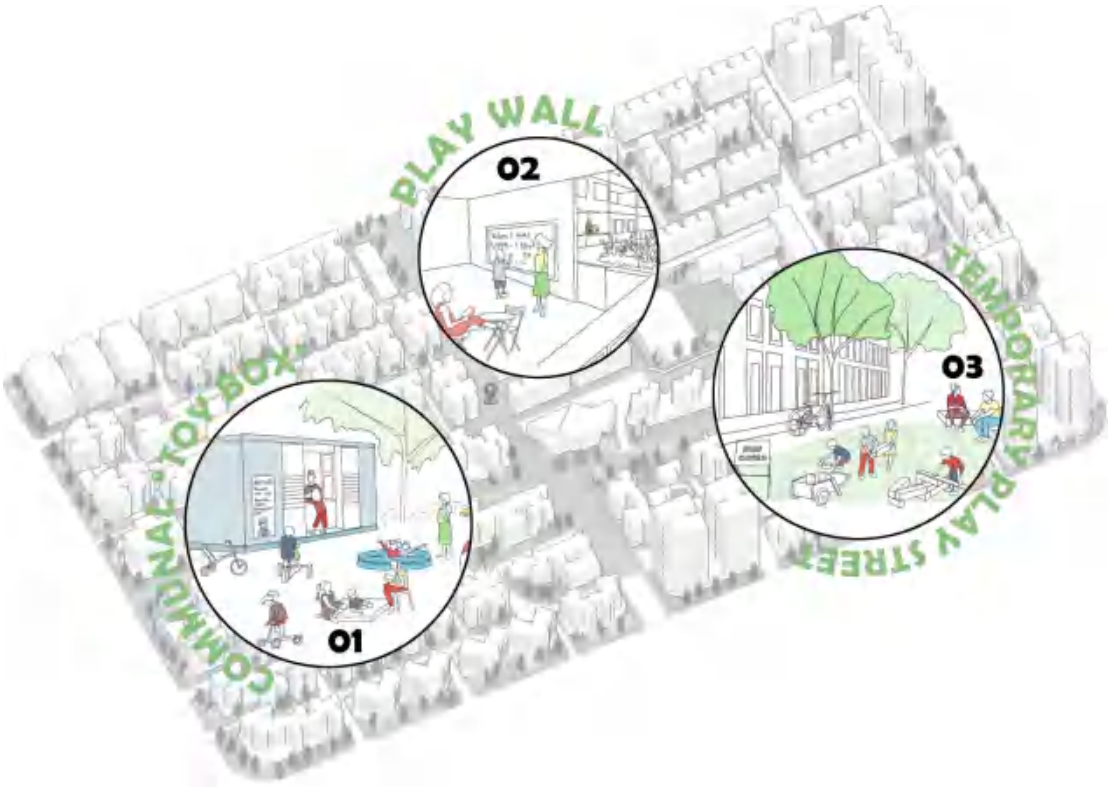


Fig. 7-74 Informal Play Spaces (Source:drawn by author)

In this process, play becomes an important way of understanding space, location, and one's own knowledge and understanding of surrounding things. Therefore, two approaches can be used for design: one is through spontaneous interaction between children and the surrounding space settings; the other is through carefully designed play spaces and play-based learning experiences. Through this "learning landscape" or design intervention, perhaps not only meaningful play and enjoyable learning opportunities can be provided for children, but also children and their caregivers can participate in this process together.

1. Communal "Toy box"

Fig. 7-75 1.Communal "Toy box" (Source:drawn by author)

The "Thumb Candy" project initiated by the city of Rotterdam, as a concise intervention program, provides a safe space for children and their parents to gather and interact through the "toy boxes" project.

In terms of community activity operations, we will set up two types of toy boxes. Fixed toy boxes will be placed in larger enclosed spaces, community playgrounds, etc., providing larger toys for children and solving the problem of community parents having difficulty finding enough private space to store toys. Mobile toy boxes will be set up along pedestrian streets and in some safe small amusement parks, providing puzzle toys for younger children.

The daily management of the "toy boxes" can not only enhance the concern between parents and children but also teach children to take care of each other and be concerned about their public space.

2. Play wall

Fig. 7-76 Play wall in the community (Source:drawn by author)

Playwall aims to enhance intergenerational communication among community members, critically reflect on meaningful ways of playing, and build confidence through community participation.

Fig. 7-77 Play wall （https://mp.weixin.qq.com/s/vOtw3LSRJlfj_sTOkTsbqg）

In the community, a suitable wall (such as the white wall at the bottom of the adjacent residential building of the community playground or the promotional wall along the Tianhe South pedestrian street) is selected, and parents and children are invited to write "When I was little, I liked to..." together. The wall will soon be filled with interesting games that older generations in the community can teach the younger generation, which helps promote intergenerational connections and allows adults and children to learn together while playing.

3. **Temporary play street**

The Living Streets project in Antwerp is an excellent example of government-led efforts to reclaim streets for people, promote social interaction among adults, and provide car-free areas for children to play. This project recognizes the importance of providing play opportunities for children right at their doorstep, especially for many residents who do not have private yards.

