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Research on the Conservation and Regeneration of Historic Conservation Area with the Perspective of Italian School's Typo-morphology: A Case Study of Changhua District, Guangzhou

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Research on the Conservation and Regeneration of Historic Conservation Area with the Perspective of Italian School's Typo-morphology: A Case Study of Changhua District, Guangzhou

A Dissertation Submitted for the Degree of Master

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摘要

历史文化街区作为中国城市中最为重要的文化遗产和历史传承的物质载体，其连片的历史风貌时刻向人们展示着城市独有的特色和地域识别性。近年来随着城市化进程的推进， 历史文化街区普遍存在着保护与发展的矛盾，传统与现代的类型和形态变化之间的冲突。一种可以结合中国实际的形态学分析方法亟待出现。而从意大利学派形态类型学是城市形态学三大流派中较为适合应用于城市形态的分析与设计的理论，它不仅可以解释城市形态和建筑类型的演变，最重要的是可以通过理论分析与设计将一个城市的过去、现在和未来联系起来。因此，它可以从形态类型研究的视角为历史文化街区的保护与更新提供理论和方法上的支持。

本文选取广州昌华大街历史文化街区为研究对象。作为广州西关地区新型居住区之一，昌华大街历史文化街区有着特色的空间结构，且街区内建筑形式多样，几乎涵盖了广州近代住宅的全部类型。然而其正面临着街区形态破坏、居住环境无法适应现代生活等问题，如何运用意大利学派形态类型学方法发掘其类型与形态的特色及多元价值，并对其进行合理的保护与更新，从而继承传统的精华并融入现代的城市生活，是本文研究之重点。

本文首先分析了意大利学派形态类型学的背景与发展脉络，核心的研究内容与研究方法，以及作为关键实践案例的博洛尼亚历史中心保护，总结概括出了基本的理论框架。其次，通过昌华大街历史文化街区的历史文化资源分析和现场调研，梳理出了其与形态类型学相关问题，并结合现有的历史资料对所应用的分析法进行了在地化的调整，建立了适用于本研究的形态类型学研究框架。接着，本文运用调整后的形态类型学方法对昌华大街历史文化街区进行了总体形态演变研究，在此基础上对民国时期和现状的街区进行了详细的建筑调查，绘制了两个时期的地面层平面图，并从单一肌理、街道、地块、建筑与房间、构建与材料 5 个层级对两个时期的地面层平面图进行了分析，获取了各层级形态类型的特征和演变规律。然后，本文利用以上分析成果归纳形成了对街道、地块、建筑三个层级的总体设计及设计指引，在此基础上对街区中的两个典型区域进行了详细设计，验证了意大利学派形态类型学在历史文化街区的保护与更新中从分析到设计的可操作性。最后，对论文进行了反思和总结，并提出了研究中的不足和未来的展望。

关键词：历史文化街区；形态类型学；保护与更新；昌华大街

ABSTRACT

As the most important cultural heritage in Chinese cities, the historical conservation areas with their adjacent historical features have always shown people the unique characteristics of cities. In recent years, with the progress of urbanization, historic conservation areas are generally in a conflict between conservation and development, between traditional and modern types and morphological changes. A morphological analysis method compatible with Chinese reality needs to be urgently developed. The Italian school of typo-morphology is one of the three schools of urban morphology, which is more suitable for the analysis and design of urban morphology. It can not only explain the evolution of urban morphology and building types, but especially link the past, present and future of a city through theoretical analysis and design. Therefore, it can provide theoretical and methodological support for the conservation and regeneration of historical conservation areas from the perspective of typo-morphology.

This study chooses the Changhua historic conservation area in Guangzhou as the research object. As one of the new residential areas in Xiguan area, Changhua historic conservation area has a characteristic spatial structure and a variety of building types in the district, which include almost all types of modern housing in Guangzhou. However, Changhua district faces the problems that the damage of the district morphology and the residential environment could not be adapted to modern life. The focus of this study is to explore the characteristics and multiple values of the typology and morphology of the district by applying the Italian school of typo-morphology, and to conserve and regenerate them to inherit the essence of tradition and integrate them into modern urban life.

This paper first analyzes the background and development of the Italian school of typo-morphology, the research content and research approach, and the conservation of the historic center of Bologna as a key practical case, and summarizes the basic theoretical framework. Secondly, through the overview of Changhua district, the issues

related to Changhua district and typo-morphology are clarified, and the research framework of typo-morphology for Changhua district is established by combining the historical information and adjusting the research hierarchy. Then, this paper conducts a general analysis of the morphological evolution of Changhua district according to the adapted research framework, based on which building surveys are carried out in the Republican district and the present district. The ground floor plans of the two periods are analyzed at five levels: simple tissue, streets, plots, buildings and rooms, and structures and materials, and the typo-morphological characteristics and evolution rules of each level are identified. Then, based on the above analysis, this study proposes the general design and design guidelines for the three levels of streets, plots and buildings, and on this basis, specific designs for two typical areas of the district are carried out, verifying the viability of the Italian school of typo-morphology from the analysis to the design. Finally, the study reflects and summarizes the thesis, and put forward the shortcomings of the research.

Keywords: Historic conservation area; Typo-morphology; Conservation and regeneration; Changhua district

CONTENTS

CHAPTER 1: INTRODUCTION

1.1 Research background

As the central embodiment of the origin and development of human civilization, the city can also be considered an organism like the human body: Its skeleton is urban architecture, its lifeblood is urban traffic, and human life is the soul and meaning of the city. The renewal and iteration of any organism in the city is the inevitable process of its metabolism. Therefore, with the development of urban civilization, the preservation and renewal of the historic conservation area, which is the most important cultural heritage and material carrier of historical heritage in Chinese cities, has become an eternal concern of people.

1.1.1 Urgency of conservation & regeneration of historic conservation areas

Since the reform and opening up, the urbanization process in China has progressed rapidly, and a large number of cities have developed rapidly, which can be seen in the improvement of infrastructure, the expansion of urban area and the improvement of functional structures. However, the large-scale urban construction activities have consumed the historic conservation area that has been gradually formed over a long period of time. In recent years, the adjustment of China's industrial structure and the change in consumption tendency have led urban development and urban planning to enter a new phase, from the phase of gradual expansion, which emphasized size, to the phase of stock planning, which emphasized quality.

Overall, China's urban historical conservation has gone through a process of moving from the partial to the whole, from the individual historic building to historic conservation area, forming a multi-level historic heritage protection system with historical conservation area as the center. The relevant departments in China have issued a series of laws and regulations, which is a clear sign that the relevant departments have

gradually realized the importance of protecting urban history and are expanding the scope of protection and strengthening protection work. Although China has made some progress in raising awareness and actual conservation of historic conservation areas, it cannot be ignored that the contradiction and conflict between the desire to restore historic buildings and preserve the identity of cities and regions in historic conservation areas and generic modern architecture is still very serious.

1.1.2 The applicability of Italian school's typo-morphology in the conservation and regeneration of historic conservation areas

Many Italian metropolises were more or less damaged after the World War II, and after about a decade of restoration, the historic buildings were revived. The 1950s and 1960s, on the other hand, were a difficult historical period for the historic districts, as the traditional buildings of the metropolises continued to be destroyed and demolished. The great population explosion in the city and the recent industrial and social progress brought many problems. The city had developed to the point where it could no longer be demolished and rebuilt, so in the 1970s Italy began to reconsider the choice of a development approach based on traditions, and the historical remains of the urban and regional environment gradually became visible as a cultural value. Based on this history, there are many similarities between the historical situation in Italy and our general development today: the same reform of the national economic system initiated a rapid socio-economic explosion, industrialization and modernization, and the general environment of the country was constantly changing. Therefore, the context of nature conservation in both countries is very similar, and modern urban problems are also similar. Both the Italian government and historic conservation organizations have developed various conservation principles and transformation methods to ensure the revival of Italian identity and tradition. The Italian school of urban morphology (also known as the typo-morphology school, named after its typological approach to the study of urban morphology) has made an important methodological contribution.

In the broadest sense, there are three main schools of urban morphological research (Figure 1-1), in addition to the Italian school of typo-morphology, the English school of morphogenesis (initiated by the work of M. R. G. Conzen), and the French school of historical morphological analysis (concentrated in the Versailles school)[1]. Each school has a different focus on urban morphology due to their different disciplinary backgrounds: The Italian school was founded by architects, so its approach shows a strong interest in what kind of buildings should be built and how they should be designed in an urban environment where modernity and history are intertwined; the British school was founded by geographers, and its approach is more descriptive and explanatory, interested in developing theories of urbanization; and the French school was somewhere in between and included architects, geographers, historians, and sociologists.

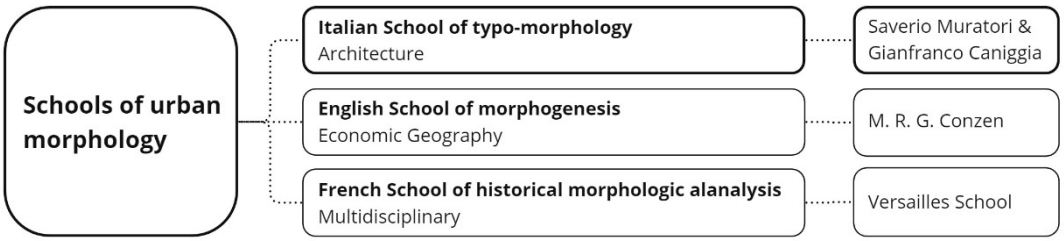


Fig. 1- 1 Schools of urban morphology (Source: by the author)

The Italian school is relatively the most appropriate of the three theories for the conservation and regeneration of historic conservation area. This school, basedon the typology of early 19th century rationalism, was founded in the 1950s by Italian scholar Saverio Muratori and his student and assistant professor Gianfranco Caniggia, who developed his theory and practice into a complete design methodology. Muratori's and Caniggia's goal is not only to study and document the evolution of urban morphology and building typology, but also to explore how the essential features of the existing typology can be carried forward in new urban and architectural projects that are both historically and culturally relevant.

After years of teaching and practice, the Muratori-Caniggia school of typo-morphology

has taken an important place in Western urban studies. It is used not only to understand and analyze the evolutionary process of urban development, but also to guide design and planning practice to link the past, present and future of a city, and can provide new ideas and a solid theoretical basis for the conservation and regeneration of historic conservation areas in China.

1.2 Research object

The research object is located in Liwan District, Guangzhou City, Guangdong Province, China (Figure 1-2), and is the core conservation area of the Changhua historic conservation area (Figure 1-3), which extends from Enning Road to the east, Dobao Road to the north, and Changhua River to the west and south, and has an area of 4.84 hectares. For simplicity, Changhua district is used as the research object.

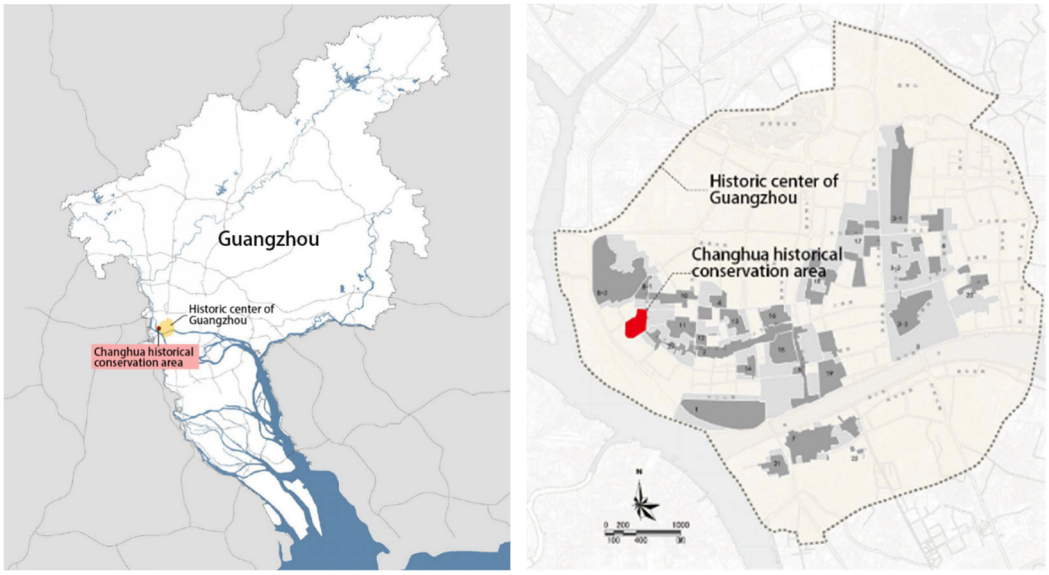


Fig. 1- 2 Location of Changhua district (Source: by the author)

Changhua district is a residential area developed in the late Qing Dynasty and early Republic of China. It is located at the end of Dobao Road in Liwan District, Guangzhou, and is bounded by Dobao Road to the north and Longjin West Road to the east, with the tributaries of the former Lijiwan River (i.e. Changhua River) on the western and southern borders. The word "Changhua" comes from the Liu Palace of the Southern Han Dynasty, one of the Ten Kingdoms of the Five Dynasties at the end of the Tang

Dynasty, which was a watery and idyllic landscape until the 19th century. The construction of Changhua Street began in the late 19th century, when rich merchants and magnates gathered here, and it was the last district to be built in the Xiguan area. Due to the long construction period, Changhua district has formed a spatial structure that is different from other neighborhoods in the Xiguan area. The buildings in Changhua district have various types, including traditional houses from the late Qing Dynasty, western-style houses and modern collection houses. It is called "a living museum of modern housing in Guangzhou". In addition to the many tangible cultural heritages in the district, there are also intangible cultural heritages such as the Cantonese Opera, the revolutionary industrialist Liu Xuexun and other celebrities in Changhua district. However, the unique morphology of Changhua district has been seriously damaged in recent years because many residents has renovated their houses independently and the living environment has not been able to adapt to modern needs.

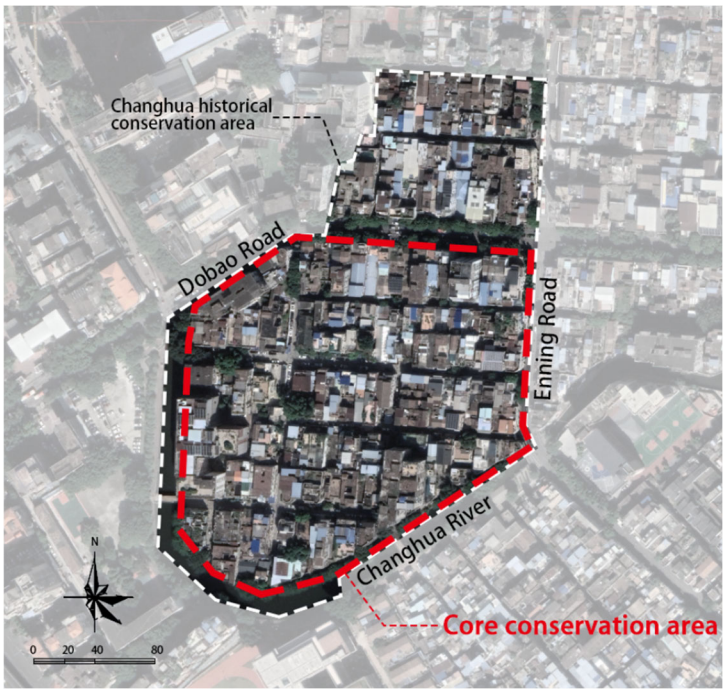


Fig. 1- 3 Satellite map of Changhua district (Source: by the author)

1.3 Review of relevant studies

1.3.1 Studies related to the Muratori-Caniggia school of typo-morphology

（1）International related studies

The Italian school, which grew out of the traditional concept of typology, was extended by Muratori and others to the study of the central areas of historic cities. In his works *Studi per una operante storia urbana di Venezia* and *Studi per una operante storia urbana di Rome*, he developed a method and tools for interpreting the evolution of historic urban buildings and built spaces over time[2]. In 1979 Caniggia and Gian Luigi Maffei published *Composizione architettonica e tipologia edilizia: I Letturadell edilizia di base*[3] and *Composizione architettonica e tipologia edilizia: 2 II progettonell edilizia di base*[4]. He applied the concept of typology within a continuous hierarchy of scales, from small material and buildings to cities and regions, merging new designs at each level with valuable histories as well as existing forms, bridging tradition to modernity, from city to building, an approach also known as design typology.

In 1993, Karl Kropf, Research Fellow in Geography at the University of Birmingham, United Kingdom, completed his doctoral dissertation entitled "*An Enquiry into the Definition of Built Form in Urban Morphology*," in which he made a detailed analysis and comparison of Caniggia and Conzean's method of subdividing the elements of built elements and synthesised, improved, and deepened it. Based on the morphological subdivision and specificity, the analysis method of "morphological zoning" is developed[7].

In 1994, ISUF was founded to provide a platform for all scholars of urban morphology to communicate with each other, break down language barriers, and overcome barriers between schools of thought, ushering in a new phase of comprehensive exchange and integration in the study of urban morphology. *Urban Morphology*, the biannual journal of ISUF, offers a series of articles written in English on the thought and practice of the Muratori-Caniggia school of urban morphology, mainly by Gian Luigi Maffei, Nicola

Marzot, Ivor Samuels, Jeremy Whitehand, Anne Vemez Moudon, such as Giancarlo Cataldi's study *From Muratori to Caniggia: The Origins and Development of the Italian School of design typology*[8] compares the differences in the professional vocabulary of Muratori and Caniggia and summarizes the theoretical contributions of Caniggia. Paolo Vaccaro's study *Saverio Muratori and the Italian School of Planning Typology* systematically illustrates the development of Muratori's school[9].

（2）Domestic related studies

The theory of the Western school of urban morphology was brought to China by Chinese scholars from abroad in the late 1980s and early 1990s. The introduction and reflection on typology increased after the late 1990s, but the focus was mainly on the study of Rossi and the thinking of typology in the field of architectural design, and the study of typological process was very limited. Due to the academic exchange between the British and Italian schools, Chinese and Western scholars will pay attention to the Muratori-Caniggia school when exploring Conzean's theory of urban morphology, but its dissemination is still not fast. With the 16th and 23rd International Seminar on Urban Form held in Guangzhou in September 2009 and Nanjing in July 2016, respectively, domestic scholars began to study Caniggia's theory and try to apply it to the study of traditional Chinese urban forms.

Some of the more representative studies are. Whitehand, Tian Yinsheng and Gu Kai (2008) jointly conducted a study on the historical cities of Guangzhou, analyzing the morphology of traditional building types in the districts and their development process. Chen Fei and Gu Kai (2009) briefly summarize the development, main ideas and research directions of the school of typological morphology in England, France and Italy[10]. Chen Fei (2009), on the other hand, introduces the practice of typological morphology in Chinese urban design[11]. Researchers Chen Jintang and Tian Yinsheng (2015) applied the approach of morphological typology to interpret the external features and internal patterns of the morphological development of Guangzhou's new villages[12]. On this basis, Chen Jintang, Tian Yinsheng and Yao Sheng (2015) explore

the research thinking, analytical framework and local application of morphological typology by summarizing the relevant studies on the theory and application of morphological typology in recent decades in the West[13]. Deng Hao (2015) takes Muratori, the founder of the Muratori-Caniglia school in Italy, as the main object of his study, and systematically describes Muratori's academic career and the theory of "city as organism" in detail[14]. Based on the literature, we found that the research and application of morphological typology in China mainly focuses on theoretical introduction and construction as well as case studies (Figure 1-4).

Year of publication	Authors	Classification	Publications / Papers	Research Content
2008	Chen Fei	①	**Typo-morphology and the Crisis of Chinese Cities**	This paper focuses on the role of typo-morphology based on the dimensions of effective communication, design language, and exploration of culture.
2009	Chen Fei	②	**Preserving the Cultural Identity of Chinese Cities in Urban Design Through a Typo-morphological Approach**	Taking the Suzhou blocks as an example, a morphological typology is used to illustrate its historical evolution. Policy makers and planning use the results of this study as a basis for design recommendations, illustrating the suitability of introducing typo-morphology to urban studies in China.
2009	Chen Fei Ombretta Romice	①	**A new research framework: the application of urban morphological typology in China**	The study is based on Chinese cities, combined with typo-morphology to illustrate the spatial morphological characteristics of Chinese cities, and form a new framework. This framework is in line with the characteristics of Chinese cities and can be used as a basis for urban design management of townscape in China.
2010	Chen Fei	①	**Typo-morphology and Public Participation in China**	This paper illustrates the shortcomings in the design and implementation process and discusses the advantages of the typo-morphology approach in the communication between designers and locals.
2013	Chen Fei Kevin Thwaites	①②③	**Chinese Urban Design: The Typo-morphological Approach**	The evolution of morphology in Chinese and Western cities is summarized, and a new research framework is developed to validate the idea that Chinese cities can introduce the theory of typo-morphology using Nanjing, China as an example.
2014	Tian Yinsheng	①②	**Urban Morphology, Architectural Typology and Cities in Transition**	The role of disciplines such as architectural typology and urban morphology in urban historic preservation is mainly discussed. In addition the study prefocuses on defining the connotations of these disciplines.
2015	Chen Jintang	①	**The Theory and Localization About Typo-morphological Approach**	The development of Western typo-morphology is discussed in terms of theoretical and practical dimensions, and a new theoretical framework is developed, and the process of localizing and developing the theory is discussed.
2015	Tian yinsheng Chen Jintang	①	**The Evolutionary Process About the Form of Jianshe New Village, Guangzhou in the Perspective of the Typomorphology**	In this paper, we analyze the typo-morphology of Jianshe New Village in Guangzhou to obtain the external characteristics and internal patterns of its morphological evolution.

①Theoretical introduction and structure, ②Case study, ③Practice planning

Fig. 1- 4 Development of domestic studies related to the Italian school of typo-morphology (Source: by the author)

Since the research on the Italian school of typo-morphology in China started relatively late, a rich localized research theory has not yet been developed, In particular, there are few cases of typo-morphology research for cities and historic conservation areas. In a way, the independent application of traditional morphological and typological research results can enrich and compensate for the lack of research results in this field.

1.3.2 Studies related to historic conservation areas

（1）International related studies

① Embryonic stage（before 1930s）

As early as Sweden (1630), a professional state authority was established to protect historical and cultural heritage. France (1830) established the first institution for the protection of historical monuments in the country. Greece (1834) enacted a special law for the protection of monuments, the first law for the protection of monuments in the world. At that time, the understanding of "monument protection" in Western countries focused mainly on individual historic buildings, with palaces, churches, bridges and other historic buildings as the main objects of protection, and "static protection" as the main method of protection. In contrast, before the advent of modernism in the 1930s, there were many setbacks in the conservation and regeneration of historic districts.

② Initial stage (1930s to late 1960s)

In 1933, the International Institute of Modern Architecture (CIAM) promulgated the *Athens Charter*, a policy document on urban planning that clarified the importance and basic principles of preserving historic buildings. The International Council on Cultural Heritage (1964) published the *Venice Charter*, which not only extended the scope of historic preservation to historic districts, but also defined specific conservation principles and methods. For the protection of historic sites, countries have proposed relevant laws and regulations, such as the *French Loi Malraux* (1962). In this way, the movement of conservation and regeneration of historic districts has reached a new stage in Western countries.

③ Improving stage (1970s to present)

At the General Conference of UNESCO in Kenya (1976), the *Nairobi Recommendation* was formally adopted, introducing for the first time the concept of "historic areas" and establishing the principle of integrated conservation. The *Recommendation* also addresses specific conservation measures and legislation for historic areas. The *Machu Picchu Charter*, signed in Peru in 1977, emphasizes the importance of preserving the city's historic heritage and expanding the scope of urban historic preservation while preserving its overall cultural tradition. The *Washington Charter* was formally adopted at the (1987) International Conference of Governors of Monuments and Historic Sites. Since the 1990s, more emphasis has been placed on sustainable development in the conservation and regeneration of urban history. Since the 1990s, more emphasis has been placed on the basic concept of sustainable development in the conservation and regeneration of urban historical heritage, and it has received considerable attention from society. The question of how to achieve a certain level of social justice based on the economic decline and recovery in cities has become a greater concern for many researchers, increasing the demand for democratic decision-making procedures and public participation.

In summary, studies and practice of the conservation of historic districts have undergone a long period of development and evolution at the international level. From the initial conservation of valuable works of art to historic buildings, the scope of conservation has been broadened and extended, and eventually the conservation of historic districts and even entire cities has come to the fore. Of course, as theoretical research deepens, practical and effective operational methods should be gradually developed, rather than being limited only to the theoretical aspect of the boundary dogma. So far, the conservation and regeneration of historic districts has entered a virtuous cycle in many developed countries (mainly in Western countries)[15].

（2）Domestic related studies

The theoretical research and practice of historic district conservation in China began

later than in Western countries. However, with the increasing attention paid to historic conservation in China, more and more scholars have begun to study this topic. In this domestic literature review, the author found that research on historic districts is very fruitful. These studies are generally based on urban renewal, dynamic conservation, economic development, and other dimensions.

① Embryonic stage (1950s)

Liang Sicheng was the earliest practitioner of urban historic conservation in China. In his works such as *An Investigation of the Mountain Gate of Guanyin Pavilion in Dule Temple, Jixian County*, he explained in detail and systematically the basic concepts and methods for the conservation of ancient monuments. In the 1950s, together with Chen Zhanxiang, he proposed the "Liang Chen Plan", which became the earliest urban conservation plan in China. The plan was not successfully implemented for various reasons, but it was undeniably the most advanced urban development concept in the world at that time and a visionary urban plan in the history of new Chinese planning.