Fig. 7-78 Temporary play street (Source:drawn by author)

The Living Streets program encourages residents to close their streets during the summer and transform them into public gathering and gardening spaces. Its approach is similar to PARK(ing) Day in Philadelphia, child-friendly roads in Japan, and car-free days in the community of Shekou in Shenzhen(Fig.7-79).

Fig. 7-79 PARK(ing) Day in Philadelphia, child-friendly roads in Japan

For the Liuyun community, selecting World Car-Free Day or a specific date or time period to create a temporary playground street directly in front of their homes provides parents with an opportunity to supervise their children while doing daily tasks and chores. This also means that children can easily transition between home and outdoor play and meet young people living nearby.

7.4.6 Playspace Web of Liuyun Community

In Antwerp, the local council believes that every child should have the opportunity to play near their home (ideally right outside their door). To achieve this vision, the city has developed a comprehensive neighborhood play strategy that considers providing diverse play opportunities for children of different ages and how these opportunities connect to pedestrian or cycling infrastructure.

Although the scope of this design is limited to the Liuyun community, Antwerp's Speelweefselplan (Play Weaving Plan) can still inspire our design. By consulting and surveying children in the community, analyzing and mapping the way children go to school, the locations of play spaces, and places to meet friends, we have created the Play Space Web of Liuyun community, linking children's infrastructure such as play spaces, schools, and community workstations into a cohesive network.

The construction of the Playspace Web can be used to improve infrastructure, increase the playability of the community, and optimize children's travel routes. In turn, the consultation process ensures that children's voices are heard, their ideas and suggestions are valued, and this gives them a sense of belonging and agency to improve the community(Fig.7-80).

Fig. 7-80 Playspace Web of Liuyun Community (Source:drawn by author)

7.5 Summary

Based on the design principles of prioritizing safety and considering diversity, accessibility, naturalness, comfort, and participation, this chapter takes the renovation design of child-friendly public spaces in the Liuyun community in Guangzhou as an example. Starting from the overall space to various types of detailed nodes, the design aims to improve the child-friendliness of the public spaces in the Liuyun community.

Based on the existing spatial situation of Liuyun community, certain updates should be made to areas with average child-friendliness and high frequency of children's travel, focusing on spatial form. Specific optimization methods can refer to the four types of updates for spatial nodes and three types of updates for streets mentioned earlier(Fig. 7-81).

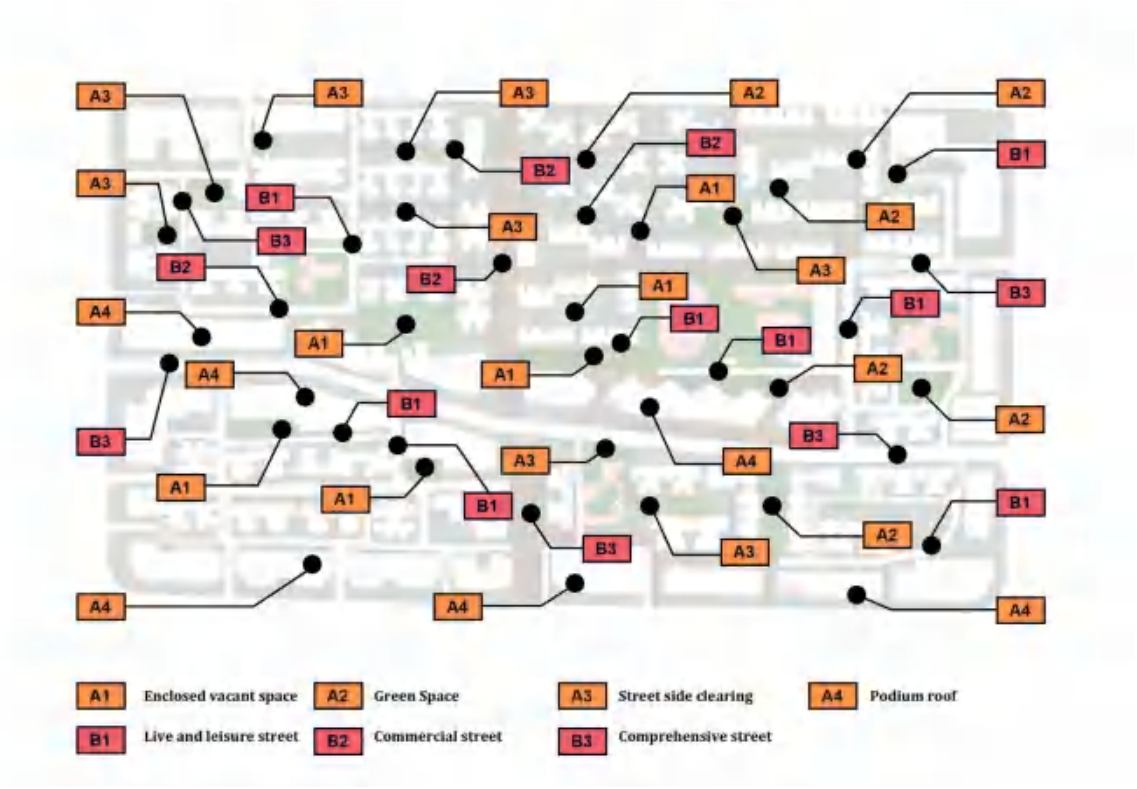


Fig. 7-81 Application of different regeneration measures in the Liuyun community (Source:drawn by author)

Conclusion and Suggestions for Further Research

Conclusion

"Human habitats shape children in ways we don't perceive," says Tim Gill, author of "Urban Playground: How Child-Friendly Planning and Design Can Save Cities," succinctly pointing out how public spaces profoundly affect children's childhood. Community public spaces are an important part of the city, where many children and families interact socially. In the context of urban renewal and community reconstruction in China, the introduction of child-friendly spaces provides us with a new perspective on planning community public spaces. Researching child-friendly community public spaces can not only improve the current spatial environment but also create a beautiful home that meets the needs of the next generation's healthy growth, which is friendly to everyone.

This article aims to explore how to optimize community public spaces under the standards of child-friendliness, allowing families and children to interact and establish social connections, forming community cohesion. Starting from theoretical research, this article summarizes the development of child-friendly theory at home and abroad, the physical and psychological characteristics of children at different stages, and the latest space construction guidelines in various countries. It also sorts out the common construction dimensions and specific contents of community public spaces under the perspective of child-friendliness. Furthermore, combining relevant case studies of child-friendly community public space construction worldwide, it summarizes the specific measures in space construction, route construction, activity construction, etc., providing practical support for the strategies proposed in the later chapters. Moreover, the article selects the Liuyun community in Guangzhou for field research, investigating the outdoor activities of children in the community and analyzing the construction of the five major dimensions of community public spaces from a child-friendly perspective. On this basis, a three-level index evaluation system of child-friendly community public spaces is established to evaluate community public spaces and guide the generation of

design strategies. Finally, these strategies are applied to the public space improvement and optimization of the Liuyun community, and the following conclusions and results are drawn:

(1) Summarize the evaluation standards of community public spaces under the child-friendly perspective in various countries and propose six factors that affect the child-friendliness of community public spaces: spatial diversity, accessibility, safety, comfort, naturalness, and participation. These factors are used as the criteria layer for subsequent evaluation construction based on the actual situation of the Liuyun community.

(2) Establish a three-level index evaluation system for the child-friendliness of community public spaces and verify its practical value. Taking the six factors that affect the child-friendliness of community public spaces as the evaluation standard dimensions, 24 evaluation factors that can reflect the characteristics of the Liuyun community and resident children's use are finally determined, among which the top three factors of concern for children and guardians are safety, participation, and comfort. The CFI (Children-friendly-index) is proposed as the final evaluation result of the child-friendliness of community public spaces, reflecting the degree of child-friendliness of community public spaces, and divided into three levels of friendly, generally friendly, and unfriendly, corresponding to three score ranges of 4-5, 2-4, and 0-2 in the evaluation results. According to the content and standards of the evaluation system, the child-friendliness of the public space in the Liuyun community is evaluated. Finally, through objective scoring of field research and subjective scoring of questionnaire survey, the child-friendliness index of each indicator factor in the Liuyun community is obtained, which clarifies that safety is the most urgent problem to be solved in the Liuyun community and further specifies which safety issues various types of public spaces and streets should solve first.

(3) Based on the theoretical research and case practice mentioned earlier, considering the score rate and influence factor score of various indicators in the Liuyun community, a design

principle is proposed that emphasizes safety while taking into account diversity, accessibility, naturalness, comfort, and participation. Based on the characteristics of children's behavior and evaluation indicators, child-friendly community public space safety enhancement strategies are proposed from the aspects of space construction, route construction, activity construction, policy construction, and neighborhood Culture construction. The aim is to create a child-friendly community public space with safety considerations from different dimensions.

(4) Finally, the optimization of public space in the Liuyun community is implemented at three levels. Firstly, the overall walking and cycling network of the Liuyun community is constructed. Secondly, by planning the daily travel routes of children, the focus is narrowed down, and the four major space nodes and three streets that will be improved in this renovation are selected. A detailed analysis of safety issues is conducted for each renovation node, and specific enhancement methods are selected from the strategy menu based on different safety issues. For example, using the shared street model, providing crosswalk facilities and isolation zones, improving the safety level of the street, reallocating the walking and cycling space of the street, and fully utilizing the idle space of the street by adding structures and game elements that children love. Finally, from the perspectives of fixed daily activities, fixed event activities, and informal play spaces, the activity operation dimension is constructed to solve the urgent game crisis in the Liuyun community.