② Initial stage (1950s to late 1990s)

In the middle of the last century, the situation in the country changed fundamentally and this period can be called the embryonic stage of historical and cultural conservation in China, but the general awareness of the protection and use of ancient cultural relics remained weak. Only when *the Law of the People's Republic of China on the Protection of Cultural Relics* was promulgated in 1982 did China officially begin to work on it. At the same time, *the Law* specified the mechanism of designated "units for the protection of cultural monuments" and established "historical and cultural cities." In 1986, the State Council promulgated the *Announcement of the List of the Second Group of National Historical and Cultural Cities*, which proposed the establishment of "historical and cultural reserves" for the first time, and formulated the relevant regulations for the protection planning of historical and cultural cities. Among the innovative research results of this phase, the theory of organic renewal is the most important. Wu Liangyong (1979) led the relevant staff in the renovation of the Ju'er

Hutong housing project. The project was well received in various fields and is also a successful introduction of the theory of organic renewal in the field of architectural practice. After that, Fang (1999) took Beijing's old residential area as an example and examined the theory of "organic renewal" in depth. Liu Dingwei (1999) examined the renewal strategies and approaches related to this theory using Daqing district as an example.

③ In-depth stage (21st century to present)

The term "historic conservation area" was first officially included in the Law of the People's Republic of China on the Protection of Cultural Relics in 2002. In 2005, the Conservation Plan for Historical and Cultural Cities and the Regulations on the Conservation of Historical and Cultural Cities, Towns and Villages were successively introduced, marking a new progress in the conservation and regeneration of historical districts in China. Among others, scholars Liu Dingwei and Xia Qing (2006) advanced the theory of organic renewal in their research. During this period, many concepts for the conservation of historic districts emerged, such as Li Hui (2003) and Zhou Chang (2004) applied the theory of sustainable development to put forward corresponding proposals for the conservation and regeneration of historic districts; Zheng Lijun (2004) proposed the concept of dynamic conservation of historic districts; Hu Xingxing and Dong Wei (2004) tried to develop the concept of dynamic conservation of historic districts based on the concept of sustainable development. Xuefei Liu (2004) tried to study and prepare conservation plans based on GIS technology in historic districts to illustrate management and conservation control methods. Yang Junyan (2015) proposed a "micro-community" model for the conservation of historic districts.

（3）Studies related to the morphology of historic conservation areas

Currently, there are numerous studies on historic conservation areas in China, which generally focus on conservation planning of historic districts in conjunction with case studies, while relatively little research has been done on analyzing the morphology of districts and their internal economic structures.

In the urban context with Chinese characteristics, the development of conservation research of historic conservation areas includes various aspects. These issues have attracted great academic attention, and more master's and doctoral studies have been conducted to address these very issues. Zhang Mingxin (2007) proposed a rational model for the development of historic districts, affirmed the multiple values of historic heritage, and explained its value and significance based on the economic field, after which he proposed relevant economic theory solutions for the impact of economic aspects on the development of historic districts. Zhou Kebin (2010) takes Guangzhou Xiguan as an example, evaluates the overall appearance of this characteristic street, and specifically makes relevant suggestions[16]. Wu Chun (2010) innovatively discusses the impact of socio-spatial changes on the morphology of the historic district using the morphological changes of the historic district with a sociological dimension and presents a unique perspective. Wang Ling (2011) compared and analyzed the similarities and differences in the control of architectural forms in historic districts at home and abroad, carefully analyzed the factors of architectural forms, and finally put forward corresponding suggestions for control based on the analysis results. Nie Zhen (2005) discusses the application of typological methods in the preservation and renewal of historic districts. In general, the research on conservation and regeneration of historic districts in China is relatively small and still in the stage of primary research. The research in this paper is innovative and can break through the existing research theories and operational methods. Wu Luyin (2008) points out that identifying the "cultural lineage" of a historical neighborhood is the basic starting point for studying its morphological evolution, and on this basis, he analyzes the possible development mode. Yao Sheng (2013) applies the theory of urban morphological regionalization to the conservation planning of Guangzhou's historic districts by delineating the urban morphological areas and the arrangement of a series of morphological elements, and makes suggestions for the conservation planning of the historic districts of the Xiguan area[17]. The analysis summarizes that the original intention of the existing studies

generally stems from the concern about the deteriorating condition of the historic districts. Therefore, it is possible to analyze the historic districts in a more rational way by combining various dimensions such as economic and social interests, specifically discussing the coordination of internal socio-spatial relations based on each dimension, and proposing methods and strategies for preserving the morphology of the historical district.

1.3.3 Studies related to the Changhua historic conservation area

There are few studies on the Changhua historic conservation area in Guangzhou. Only the journal paper *From the Rural To the City: Space Production and Construction Evolution of Guangzhou Changhua Street* published by Peng Changxin and Zhou Xiaojuan from the South China University of Technology refers to it. The method compares the formation and construction history of Changhua district, studies the spatial structure and street tissue of the district from the perspective of the city, and concisely examines the evolution of residential buildings, building forms and decoration characteristics of Changhua district from the perspective of building typology. Although the research perspectives are different, since his work also includes historical contexts and building typology, it has some reference value for this work to study Changhua district from the perspective of the Italian Muratori-Caniggia school of typo-morphology.

1.4 Research significance

Theoretical significance: Although the theoretical system of the Italian Muratori-Caniggia school of typo-morphology is relatively well developed, there are certain limitations. After all, these research theories are based on the urban planning backgrounds and research traditions of developed European countries, and it is a big problem to adapt them to the actual situation in China when they are used to study regions with very different cultural backgrounds. With this study, the author hopes to improve the adaptability of the traditional research theories of urban typo-morphology

to a certain extent and explore the appropriate methods for interpreting and representing the morphology and typology of the historic conservation area of Changhua Street in Guangzhou by relying on and optimizing the Italian typo-morphology methodology.

Practical significance: the way the city is observed and interpreted determines the future methods of urban design and management. The starting point and aim of this study is to provide some cognitive foundations and methodological guidance for the process of conservation and regeneration of the Changhua district in Guangzhou based on the results of Italian school's typo-morphological analysis and adaptability research.

1.5 Research methodology and framework

Theoretical arrangement: by using and optimizing the relevant theoretical approaches developed in the context of similar developments in Italy, a basic methodological system for understanding and interpreting the historic conservation area is created.

Case study: interpret the construction background, renewal model and supporting policies of relevant domestic and foreign cases, and provide reference values for Changhua district.

Historical information search: to understand the historical evolution of Changhua district and the Xiguan area in Guangzhou, to learn from the past and clarify the characteristics and evolution of typo-morphology of Changhua district.

Site surveys: including architectural mapping and interviewing residents, to fully understand the material remains and needs of Changhua district residents, and to establish the relationship between abstract drawings and real scenes.

Typo-morphological analysis: It is a comprehensive presentation of the historical information and site surveys. Through the evolution of streets and plots, and the generalization of building types and structures, the Changhua district is interpreted and

represented at different levels.

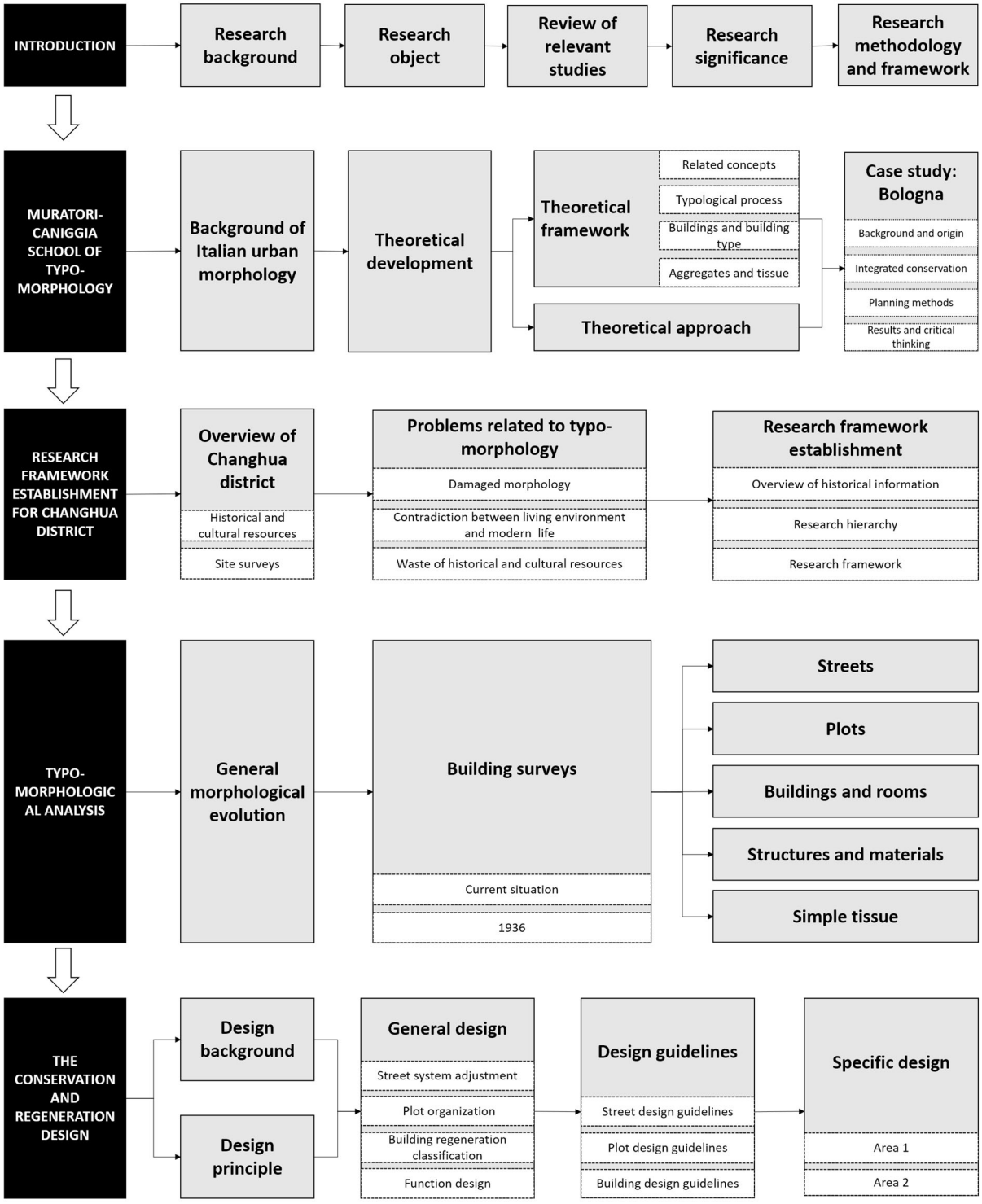


Fig. 1- 5 Research framework (Source: by the author)

CHAPTER 2: MURATORI-CANIGGIA SCHOOL OF TYPO-MORPHOLOGY

European cities underwent massive urban transformation and construction after the two World Wars, especially in the 1950s and 1960s. The rapid economic development and population boom brought about massive urban construction activities and intensified land use in the central areas, which once brought prosperity to the cities, but soon emerged in sharp contradiction with the historical centers of the towns. All these questions and discussions led to a reflection on the relationship between the long history of traditional towns and their future development, and in this context Muratori and Caniggia established a complete methodological system of urban research to design based on the Italian typological research tradition and the concept of typology. This school focuses on the historical evolution of cities and architecture and the motivations behind them, developing a theoretical approach that starts from history and points to the future.

This chapter firstly analyzes the background and theoretical development of the Italian Muratori-Caniggia school of typo-morphology, then describes the main theoretical structure and approach, and its key case study the conservation of the historic center of Bologna, and sorts out the basic research framework of this theory from analysis to design.

2.1 Background of Italian urban morphology

Among several schools of urban morphological research with different perspectives (e.g., Figure 2-1), the Italian morphological research tradition has always recognized a strong link between tradition and change, and various researchers of this school have been interested in the question of morphological evolution over a long historical process. They have recognized the link between tradition and change and argued that there is an evolution and transition between pre-industrial urban morphology and

modern urban morphology, which provides a solid basis for typological research. Therefore, the Italian school of urban morphology can also be called Italian school of typo-morphology[9].

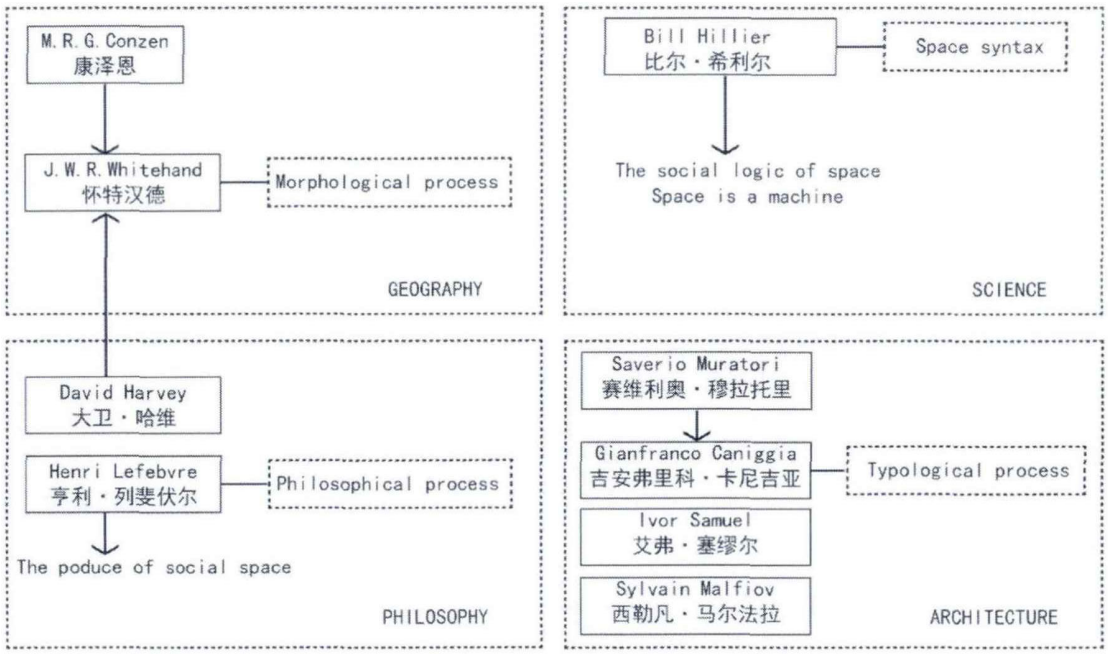


Fig. 2- 1 A Genealogy of Urban Morphology Research from Different Perspectives
（Source：Yina Sima, D Zhang. Comparative Precedents on the Study of Urban Morphology[J]. TRITA-ARK-Forskningspublikation, 2009: 1-8）

In the 1940s, Muratori analyzed traditional Italian urbanism and used this analysis as a basis for design theory, founding the Italian school of urban morphology. Her detailed analysis of architecture and its associated spaces, from their original state to their various variations throughout history, has had a great influence on Italian design theory and practice. The theoretical approach of the school was developed based on the dialectical relationship between complementary, supplementary and reversible elements in the study of historical typologies and the different phases of design development. In order to understand the theoretical background and the main theoretical contributions of Muratoni-Caniggia, this paper explains the background of the theoretical formation of the Italian School of urban morphology in terms of the social context of the 1920s to 1940s and the explorations of architects.

2.1.1 Social background

The theory of Italian urban morphology emerged in the period between the two World Wars. During this time, the Italian nation was in decline, the economy was in recession, and the fascist totalitarian government was committed to military construction and the building of a "new Rome." The debate over form and function meant that form, which had long held a central position in architecture, was giving way to function, and the aesthetics of the machine were in full swing. In Italy, on the other hand, modernism was developing into a modest improvement, with the link to classical tradition still present in the minds of architects.

The "twenty-year armistice" of 1920-1940 was a chaotic and frustrating time. The population losses of the war and the economic devastation, disease, famine, and shortages caused a rapid decline in world industrial production and slowed the growth of the entire European economy. After the war, Italy was saddled with a heavy war debt, and by 1920 its per capita income was probably only as high as that of Britain and the United States in the early 19th century and of France in the decades that followed. When Mussolini came to power, he pushed Italy to the forefront of the war. He believed in force and conquest and was eager to expand Italian territory. Fascism emphasized modernization, science, and speed, but the enormous military expenditures under Fascist power made Italy even weaker in the 1930s.

Similar to the central governments in Soviet Russia and Germany, the Italian central governments that came to power during the two world wars largely focused on invoking past architectural traditions to reinforce their respective nationalist sentiments, calling for the salvation of that nostalgic position that was not native to fragmented modern civilization. In order to maintain their dominance, the image of the former empire had to be used to meet the expectations of the contemporary population and find a broader resonance[18].

In the 1920s and 1930s, architectural thought flourished in Italy. Architects sought

complex and subtle connections to official cultural policy in a variety of ways, and some of them even received official recognition on occasion. Mussolini took a keen interest in urban planning and made ancient Rome his stage at will, free of constitutional constraints. For the architecture of centralism was not clearly defined, nor was there a single recognised style. The Fascist rulers skillfully manipulated the hard-fought architects, giving preference to projects that proclaimed the national mission of the Fascist party, while at the same time quite practically awarding various tasks to modernist or academic architects, or even eclectic architects.

Against this background, the modernist movement became embroiled in the contradictions of fascism in Italy, but nevertheless developed in parallel with classicism. Influenced by Italy's long architectural tradition and building achievements, the modernist architectural movement had the interesting characteristic of minimising the "functionalist" and "machine-age" viewpoint and replacing it with an abstract aesthetic intended to recall the classical models of classicism. The abstract aesthetic was intended to evoke the classical precedents of classicism. At that time, architecture was considered a language, and attention was generally paid to its symbolism. Both symbolic expressions derived from the traditional simplification of the composition of walls, arches, columns and pilasters, and very modern expressions: horizontal lines, transparent skins, dynamic spaces, etc. were shown in the operation. The architects believe that this historical awareness opens p new possibilities for the modern tradition, so that the concrete framework system of modern architecture and the basic features of the classical building system can support each other on a deeper, more abstract level. "The spirit of tradition is deeply rooted, and the new architecture unconsciously preserves the national identity ... so that tradition does not disappear, but only changes its appearance." Guided by this awareness, Italian architects reintroduced the question of architectural form in conjunction with contemporary social, historical, cultural, and psychological theoretical ideas to the centre of architectural theory, opposing it to pure functionalism. The "ca' brutta" and Meridiana apartments designed by Giovanni Muzio,

the Bank of Italy building by Marcello Piacentini and the Novocomum on the lake by Giuseppe Terragni were created during this period. The apartments "ca' brutta" and Meridiana designed by Giovanni Muzio, the building of the Bank of Italy designed by Marcello Piacentini, the Novocomum apartments on the lake designed by Giuseppe Terragni and Palazzo Fascia in Como.

2.1.2 Academic Background

In 1925, Mussolini's government introduced an urban policy to encourage the development of construction, which laid the foundation for the country's subsequent large-scale urban regeneration and public works. The result of this initiative was twofold: on the one hand, the transformation of the historic centers of traditional cities for conjectural purposes and, on the other, the development of suburban and rural housing[19]. The results of these two aspects contributed to the Italian architects' preoccupation with historical urban centers and rural architecture, in particular Giuseppe Pagano with his study of rural architecture and Gustavo Giovannoni with his study of historical centers. Giovannoni's student Muratori, in turn, later established the framework for typo-morphology and, with his student and assistant professor Caniggia, undertook more far-reaching studies on the definition of typology, the typological process, and the development of urban morphology.

The rationalist Giuseppe Pagano was editor-in-chief of *Casabella* in the 1930s and, together with his colleague Edoartlo Persico, dominated the development of the magazine until 1943. To illustrate the similarities between the local Mediterranean tradition and the new international style from a historical and territorial point of view, and to avoid attacks from conservatives, Pagano began to study rural aggregates. Corresponding articles appeared frequently in *Casabella*, with many of the case photographs taken by Pagano himself[20] (e.g., Figure 2-2).

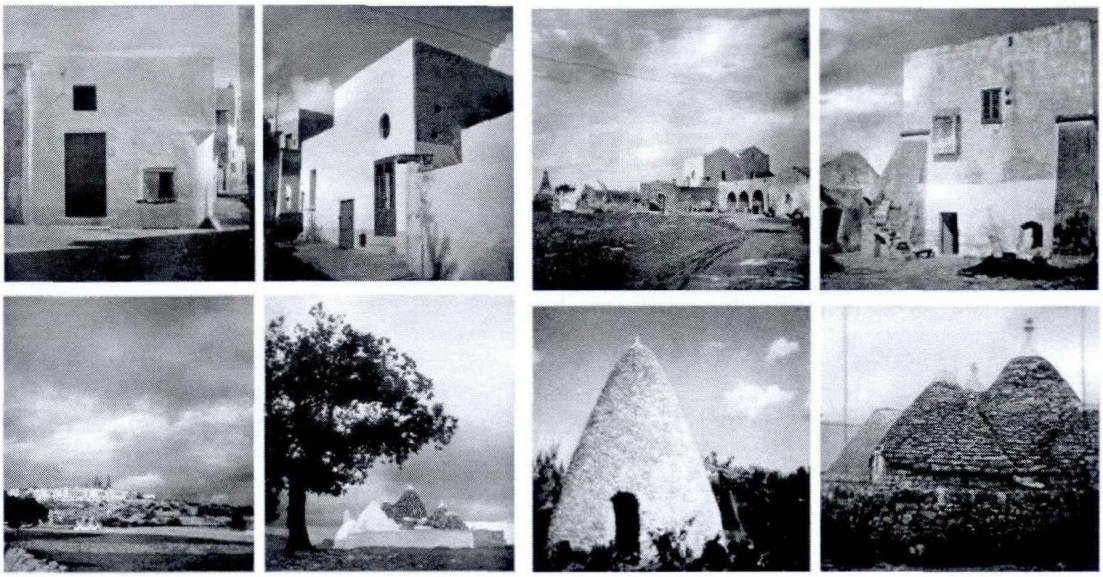


Fig. 2- 2Pictures of Italian countryside architecture published in CASABELLA
（Source：Michelangelo Sabatino. Documenting Rural Architecture, by Giuseppe Pagano[J]. Journal of Architectural Education, 2010, 63:2, 92-98）

Pagano's exhibition "*Italian Rural Architecture*" with Daniel at the Milan Triennale in 1936 was a crucial turning point in the rationalist movement of Italian modernists and their ongoing debate about their interest in indigenous traditions. Unlike other exhibitions on rural architecture, Pagano's exhibition is based on a typological rather than a chronological logic, so it has an engineering-architectural rather than a historical bias, and shows a very different kind of adoption of local culture. He gives a detailed and precise overview of Italian rural architecture, in which cases of country houses and rural environments appear throughout the Italian peninsula, showing the causal relationships between land, climate, economy and technology.

He finds a logical, clear and rational principle in the construction of houses in rural aggregates, which is a strong evidence of the systematic development of modernist architecture. He saw rural architecture as a unique renaissance in contrast to "stylistic architecture" and considered the reserve of rural architecture as a vast encyclopedia of abstract forms and creative expressions related to land, climate, economy, and technology. The aim of Pagano's efforts is to characterize contemporary rural houses through their origins and evolution, to discover the evolutionary threads between

traditional rural houses and modernist architecture, to uncover certain internal laws of development, and to develop esthetic ideas from logical functionalism. He traces the contemporary rural type as the source of a conceptual system of modern architecture that can be applied to the design of villas, a large number of houses, and other building types such as hotels and schools.

For Pagano, the rational and logical idea of architecture is not a universal system that can be detached from the conditions of time and space and possess universal value. On the contrary, it is subordinated to the process of building itself. In some extreme cases, a form originating in the past, once it has lost its former functional limits, is finally reduced to a purely aesthetic thing. Rationality, on the other hand, stands for the intelligibility of this process. Rationality, then, is a property of the form itself, its structure, and the historical process of its change. Pagano advocates the definition of morphology as a temporary representation of stages of historical processes. From the simplest floor plans to more complex configurations, each evolution of the house preserves the formal memory of the previous state that is inseparable from it. Even when the original function of the house disappears, the form remains. In this sense, Pagano assumes the existence of a typological process. Later generations have deepened this intuition.

Gustavo Giovannoni, a leading lecturer at the Rome School of Architecture and participant in AACAR, is also considered the founder of the discipline of urban planning in Italy. At the International Conference in Athens in 1931, Giovannoni adapted and added to Camillo Boito's theories[21] by suggesting that modern techniques could be used to preserve, repair, and if necessary, reinforce the artistic life of monuments. He distinguished four categories of restoration: 1. reinforcement; 2. original restoration; 3. liberation; 4. addition or renovation[10]. Emphasis on the importance of "informed criticism" to avoid mistakes and prevent the loss of character and historical values, as well as recognition of the judicious use of modern technologies and materials, played an important role in the drafting of the *Athenian Charter*[21].

Giovannoni's famous *Vecchie citta ed edilizia nuova* (Figure 2-3), published in 1931, was a successful attempt to develop a theory and methodology of urban design. In contrast to Piacentini's theory of "elimination," Giovannoni advocated a strategy of "reduction." The two sparked a heated debate about the integration of modern architecture into historic cities, which led to great controversy. In addition to influencing the urban tissue of certain historic cities (including Rome in particular, but also other small Italian towns), these two opposing theories were the linchpin of the Roman Academy's approach to the restoration of monumental buildings and the teaching of urban planning. The dispute between the two led to the founding of the *Centra Studi di Storia dell' Architettura*, which remains an important cultural reference in Rome for art historians[8].

Fig. 2- 3《Vecchie citta ed edilizia nuova》by Giovanno

（Source：https://www.anobii.com/zh-Hant/books/Vecchie_citt%C3%A0_ed_edilizia_nuova/9788825171273/01c6d3ee980cf64756）

Starting from a historicizing thought, Giovannoni supported the policy of counter-urbanization pursued by the fascist rulers and considered that the laws of urban growth and change should be won in response to long periods of territorial environmental change. He sought a strategy of supplementing the old with the new. He argued that the growth and development of urban areas put more and more pressure on the historic center, and rejected the systematic regeneration of urban centers and their replacement by modernist city blocks such as Corbusier's skyscrapers. He proposed

the concept of "organism," a new concept under which tradition and modernity can continue to coexist in harmony, with the historic center of the traditional city being the site of cultural application and new urban sprawl being addressed through urban satellite areas. The former can preserve the continuity of the existing urban tissue, while the latter can use modern technological means to meet urban evacuation needs.