Innovation

(1) Innovation in research content: This article examines the latest documents published abroad on the construction of child-friendly cities and introduces the perspective of children to evaluate the friendliness of community public spaces. In the research field of community public spaces, more attention has been paid to the friendliness of spaces for the elderly, while in the field of child-friendly research, more attention has been paid to the friendliness of urban-level public spaces for children. This article focuses on the child-friendliness of public spaces at the community level, not only focusing on the space construction within public

spaces, but also including route construction, activity construction, policy construction and neighborhood Culture construction within the scope of this research.

(2) Innovation in research methods: The evaluation criteria and factors established in this article's evaluation system have sufficient theoretical foundations and selection basis and are representative of Guangzhou. Based on a thorough analysis of the mechanisms that promote the healthy growth of children in friendly community public spaces, this article proposes six elements of child-friendliness in community public spaces, which are used as the criteria layer of the evaluation system. The selection of the 24 evaluation factors in the evaluation system went through three steps of preliminary selection, selection, and determination, with a scientific selection method and comprehensive and targeted selection sources. The selection of evaluation factors not only incorporates the research results of previous studies, but also integrates the opinions of experts and scholars in multiple fields, such as child education, child psychology, urban planning, and architecture. Moreover, the opinions of a large number of children and their guardians in Liuyun community were also considered to ensure the local characteristics of the evaluation factors.

(3) Innovation in design practice: This article is based on the methodological foundation of "related theoretical research - related case studies - field research and analysis - establishment of evaluation system - generation of targeted principles - design strategy guided by principles - application of strategy to the plan." During the transformation process, specific countermeasures can be selected from the strategy list based on specific safety issues, which have strong pertinence and operability.

Shortcomings

Although the author has constructed a relatively comprehensive and feasible evaluation system for the child-friendliness of community public spaces, there are still three shortcomings:

(1) Evaluation factors for the child-friendliness of community public spaces: Due to the different development conditions of different countries and the different emphasis on the construction of child-friendly cities in each country's planning guidelines, there are no professional and truly child-oriented public space planning guidelines and construction standards in China. The author only selected planning documents from Japan, the United Kingdom, Canada, the Netherlands, the United Nations, and the European Union for research within a limited time, which resulted in a slight deficiency in quantitative evaluation indicators for child-friendly physical space.

(2) Evaluation methods for the child-friendliness of community public spaces: Due to the age limit of children and their lack of social life experience, the evaluation process is entirely based on their own cognitive range and life experience to evaluate public spaces, which leads to a high degree of subjectivity and limitations in the evaluation. Although it reflects the relevant situation of children using public spaces to a certain extent, the final evaluation result may not fully reflect the problems of public spaces.

(3) Optimization strategies for child-friendliness in community public spaces:Based on empirical research on the Liuyun community, a list of strategies has been proposed to improve the child-friendliness and safety of public spaces, according to the six evaluation criteria. However, public spaces serve not only children but also all residents of the community. Therefore, the implementation of the proposed optimization strategies may encounter obstacles such as insufficient driving force and local planning obstacles. It requires a trade-off of interests among different groups. Therefore, it is necessary to communicate among multiple fields, groups, and departments to develop a more feasible and targeted strategy for optimizing child-friendly public spaces in communities.

Suggestions for Further Research

(1) Research on the usage of community public spaces supported by new technologies. With the continuous development of big data and the improvement of government data statistics, the study of the usage characteristics and mobility patterns of children in public spaces will be more convenient in terms of technological operations in the future. This will enable us to accurately summarize the usage characteristics of children in community public spaces, and therefore, more quickly and accurately identify problems in public spaces, in order to do better in subsequent updates and renovations.

(2) Expand the sample size of research on community public spaces. Through extensive research on community public spaces of different types, different ages, and different regions, we can conduct in-depth comparative analysis and propose more targeted strategies for optimizing community public spaces to be more child-friendly.

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Appendix I: Research Questionnaire I

Survey on Evaluation Factors of Child-Friendly Community Public Spaces

Dear parents,

I am a master's student from the School of Architecture at South China University of Technology. I am currently conducting a survey for my graduation thesis on child-friendly communities. This questionnaire is completely anonymous and does not involve any of your personal information. All responses will be used for academic research purposes only. Thank you very much for your understanding and support.

I Diversity

1. Spatial diversity: The space is diverse and rich in form, size, and static and dynamic attributes, allowing for different amounts and types of activities to occur

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

2. Variety of activities: Spatial elements encourage and stimulate a variety of children's play, including social and physical play, formal and informal play

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

3. Variety of ages: public spaces allow children and adults of all ages to gather for activities

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

4. Variety of facilities: Different kinds of play facilities are available

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

5. Cultural diversity: Respect for cultural diversity, with cultural or festivals and events in which children participate

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

II Accessibility

6. Balanced spatial distribution

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

7. No need to cross complicated traffic environments such as urban arteries

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

8. There are paths and signage systems for children only

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

9. Roads and spaces with barrier-free design

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

10. Short walking time

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

11. Space entrance is eye-catching and easy to enter

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

III Safety

12. Space safety: children's activity space without sharp edges and angles, with elastic protection layer to prevent fall damage

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

13. Space boundary: the space has a certain boundary, and vehicles cannot enter directly

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

14. Visual penetration: The play space has good visual penetration, which enables adults to effectively supervise children's play behavior.

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

15. Neighborhood surveillance: residents should be able to overlook the shared space between residential buildings and monitor them

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

16. Mixed-age coexistence: provide places where adults can rest and observe their children at play

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

17. Neighborhood solidarity: If children are out of the house and in danger or in danger, someone will be there to help them

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

18. Site safety: keep the site away from traffic and keep the area frequented by children and youth away from heavy traffic

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

19. Path safety: to ensure that children's daily routes have easy to identify, to ensure the safety of children signs

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

20. Facility safety: children's activity space with security facilities (such as monitoring,

lighting facilities, guidance facilities, etc.)

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

21. Surrounding environment: There are no toxic and harmful stimulating substances or pollution sources around

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

22. Medical configuration: there are clinics, hospitals, etc., with emergency care facilities

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

23. Management and operation: management and maintenance personnel should have knowledge related to children, regular maintenance of the playground and facilities

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

24. Policies and education: policies and education are also provided to improve children's safety awareness

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

IV Comfort

25. Adequate space and facilities for rest and play

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

26. Space and facilities conform to children's physiological scale

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

27. Good lighting and ventilation conditions, with shade in summer

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

28. There are seats for parents to rest

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

29. Spatial elements such as colors and shapes are in line with children's psychological characteristics

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

30. A certain division between the activity area and rest area in the space

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

31. Adequate toilets, trash cans, etc.

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

32. Space and facilities are regularly cleaned by maintenance staff

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

V Naturalness

33. Provide a variety of opportunities for sensory stimulation of nature, from the natural environment around them to the natural environment, and provide spatial conditions for activities, such as vegetation, sand, water and other natural elements

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

34. Children can enter the community garden and participate in nature-related activities such as planting, caring for and picking flowers and vegetables

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

35. Plants change significantly from season to season

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

VI Participation

36. Children can participate in the planning and design process of neighborhood space development

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

37. The community actively organizes various community festivals and intergenerational activities to promote children's participation and intergenerational communication

☐ Very important ☐ Somewhat important ☐ Neutral

☐ Somewhat unimportant ☐ Very unimportant

Appendix II: Research Questionnaire II

Child-friendly evaluation factors-pairwise comparison matrix

Dear teacher,

I am a master's student from the School of Architecture at South China University of Technology. I am currently conducting a survey for my graduation thesis on child-friendly communities. This questionnaire is completely anonymous and does not involve any of your personal information. All responses will be used for academic research purposes only. Thank you very much for your understanding and support.

Explanation of pairwise comparison matrix scores: 1 equally important, 3 somewhat important, 5 significantly important, 7 strongly important, 9 extremely important, and the median scores of 2, 4, 6, 8.

1. What is your identity?

○ Student

○ University teacher

○ Designer

2. What is your field of work?

○ Urban planning and design

○ Architectural design

○ Children's education

3. What is your academic degree?

○ Bachelor

○ Master

○ Ph.D.

4. Criterion

Diversity	○9	○7	○5	○3	○1	○3	○5	○7	○9	Accessibility

5. Criterion

Diversity	○9	○7	○5	○3	○1	○3	○5	○7	○9	Safety

6. Criterion

Diversity	○9	○7	○5	○3	○1	○3	○5	○7	○9	Comfort

7. Criterion

Diversity	○9	○7	○5	○3	○1	○3	○5	○7	○9	Naturalness

8. Criterion

Diversity	○9	○7	○5	○3	○1	○3	○5	○7	○9	Participation

9. Criterion

Accessibility	○9	○7	○5	○3	○1	○3	○5	○7	○9	Safety

10. Criterion

Accessibility	○9	○7	○5	○3	○1	○3	○5	○7	○9	Comfort

11. Criterion

Accessibility	○9	○7	○5	○3	○1	○3	○5	○7	○9	Naturalness

12. Criterion

Accessi	○9	○7	○5	○3	○1	○3	○5	○7	○9	Particip

bility									ation

13. Criterion

Safety	○9	○7	○5	○3	○1	○3	○5	○7	○9	Comfor t

14. Criterion

Safety	○9	○7	○5	○3	○1	○3	○5	○7	○9	Natural ness

15. Criterion

Safety	○9	○7	○5	○3	○1	○3	○5	○7	○9	Particip ation

16. Criterion

Safety	○9	○7	○5	○3	○1	○3	○5	○7	○9	Natural ness

17. Criterion

Safety	○9	○7	○5	○3	○1	○3	○5	○7	○9	Particip ation

18. Criterion

Natural ness	○9	○7	○5	○3	○1	○3	○5	○7	○9	Particip ation

19. Sub-Criterion:Diversity

C1 Spatial diversity: The space is rich in variety of forms, sizes, and dynamic and static properties

C2 Activity diversity: the space allows and stimulates a variety of children's activities