For Giovannoni, the key to solving the problem lies in exploring the urban fringe, the zone between the old and new urban areas. To solve this problem, he studied the structure of the historic center with the aim of integrating life and history. Through specific case studies, he established that there is no such thing as a completely old city and a completely new city. He also introduced the concept of the "city plan as overlay," pointing out that the different layers of the city plan reveal different things. Most importantly, Giovannoni drew a conclusion from the study of urban morphology Morphology is a transitional representation of a never-ending development process. It is a dynamic process of development that is not completely static and fixed. Morphology itself constantly preserves and reveals the internal threads of development. On this basis, Giovannoni argues for the limited nature and importance of master planning, which creates good conditions for urban design.

The crucial thing about Italian urban morphology is that it always examines and treats tradition and innovation as an inseparable whole. The Italian architects represented by Pagano, in their search for traces of rural archetypes, have brought rural architecture back to the forefront and have developed a preliminary concept of the evolutionary process of house types. In the renovation of the historic center, Giovannoni's concept of "organism" and the stability of the urban plan have led to a respectful and rational analysis and conservation of the existing urban morphology. Muratori-Caniggia's building typology was inspired by the explorations of these earlier architects and developed their theories into a more systematic theory.

2.2 Theoretical development of the school

Muratori was inspired by Giovannoni's theory and teaching, which led him to reflect on the diachronic processes of the urban morphological development. Concepts such as the development process of morphology were developed within Muratori's research. Based on Saverio Muratori's research and theories, the Muratori-Caniggia theory of typo-morphology was systematically elaborated by his academic successor Gianfranco Caniggia, and the reading of the urban tissue was to be based on a four-level hierarchical subdivision system.

2.2.1 Muratori and his theoretical development

Saverio Muratori was born in Modena, Italy, on August 31, 1910, to a noble family. After graduating from high school in Rome, he began studying architecture at the University of Rome in 1928. His years of study coincided with a period of upheaval in which he was influenced by numerous ideas. At first Muratori was strongly influenced by Croce's idealism, but then his thinking changed and, as an architect, aesthetics was no longer the starting point but the end point of the design process, and aesthetics was thus no longer unique but part of the design process. In 1954 he defined the house type as an "a priori complex" and established his philosophical system[22].

As a participant in the 1949-1950 Ina-Casa housing project, Muratori collaborated with De Renzi on the design of the Stella Aggregate (1949), the Valeo San Paolo Aggregate (1949-1950), and the Tuscolano Aggregate (1949-1950) in Rome (see Figure 2-4). The aggregate was highly praised, but Muratori was not satisfied, noting in his book *Architettura e civilta in crisi* that after a long time, the Ina-Casa project was still not well integrated with its surroundings, and that the formal but senseless arrangement of the project's houses had no commonalities or even contradictions with the city, and they were never integrated into the urban tissue. In contrast, the spontaneous aggregates, even if of poor quality, form a coherent urban tissue and create a regional identity all their own[14]. Muratori thus recognized that overly rational modern architecture had lost

the organic character of the city and its suburbs. He attributed this result to a misunderstanding of the residential typology of the time and therefore abandoned the CIAM design strategy of the past. As an enthusiastic supporter of the modern movement, he began to question everything he had learned in his youth. He felt the need to go further and study the process of urban development, which led him to do urban research in Venice.

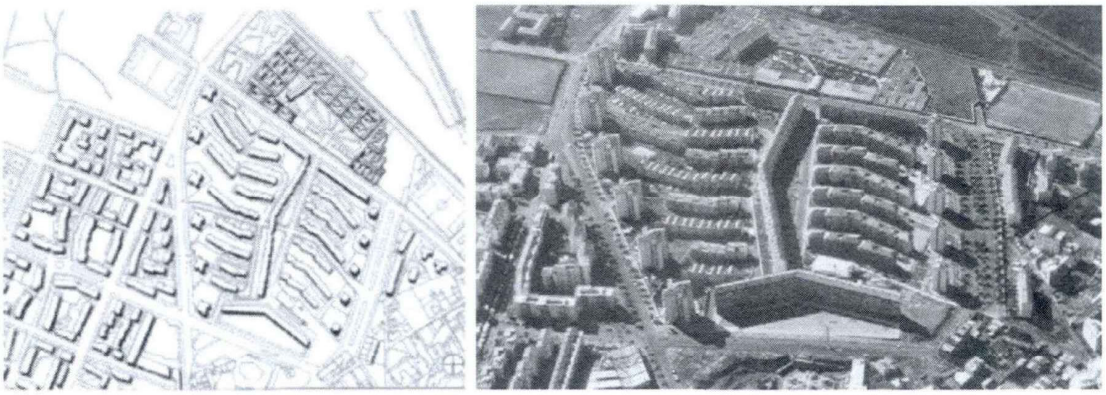


Fig. 2- 4 Tuscolano residential，by Muratori and De Renzi, 1949-1950
（Source：Deng Hao, Zhu Peiyi, Han Dongqing. Operative Urban History: Reading Saverio Muratori's Typomorphological theory and design practices [J].The Architect, 2016(01):19）

In 1950 Muratori went to Venice to teach the course "Characterization of Houses" at the Academy of Architecture in Venice. In his critical essay "*Vita e storia delle citta*", published the same year, he proposed for the first time the need to recognise in design the characteristics of the urban organism and to adapt new buildings to it[23]. This article can be considered as a preface to his subsequent studies on the historical geography of cities[24], In conjunction with the School of Architecture curriculum, Muratori guided students in their research on the development of Venice through field observations and literature reviews. Her research is based on a house typology, which is based on extensive work classifying houses and their associated open spaces, block by block and plot by plot. This involves tracing the houses from their beginnings to the variants of each period that have evolved over time, in order to verify the actual situation of the city as it has evolved. Having recognized for the first time the importance of the urban tissue and historical continuity[25], he suggested that modern architecture should adapt

to it, which he demonstrated with the design of the ENPAS office building in Bologna. It can be said that Muratori's work in Venice established a solid empirical foundation for the establishment and development of residential typology and urban morphology in Italy.

In 1954, Muratori was recalled to Rome to assume the chair of *Composizione Architettonica* at the School of Architecture. The experience of urban research in Venice triggered his interest in "operational history," that is, the influence and impact of urban history on planning and design-from the inclusion of new buildings in the midst of high-density historic centers to the sprawling suburbs where all sorts of solutions seem applicable-and provided, on the one hand, the basis for developing a solid evidence base for the rationale and development of morphology[9]. On the other hand, it inspired and informed Muratori's teaching program.

Gianfranco Caniggia, who was born in Rome in 1933, was one of Muratori's students at the School of Architecture in Rome. Muratori's teaching differed from other courses of his time in that he fundamentally changed the way he taught: from the beginning, he introduced a new set of design theories, gave a series of memorable lectures on modern architecture, such as how to fit an appropriate architectural organism into its environment, how to restore a broken architectural structure in the heart of a historic city, the various degrees of urban sprawl, and, above all, the case of the famous masonry church. At the beginning of the academic year, Muratori always began with a theoretical update, personally teaching a course on architectural composition to senior students, formulating doctrines in conversation with his assistants, advising them on the direction of the weekly design themes, and interacting with students in the free courses he set up to validate specific themes. This Socratic teaching left a deep impression on a generation of students at the School of Architecture in Rome, especially those interested in the relationship between design and architectural history, and contributed to the theoretical generation of the school, an atmosphere that naturally and profoundly influenced the growth of Caniggia.

In 1959 Muratori published *Studi per una operante storia urbana di Venezia*, which marked the formal establishment of the discipline of urban morphology in the field of Italian architecture, in which Muratori defined for the first time the concepts of building type, urban tissue, and urban organism. In this text Muratori gave the first fundamental definitions of building type, urban tissue and urban organism, which were later elaborated upon by his students and assistants. He emphasized that the typological process can be used as a tool to understand urban architecture, while the urban morphological analysis serves as a necessary preparatory step before the design. Together with Bollati and Marinucci, Muratori was responsible for the completion in 1963 of *Studi per una operante storia urbana di Roma*, a further examination and extension of Venice's research methods and concepts. In 1959, he and his assistants participated in and won the S. Giuliano Sandbank competition in Venice, validating the concept of the "viable city." In 1959 he participated with his assistants in the S. Giuliano Sandbank competition in Venice and won it. In this competition he tested the theory of "operative history" and studied the corresponding logical procedures and design methods.

Muratoni's teaching, however, provoked contrary opinions at the college, and he was eventually labeled a "rigid conservative" and expelled from the academic mainstream, while his teaching and design practice were severely curtailed, and some of his assistants and followers suffered to varying degrees, some even having to leave Rome. The school suffered from unprecedented academic stagnation. At the same time, many of Muratori's assistants began to develop individual research projects based on his theme of "*tissues, urban organisms, and territory*."

Muratori, a lonely and excluded man in his time, nevertheless left case studies and theoretical results as a legacy to his students, and his successors have made important developments accordingly. Every aspect of Muratori's thought was systematically developed by his successors at three different levels of complexity: Alessandro Giannini, Sergio Bollati, Renato Bollati, Giancarlo Cataldi, Attilio Petruccioli, and Marco

Maretto all deal with the local or regional scale; of these, Maretto tends to base his design theory on the practical study and interpretation of historic urban centers in need of reconstruction and resistance to the threat of modern architecture; Giannini focuses on a series of regional studies that are undoubtedly the most difficult and relevant part of the post-Muratori school work. Paolo Vaccaro, Gian Luigi Maffei and Nicola Marzot focused on urban and architectural tissue, while Giuseppe Strappa devoted himself to the study of the organization of the architectural organism[26]. Caniggia was concerned with the urban tissue, developing Muratori's definition of architectural type as an a priori complex and paving the way for a scientific approach to building by linking the science of the built environment with a typological approach. He was certainly a key figure among Muratori's students and in the development of the school's legacy.

2.2.2 Caniggia and his theoretical development

While Muratori was more concerned with the general design of historical Rome, Caniggia was more concerned with the development of Como. The Como research was the starting point for Caniggia, who used the potential of Muratori's definition of building types and applied it to the urban tissue (Figure 2-6), developing Muratori's concept of the basic unit and related definitions and publishing the results in 1963 (Figure 2-5). He organized and analyzed the historical process of urban development in an architectural rather than historical manner, attempting to isolate the basic principles of urban design, which he later verified through comparisons within the framework of the *Istituto di Metodologia Architettonica*. He supplements and links this with a survey of street formation, inventing an interpretation more detailed than Muratori's interpretation of Venice and Rome[8].

From the 1960s to the 1970s, Caniggia's research branched out organically into the architecture of different areas, and the theoretical-practical approach to typology reached remarkable maturity: the analysis and design of the historic center and outskirts of Como; the analysis and restoration of Como's historic buildings; the

definition of the specialized building in the 1970s as a specialization of the rural building type; and the study of urban tissue and building type in Milan, Genoa, and Florence. In 1974 he published some of his results in *Strutture dello spazio antropico*. These studies by Caniggia helped in the preparation of the urban plan of Bologna and directly influenced the political and legal debate that led to the law on the complete restoration of the historic center in 1978. The new plan for the center of Rome was also strongly influenced by Caniggia's theories.

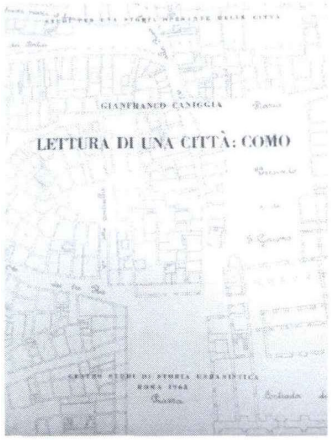


Fig. 2- 5 Dalla lettura di Como (Source：www.google.com）

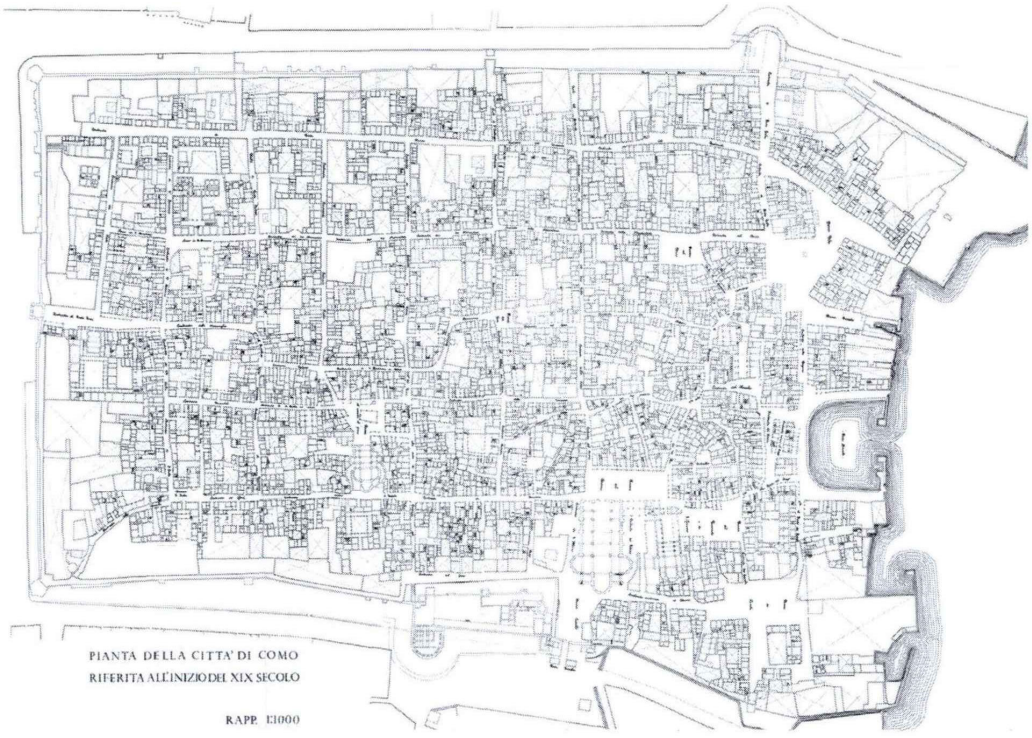


Fig. 2- 6 Como urban plan (Source：Dalla lettura di Como)

Caniggia believes that part of the reason Muratori's ideas were not popularized was due to the obscurity of their content, which made them difficult to understand, so he tried to simplify this theoretical system. In his writings he devoted himself to the dissemination of Muratori's ideas in architecture. For him, the emergence of the architectural world is the result of a dialectic or a positive relationship between human behavior and a "feedback with the environment". These human actions are guided by a "spontaneous consciousness" or a "critical consciousness", which is the understanding of the necessary elements of the house from which the basic structure emerges (analysis The presence of a "critical consciousness", which is the understanding of the necessary elements of a house, leads to the creation of a specific structure (analysis of the basic house); while the "critical consciousness" is a conscious thought process that leads to an architectural activity that does not involve architectural heritage.

In 1979 Caniggia and his student Maffei published the book *Composizione architettonica e tipologiaedilizia. I: Lettura dell'edilizia di base* (Figure 2-7). The aim of the book is to develop a methodology for architectural practice that provides a system of analysis applicable to different scales of the built environment: it can be used to interpret the structures of houses, to assess their form and different uses. This book establishes a theory of the historical evolution of urban morphology, both theoretically and empirically, and lays the groundwork for a horizontal connection to geographers' thinking about the historical evolution of the human built environment. While urban morphologists with a background in geography tend to focus on how urban morphological patterns evolve, Caniggia's theory of "typological process" paints a dynamic picture of the evolution of individual houses and aggregate organisms. Many of the concepts he explores are similar to and complement those of geography. This is especially true of his emphasis on the "typological processes" that develop and refine geographic concepts at the level of the individual house[3].

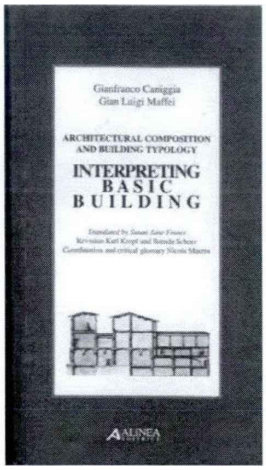


Fig. 2- 7 《Interpreting Basic Building》English edition （Source：https://www.amazon.com/Interpreting-building-Maffei-Gianfranco-Caniggia/dp/8881254263）

From interpreting basic building to the publication of *Composizione architettonica e tipologia edilizia. 2. Il progetto nell'edilizia di base base* Caniggia's theoretical development entered a phase of "design for the sake of replanning". Re-planning seeks to recreate the built expression of the site, while the architect chooses the most appropriate phase as the best design expression of the current environment. The architect's design is thus divorced from his perception of the man-made environment, from the "human production" that guides and limits the design[4]. Caniggia's plans reflect the traditional Italian continuity of the period, with a gradual refinement of detail that takes into account the local architectural character.

Caniggia has sought a method of analysis that maximizes the way people live and shape their surroundings. He seeks to explain how a house is built and presented, and how its form and functional role evolve over time. In this way, the cultural context that preceded the physical construction, and even the conceptual imagination in the mind of the builder, is restored. This evolutionary process of house type is dominated by subsequent builders and changes in empirical and conceptual culture about construction. Thus, house analysis is essentially an analysis of building typesand typological processes. In rigorous and objective analysis of existing and historic houses, one not only learns about construction methods, but also understands how new houses can be effectively integrated into the context to guide the design and

construction of new houses and to preserve and perpetuate the symbiotic and derivative system of local houses[27]. These two books are considered manuals, are used in many architectural courses, and have been translated and widely used in many languages.

The Italian typo-morphology Muratori-Caniggia is based on Muratori's theory and was refined and developed by Caniggia. Muratori's philosophical outlook was gradually shaped by the philosophical disputes between Croce and Gentile during his university years and the debate between Giovannoni and Piacentini on the transformation of the historical centre. He adopted and developed Giovannoni's concept of "organism," proposed the idea of "operative history," established a new architectural approach to urban studies, and his theories and case studies formed the basis for the concept of typology in contemporary Italian theory and design. His theories and case studies formed the basis for the concept of typology in contemporary Italian theory and design and influenced a large number of architects during his lectures at the School of Architecture in Rome.

Caniggia is the key successor of Muratori, who inherited his teacher's ideas in both research and teaching, proving the possibilities of Muratori's design ideas in simple, general and easy to understand expressions, and organizing and defining many concepts that Muratori did not completely understand. With the development of analytical design theory, Caniggia translates Muratori's philosophical theory into a "science of the built environment." He integrates theory and practice into an organic approach that can be analyzed at all scales of the built environment (house, tissue, city, and habitat) and in all fields of architecture, from the restoration of historic monuments to urban design, from structural design to architecture and urban planning.

2.3 Theoretical framework

The Muratori-Caniggia school of typo-morphology proposes a methodology for the analysis of the built environment at the scale of buildings, aggregates, towns and

habitats, based on the organismic perspective and the study of concepts at different scales. It constructs a complete typology of design based on the concept of typology, from urban reading to concrete construction. This paper mainly deals with the theories related to the scales of buildings and aggregates.

2.3.1 Related concepts

（1）Urban organism

Muratori's studies of cities such as Venice and Rome have extended the concept of typology to the urban scale, not only to the individual building but also to the urban context in which it is located the "urban organism"[28]. In nature, organicity is reflected in the interrelationships between and within the components of an entity. An urban organism is a complex entity composed of constituent elements, and the concept of a city as an organism encompasses not only the characteristics of a component, but also the cohesive and coherent relationships between that component and other components at the same or different levels.

（2）Scale

Muratori emphasizes the concept of scale, the idea that the construction of houses is linked by a sequence of different levels, the upper level being a collection of the lower level, the relationship between the whole and the parts, from the smallest material component and building unit to the largest city and region, and that new design at each level should be integrated with the valuable history and existing morphology.

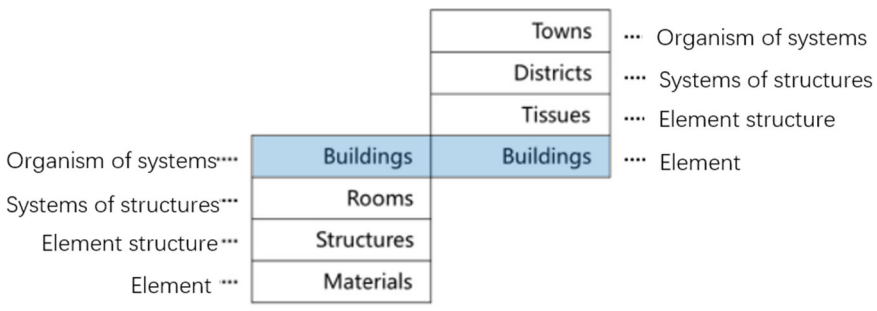


Fig. 2- 8 Caniggia morphological system (Source: by the author)

Caniggia further developed Muratori's concept of scale into a system of morphological subdivision (Figure 2-8) by establishing a hierarchical sequence with four levels: element, element structure, structural systems, and organ ism of systems, in order of increasing complexity. organism of systems, in order of increasing complexity, and applied it to buildings and cities. According to this hierarchy, the building sequence is divided into four levels of "materials- structures-rooms-buildings". Materials are elements such as bricks, tiles, wood, etc. Structures are combinations of several elements, such as floors, walls, partitions, roofs, etc. The third level of rooms refers to the combination of relatively independent components that can be identified together, including stairs, corridors, etc. Finally, all rooms, staircases and corridors are combined into one organism, the building. Similarly, the city is divided into four levels of sequence: “buildings- tissues-districts-towns”. The building, as the interface between the two sequences, becomes the fundamental element of the city sequence. In this way, a morphological subdivision system from material to city is constructed as the main object of typological process analysis. To reassemble the components according to a sequential approach, it is necessary to understand that each component must be seen in relation to its elements on a larger and smaller scale.

（3）Spontaneous consciousness and critical consciousness

The former refers to the state of cultural experience inherited from the builder, while the latter refers to the state of being influenced by systematic building regulations or subjective thinking. These two play a key role in the concept of type.

2.3.2 Typological process

The main theoretical achievement of this school is the typological process, a concept derived from the basic idea of the city as an organism. Having taken "evolution" and genetic variation from biology, Caniggia establishes an uncanny analogy between the concepts of typological processes and biological evolution. That is, organisms at all levels, i.e., cities, blocks, tissues, houses, undergo (and should undergo) a progressive

metabolic process. The typological processes of organisms at each scale interact with each other and, when placed in a spatiotemporal context, are subject to both co-evolutionary and diachronic change.

In the emergence and transformation of architectural typologies, the typological process shows the most striking gradual continuity. Caniggia emphasizes the inherent continuity of urban house building as the basis of architectural design theory. The typological process can be identified by studying the gradual transformation of typologies in successive phases. It goes without saying that architecture and social history evolve in parallel, that all buildings can be traced back to their origins, and that existing building typesevolve from dynamic changes. In short, all existing houses are at some point in the evolutionary process, and all exist only temporarily. The position of each house in history can thus be seen as a point in a coordinate system of diachronic and coevolutionary change, while the transition from basic types to specific houses can be seen as a linear space with the same specific spatiotemporal information as an object of observation, a route through the coordinate system. The typological process seamlessly bridges the stages of development, and each significant change of type in history leaves its traces in its own components, connecting the essence of the historical development of type with the spontaneous consciousness of people.

2.3.3 Buildings and building types

（1）Type

From a rationalist or positivist perspective, there is a clear difference between houses and types. The typological view of Muratori-Caniggia's typo-morphology can be traced back to Muratori's basic theory: "First, the architectural type is a synthesis of previous experiences or a certain spontaneous consciousness in a culture, which changes in time and space. Second, the building history is a series of spontaneously constructed phenomena; moreover, the architectural history is a series of constructed

phenomena ....."[23]. Muratori emphasizes that there are also typologies for the city's buildings and their associated spaces, and that each typology is the essence of its own material-spatial character, which can be used to define the structure of the built environment. He thus points out that typology is not a distillation of a set of examples for empirical purposes in taxonomy, but rather an a priori comprehensive construction that anticipates some change.

Caniggia continues the study of types with clarity. He shows that the house reflects the contradiction between innate genes and acquired environment, that it is both internalized and independent, in other words, the house type is part of the nature of human construction and is a spontaneous consciousness that adapts our environment to nature, derived from the collective experience of human life over time, it is a vision that is neither designed nor written, but exists as a systematic synthesis in the mind of the builder. It is from the interaction of spontaneous consciousness and critical awareness that all kinds of architectural activities emerge. When confronted with similar construction conditions, a series of conceptual consciousnesses dominated by "spontaneous consciousness" leads the builder to "spontaneously" select similar forms that are abstracted and conceptualized as types. However, each building process is unique in that the designer and the builder adapt to different site conditions, economic situations, etc. In other words, the intervention of "critical consciousness" leads to different results, and each house of the same type will have small differences depending on the specific situation. This process is also a spontaneous participation of the builder in transmitting the local culture at a certain time and place, leading to the development of the city and its architecture.

Different types of houses have different characteristics such as location, number of windows, floors and doorways. The physical presence of different houses is recorded based on statistical assumptions about the study population, and houses are treated as a composite of many characteristics. Accordingly, the house type is determined by classifying the houses in the study area in an "posteriori analysis".

（2）Basic building and special building

The houses that occupy most of the city plan, usually residential, are called basic buildings, which are the result of a "spontaneous consciousness," while the large blocks in the residential survey, churches, monasteries, noble houses, and other special buildings are the result of a "critical consciousness" that acts on the basic buildings and gradually develops into non-residential buildings with public functions. The special buildings, such as churches, monasteries, and noble houses, are non-residential buildings with public functions that have gradually developed as a result of "critical consciousness." All special buildings derive from the basic building and are derivatives of it. The origin of each specialized type of special building is necessarily to be found in the type of family house, which is far removed from the basic type.

（3）Synchronic variations and diachronic variations

This school of thought understands the built environment by examining the historical process of its creation. Synchronicity and diachronicity are two characteristics of the spatial and temporal "spread" of types. Synchronicity is a spatial association that can be understood simply as the characteristic of the same type occurring in different areas during the same time period and manifested as the geographic continuity of the type. The dual existence of diachronic change and contemporaneous change of houses jointly affects the orderly occurrence of building typesin a certain time and space, which is an objective historical phenomenon. When the two characteristics are reflected in the house as a physical projection of the type, they manifest as synchronous variations and diachronic variations.