C1	○9	○7	○5	○3	○1	○3	○5	○7	○9	C2

20. Sub-Criterion:Diversity

C1 Spatial diversity: The space is rich in variety of forms, sizes, and dynamic and static properties

C3 Facilitiy Diversity: different kinds of play facilities are available

C1 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C2

21. Sub-Criterion:Diversity

C2 Activity diversity: the space allows and stimulates a variety of children's activities

C3 Facilitiy Diversity: different kinds of play facilities are available

C2 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C3

22. Sub-Criterion:Accesibility

C4 Walking time: short walking time

C5 Walking environment: no need to cross city arteries and other complex traffic environments

C4 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C5

23. Sub-Criterion:Accesibility

C4 Walking time: short walking time

C6 Walking route: there are paths and signage systems exclusive to children

C4 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C6

24. Sub-Criterion:Accesibility

C5 Walking environment: no need to cross city arteries and other complex traffic environments

C6 Walking route: there are paths and signage systems exclusive to children

C5 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C6

25. Sub-Criterion:Safety

C7 Space safety: children's activity space without sharp edges and angles, with a flexible protective layer

C8 Boundary safety: the space has a certain boundary, and vehicles cannot enter directly

C7 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C8

26. Sub-Criterion:Safety

C7 Space safety: children's activity space without sharp edges and angles, with a flexible protective layer

C9 Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources

C7 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C9

27. Sub-Criterion:Safety

C7 Space safety: children's activity space without sharp edges and angles, with a flexible protective layer

C10 Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)

C7 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C10

28. Sub-Criterion:Safety

C7 Space safety: children's activity space without sharp edges and angles, with a flexible protective layer

C11 Surveillance safety: children's activity space has a good line of sight penetration and parental observation area

C7 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C11

29. Sub-Criterion:Safety

C7 Space safety: children's activity space without sharp edges and angles, with a flexible protective layer

C12 Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety

C7 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C12

30. Sub-Criterion:Safety

C7 Space safety: children's activity space without sharp edges and angles, with a flexible protective layer

C13 Configuration safety: there are clinics, hospitals, etc., and emergency care facilities

C7 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C13

31. Sub-Criterion:Safety

C7 Space safety: children's activity space without sharp edges and angles, with a flexible protective layer

C14 Operation safety: Management and maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities

C7 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C14

32. Sub-Criterion:Safety

C7 Space safety: children's activity space without sharp edges and angles, with a flexible protective layer

C15 Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents

C7 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C15

33. Sub-Criterion:Safety

C7 Space safety: children's activity space without sharp edges and angles, with a flexible protective layer

C16 Policy and education: Policy and education are also provided to enhance children's safety awareness

C7 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C16

34. Sub-Criterion:Safety

C8 Boundary safety: the space has a certain boundary, and vehicles cannot enter directly

C9 Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources

C8 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C9

35. Sub-Criterion:Safety

C8 Boundary safety: the space has a certain boundary, and vehicles cannot enter directly

C10 Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)

C8 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C10

36. Sub-Criterion:Safety

C8 Boundary safety: the space has a certain boundary, and vehicles cannot enter directly

C11 Surveillance safety: children's activity space has a good line of sight penetration and parental observation area

C8 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C11

37. Sub-Criterion:Safety

C8 Boundary safety: the space has a certain boundary, and vehicles cannot enter directly

C12 Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety

C8 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C12

38. Sub-Criterion:Safety

C8 Boundary safety: the space has a certain boundary, and vehicles cannot enter directly

C13 Configuration safety: there are clinics, hospitals, etc., and emergency care facilities

C8 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C13

39. Sub-Criterion:Safety

C8 Boundary safety: the space has a certain boundary, and vehicles cannot enter directly

C14 Operation safety: Management and maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities

C8 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C14

40. Sub-Criterion:Safety

C8 Boundary safety: the space has a certain boundary, and vehicles cannot enter directly

C15 Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents

C8 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C15

41. Sub-Criterion:Safety

C8 Boundary safety: the space has a certain boundary, and vehicles cannot enter directly

C16 Policy and education: Policy and education are also provided to enhance children's safety awareness

C8 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C16

42. Sub-Criterion:Safety

C9 Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources

C10 Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)

C9 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C10

43. Sub-Criterion:Safety

C9 Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources

C11 Surveillance safety: children's activity space has a good line of sight penetration and parental observation area

C9 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C11

44. Sub-Criterion:Safety

C9 Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources

C12 Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety

C9 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C12

45. Sub-Criterion:Safety

C9 Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources

C13 Configuration safety: there are clinics, hospitals, etc., and emergency care facilities

C9 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C13

46. Sub-Criterion:Safety

C9 Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources

C14 Operation safety: Management and maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities

C9 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C14

47. Sub-Criterion:Safety

C9 Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources

C15 Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents

C9 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C15

48. Sub-Criterion:Safety

C9 Site safety: the site is far from traffic arteries or toxic and harmful stimulating substances and pollution sources

C16 Policy and education: Policy and education are also provided to enhance children's safety awareness

C9 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C16

49. Sub-Criterion:Safety

C10 Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)