The two variations require more detailed geographic, historical, and comprehensive comparative analysis. The evolutionary characteristics of the basic types in Florence, Rome, and Genoa (Figure 2-9) show how the two characteristics are projected onto the house. In the case of the single-family house, for example, the prototype house is essentially the same in all three cities. However, in the evolution to multi-story buildings, differences in the location of the staircase and whether or not a backyard is created

lead to differences in the plan form of the houses built thereafter, as well as differences in the building elevations, resulting in a variation of the type. It can be seen that all the variants listed horizontally are short-lived variants, while the variants listed vertically are same-age variants of the same type. Comparing the matrices in this way, it is possible to understand the variation in the physical projection of the type in the spatiotemporal dimension.

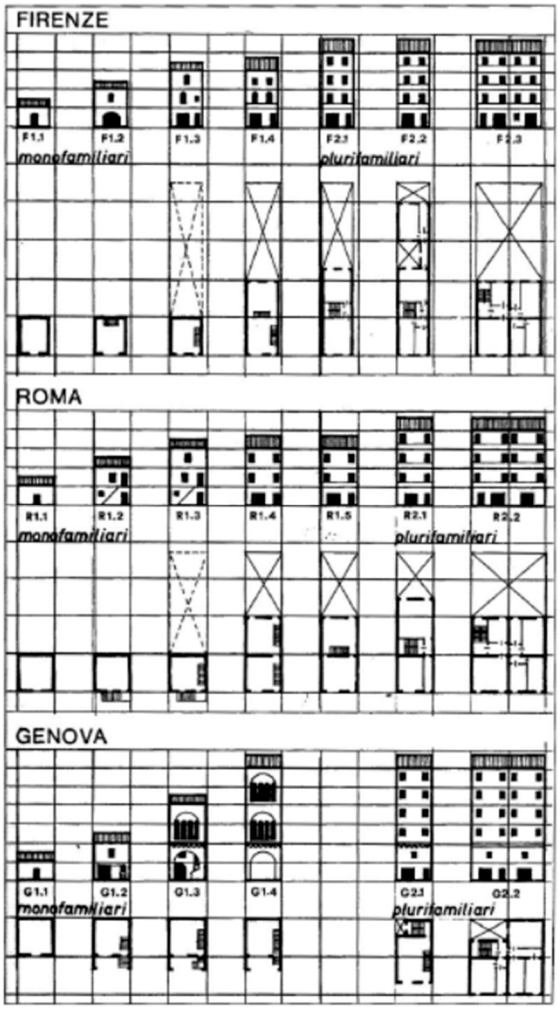


Fig. 2- 9 Comparison of the main ephemeral variants of houses in Florence, Rome and Genoa （Source：Gianfranco Caniggia，Gian Luigi Maffei. Architectural composition and building typology: interpreting basic building）

2.3.4 Aggregates and tissue

（1）Tissue

From a typological point of view, the rules for the configuration and classification of

aggregates can be studied in the same way as building typesand can be referred to by the term "urban structure". The relationship between the tissue and the aggregate is the same as the relationship between the house type and the house: the tissue is the type of the aggregate, the concept of how the groups of houses gather and live together in the mind of the builder before they are actually built, and it is at the level of spontaneous consciousness, the civilized result of the accumulated experience of organizing and coordinating the individuality and diversity of the house plan. In short, it is an "priori synthesis" of house types, so that some of the properties of "building types" and "types" already recognized can be applied to "tissue". However, tissue does not always follow "type". Because of the multiple roles they play in the urban organism, it is recognized that building types are limited to momentary and simultaneous changes, but this does not mean that tissue also changes accordingly.

By identifying the "pertinent strip" of routes, we analyze the relationship between matrix routes, planned building routes, connecting routes, and breakthrough routes. We trace the formation time of each aggregate in the temporal dimension, and by subtracting the late morphological tissue in historical retrospect, we can obtain a series of maps with time points going back to the state before houses were built. Although it is not possible to determine the time at which each house was built, and thus to obtain a progressive evolutionary picture of the whole process, it is possible to identify some typical periods of formation and development of the urban tissue.

（2）Formation of Urban tissue

The urban tissue was formed by the development of the route and the pertinent strip. A road is an urban structure that provides access to a place, as opposed to the concept of physical space implied by the word "street", which refers only to the route of imaginary space. A pertinent strip is the area that belongs to each road, that is, the house and the pertinent area, such as the backyard. The entire route and the pertinent strips with identical or similar strips on both sides is a simple tissue.

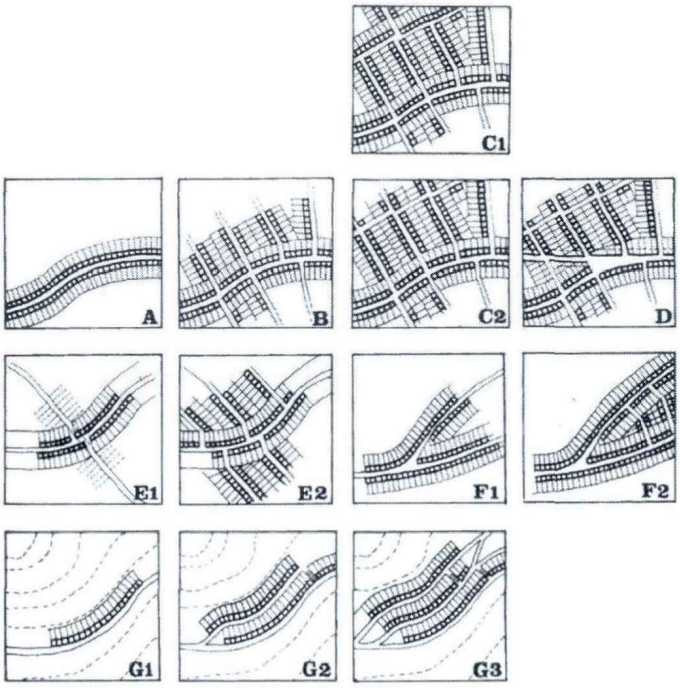


Fig. 2- 10 Urban tissue formation: A: housing construction along the matrix route; B: housing construction along the planned building route; C1: continuous construction of planned roads that connect each other; C2: increased connectivity between Planned building routes The expansion and extension of the Planned Building Route; D: the formation of the break-through route（Source：Gianfranco Caniggia，Gian Luigi Maffei. Architectural composition and building typology: interpreting basic building）

The route is the most indestructible element of urban planning and the main component of the urban tissue, no building or built plot is without a route to it. Therefore, the organization of aggregates is necessarily identified and solved through a dialectical observation of the development of routes. There are four types of routes related to the process of urban tissue formation (Figure 2-10): The formation of a aggregate depends on an already existing route, the matrix route, which precedes the construction of houses and connects one aggregate to another or to a site (industrial or agricultural, etc.); the planned building routes, which anticipate the orientation of houses along the road before construction, are subordinate to the matrix route and usually orthogonal to it; and the planned building routes, which are subordinate to the matrix route and usually cross it. route and are usually orthogonal to it; after two or more planned

building routes are formed, connecting routes are formed that define blocks while connecting the planned building routes; breakthrough routes cannot be built until construction of a development is largely complete.

（3）Development of Urban tissue

Any type of street can have pertinent strips on both sides, and by combining different pertinent strips in sequence, an urban block is formed. A built-up plot (plotto edificato) is a type of plot used for residential construction, consisting of an area occupied by buildings and an pertinent area (yard). The block, in turn, is determined by the scale of the study and the hierarchy of the elements involved. For example, when studying the typological characteristics of a row of houses, a block is a generally defined space enclosed by streets; when studying a larger urban development area, a block may be a modular component of the urban space, understood as a combination of several of the former buildings and the internal route system.

However, the urban tissue is not a simple superposition of different pertinent strips, but they have a unique self-organization in the process of combination formation. When two routes, especially the matrix route, intersect with the planned building route, taking into account the double-sidedness of the corner houses, especially the pertinent strip of the planned building route, the undeveloped area of the pertinent area, which was previously attached to the houses on the corner, becomes a buildable area. The pertinent area becomes a buildable area. By using the edge areas, infill tissue is formed, a process that creates basic types of "synchronous variants". A gradual adjustment to the plan to be consistent with the city as a whole (Figure 2-11).

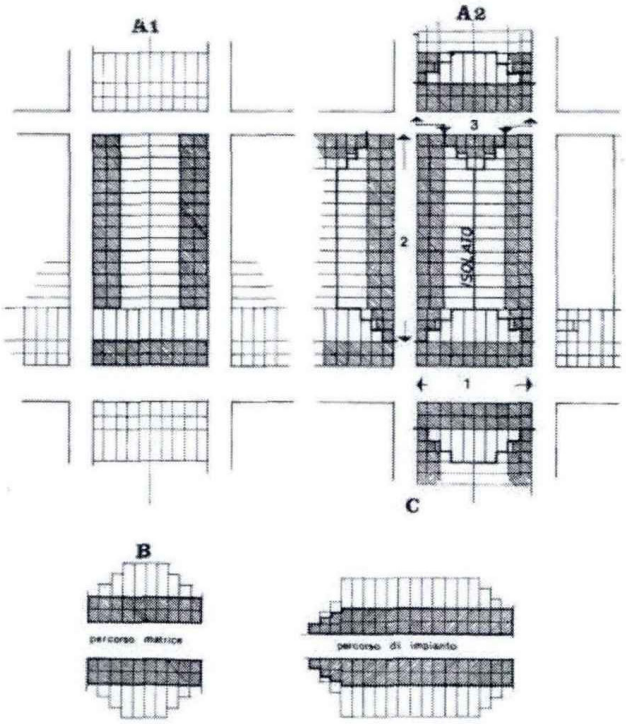


Fig. 2- 11 Relationship between block and plot: A1 in the road grid composed of matrix route, planned building route and connecting route, the block is formed by progressive housing construction; A2 block's tissue is reused along the street surface by self-adjustment; B and C in the plot Even if the state of infill tissue, the form of pertinent strip of matrix route and planned building route after complete filling according to Contrada model

（Source：Gianfranco Caniggia，Gian Luigi Maffei. Architectural composition and building typology: interpreting basic building）

Eventually, the urban tissue will adjust itself, forming a 45-degree "zipper" at the corners in plan view. The buildings on the developed plot, even if they are the same type of physical projection, have some differences in the floor plan, such as the number of rooms, the size of the backyard or even the absence of a backyard at the corner. In contrast, the floor plans of the houses and backyards in the central part of the block are more homogeneous.

In terms of heights, the district has a series of coordinated, uniform house heights on the side facing the base street, but house heights vary at the beginning and end of the block. Unlike the matrix route, the house facades on both sides of the planning building route are less balanced and coordinated. At the beginning of the planning building

route branching from the matrix route, first the slope wall of a house (without windows and doors) becomes the street front of planning building route, followed by the route front of each housing unit in turn, the type of " synchronic variant" are formed with different disturbances and uneven dimensions, and end with a more standard and modal series of house facades along the route - the facade of the first house becomes the object of reference and imitation. The street facade of the connecting street generally returns to homogeneity, with the facade of a house at each end and the middle consisting of the facade of a filler house along the street, which is still irregular in size. It can be concluded that the "side streets" also have their own pertinent strips, which is the result of the change of the urban tissue over time and is irregular in depth.

2.4 Theoretical approach

The Muratori-Caniggia school of typo-morphology with an architectural background obtains a special kind of map information by surveying the ground floor plan of an actual building in a city or region. Such maps not only express the morphological structure of a city, but also allow the study of certain types of buildings by analogy, showing the overall morphology of the city and the ground plan of the buildings on the same drawing.

Building surveys as a research method can be traced back more than two hundred years to Italy, where in 1748, at the request of Pope Benedict, Giovanni Battista Nolli XIV mapped the city and suburbs of Rome through building surveys of "*La Nuova Pianta di Roma*" (Figure 2-12), a series of twelve interconnected maps that depicted the shape of public space throughout the city. The difference is that the Nolli map reproduces only the public space of the city, including the streets, squares, public buildings, and the foyers and courtyards of the residential buildings, while all other private areas are blacked out (Figure 2-13). This source, with its accuracy and completeness, became the basis for future generations to understand the historical center of Rome.

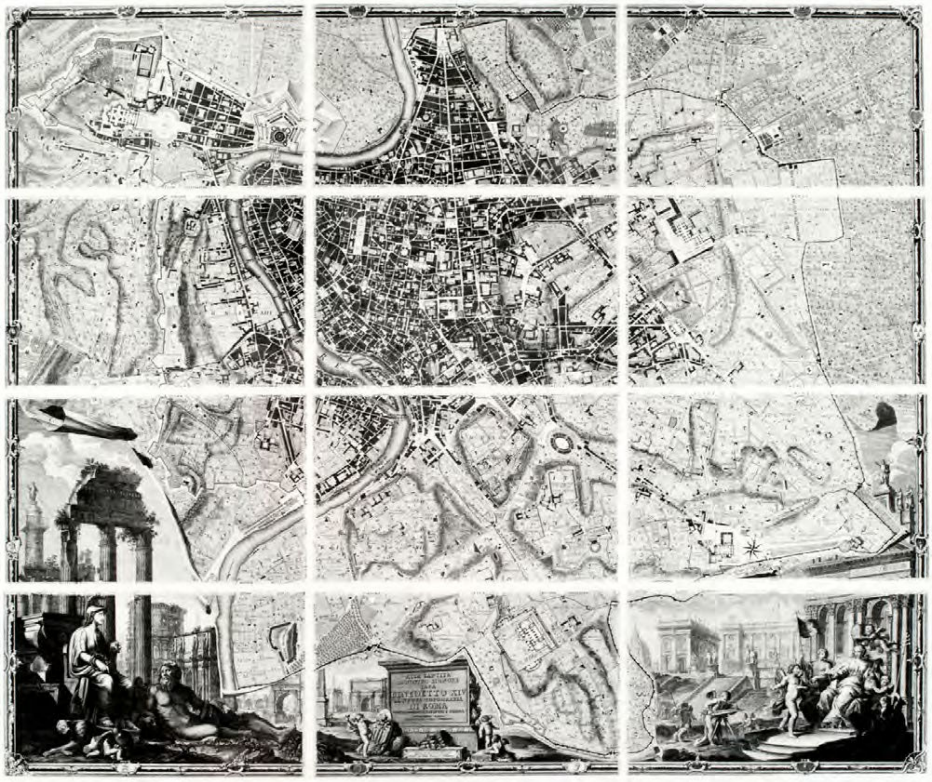


Fig. 2- 12 La nuova Pianta di Roma (Source: Nolli, 1748)

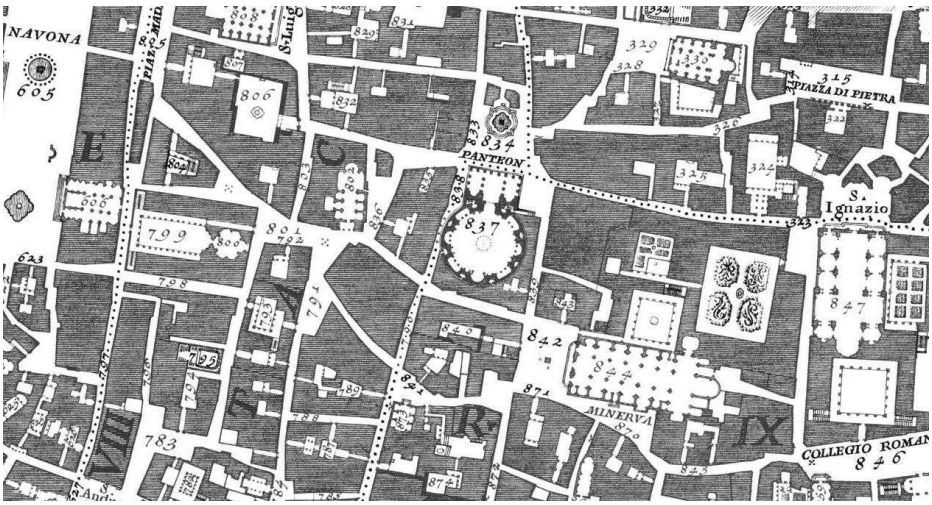


Fig. 2- 13 Partial La nuova Pianta di Roma (Source: Nolli, 1748)

In 1958 Muratori taught a course on "Typology of Architectural Spaces" at the University of Architecture in Venice, teaching students to conduct typological studies based on building surveys. He led the students through a selection of areas in the city, meticulously measuring all the buildings and drawing the first floor plan of the entire area (Figure 2-14); they then conducted conjectural building surveys based on

documentary sources and archaeological maps and drew the same area in Gothic style (Figure 2-15). Muratori believes that the last two maps clearly show the urban form and building types of the different historical periods and, by comparing them, allow further study of their evolution and development process[28].

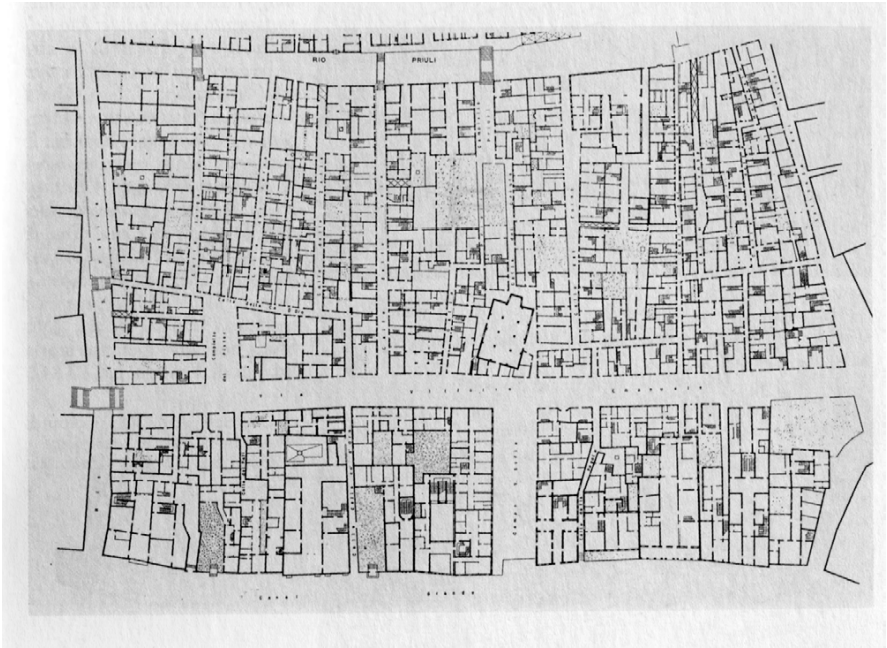


Fig. 2- 14 Building surveys of the S. Sofia district of Venice in the 20th century

（Source：Muratori, 1959）

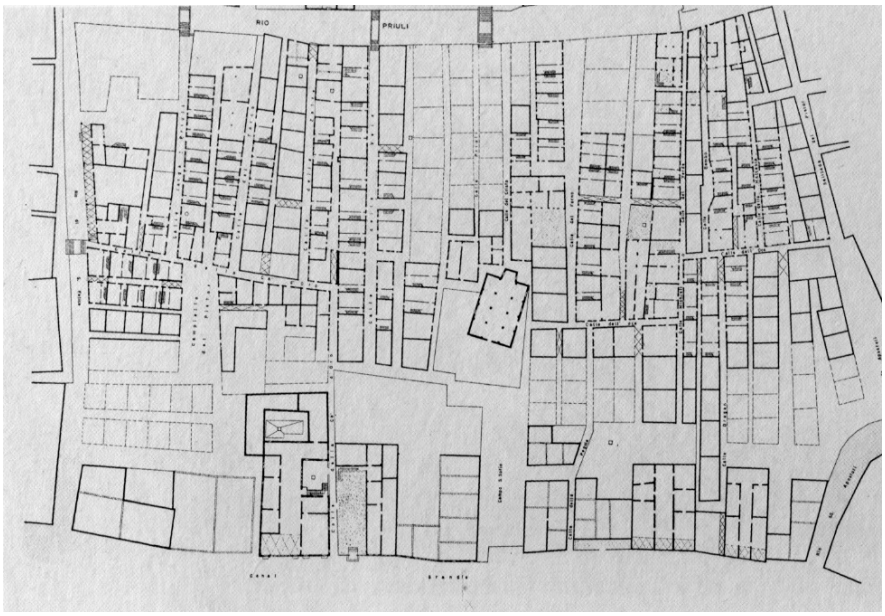


Fig. 2- 15 Conjectural building surveys of the Gothic Venice district of S. Sophia

（Source： Muratori, 1959）

And Caniggia, as a student and assistant of Muratori, transformed the latter's theories

and experiments into a methodology aimed at creating a scientific system that could interpret any urban aggregate. This effort was first reflected in his study of the ancient city of Como, where Caniggia made a large, detailed floor plan (1:200 scale drawings) based on 19th century building surveys of downtown Como and showed, by overlaying them with presumed building surveys from the Roman period, that the new urban construction still had some relationship to the ancient markings that had existed (Figure 2 - Fig. 2). The new city construction still has some relationship with the ancient markers that once existed (Figure 2-16). He then compares the basic building types using building drawings of the Italian cities of Rome, Como, Genoa and Florence at different times in history (Figure 2-17), both horizontal and vertical. These drawings are included in two works, *Lettura di una città: Como* and *Architectural Composition and Building Typology*[29].

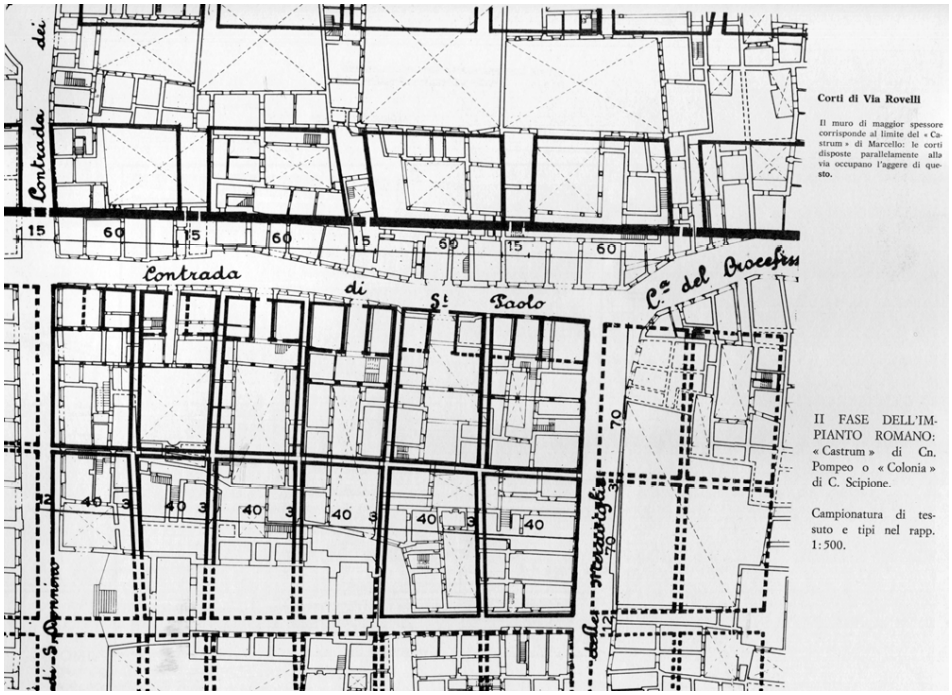


Fig. 2- 16 Como, Building surveys overlaying the Roman period and modern cities
（Source：Caniggia, 1963）

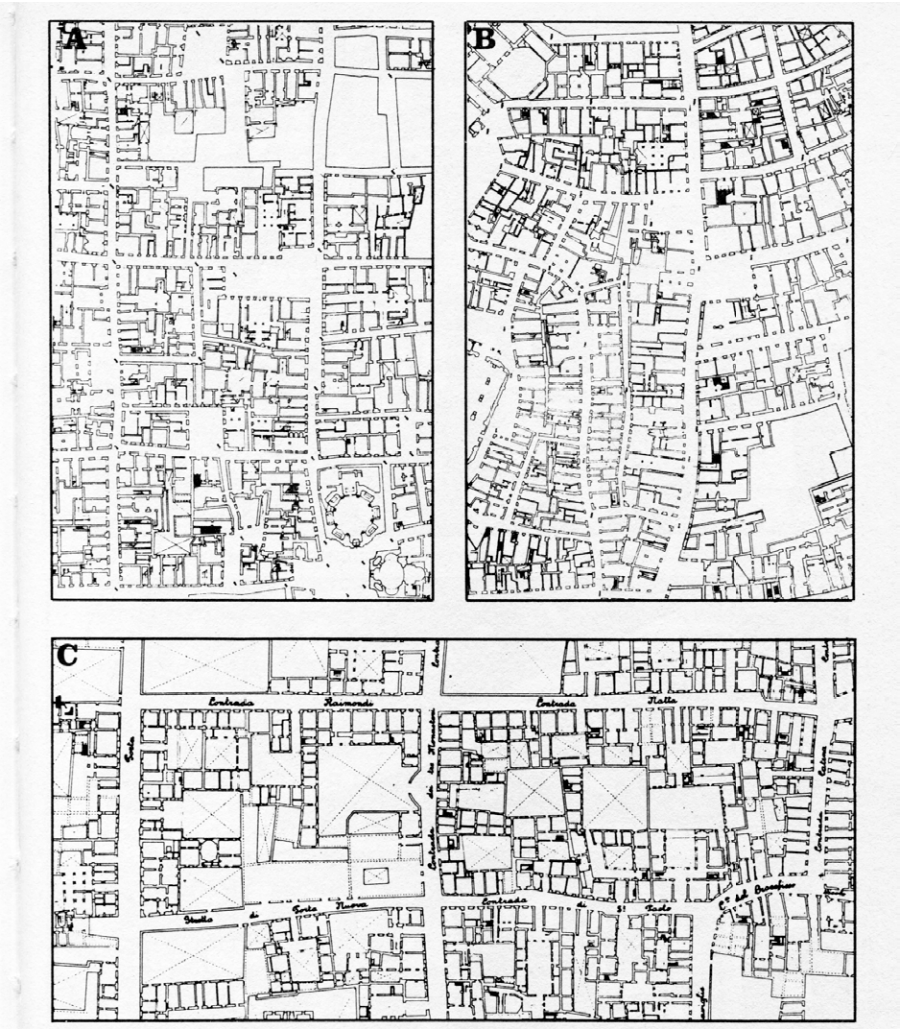


Fig. 2- 17 Examples of building surveys in different cities: A Genoa, B Lucori, C Como
（Source：Caniggia, 1979）

Based on the above research, Caniggia, in the second part of the monograph series *Basic building design/ Il progetto nell' edilizia di base* published in 1984, establishes a step-by-step derivation from the urban environment under certain environmental conditions to four different scales of architectural design are: the design of tissue - to control the scale of building types, the selection and adjustment of building types, the types of building structures and the types of building materials. The four layers of systems, types, structures and materials serve as a direct and indirect architectural language that bridges the entire process from research to design[3].

He then designed the restoration of a medieval block in the San Frediano district of Florence. Although this design was a research project that was not fully realized, it

shows how Caniggia built a complete system of methods, ranging from the study of buildings to design applications. The medieval blockr studied and designed by Caniggia is located near a section of the 13th-century city wall and a gateway that forms the western boundary of the San Frediano district on the south bank of the Arno River (Figure 2-18).

First, he studied the general morphological evolution of the block, analyzing and speculating on the evolution of streets, plots and buildings in different periods, based on historical information(Figure 2-19): in the mid-13th century, before the construction of the city walls, the main plots and buildings grew along the Via dell'Orto on the north side; after the construction of the city walls, several streets were built leading to the After the construction of the walls, several streets were built leading to the city gates, and a new division of plots and architectural layout emerged in response to these streets; with the construction of the Cosimo I castle, the division of plots and buildings on the southern side of the block were also completed, and this morphological character was maintained until the 20th century.

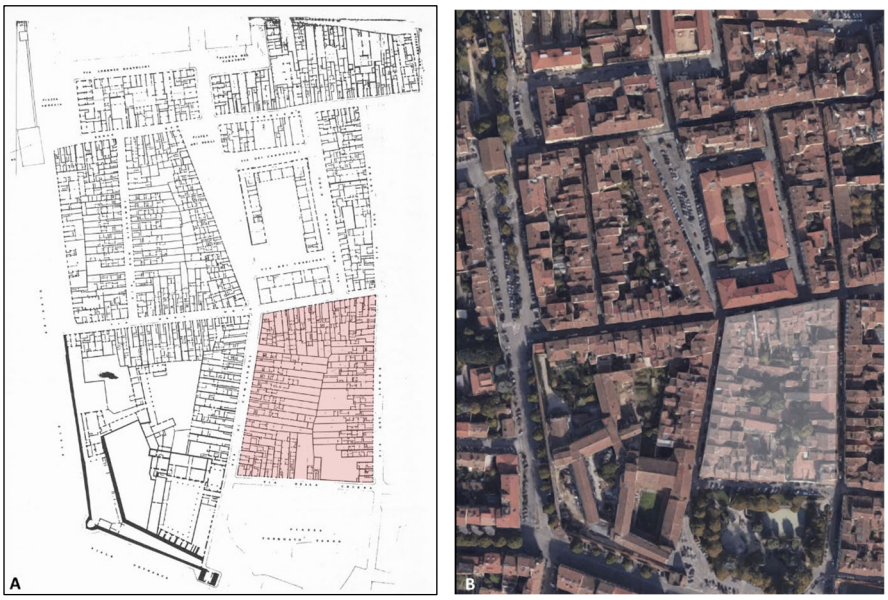


Fig. 2- 18 San Frediano district in Florence A ground floor plan　B Satellite Map

（Source：Google map）

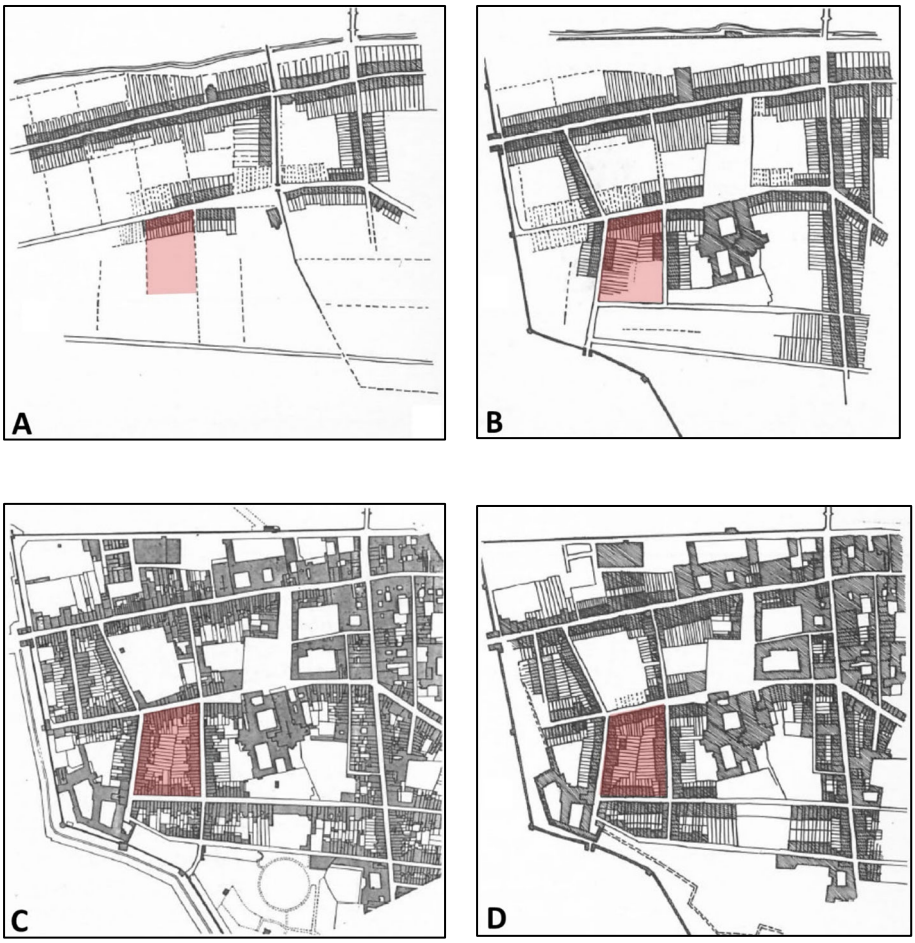


Fig. 2- 19 The morphological evolution of San Frediano district
A Before the construction of the city walls in the mid-13th century B After the construction of city walls C After the construction of castle D 1833 Cadastral Map
（Source：Caniggia, 1984）

Based on this research, Caniggia selected two periods, 1833 and at that time, for detailed building surveys and drew ground floor plans for both periods. The results clearly show that most of the surviving medieval plots are rectangular in shape and that the plots are generally narrow in width and deep in depth, as the inhabitants of medieval Italy paid city taxes based on the width of the buildings along the street and the number of openings facing the street. Based on building surveys of the block's history and current condition, Caniggia identified three distinct trends in building tissue development: a. medieval plot divisions and building layouts were largely retained, with local additions; b. buildings were destroyed and plots were merged and remained unused; and c. Plots were merged and large openings were created.

To restore the character of the medieval urban tissue and building types in the new design, Caniggia re-subdivided the damaged tissue with reference to the 1833 cadastral map and filled in the vacant plots based on his earlier studies of the various "row house" building types in the Florentine area (Figure 2-20).

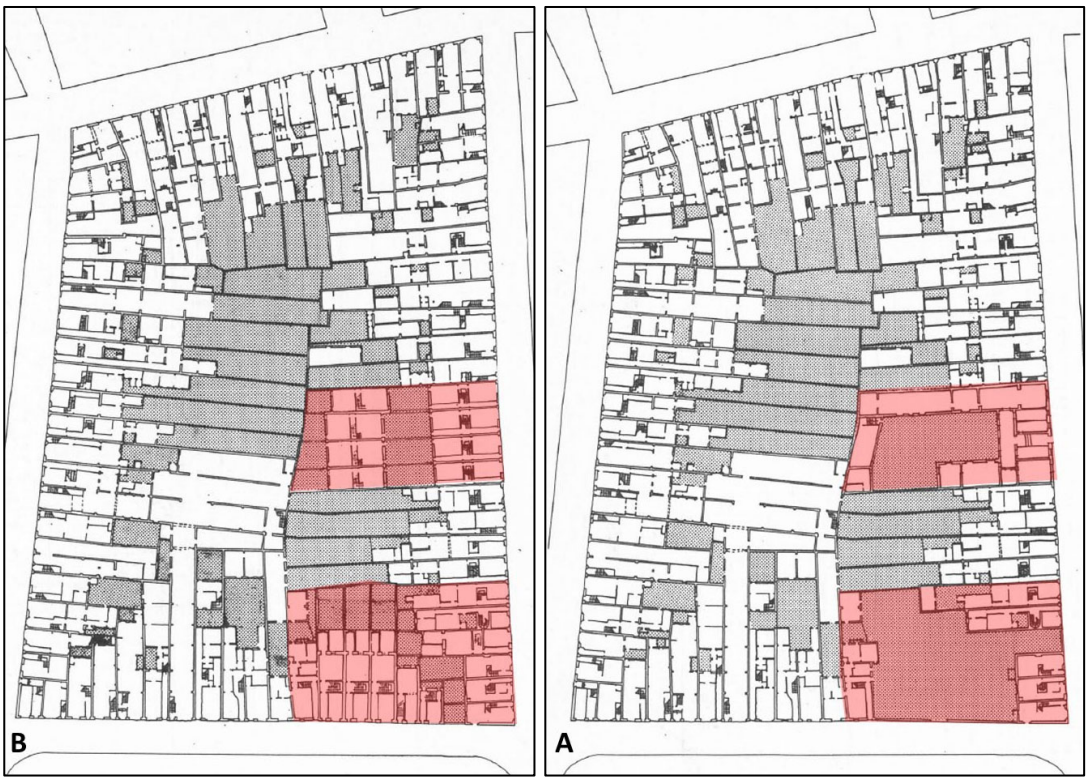


Fig. 2- 20 San Frediano A Ground floor plan in current situation B Design result
（Source：Caniggia, 1984）

2.5 Case study: Conservation of the historic center of Bologna

The conservation of the historic center of Bologna (Figure 2-21) is the first classic example of the application of Muratori-Caniggia's morphological-typological approach to a large-scale practice. Pier Luigi Cervellati, the principal author of the 1969 Bologna Master Plan and the 1973 PEEP, has stated that the Bologna practice was implemented based on Muratori's typological research and further elaboration by Caniggia[30]. As one of the best examples of conservation of historic cities in Italy and internationally, the Bologna practice provides an example of preserving the historic value of a city in a historic place and maintaining its population and sociological

character.

Fig. 2- 21 The historic center of Bologna

（Source：Luisa Bravo, Contemporary historic city: genius loci and genius saeculi）

2.5.1 Background and origin

After World War II the real estate industry, the leading force in the development and construction of cities, contributed to Italy's rapid industrialization, urbanization and economic recovery, but also gave rise to a great deal of real estate speculation. In the mid-to-late 1960s, Bologna offered an ambiguous cityscape: the aggressive expansion of urban space into the suburban hinterland and surrounding hills, oriented toward private automobile traffic, created an excess of urban areas outside the historic center without meeting the large housing and living needs that resulted from rapid urbanization.

On the contrary, the historic center, with an area of 4.35 k ㎡, experienced both a spatial and a socioeconomic decline. At the physical space level, a large number of buildings (especially historic houses) are vacant, deteriorating, or even collapsing (Figure 2-22). 75% of houses are rented and only 21.2% are occupied by owners[31]. There is also a lack of public services and public transportation. On a socioeconomic level, the number of residents in the center of Bologna has declined by a total of 29.5% between 1951 and 1971, resulting in a gradual loss of social vitality. The identity of the inhabitants has also changed significantly, as the historic center has become a place of residence for a diverse population of elderly people, students and workers[32].

Fig. 2- 22 The physical decay of the historic center of Bologna in the 1960s
（Source：DE ANGELIS C. Quarant' Anni Dopo Piano PEEP Centro Storico 1973, Note a Margine, tra Metodo e Prassi[J]. IN_BO. Ricerche e Progetti per il Territorio, la Citta e L' architettura,）

When the Italian Communist Party took power over most of the cities in the Emilia-Romagna region, where Bologna is located, in 1959, it initiated a series of municipal reforms. In this process, urban planning was considered one of the few core areas in which local governments could intervene directly, and the conservation of historic centers was representative of its experiments in urban planning reform.

In the 1960s, the preparation and implementation of two plans prepared what would later become the Bologna practice: first, the *Regional Plan of the Municipal System (PIC),* which included Bologna and the 15 surrounding municipalities and became the basis for the planning and construction of regional municipalities, with the main objective of coordinating at the regional level to solve the problems of municipal sprawl and real estate speculation, Among the most important measures were the relocation of large plants and production activities from Bologna to neighboring municipalities, the construction of a new infrastructure system to strengthen the development of neighboring municipalities, the control of the growth of regional municipalities, the protection of land and countryside in the suburbs, and the general equalization of urban living conditions and standards in rural areas, the Bologna government created the first "People's Economic Housing Zone" around the historic center in 1963, which allowed workers to obtain affordable housing in urban areas. Later, the *Law on Planning and*

Coordination of Public Housing (L.n. 865/1971) allowed the creation of "people's economic housing zones" in the built-up areas of municipalities through the expropriation and renovation of existing housing for the public good, which "confirmed for the first time in the Italian planning system the rehabilitation of historic centers." This was "the first time in the Italian planning system that the rehabilitation of a historic center was confirmed" and became the main political opportunity to advance the Bologna practice.

2.5.2 Integrated conservation

A significant achievement of the Bologna practice was the revision of the 1969 Bologna Master Plan, which for the first time systematically elaborated the concept of integrated conservation. The plan "protects social, cultural, economic, and artistic identity as a whole," in terms of both physical and social conservation, and specifically gives "priority to civic and social values," i.e., "protects people and houses together." It explicitly protects the right of different social groups and classes to live in the historic center and its public functions, services and activities, but also integrates the historic heritage with the residential, social and economic functions of the city to integrate the historic center into the reality of citizens' daily lives and ensure socio-economic vitality "to avoid the material and social decay of the historic center and the capitalization of the capitalization scheme. To prevent decay and arbitrage through capitalization and to stop the displacement of less affluent social classes and less economically efficient socio-economic activities." The essence of integrated conservation, in which all conservation activities are carried out with respect for people, is that the human element is more valuable than architecture. This is important because preserving historic cities is an important way to preserve the memory of a city and maintain its urban historic tissue. To preserve it in its entirety, the people who live in those memories must also be protected. Historic buildings without people will quickly age and lose their original interest and charm[33].

2.5.3 Planning methods

The planning methods of the Bologna practice is divided into two levels, the core of which are the *1969 Revision of the General Control Plan of the City (PRG Variante 1969)*, which includes the Historic Centre Plan, and the Plan of the *People's Economic Residential Area of the Historic Centre (PEEP-CS 1973)*, prepared in accordance with the Law on the Planning and Coordination of Public Housing.

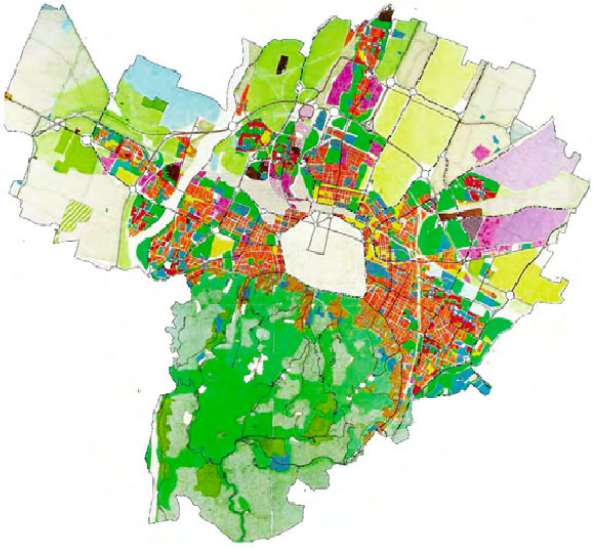


Fig. 2- 23 The general plan for Bologna (1969). The light grey area at the centre of the drawing represents the centra storico（Source：Commune di Bologna. Per il Recupero Urbano[M]. Bologna:Topografia Graficoop,1982）

（1）The general plan for Bologna（PRG Variante 1969）

Within the legal framework, the 1969 revision of the Master Plan proposed a three-pronged strategy based on a sense of typo-morphology that provided the overall framework for the conservation of Bologna's historic center. First, the planning position of the historic center was established (Figure 2-23). The urban function designates the historic center as Zone A only, relegating functions that are incompatible with the historic, cultural, and artistic characteristics of the historic center to the surrounding urban areas[34]. Second, historic buildings are divided into four types (Figure 2-24), and adaptive uses preserve special buildings. Most of the existing residential functions, the protection of existing social activities and small and medium-sized commercial and craft businesses, and the addition of educational, cultural, recreational, and social

support functions (elderly and child care) compatible with the characteristics of the historic center, mainly based on the characteristics of the large historic building complexes (mostly religious buildings) in the four types, propose after-use measures for rehabilitation and conversion into public services such as culture, education and tourism reception. Third, using a typo-morphology, we analyze the spatial form, the historical evolution, the formation mechanisms and the current situation of the urban space of Bologna, defining the "homogeneous zones"（Figure 2-25）and the corresponding spatial interventions[35].

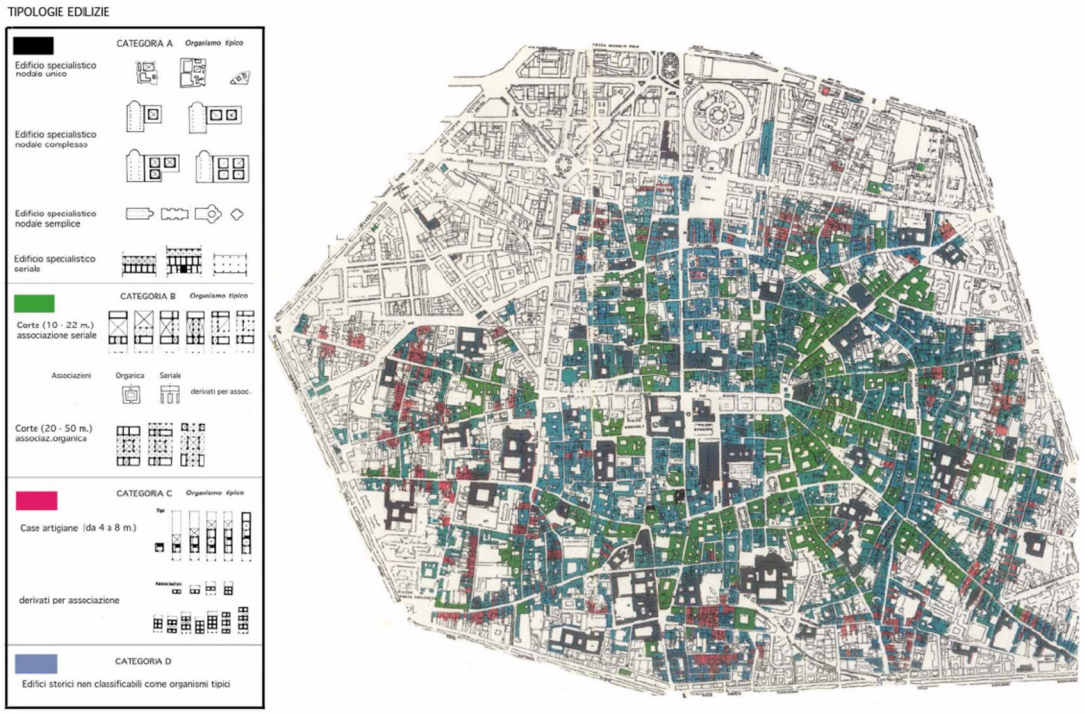


Fig. 2- 24 1969 Bologna Master Plan Revision-Building typologies, where black represents BIG "containers" with specific functions, many of which are religious buildings; green represents SMALL "containers "; pink and blue are PRIVATE buildings, pink for general buildings and blue for irregular buildings（Source：Commune di Bologna. Per il Recupero Urbano[M]. Bologna:Topografia Graficoop,1982）

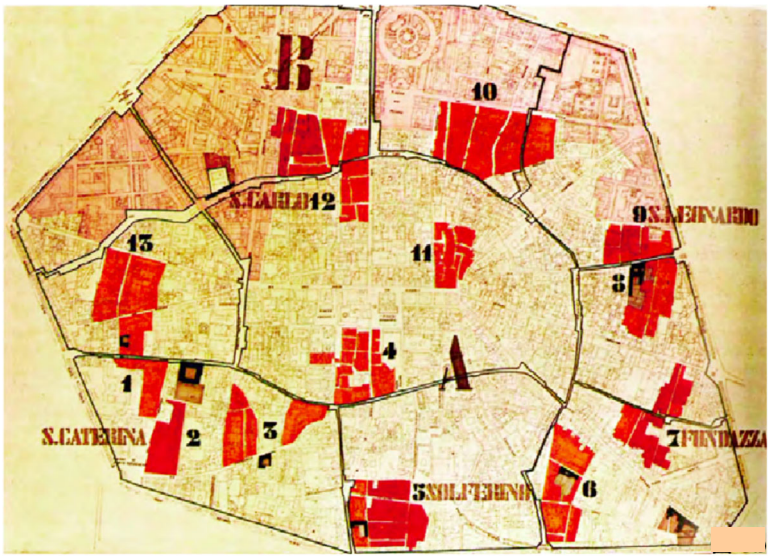


Fig. 2- 25 Homogeneous areas within the historic center and 13 people's economic residential blocks （Source：ORLANDI P. La Questione dei Centri Storici Esiste Ancora? [J]. Ricerche e Progetti per il Territorio, la Citta e L' Architettura, 2010(1): 31-38）

（2）Plan of the People's Economic Residential Area of the Historic Centre（PEEP-CS 1973）

Based on the 1969 Master Plan, the 1973 PEEP-CS (Plan of the People's Economic Residential Area of the Historic Centre), for which P. L. Cervellati was largely responsible, identified 13 of the most deteriorating blocks in the historic center as economic housing areas and selected five of them as pilot areas containing more than 15,000 dwellings. Five of them were selected as pilot areas with more than 15,000 apartments and were implemented in two phases, with about 600 apartments renovated and built in the first phase[36].

Fig. 2- 26 Leonardo Benevolo's survey of historical center values in 1965（Source：Carlo De Angelis, Forty years later. PEEP Plan for the historic city 1973）

Cervellati was influenced by the Italian urban planner and architectural historian Leonardo Benevolo, who developed a typo-morphology of the urban and architectural heritage of Bologna between 1962 and 1965[37]（Figure 2-26）. Cervellati conducted a general morphological study of the historic center of Bologna (Figure 2-27), paying particular attention to the evolution of streets, plots, and building forms in the five pilot districts over time[32]. And Cervellati builds on Benevolo's study by counting the typology and arrangement of typical public and residential buildings from the 17th century onward, focusing mainly on the fundamental buildings that form the basis of the historic city (Figure 2-28).

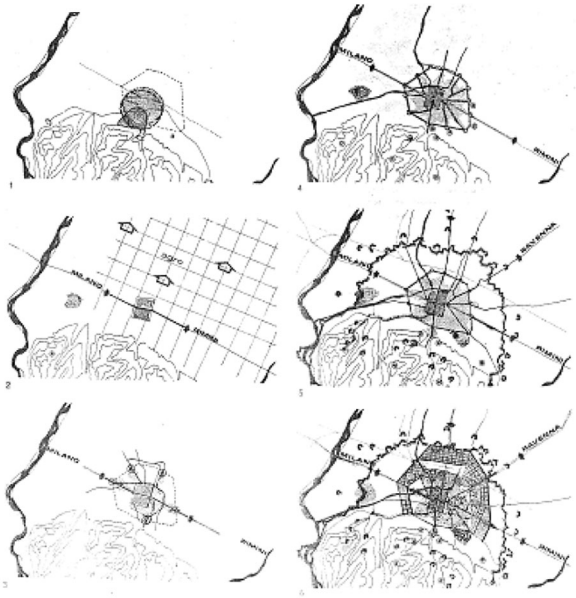


Fig. 2- 27 The general morphological evolution of the historic center of Bologna
（Source：Cervellati, 1965）

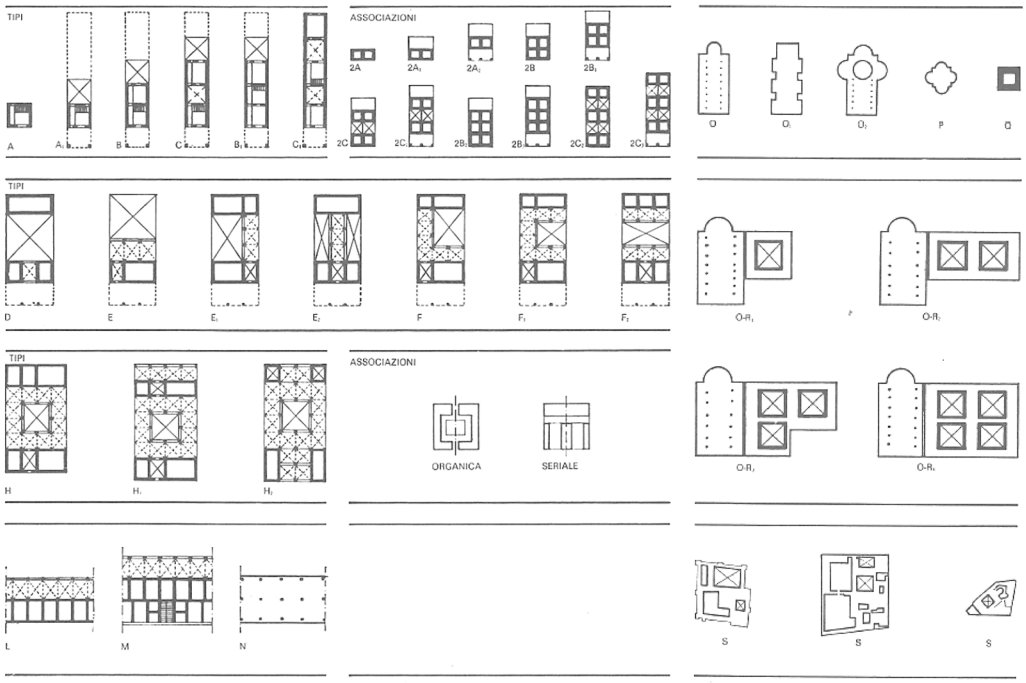


Fig. 2- 28 17th century building types A-C Worker's dwellings and combination patterns with 4-7m wide faces D-F Courtyard houses and combination patterns with 10-20m wide faces H Courtyard houses and combination patterns with 21-50m wide faces L-N Special arrangement pattern dwellings O-Q Public buildings with simple nodes R Public buildings with complex nodes S Unique nodes（Source：Cervellati, 1973）

According to the research results of typo-morphology, the detailed restoration and remediation program mainly includes the environmental improvement of the block, the functional adjustment of the plots and important buildings (adding cultural and educational functions), and the need to protect the business activities of small and medium-sized craftsmen in the concept of integrated conservation. The typo-morphology can be summarized by focusing on three urban elements: streets, plots, and buildings.