C11 Surveillance safety: children's activity space has a good line of sight penetration and parental observation area

C10 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C11

50. Sub-Criterion:Safety

C10 Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)

C12 Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety

C10 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C12

51. Sub-Criterion:Safety

C10 Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)

C13 Configuration safety: there are clinics, hospitals, etc., and emergency care facilities

C10 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C13

52. Sub-Criterion:Safety

C10 Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)

C14 Operation safety: Management and maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities

C10 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C14

53. Sub-Criterion:Safety

C10 Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)

C15 Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents

C10 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C15

54. Sub-Criterion:Safety

C10 Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)

C16 Policy and education: Policy and education are also provided to enhance children's safety awareness

C10 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C16

55. Sub-Criterion:Safety

C11 Surveillance safety: children's activity space has a good line of sight penetration and parental observation area

C12 Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety

C11 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C12

56. Sub-Criterion:Safety

C11 Surveillance safety: children's activity space has a good line of sight penetration and parental observation area

C13 Configuration safety: there are clinics, hospitals, etc., and emergency care facilities

C11 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C13

57. Sub-Criterion:Safety

C11 Surveillance safety: children's activity space has a good line of sight penetration and parental observation area

C14 Operation safety: Management and maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities

C11 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C14

58. Sub-Criterion:Safety

C11 Surveillance safety: children's activity space has a good line of sight penetration and parental observation area

C15 Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents

C11 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C15

59. Sub-Criterion:Safety

C11 Surveillance safety: children's activity space has a good line of sight penetration and parental observation area

C16 Policy and education: Policy and education are also provided to enhance children's safety awareness

C11 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C16

60. Sub-Criterion:Safety

C12 Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety

C13 Configuration safety: there are clinics, hospitals, etc., and emergency care facilities

C12 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C13

61. Sub-Criterion:Safety

C12 Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety

C14 Operation safety: Management and maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities

C12 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C14

62. Sub-Criterion:Safety

C12 Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety

C15 Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents

C12 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C15

63. Sub-Criterion:Safety

C12 Route safety: children's daily routes are easily identifiable and have signs to ensure children's safety

C16 Policy and education: Policy and education are also provided to enhance children's safety awareness

C12 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C16

64. Sub-Criterion:Safety

C13 Configuration safety: there are clinics, hospitals, etc., and emergency care facilities

C14 Operation safety: Management and maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities

C13 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C14

65. Sub-Criterion:Safety

C13 Configuration safety: there are clinics, hospitals, etc., and emergency care facilities

C15 Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents

C13 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C15

66. Sub-Criterion:Safety

C13 Configuration safety: there are clinics, hospitals, etc., and emergency care facilities

C16 Policy and education: Policy and education are also provided to enhance children's safety awareness

C13 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C16

67. Sub-Criterion:Safety

C14 Operation safety: Management and maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities

C15 Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents

C14 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C15

68. Sub-Criterion:Safety

C14 Operation safety: Management and maintenance personnel should have knowledge related to children, and regular maintenance of playgrounds and facilities

C16 Policy and education: Policy and education are also provided to enhance children's safety awareness

C14 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C16

69. Sub-Criterion:Safety

C15 Neighborhood safety: Harmonious neighborhood relations, children can seek help from community residents

C16 Policy and education: Policy and education are also provided to enhance children's safety awareness

C15 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C16

70. Sub-Criterion:Comfort

C17 Adequate and good quality space and facilities for recreation and play

C18 Adequate and good quality of supporting facilities (toilets, trash cans, etc.)

C17 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C18

71. Sub-Criterion:Comfort

C17 Adequate and good quality space and facilities for recreation and play

C19 Space, facilities, colors and elements conform to children's physiological scale and psychological characteristics

C17 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C19

72. Sub-Criterion:Comfort

C17 Adequate and good quality space and facilities for recreation and play

C20 Good lighting, ventilation and natural conditions

C17 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C20

73. Sub-Criterion:Comfort

C18 Adequate and good quality of supporting facilities (toilets, trash cans, etc.)

C19 Space, facilities, colors and elements conform to children's physiological scale and psychological characteristics

C18 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C19

74. Sub-Criterion:Comfort

C18 Adequate and good quality of supporting facilities (toilets, trash cans, etc.)

C20 Good lighting, ventilation and natural conditions

C18 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C20

75. Sub-Criterion:Comfort

C19 Space, facilities, colors and elements conform to children's physiological scale and psychological characteristics

C20 Good lighting, ventilation and natural conditions

C19 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C20

76. Sub-Criterion:Naturalness

C21 Space natural coverage situation

C22 Children can contact nature and participate in nature-related activities

C21 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C22

77. Sub-Criterion:Participation

C23 Children can participate in the planning and design process of neighborhood space development

C24 The community actively organizes activities to promote children's participation and intergenerational communication

C23 ○9 ○7 ○5 ○3 ○1 ○3 ○5 ○7 ○9 C24

Appendix III: Research Questionnaire III

Survey questionnaire on evaluating child-friendliness of public spaces in the Liuyun community

Dear parents,

I am a master's student from the School of Architecture at South China University of Technology. I am currently conducting a survey for my graduation thesis on child-friendly communities. This questionnaire is completely anonymous and does not involve any of your personal information. All responses will be used for academic research purposes only. Thank you very much for your understanding and support.

I Diversity

38. Spatial diversity: The space is diverse and rich in form, size, and static and dynamic attributes, allowing for different amounts and types of activities to occur

☐Extremely rich ☐Quite rich ☐Average ☐Not rich ☐Not at all rich

39. Variety of activities: Spatial elements encourage and stimulate a variety of children's play, including social and physical play, formal and informal play

☐Extremely rich ☐Quite rich ☐Average ☐Not rich ☐Not at all rich

II Safety

40. Facility safety: children's activity space with security facilities (such as monitoring, lighting facilities, guidance facilities, etc.)

☐Extremely safe ☐Very safe ☐Average ☐ Not very safe ☐Not at all safe

41. Visual penetration: The play space has good visual penetration, which enables adults to effectively supervise children's play behavior.

☐Over 80% ☐60%~80% ☐ 40%~60% ☐20%~40% ☐Below 20%

42. Management and operation: management and maintenance personnel should have knowledge related to children, regular maintenance of the playground and facilities

☐ Completely sufficient ☐ Basically sufficient ☐ Average

☐ Not quite sufficient ☐ Not at all sufficient

43. Neighborhood solidarity: If children are out of the house and in danger or in danger, someone will be there to help them

☐ Completely satisfied ☐ Basically satisfied ☐ Average

☐ Basically dissatisfied ☐ Completely dissatisfied

44. Policies and education: policies and education are also provided to improve children's safety awareness

☐ Completely sufficient ☐ Basically sufficient ☐ Average

☐ Not quite sufficient ☐ Not at all sufficient

III Comfort

45. Adequate space and facilities for rest and play

☐ Satisfied ☐ Somewhat satisfied ☐ Average

☐ Somewhat dissatisfied ☐ Dissatisfied

46. Spatial elements such as colors and shapes are in line with children's psychological characteristics

☐ Completely satisfied ☐ Basically satisfied ☐ Average

☐ Basically dissatisfied ☐ Completely dissatisfied

47. Good lighting and ventilation conditions, with shade in summer

☐ Good ☐ Fairly good ☐ Average ☐ Poor ☐ Bad

IV Naturalness

48. Provide a variety of opportunities for sensory stimulation of nature, from the natural environment around them to the natural environment, and provide spatial conditions for activities, such as vegetation, sand, water and other natural elements

☐ High ☐ Somewhat high ☐ Average ☐ Somewhat low ☐ Low

49. Children can enter the community garden and participate in nature-related activities such

as planting, caring for and picking flowers and vegetables

☐ High ☐ Somewhat high ☐ Average ☐ Somewhat low ☐ Low

V Participation

50. Children can participate in the planning and design process of neighborhood space development

☐ Frequently participate ☐ Participate more often ☐ Average

☐ Participate less often ☐ Never participate

51. The community actively organizes various community festivals and intergenerational activities to promote children's participation and intergenerational communication

☐ Frequently participate ☐ Participate more often ☐ Average

☐ Participate less often ☐ Never participate

Appendix IV: Research Questionnaire IV

Research Survey on Child-Friendly Community Public Spaces (Additional Version)

Dear parents,

Hello, I am a graduate student from the School of Architecture at South China University of Technology. I am currently working on a thesis related to child-friendly public spaces and would like to distribute this survey to you. This survey is completely anonymous and does not involve your privacy. All content is for academic research purposes. Thank you very much for your understanding and support.

1. What is the gender of your child?

☐ Boy

☐ Girl

2. How old is your child?

☐ 0-3 years old

☐ 4-6 years old

☐ 7-12 years old

☐ 13-15 years old

3. How long do you usually let your child play outside?

☐ Within half an hour

☐ Half an hour to one hour

☐ One to two hours

☐ More than two hours

4. How many times does your child engage in outdoor activities per week?

☐ 1-2 times

☐ 3-4 times

☐ More than 5 times

☐ Other

5. What type of outdoor activities does your child enjoy? (Multiple choices)

☐ Fitness equipment (fitness equipment, swings, slides, etc.)

☐ Transportation (scooters, rollerblades, bicycles, etc.)

☐ Sports (basketball, badminton, rock climbing, etc.)

☐ Role-playing (playing house, hide-and-seek, etc.)

☐ Observation (observing plants, small animals, etc.)

☐ Spectator (watching other children play games)

☐ Other

6. What is your biggest concern about your child playing alone in the community? (Choose up to three)

☐ Traffic safety

☐ Public health

☐ Safety issues with activity facilities

☐ Being taken away by strangers

☐ Being bullied by other children

☐ Getting lost

攻读硕士学位期间取得的研究成果

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

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

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

二、与学位内容相关的其它成果（包括专利、著作、获奖项目等）