First of all, through the building surveys, the repair and improvement of the street level is mainly reflected in the restoration of the colonnade and the architectural interface. Due to the long history of urban development in Bologna, the number of streets and the street profile are relatively mature and rarely change. The street space in Bologna was extremely characteristic, with continuous porch spaces under the first floors of the row houses (Figure 2-29). However, at that time, the demolition and consolidation of many buildings due to the decay of the historic center led to the fragmentation of the

street space, as exemplified by Via Sant' Apollonia (Figure 2-30). Through the analysis of building surveys, the original colonnade and architectural interface were restored in the design, effectively passing on the essence of Bologna's street space.

Fig. 2- 29 Images from photographical census by Paolo Monti（Source：Bologna centro storico, Catalog of the exhibition at Palazzo d'Accursio, Alfa, Bologna 1970）

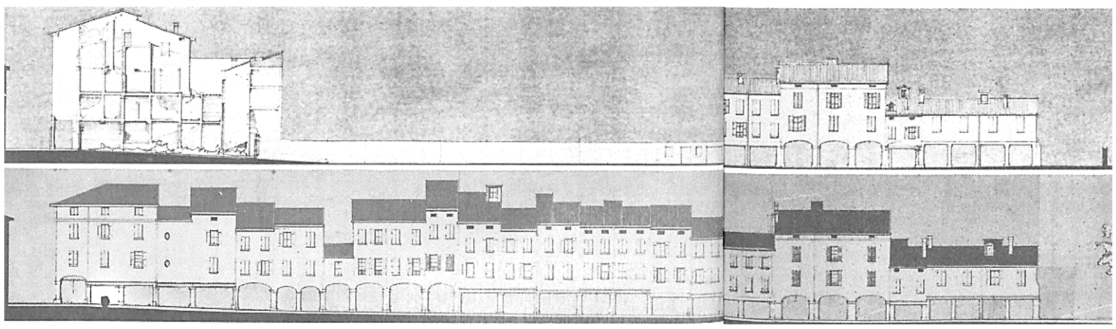


Fig. 2- 30 Current status and restoration design of St. Apollonia Street
（Source：Cervellati, 1973）

A typical example of the application of Italian typo-morphology at the plot level is the planning of the restoration of San Leonardo C in Area 9. Cervellati first compared cadastral maps of the block from 1700, 1833, 1873, and 1965 (Figure 2-31). Again based on the municipal building tax, it is clear that most of the surviving medieval plots have a rectangular shape with narrow widths and large depths. Subsequently, a series of mergers and subdivisions created a large number of irregularly shaped plots whose organizational pattern became increasingly unclear. In the 1960s, due to wartime destruction and shifting land ownership, a number of small plots were merged into larger plots, with the two largest plots on the east side of the block, along San Leonardo Street, vacant (Figure 2-32). To restore the character of the medieval urban tissue and building types in the new design, Cervellati first redivided the large plots, following the plot tissue of the 1700 cadastral map[39] (Figure 2-34).

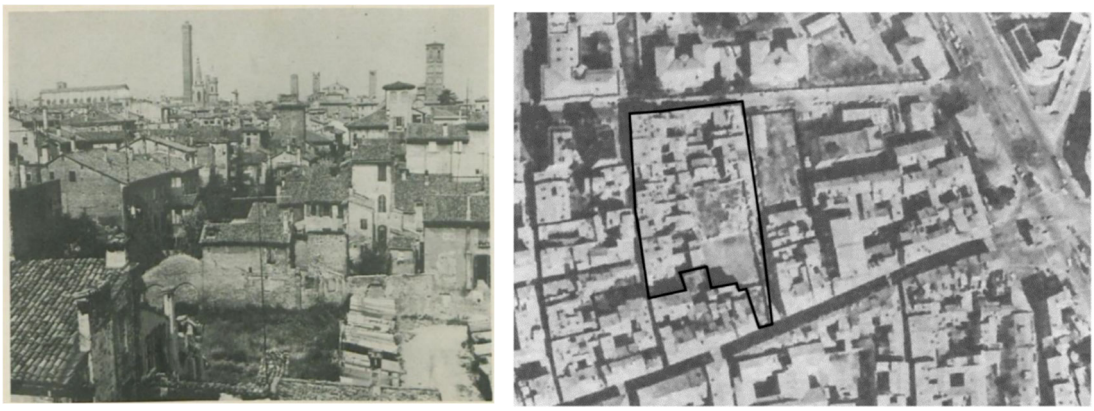


Fig. 2- 31 San Leonardo C block in 1966（Source：Cervellati, 1973）

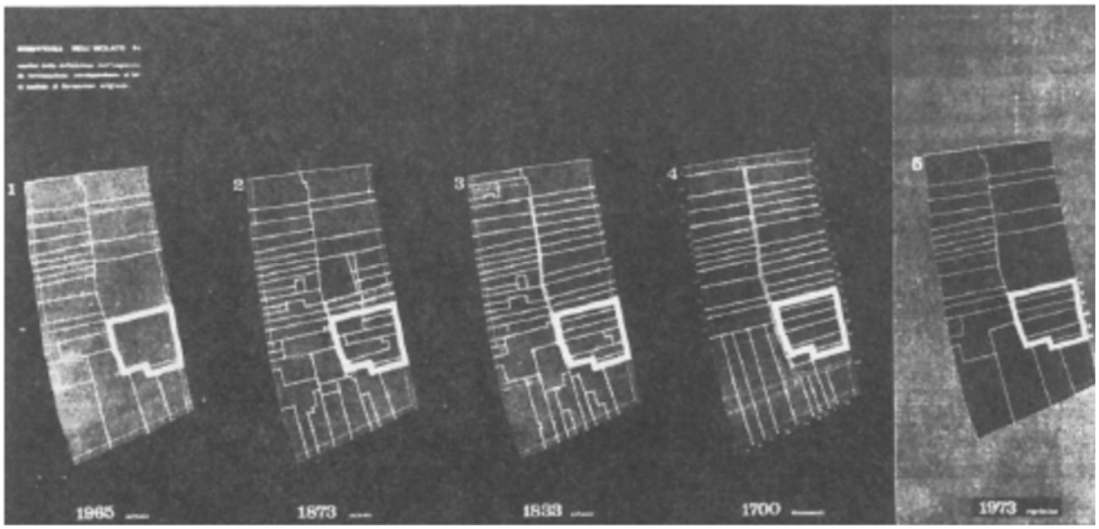


Fig. 2- 32 The revolution of San Leonardo C block plots（Source：Cervellati, 1973）

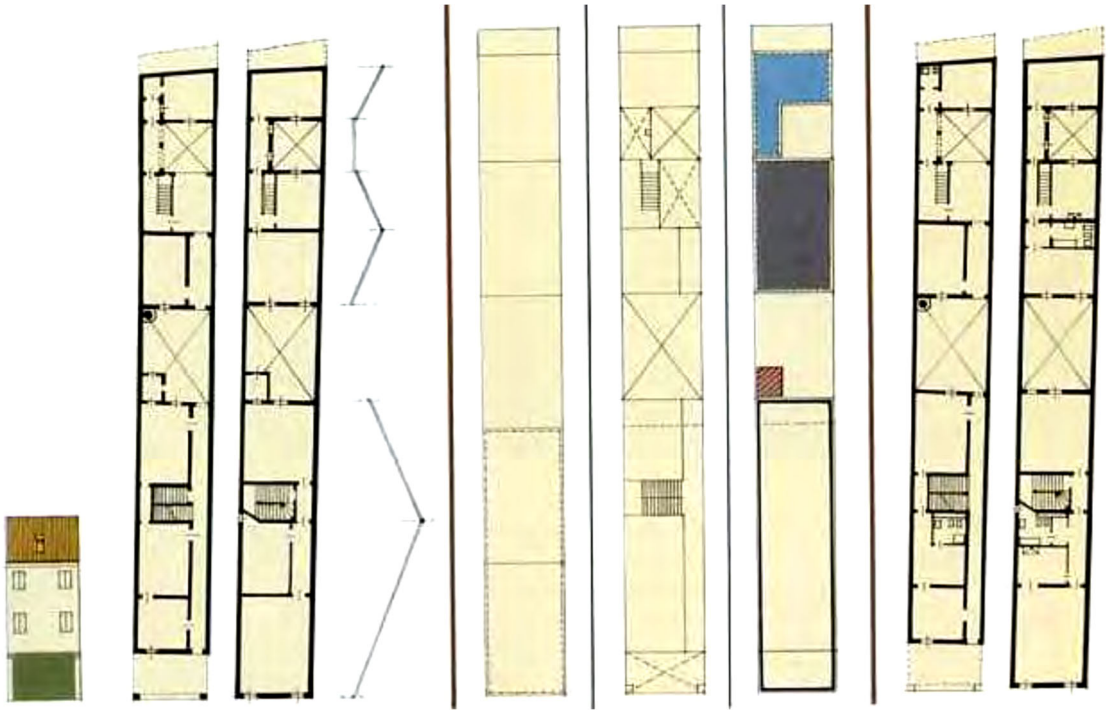


Fig. 2- 33 Building type analysis and design, from right to left, elevation, ground floor, standard floor, roof, land use module, type element, attachment area, and design results
（Source：Carlo De Angelis, Forty years later. PEEP Plan for the historic city 1973）

At the architectural level, he then added new functional modules based on the layout features, roof forms, and land use patterns of various types of traditional buildings to create a new building plan (Figure 2-33). Several different types of floor plans are adapted to the width and shape of the plot and placed in the open space along San Leonardo Street to effectively complement the missing traditional tissue of the site (Figure 2-34). In addition, some low buildings in the center of the site have been cleared and separated by walls according to the plot boundaries to form internal gardens (Figure 2-35).

Fig. 2- 34 Ground floor plan of San Leonardo C. The top picture shows the current situation and the bottom picture shows the design

（Source：Cervellati, 1973）

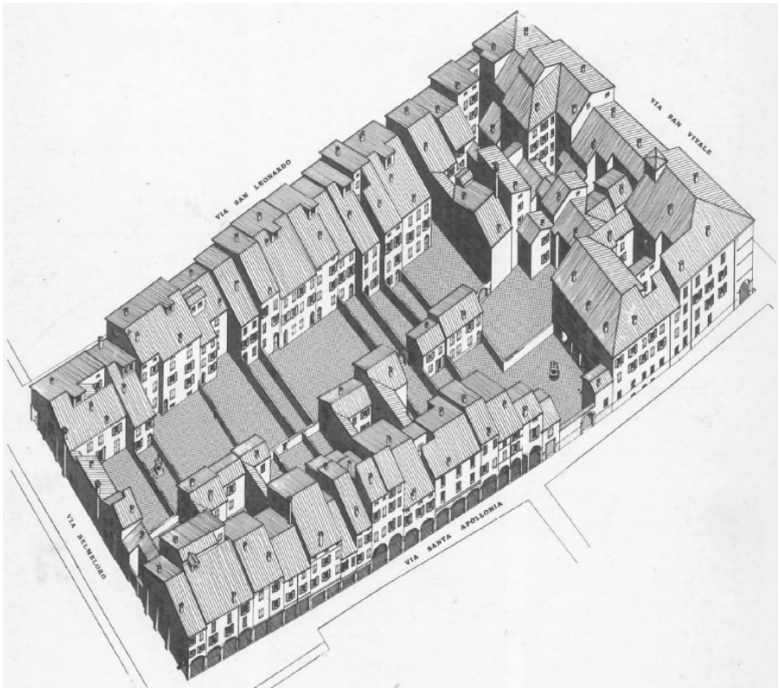


Fig. 2- 35 Axonometric of San Leonardo C block design

（Source：Cervellati, 1973）

Through the analysis and consideration of typo-morphology at the street, site and building levels, guided by the Master Plan, the typo-morphological values of blocks

such as the San Leonardo block have been passed on by Cervellati and are well integrated with the new demands of contemporary life and remain today as areas of high residential quality in the city[38] (Figure 2-36).

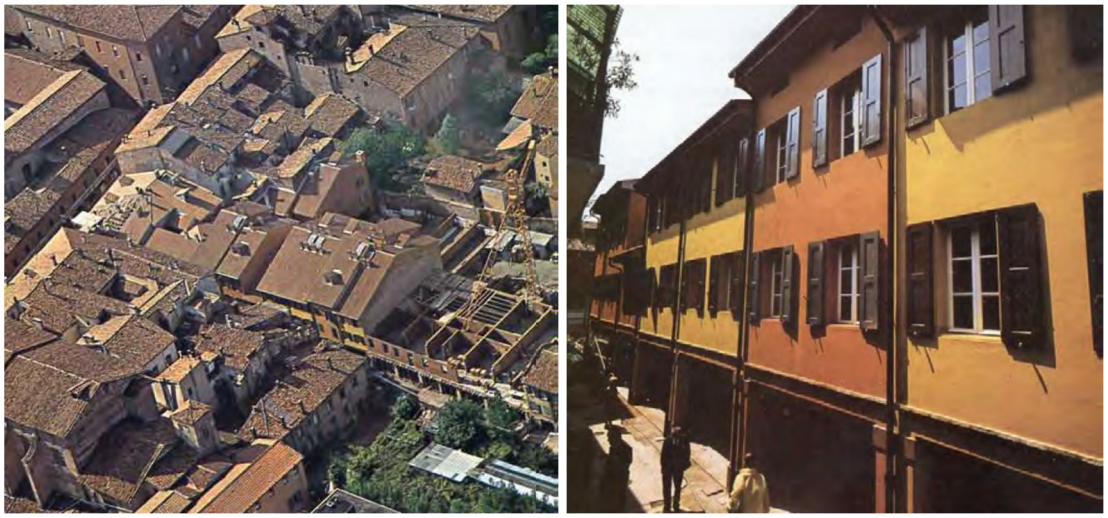


Fig. 2- 36 Current situation of San Leonardo neighborhood（Source：Carlo De Angelis, Forty years later. PEEP Plan for the historic city 1973）

2.5.4 Results and critical thinking

In 1973, the five pilot projects mentioned above were launched under the direction of the government and with direct private participation. The local public sector took the initiative and led the implementation process, with the Bologna government as the center, the departments of planning and urban development as the main executors, the relevant public housing departments responsible for the management and operation of public housing, and the Treasury bearing the bulk of the implementation costs. The private sector is directly involved in the pilot project through 14 "block councils."

By June 1978, the five pilot projects had been completed with a total investment of 4.7 billion lire (17%, 40.4% and 42.6%, respectively) from the City Treasury, the State and the Workers' Housing Corporation (Ges-Cal), representing about 90% of the total investment, with the majority of the investments and projects located in the five residential districts, including housing, social and cultural services and the renovation

of historic buildings. The majority of these investments and projects are located in the five residential areas, including housing, social and cultural services and the restoration of historic buildings, as well as the investment of private owners in the restoration of nearly 250 private homes and 50 stores with a total area of about 27750 m². Indeed, the conservation of Bologna's historic center has meant that the percentage of the population living in the historic center has remained at a relatively stable level over time - 14.15% of the total population in 1991 and 14.5% in 2001, only 1.5% less than in 1971 and significantly less than in other historic centers such as Venice, Rome and Genoa. This is significantly less than the decline in population percentage in other historical centers such as Venice, Rome and Genoa.

Since the 1970s, there have been different evaluations of integrated conservation and Bologna practices in Italy. This is because, although the Bologna practice was based on public interest, the objectives of "social conservation" were not fully achieved, even after the implementation of the project, in terms of number of families and social structure. This is due to the fact that direct government intervention not only ignores the complexity of the market, but also places a heavy burden on public finances and is not sustainable. The over-reliance on local public administration to implement conservation and regeneration projects has made the implementation process too cumbersome and consumed many political and administrative resources. In addition, socioeconomic problems within the historic center remain central, particularly the decay and fragmentation of traditional commerce, public services, and tertiary activities. The reality of the development of the historic center of Bologna in the last 20 years shows that "the conservation of stones, although successful, has not yet been integrated into the overall process of urban development."

Despite the inappropriateness of the timing and the complexity of the realities, the Bologna practice is recognized as having significant historical value in two respects[40]. Theoretically, it proposes that there is "no integrated conservation without social conservation," assuming on the one hand that residents are the primary agents of

historic district conservation, and on the other hand that preserving the vitality of residents is inseparable from the goal of historic district conservation. In practice, the abstract conservation theory is tested and, for the first time, the Italian typo-morphological approach is applied to the conservation and regeneration of such a large historic district, which in fact leads to the conservation of the historic environment of the old town in the process of rapid urbanization, partially preserving the organization of urban plots and building tissue since the Middle Ages and achieving the goal of typo-morphology.

2.6 Summary of this chapter

The theory of the Italian school of urban morphology emerged between the two World Wars. The social environment in Italy at that time promoted the interest of Italian architects in historic urban centers and rural architecture, most notably Giuseppe Pagano and Gustavo Giovannoni. And Muratori was inspired by Giovannoni's theory and teaching, which led him to think about the diachronic process of urban morphological development. The Muratori-Caniggia school of typo-morphology is based on the research and theory of Saverio Muratori, and his academic successor Gianfranco Caniggia systematically elaborated the typological process, and the reading of the urban tissue is defined in a four-scale hierarchical classification system. This paper is mainly concerned with the theories related to the two scales, building and aggregate.

In terms of research methodology, the Italian Muratori-Caniggia school of typo-morphology focuses on the hierarchical system of research and the transformation from research to design. The basis of the relevant research comes from archaeological maps, historical maps, documentary sources and building surveys, which eventually produce a kind of precise drawing material that visually reflects the relationship between the building and the urban environment. Muratori and Caniggia have developed a methodological system that uses building surveys as a basic research

approach to interpret the "urban organism" at different levels, from the city to the material, and more importantly, they want to develop new designs through the understanding of the city.

The specific research process includes (Figure 2-37): first, study the general morphological evolution of the district through historical information, analyze and understand the evolutionary trends of streets, plots and buildings in different periods; based on this, conduct building surveys of the current state of the district and conjectural building surveys of the district's relative maturity period; next, sort out and summarize the evolution of tissue and building types according to the two ground floor plans; in the fourth step, reorganize plots according to the new urban environment and functional requirements, and transform buildings type. Finally, the new building types are filled into the reorganized plots, and the traditional style features are inherited and transformed at the level of structures and materials.

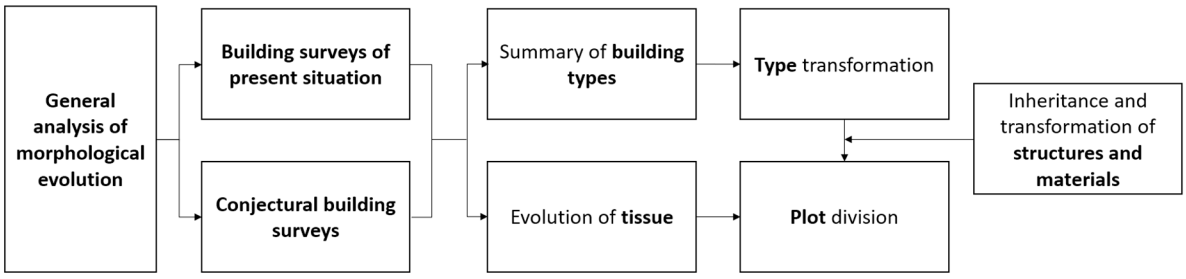


Fig. 2- 37 The main research methods of the Italian Muratori-Caniggia school of typo-morphology (Source: by the author)

CHAPTER 3: RESEARCH FRAMEWORK ESTABLISHMENT OF ITALIAN SCHOOL'S TYPO-MORPHOLOGY FOR CHANGHUA DISTRICT

In this chapter, the important historical and cultural resources of the Changhua historic conservation area are examined, and the contents of the author's site surveys in Changhua district to clarify three important issues related to typo-morphology in Changhua district. Finally, the basic research framework is localized and adapted to the specific situation and historical information of Changhua district, and a research framework of the Italian school of typo-morphology is established for Changhua district.

3.1 Overview of Changhua district

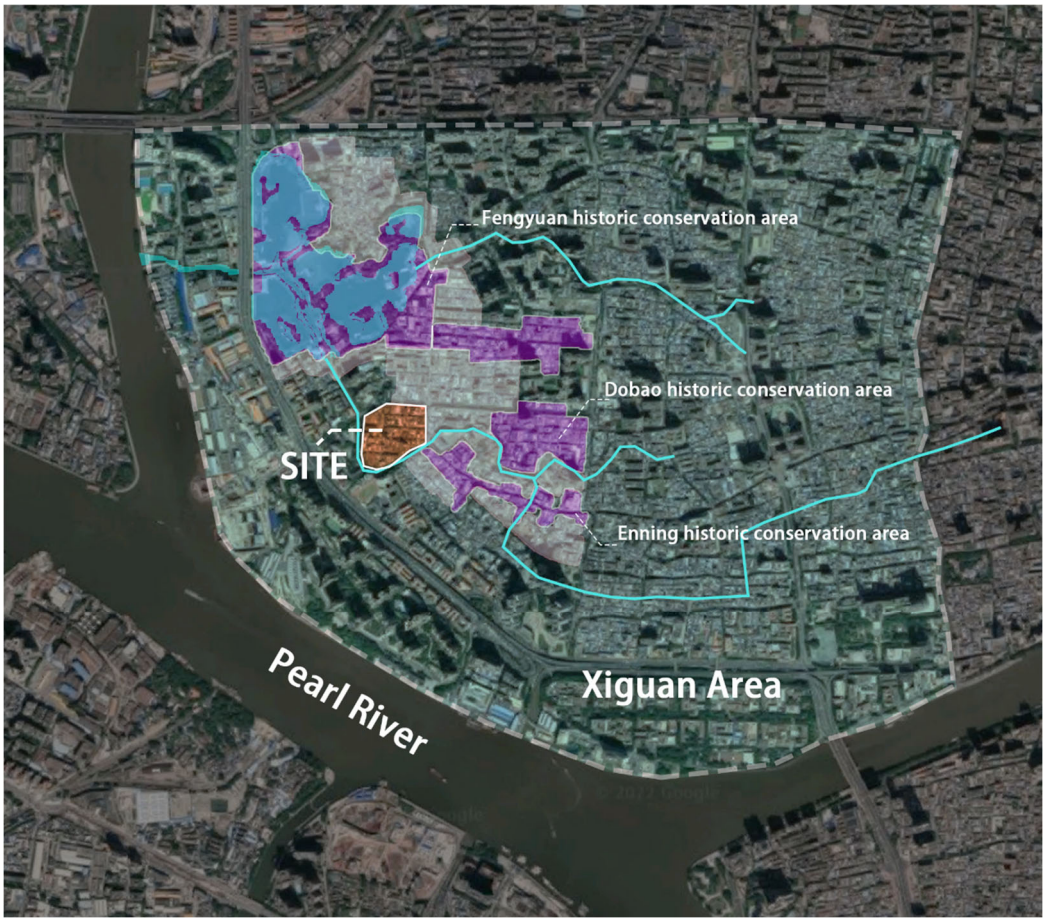


Fig. 3- 1 Location of Changhua district in Xiguan area (Source: by the author)

Changhua district is located at the southwestern end of Guangzhou's Xiguan Area

(Figure 3-1), a high-class residential area with a long building history and late formation in the Xiguan Area. It has developed into a unique existence in the Xiguan area. In this section, Changhua district is briefly introduced from two aspects: the historical and cultural resources and site surveys of Changhua district.

3.1.1 Historical and cultural resources of Changhua district

Changhua district was transformed from a palace to a private garden and from a marsh to a Xiguan residential area, and is an important example of the evolution of the Xiguan area from a palace to a modern residential area. Due to the long period of construction, buildings in the district include almost all of Guangzhou's modern residential building types and reflect the development of modern housing patterns and styles of Guangzhou citizens' housing concepts. Changhua district is known as “the living museum of Guangzhou modern residential buildings”. The neighborhood was mainly built in the middle of the Republic of China and was an important area for westward expansion and development of the Xiguan residential area. It is a typical example of the residential life and social relations of military and political celebrities of the Republican period, such as the revolutionary industrialist Liu Xuexun.

（1）An important example of the evolution of the Xiguan area from an isolated palace to a modern residential area

First, Changhua district is an important example of the evolution of Xiguan area from a private garden to a modern residential area, which has changed from a private garden to a private garden and from a wilderness to a residential area in Xiguan. Due to the low terrain, the area of Xiguan used to be a water field, and the Liu clan of the Southern Han Dynasty established a royal garden here. In the Ming and Qing Dynasties, Xiguan became the main direction of Guangzhou's outward expansion and experienced rapid development after the middle of the Qing period, during which Changhua district also formed. During the great development of Guangzhou Xiguan in the late Qing period and the beginning of the Republic of China, Changhua district

developed a unique charm that was different from other districts. In the early 1930s, the pattern of the district was established. Due to the long construction period, Changhua district formed a street pattern with a square grid of intersecting east-west and north-south streets overlaid by the Changhua River water system, combining the major street morphology of Guangzhou such as boulevards, flagstone streets and riverside streets (Figure 3-2), which has become an important example for the study of the construction history of Xiguan area.

Fig. 3- 2 Major street morphology of Changhua district (Source: by the author)

（2）The living museum of Guangzhou modern residential buildings

Secondly, Changhua district is known as "the living museum of Guangzhou modern residential buildings". Changhua district is a high-class residential area with a long period of time. Unlike other residential districts in the Xiguan area, such as the Fengyuan district, which is dominated by the traditional dwellings of the Xiguan Dawu, and the Dobao district, which is dominated by the traditional dwellings of the nobility in the late Qing Dynasty, the special value of the Changhua district is that the architectural remains in the district include almost all modern residential building types in Guangzhou (Figure 3-3). From the traditional Zhutongwu and Xiguan Dawu of the late Qing Dynasty to the assembled houses of the middle and late Republic of China, it reflects the evolution of modernized housing patterns and architectural styles of Guangzhou citizens' housing concepts.

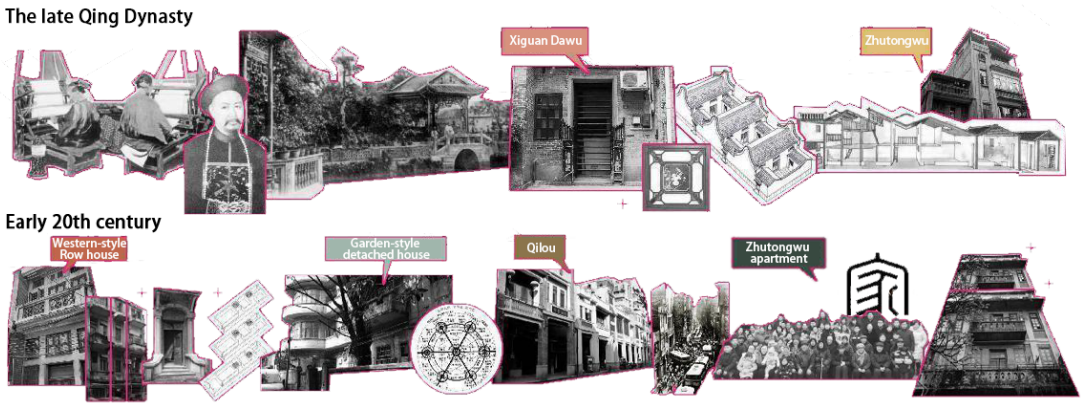


Fig. 3- 3 Changhua district as he living museum of Guangzhou modern residential buildings (Source: by the author)

Zhutongwu and Xiguan Dawu and their modified forms were the earliest forms of buildings that existed during the Guangxu period of the Qing Dynasty, when the Dobao Road was built. Narrow, wide and long houses were built along the road, which were related to the commercial life of the Xiguan area that developed from handicrafts at that time, and were also the result of land development in response to the rapid growth of the urban population. Western-style row houses and villas appeared in the early Republic of China, which were also among the early forms of architecture. Under the influence of the Dongshan Settlement in the early 20th century, housing construction in Guangzhou entered a new phase and western-style row houses appeared. These two forms of architecture once brought a significant number of middle- and upper-income people to this neighborhood. Another important building from the republican period is the garden-style detached houses that were built piecemeal after Liu Yuan was sold in the middle of the republic. These houses had gatehouses, gardens, two- to three-story buildings, with gates wide enough to let cars in, and streets in front as wide as cars can drive today. And the collective housing and row houses of the middle and late Republic of China, which were mainly built in the period from 1929 when Dobao Street was extended to Dobao Road, 1931 when North Ennin Road was extended to Ennin Road, and when Qilou was built, the buildings were about three to four stories, with small gardens in front of the doors, and were the main types of historic buildings in the district today.

（3）A typical example of the residential life and social relations of military and political celebrities during the Republic of China period

More importantly, Changhua district is a typical example of the residential life and social relations of military and political celebrities during the Republic of China period. Most people think of Dongshan in Guangzhou when they think of the area where bureaucrats lived during the Republic of China period. The bureaucrat settlement was the main driving force behind the expansion of housing in Changhua Street. Revolutionary industrialist Liu Xuexun, Chen Jitang's wife Mo Xiuying, He Qichang, China's first director of the Health Bureau, Chen Yaozhu, Chen Qingxuan and other senior officials of the Wang false government lived here. The Changhua district reflects the residential life and social relations of the military and political celebrities of the Republic of China.

For example, the house of Ho Kee Chang at No. 10 Changhua Street (Figure 3-4). He studied medicine at the Sino-French Taomei Hospital in Guangzhou and later graduated from the medical school of the Sino-French University of Lyon. He then served as director of the Guangzhou Health Department for a long time. The He residence was designed in 1934 by Lin Keming, a classmate of his while in France and a famous first-generation architect in China. As a professional with a modern Western medical education who played an important role in the emergence of modern health concepts in Guangzhou, Ho Chi Cheong must have attached great importance to architectural hygiene. Lin Keming's design took full advantage of the site's features and paid special attention to placing windows at each corner of the building to improve ventilation and lighting[42].

More importantly, the intangible cultural heritage value of the former residences of the famous Cantonese opera singers Liang Shaojia and Lang Yunyu (Figure 3-4) at 27, 29 and 29-1 Chang Hua Xin Street. As an important part of Xiguan culture, Cantonese opera developed in the unique geographical and human environment of Xiguan. At that time, many famous Cantonese opera singers settled in the Xiguan area. Liang Shaojia and Lang Yunyu also settled in Changhua district, and these former residences

witnessed the blossoming of the intangible cultural heritage of world-class Cantonese opera. The walls of the entire building have large window openings in the form of Manchurian windows, and the white sand brick walls and detailed stone pavers made of rice reflect the elegant Xiguan style.

Fig. 3- 4 No. 10 Changhua Street, No. 27, 29 and 29-1 Changhua New Street (Source: by the author)

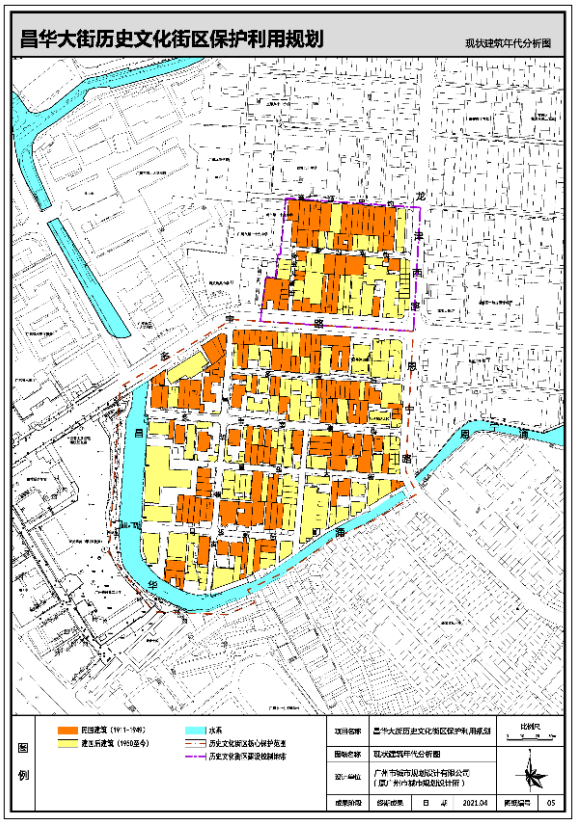
3.1.2 Site surveys of Changhua district

Changhua district has experienced several ups and downs since its rapid construction in the middle of the Republic of China. During the War of Resistance against Japanese aggression, the high-income people who originally lived here moved abroad, leaving houses empty to this day. And at the beginning of the establishment of the country, in order to meet the housing needs, the government expropriated vacant houses, divided a house into several households and flooded the whole neighborhood with more residents, and some houses were directly expropriated by the administration for administrative purposes. And after the reform and opening up, and in the process of remodeling the old city, some government units and factory enterprises took over some residential land in Changhua district to remodel it, and concrete apartment blocks were built in the block. In 2000, the census of historical buildings and the exploration of the historical city began, until now, the policy of reconstruction and rebuilding has been tightened. The old buildings in the block are 80 years old on average, most of the houses are aging and can not be repaired or can be repaired with difficulty Most of the houses are aging and those that can not be repaired or can be repaired with difficulty

have been rented and are empty. The site surveys in Changhua district can be divided into two aspects: the physical environment and the social environment.

（1）Physical environment

According to Chinese construction standards, the durability of the main structure of residential buildings is 50 years. The buildings in Changhua District are mostly made of bricks and wooden structures that have long exceeded their reasonable lifespan (Figure 3-5), and most of them were built more than 80 years ago. In addition, the ownership of houses is scattered and difficult to define for complex historical reasons, and the infrastructure in the district is not sufficiently repaired and upgraded, resulting in the deterioration of the district's physical space, aging buildings, outdated infrastructure, and a relatively backward living environment.



The orange color in the figure represents the houses built in the Republic of China (1911-1949)

Fig. 3- 5 The age of buildings in Changhua district（Source：Conservation and Use Planning of Changhua Historic Conservation Area）

①Building performance

Most of the buildings in Changhua district were built in the late Qing and early Republican periods. The building functions, materials, technologies and supporting facilities of that period are extremely backward compared to today. Over time, buildings in the district have deteriorated, been damaged or even collapsed to varying degrees, have inadequate functions and outdated equipment, and most buildings have structural and fire safety deficiencies.

The building types in the neighborhood are mainly row houses such as Zhutongwu and Zhutongwu Apartments. Due to the age and change of owners, as well as the deterioration of the houses themselves, as the functions of the old-style houses can no longer meet the requirements of modern daily life, residents are increasingly building their own private houses, most of which are privately built on roofs and balconies with additional sheds and slabs (Figure 3-6). Unauthorized illegal construction and alterations are a serious problem.

Fig. 3- 6 Private construction and reconstruction phenomenon (Source: by the author)

Residents in the district due to private funding, the building exterior wall finish peeling, broken, most forms of repair inside the building do not pay attention to, and the materials and construction techniques are sloppy, the exterior wall is arbitrarily painted or added porcelain tiles, the exterior wall has the characteristics of mountain flowers, wall gray plastic, pediment and other decorative simple repair, color chaos; air conditioning host frame, safety net, canopy, drying rack arbitrarily added, the building exterior wall is extremely chaotic. These new components have no unified management and coordination, destroy the morphology of the district and lose its

former elegance (Figure 3-7).

Fig. 3- 7 Architectural façade confusion phenomenon (Source: by the author)

The other side of the aging building performance in the district is the very poor quality of the residential environment. The old buildings in the neighborhood are on average 80 years old, and although some residents have improved their living environment at their own expense in the ways described above, most of the houses are aging and cannot be repaired or can only be repaired with difficulty. Most residents in the neighborhood live in a chaotic, poorly lit and ventilated environment (Figure 3-8).

Fig. 3- 8 the poor quality of the residential environment in Changhua district (Source: by the author)

②Infrastructure and public service

Infrastructure and public services are two important structural systems in the historic conservation area. Infrastructure guarantees the livelihood of residents, while public services determine the quality of daily life. During the research, the author found that,

on the one hand, the system of basic municipal services in Changhua district still not fully developed, and the lack of a perfect water supply and drainage system and fire-fighting measures makes it difficult to meet the requirements of modern functions. On the other hand, the existing public service facilities and supporting facilities in Changhua district are very poor (Figure 3-9). Apart from fulfilling the basic transportation function, there are almost no other public activity spaces and green areas in the district, and there is a serious lack of activity places suitable for the elderly and children. Because building land is relatively scarce in Changhua district, the number of public toilets, sanitation facilities, garbage collection points, medical and health stations, community service centers, and neighborhood cultural activity centers is very inadequate and unevenly distributed.

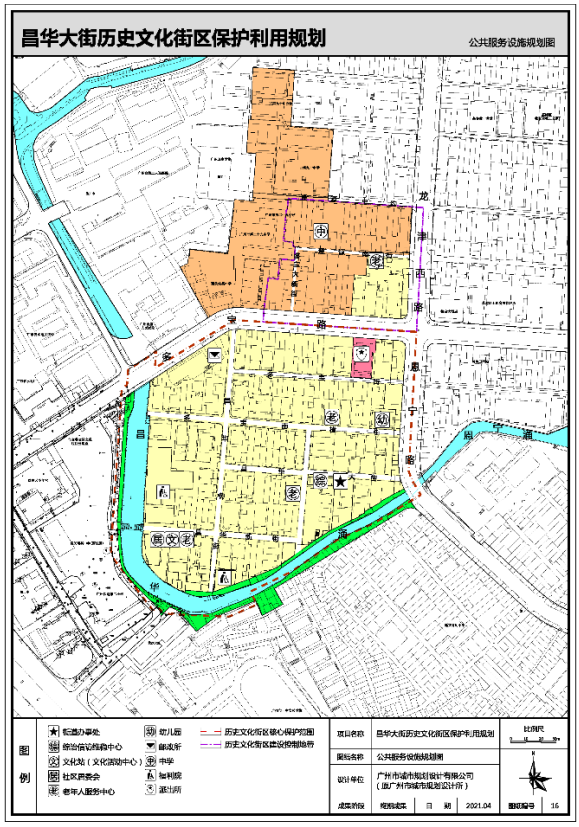


Fig. 3- 9 Planning of public service facilities in Changhua district（Source：Conservation and Use Planning of Changhua Historic Conservation Area）

③Historic buildings

According to *Conservation and Use Planning of Changhua Historic Conservation Area*

(2021), 8 immovable cultural heritage sites in Changhua district, including 1 district protected historic sites (the former residences of famous Cantonese opera singers Liang Shaojia and Lang Yunyu), 7 district registered protected historic sites, and 18 government-licensed "historic buildings" (Figure 3-10).

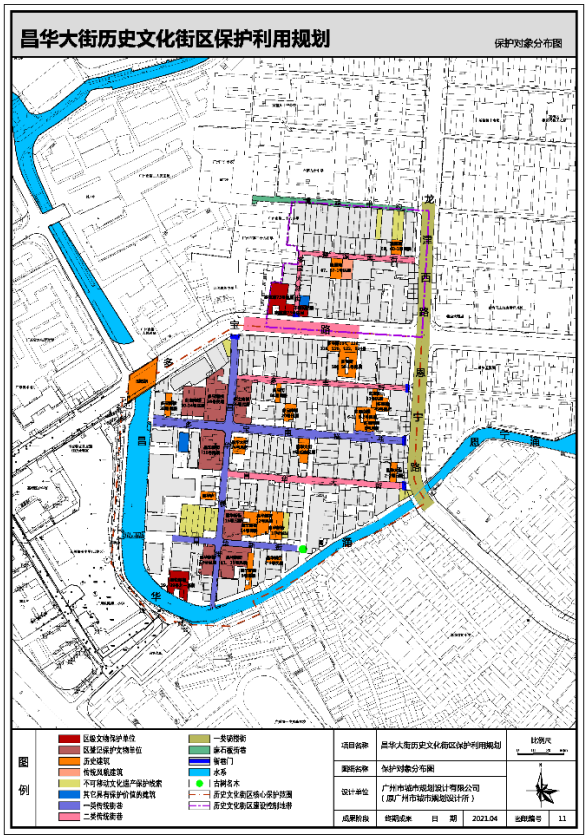


Fig. 3- 10 Historic buildings of Changhua district（Source：Conservation and Use Planning of Changhua Historic Conservation Area）

Although there are detailed regulations for the retention of these historic buildings in the *Conservation and Use Planning of Changhua Historic Conservation Area*, the author found eight valuable historic buildings that were vacant and in disrepair. Most of the main structures are intact, but the exterior walls, windows, doors, and some detail components are damaged and missing.

Fig. 3- 11 Vacant historic buildings in Changhua district (Source: by the author)

（2）Social environment

①Population composition

According to the survey, Changhua district is mainly composed of low- and middle-income people, with a current household population of about 4,400, of which 3,300 are permanent residents (Figure 3-12). Currently, more than 1,100 elderly people aged 60 or more have been living in Changhua district for a long time, accounting for 25% of the total population; young professionals who rent here for a short time account for about 12%, and their jobs are usually located nearby (e.g., hospitals); the remaining residents of Changhua district account for 38% of the total population. And according to the "2020 Guangzhou Aging Development Report and Elderly Population Data Book", the proportion of elderly aged 60 and above registered in households in Guangzhou in 2020 is 19% of the household population, the situation in Changhua Street far exceeds this figure. They have lived in the area for 20 to 50 years, and their children have moved out because of the poor living conditions, while the elderly are accustomed to the residential atmosphere of the neighborhood.

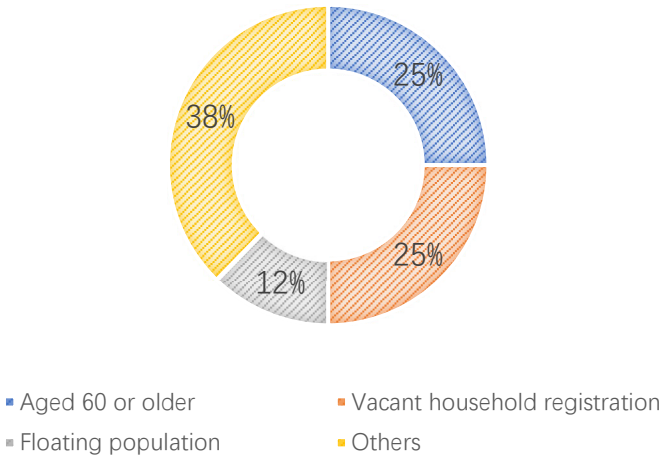


Fig. 3- 12 Population composition of Changhua district (Source: by the author)

②Daily behavior

Fig. 3- 13 Daily behavior of residents in Changhua district (Source: by the author)

Through the analysis of the pastimes of the residents in the neighborhood, it can be found that the residents are more interested in strolling in the streets and alleys, chatting with each other, working out, and some recreational activities during their leisure time, most of which occur in the few small public spaces in the neighborhood and some tables and chairs placed in the streets and alleys by the residents themselves (Figure 3-13). According to the visit, there were many recreational activities held under the big banyan trees in the neighborhood before, but now many trees have been cut down and many activities cannot be held. This also shows that the shape of the neighborhood and the habits of the residents complement each other and influence

each other.

3.2 Problems related to typo-morphology in Changhua district

By researching and studying both the historical and cultural resources and the present environment of the Changhua historic conservation area, the author has found and summarized three main problems related to the typo-morphology in the present district: first, the destruction of the district's morphology by the independent construction activities of the residents, and second, the inability of the old building types to adapt to modern life, which has finally led to a serious waste of the historical and cultural resources of the Changhua district.

3.2.1 Damaged morphology of district

Over time, residents adapt the traditional zhutongwu to the functional needs of different periods by constructing or demolishing it and transforming it into a modern zhutongwu with a apartment roof and several floors, allowing the building to be renewed. Although this process is relatively slow, autonomous renewal is often an architectural activity that is carried out without regulatory constraints and eventually leads to some damage of the morphology of the Changhua district, which is driven by profit (Figure 3-14).

On the one hand, the independent construction has led to the "overbuilding" of the patio, the partial covering of the alley, and a significant increase in the density of buildings in the district. The traditional Zhutongwu is relatively old, small and with inadequate facilities. In order to meet the new functional requirements, the patio is covered with a tin roof, resulting in a serious lack of indoor lighting and ventilation. The space in the courtyard is gradually eroded, and the spatial pattern of the original Zhutongwu is damaged. Modern apartment roof Zhutongwu also have a large number of erections, such as roofs without strict insulation and waterproof construction, with the increase in the length of the use of the building, exposure to the sun, water leakage and other problems arise, the residents themselves to solve the long solution is to add

a layer of tin slope roof on the apartment roof, simple double roof can indeed be a direct and effective solution to the problem, but damage the historical appearance of the neighborhood. Even if the Zhutongwuapartment roof is built with better construction quality, there is still the construction of tin roof on the roof surface, which is used for drying clothes. In addition, the construction activity has expanded to the alleys, and the canopies built at the entrances and exits of each house have even covered some traditional alleys with narrow scales.

On the other hand, the independent renovation of residents has resulted in the creation of numerous zhutongwu that do not conform to the historical style. The result is a mixture of old and new with different heights, which destroys the unity of the streetscape. When the functions of the traditional zhutongwu no longer met modern housing needs or appeared as aging problems, households in Changhua district who were financially able to do so decided to demolish the old buildings and rebuild them into multi-story zhutongwu that better met their needs. The zhutongwu is generally taller than the traditional zhutongwu, and the passive green technology of the patio was removed and air conditioning was used to regulate the temperature and air circulation. In addition, due to the lack of professional architectural knowledge and esthetic ability of the traditional buildings or the need to show their financial strength, the rebuilt apartment-roofed zhutongwu have chosen different colors of tiles as finishes and even compete with each other for height, resulting in some zhutongwu being up to five stories high.

Fig. 3- 14 Current confusing morphology in Changhua district (Source: by the author)

3.2.2 Contradiction between living environment and modern life

With the exception of a few traditional dwellings, most of the interiors are dilapidated and vulnerable, and the tile roofs of many dwellings are dilapidated and have been replaced only by iron sheets. Many of them still require electric light during the day. The floor under some porches is slippery, mosquitoes are abundant, and in summer the rooms are hot and humid, seriously damaging the physical and mental health of the residents. The poor living environment has led to low vitality in the district. Residents have gradually moved out of the area, and some of the traditional houses are even vacant and abandoned without repair (Figure 3-15). Unlike independent building behavior, which increases building density, aging manifests as a decline in the tissue, and both also show the fuzzy condition of building tissue. In addition, the phenomenon of aging is a more urgent situation, and if it is not repaired in time, the traditional Zhutongwu, of which there is not much left, will be in danger, and then the historical morphology of the historic conservation area may be lost.

Fig. 3- 15 Living environment can not adapt to the needs of modern (Source: by the author)

3.2.3 Waste of historical and cultural resources

As described in the previous, the three historical and cultural values of Changhua district are summarized in the morphology and building types of the district. In recent years, Changhua district, which was originally a high-quality residential area with beautiful surroundings in Xiguan district, has become one of the low-quality districts with confusing morphology due to the independent construction activities of the uncontrolled residents and the deterioration of the construction performance. As a result, the original historical and cultural resources in Changhua district wasted, and the characteristic spatial form of the district and the many historical buildings and intangible historical values behind them are gradually forgotten. Only by applying a adaptive typo-morphology method to read, analyze and interpret the built environment of the district, and using the analysis results to carry forward the essential features of the existing morphology and types in new urban planning and architectural design projects that can both inherit the historical culture and adapt to the new living needs, can we make good use of the original historical and cultural resources of Changhua district and make Changhua district shine in a new development context.

3.3 Research framework for Changhua district based on Italian school

Continuing the existing morphology of the district and exploring building types that can adapt to modern life and adopt traditional typological qualities are the core issues related to typo-morphology in Changhua district. Based on the theoretical framework

and practical cases of typo-morphology described in the previous chapter, we can see the active role of typo-morphology in the conservation and regeneration of such historic conservation area.

However, traditional typo-morphology research is rooted in the building context and cultural traditions of Western cities, and the differences in cultural, political, and building traditions between China and the West make it impossible to directly apply traditional research methods to this study. First, traditional typo-morphology is based on the study of detailed historical map data in the West, while such historical resources are scarce in China. Second, unlike the construction of Western cities, traditional Chinese cities have unique formation concepts and morphological type characteristics that require a re-examination of the original research scale. Therefore, in the face of a series of problems and challenges related to the localization of theories and methods, the original methods need to be adapted to establish a research framework of the Italian school of typo-morphology suitable for Changhua district in Guangzhou.

3.3.1 Overview of historical information for the research

As mentioned above, studies of typo-morphology usually rely on historical maps and documentary sources from different periods, which not only influence the selection of morphological elements and the division of development stages, but also determine the depth and breadth of the analysis. Whitehand believes that in both Europe and North America, most analyses of typo-morphology have been based on in-depth studies In Europe and North America, most analyses of typo-morphology have been based on detailed information such as cadastral maps and topographic maps, but there is very little such information in early China. The research object is located in Liwan District, Guangzhou, and the historical map data for this paper are listed below.

Chorographic maps: the only maps that reflect the entire city of Guangzhou in historical documents since the Ming and Qing dynasties are chorographic maps in local chronicles. These historical maps were drawn using the chorographic method and

reflect only the approximate street pattern of the city, the outline of the city walls and the location of the city gates, and the location of important temples, mansions and landscapes. Moreover, these important features are depicted in a "symbolic" form, making it difficult to trace their actual conditions. Some maps of the entire city of Guangzhou were printed in the *Guangdong General Records, the Nanhai County Records, and the Panyu County Records,* as well as some independent official chorographic maps, such as the *"Chorographic Maps of Guangzhou Prefecture, Guangdong"* (1685-1722) and the "*Chorographic Maps of Guangzhou Prefecture* (1685-1722). "*Guangzhou Prefecture* (1685, with 'Guangzhou Prefecture said')", "*Guangdong Province Map*" (1692), etc.

Cadastral map: In the Republic of China, a comprehensive survey and mapping of Guangzhou's land holdings was begun. The Municipal Bureau was established in 1918 and formally carried out warp boundary survey (cadastre) and administrative area survey and demarcation, as well as the preparation of cadastral maps. At the beginning, the English unit of length was used and the scale of mapping was 1:600. In 1933, the metric system was changed and the scale of mapping was changed to 1:500 accordingly. By the 26th year of the Republic of China (1937), a general resurvey of the cadastral map of the city centre was carried out and a total of 543 cadastral maps were completed. The drawings reflected the plot boundaries and the resulting plot series and street systems. However, these warp maps do not contain information about the extent of building on the plots, and the layout of the buildings can only be roughly deduced from the fact that the houses were built at the time when they basically covered the entire plot.

Maps drawn by foreigners: After the Xianfeng period of the Qing Dynasty, maps of Guangzhou city began to appear, drawn by foreigners using modern methods. The earliest historical map I have reviewed is the "*Map of Guangdong Province*" (1851-1861) by D. Vrooman. This map, as well as the later "*Map of Guangdong Province*" (before 1900) and the 1:5,000 "*General Map of Guangdong Province (with Henan)*"

(1907) by German architect F. Schnock, show the city in color. Guangzhou. These maps use certain projection methods and basically accurately reflect the location and shape of the landscape. Among them, F. Schnock's drawing shows the entire city of Guangzhou in the most detail, but its subtlety is limited to showing the street system at that time.

Topographic maps: In the Republic of China, the Military Survey Bureau and the Guangzhou Public Service Bureau produced a series of military topographic maps and maps of Guangzhou city based on the original topographic maps. Among them, the map "*One Ten Thousandth of Guangzhou City*" (1928) completed by Guangdong Army Survey Bureau is the earliest and most comprehensive and detailed map of Guangzhou city and its surroundings among the historical map materials I have reviewed. The map consists of a general index map (with descriptions) and 13 sub-maps, produced in color and combined in a consistent style to reflect the features of the city and surrounding areas. The built-up areas are shown in red blocks, and the main road network of Guangzhou city is clearly visible.

Other historical maps: In the Republic of China, drawings were made for the police boundary and city plan, based on military topographic maps. At that time, several editions of detailed street maps of Guangzhou were printed by some industrial companies and publishers. These street maps mainly show the location and names of major streets, roads and villages in center of Guangzhou.

The historical information mentioned above, of which there is a great variety, can only be used in part in this study. Chorographic maps, because they were made by the scene-drawing method, lack an accurate coordinate system as well as information about many important ground levels, making a comprehensive morphological study difficult. In contrast, the maps that appeared in the late Qing Dynasty and were drawn by foreigners were more accurate in locating geomorphic features and recorded a sufficient amount of ground elements to support the study of this paper. The *Cadastral Map of the Republic of China*, drawn in the 1920s and 1930s, was the first cadastral

map to record land ownership boundaries in Guangzhou, and is one of the important historical materials for the research. And the topographic maps since the Republic of China, which all record various elements in detail, are an important support for this study. There are also documentary sources such as the local chronicles of Liwan District and the construction of Xiguan, which support the historical research of this work.

3.3.2 Research hierarchy

As stated in the previous section, the Muratori-Caniggia school of typo-morphology theoretically constructs a progressive scale relationship from the material to the city. In the research design of Florence and in the specific case of Bologna, since the object of research is district, it is studied and designed according to the hierarchical sequence from tissue, building and room, structure and material, but it also reflects attention to the street space. The reason for this hierarchy is that in European cities, due to the long period of construction of the city, the street and the street outline are relatively stable elements and the most changeable element in the scale of district is often the tissue within the street outline.

However, in Chinese cities, with the acceleration of public land ownership and urban construction, phenomena such as land consolidation and construction in different cities are common, and streets and plots often lead to sudden changes, resulting in an abrupt change in urban morphology. Therefore, the first factor for the conservation and regeneration of historic districts is the structure of streets and organization of plots. And it happens that the most important parts in the analysis of the tissue are the street and the plot. The street defines the boundary of the historic district and establishes the internal tissue structure, while the organization of the plot represents the hidden order of the tissue of the district, which together express the boundary shape and structural order of the historic district. Only when we analyze them in detail can we see the tissue. Therefore, street and plot are two important research elements in this study.

After analysing the streets and plots, attention turns to the hierarchy of buildings and rooms, which outwardly reflects the tissue characteristics and inwardly considers the different functions of use and residential pattern. The buildings and structures of the different areas and periods have been built with different materials and construction methods, and the structures and materials concretely reflect the characteristics of the morphology of the historic district[43].

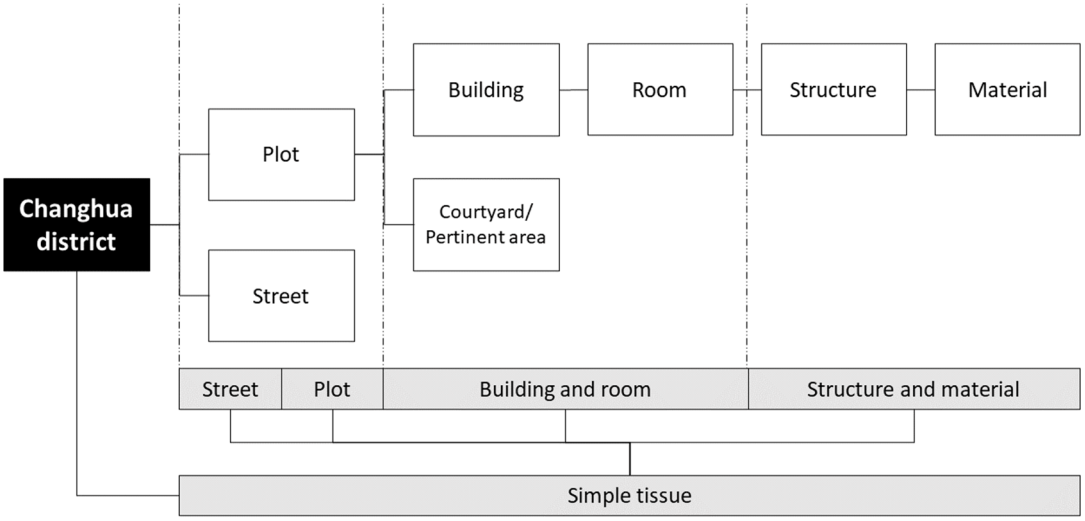


Fig. 3- 16 Research hierarchy of Changhua district (Source: by the author)

Therefore, in this paper, the Changhua historic conservation area is considered as the main research object. In order to concise the content of the research, the author tries to start the typo-morphology of Changhua district at five levels: simple tissue, street, plot, building and room, structure and material. The author tries to start the typo-morphological analysis of Changhua district on the five levels of simple tissue, street, plot, building and room, structure and material, from macro level to micro level. After summarizing the characteristics and evolution rules of the latter four levels in different historical periods, we get the simple tissue, and the different simple tissue collages together form the richness and complexity of the historic conservation area. And the division of the simple tissue is also helpful for establishing design guidelines for conservation and regeneration in future.

3.3.3 Research framework

Through the above overview of historical information and the adaptation of the research hierarchy, a typo-morphological framework was formed for this study, consisting of five elements and four steps. The five elements include simple tissue, street, plot, building and room, and structure and material described above. The four steps are: The first step is to study the general morphological evolution to understand the formation of the district tissue and to determine the period of the building surveys. The second step is to conduct the building surveys of present situation and relatively mature period, and to determine the ground floor plan of both periods. These two steps are based on the historical background of Changhua district development, documentary records and historical maps. In the third step, the typo-morphological analysis is carried out at each level, mainly by comparing ground level plans in the second step. In the fourth step, the general design and design guidelines are prepared based on the results of the typo-morphological analysis, and the specific urban designs are carried out under the guidance of both (Figure 3-17).

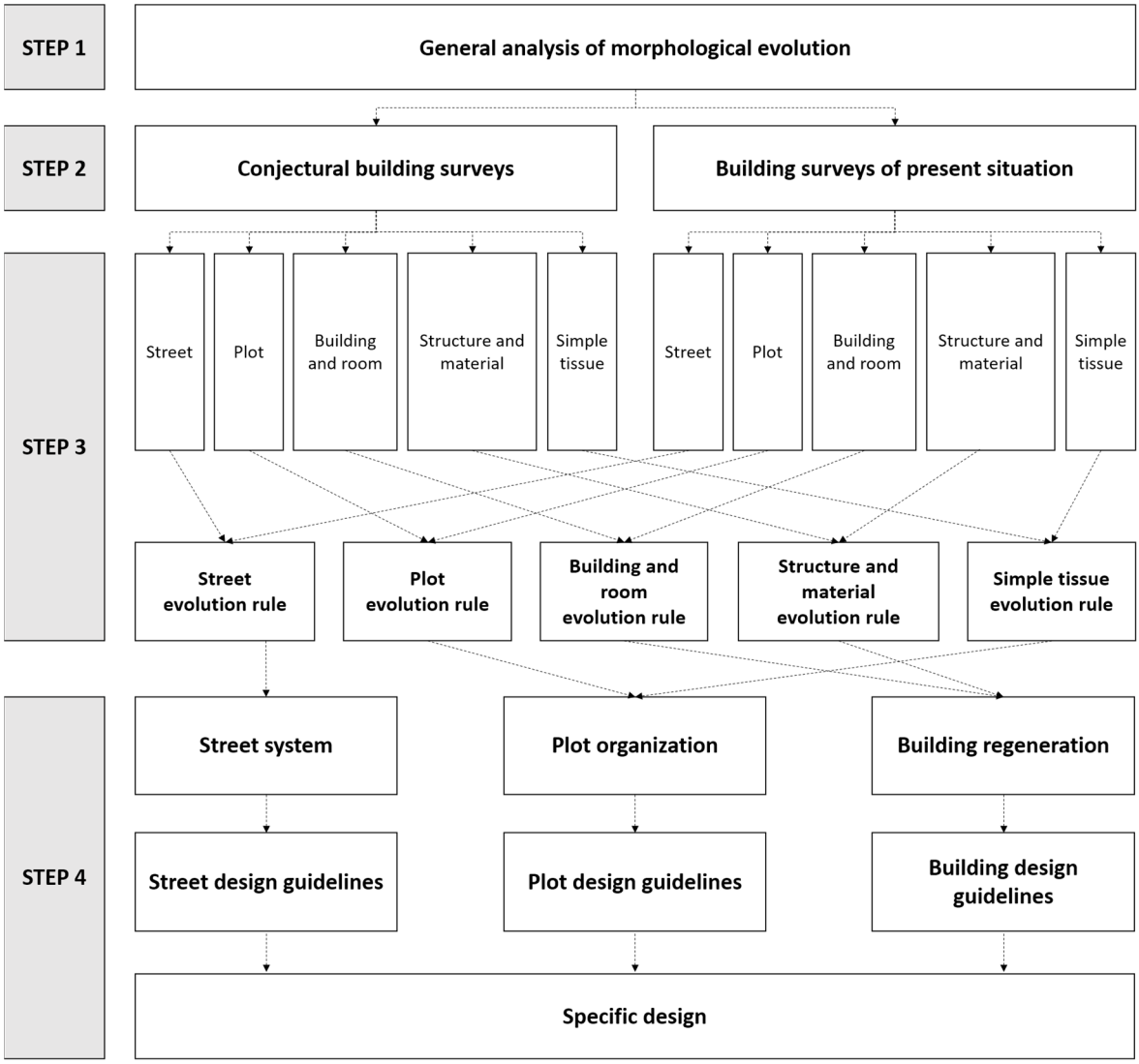


Fig. 3- 17 Research framework of Italian school's typo-morphology for Changhua district (Source: by the author)

3.4 Summary of this chapter

This chapter first presents the three main historical and cultural resources of Changhua district and the results of site surveys, and sorts out the three major problems related to typo-morphology, such as damaged morphology of district, contradiction between living environment and modern life and the waste of historical and cultural resources in Changhua district.

Further, although the theory and methodology of the Italian school of typo-morphology has played an important role in the evolutionary research and the regeneration of the

historical center of Western cities. However, in the typo-morphological study of Changhua district, the direct application of traditional research methods still faces many contradictions and challenges. On the one hand, the typo-morphology research method takes historical information of different periods as the main research foundation, while the traditional maps of Chinese cities usually cannot meet the accuracy requirements of research. The lack of historical information is the most fundamental obstacle to the application of typo-morphology method, and in practice, it is necessary to redraw the maps through detailed site surveys and reasonable speculation on historical information. On the other hand, there are differences in urban design and cultural background between China and the West, so the application of the research hierarchy must be specifically adapted to the research object.

Based on the overview of the historical information for the research and the adjustment of the research hierarchy, an Italian school typo-morphological framework is established for this study. Through the typo-morphological analysis of the five elements and the four research steps from analysis to design, a complete theoretical application method for Changhua district is developed.

CHAPTER 4: TYPO-MORPHOLOGICAL ANALYSIS OF CHANGHUA DISTRICT

As mentioned in the previous chapter, Changhua district is located in Liwan district of Guangzhou. The spatial form of the district is unique, rich in architectural types and historical and cultural heritage, which is an extremely vivid carrier of the development history of Guangzhou's modern residential district. Changhua district has important historical value and status. This chapter mainly applies the Italian school of typo-morphological analysis to Changhua district, and combines it with historical maps, documentary materials and on-site surveys to analyze the typo-morphological features and evolution rules.

4.1 General morphological evolution

By tracing the historical development of the Changhua district, it is possible to analyze and speculate on the evolution of streets, plots and building forms in general over different periods. This process is influenced by many factors and can be reconstructed from historical documents and maps, which will eventually produce a theoretical model of the process of formation and transformation of the urban tissue of the Changhua district. The diachronic analysis of the general morphology is the first step in understanding the block and is the basis for subsequent conservation and regeneration. As mentioned above, since the mapping information of the Changhua district is not sufficient, the study of its morphological evolution requires a comprehensive understanding and analysis of the evolutionary process in the context of the overall morphological evolution of Xiguan.

The Xiguan Plain, which is geographically advantageous, was once a watery field before it was developed due to its low terrain. After the construction of Xicheng in the Song Dynasty, Xiguan became more crowded and became the main direction of Guangzhou's outward expansion in the Ming and Qing Dynasties, and entered a period

of rapid development after the mid-Qing Dynasty. According to the data, its construction can be roughly divided into three stages: the first stage, as a result of the spillover of the Dobao district to the west, the construction of the Changhua district began around 1900; the second stage, from 1907 to 1924, the Changhua district began to be influenced by the completion of the Fengyuan district to the north, and the tissue gradually changed; the second stage, from 1907 to 1924, the Changhua district began to be influenced by the completion of the Fengyuan district to the north, and the tissue gradually changed. In the third stage, Changhua district was influenced by the municipal improvement plan of Guangzhou and the garden-style houses, and was basically built up in 1936.

4.1.1 Background of the development of Xiguan area

The Xiguan area of Guangzhou, where Changhua district is located, is strategically located with a network of rivers, which is conducive to agricultural production and garden construction. There is a large fertile plain, Xiguan Plain (Figure 4-1), which is the center of Guangzhou's waterway, and water transportation is very convenient, outside the river is wide and deep, inside is deep and accessible.

Fig. 4- 1 Map of Guangzhou Prefecture (Source：《广州历史地图精粹》)

During the Five Dynasties and Ten Kingdoms period (around 950 A.C), Liu's court of

the Southern Han Dynasty built a large number of palaces and gardens in Lijiwan, Xiguan, more than 30 miles wide, where the word "Changhua" originated.

Before the Sui and Tang dynasties, the Xiguan area was full of rivers, wells, ditches and ponds, before the formation of land, and gradually became shallow land by the Sui and Tang dynasties. At this time, Guangzhou City basically determined the pattern of urban development, but did not include the Xiguan plain. At that time, a dike was built near Liwan River and lychees were planted, forming the landscape of "Liji Fish Pond". After the Song and Yuan dynasties, the Xiguan Plain was continuously developed and trade activities gradually flourished, with the earliest commercial aggregate in Xiguan appearing in the present-day Xiagiu Road. With the opening of the Daguan River in the Ming Dynasty, the Xiguan area was further developed. By the end of the Ming Dynasty, eighteen "pu" were established along the Xilhao and Daguan River, which were conveniently located along the Xilhao and Daguan River, and the area around the eighteen pu was still a natural village. At this time, 3-4 east-west roads and some north-south roads were built in Ming Dynasty, forming a road system with a grid network of roads in Xiguan[44].

As a part of Guangzhou Xiguan, the sprouting of Changhua district was the result of the gradual outward expansion of the built-up area of the city, and had a certain relationship with the prosperity of Guangzhou's weaving industry in the late Qing Dynasty.

Fig. 4- 2 The Xiguan area of Guangzhou in the Qing Dynasty

(Source：According to Guangzhou map)

During the late Qing and early Ming dynasties, the weaving industry, well developed since the Ming dynasty, accounted for most of Xiguan, the centre of trade, commerce, and handicrafts in Guangzhou at that time (Figure 4-2). The development of the weaving industry drove the utilization of urban spatial resources and the creation of new urban spaces. In order to be close to the main market of silk weaving, the Western Trading House of the Thirteen Houses, textile entrepreneurs used the agricultural land in Xiguan to build machine houses and gradually formed the "Machine House District". The operators of textile and related industries and industrial workers moved to Xiguan, and the population grew day by day, so the demand for housing increased dramatically. The farmland in the plain of Xiguan on the periphery of the factory area was developed into a large area with many complete "characteristic houses". The residential area was based on commercial and economic activities, forming a special urban layout with trade, commerce and handicraft activities as the main features of the complementary commercial and residential areas, and the punched combination of market and residential areas made the residential culture a strong expression of commercial

culture. In 1862-1880, the residential area of Baohua Street was first developed, which then expanded to the north and west, eventually forming the residential areas of Yaohua and Baoyuan in the north and Fengyuan and Dobao. By this time, the street system of the Xiguan area had essentially taken shape, and the emerging residential area formed a dual, overlapping street structure of a straight, regular grid pattern and free-growing small streets [45](Figure 4-3).

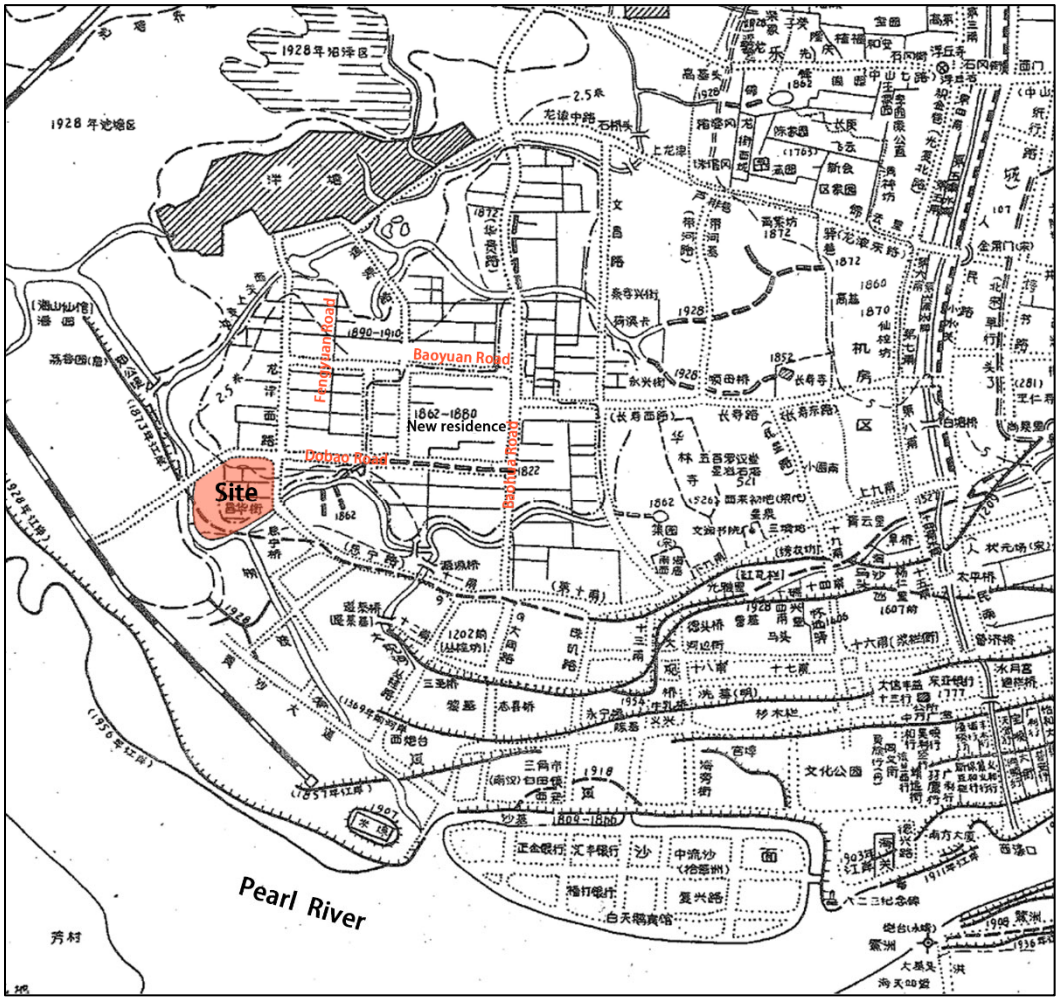


Fig. 4- 3 The emerging residential area in the Xiguan area during the Qing Dynasty
(Source：Based on Zeng Zhaoxuan's "Historical and Geographical Sketch of Guangzhou City")

Changhua district, on the other hand, is at the western edge of the Xiguan area, so it was relatively later than the construction of all the residential areas such as Baoyuan and Dobao. The 1860 revised edition of *Map of the city and Entire Suburbs of Canton* drawn by Vrooman shows that the Baohua block was taking shape at that time, and Baohua Square and Baohua Main Street had already appeared, but a large area west

of the Baohua block and south of the village of Pantang, enclosed by Liwan River and its tributaries, was still labeled as "RICE", which includes the Changhua district (Figure 4-4).

Fig. 4- 4 《Map of the city and Entire Suburbs of Canton》
(Source：By Rev. Daniel Vrooman in 1860)

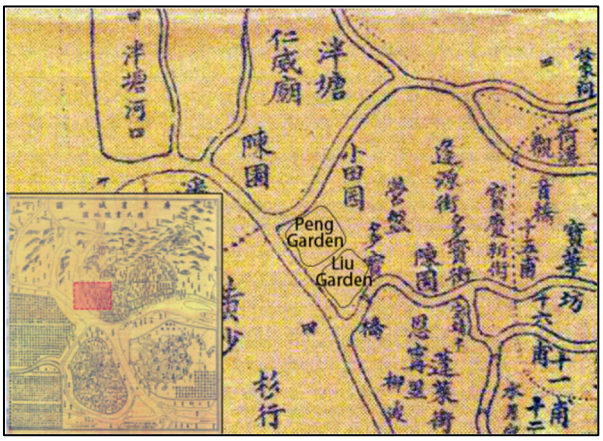


Fig. 4- 5 *Complete Map of Guangzhou Provincial City*
(Source：Based on the 1888 map by Qiu Zhaonan and Chen Kaixi)

Most of Changhua district was once the site of Liu Garden. Qing Guangxu fourteen years (1888), Qiu Zhaonan, Chen Kaixi painted "Guangdong Province City Map" (Figure 4-5), the map shows that Puntingqa's garden remains are still there, but across the Dobao Bridge to the north appeared a number of private gardens, including Xiaotian Garden, Chen Garden, Peng Garden, as well as in the area of today's Changhua Liu Garden, etc, all for the wealthy merchants of Guangzhou at that time. The Liwan area was originally a garden ruin of the Southern Han Dynasty, with a green bank and beautiful scenery suitable for gardening. After the completion of Puntingqa

Garden by Pan Shicheng, the celebrities of the city, the wealthy merchants and the people from the West who came to the city took their cue from this garden and formed a model. One of these followers was Liu Xuexun, a wealthy man from Guangdong, who built Liu's Garden between 1887 and 1888. Most of today's Changhua district was within this garden, including almost all of Lin Ho River on the western and southern corners. The existence of Liu Garden influenced the formation and development of the structure of the Changhua district in every way[42].

4.1.2 First phase: 1900

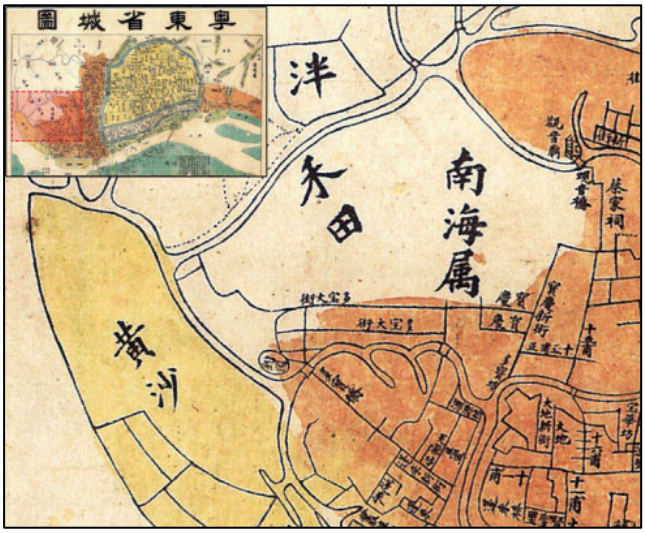


Fig. 4- 6 The Map of Guangdong Eastern Province
(Source：Dianshi Shuju in Guangzhou, 1900)

As can be seen from *the Map of Guangdong Eastern Province* (Figure 4-6) from the 26th year of Guangxu (1900) of the Qing Dynasty, the Dobao district has essentially taken shape as a result of the development of the Baohua district to the west and has been extended westward to Changhua district right on the eastern border of Liu Garden. The Changhua district during this period (Figure 4-7) is mainly the result of the westward development of Dobao Street and its pertinent strips. Dobao Street is the matrix route of the block, the remains of the road leading to Haisan Senkan form Enning Road as the planning route, and the horizontal Dobao South Cross Street and Changhua Street appear for the first time as the connecting route. The Liu Garden in

the block limits the development of Dobao South Cross Street and Changhua Street to the west.

Fig. 4- 7 The morphology of Changhua district in 1900
(Source：Self-drawn from historical sources)

Since Dobao Street was developed earlier as a matrix route, the development was mainly single-wide, and Zhutongwu with a more uniform scale were built, forming a relatively mature strip. Since the northern part of Changhua Street has not yet been developed, the north-south function of Enning Road has not yet fully developed, and Enning Road as a planning route has not formed a mature strip. The newly developed Dobao South Cross Street and Changhua Street are relatively more generous in development, with both single-sided and multi-sided strips and a mix of Zhutongwu and Xiguan Dawu.

4.1.3 Second phase: 1907-1924

By this time, the Fengyuan district had also been developed and built upon, and the northern boundary of the built-up area of Xiguan extended to the south of Pan Tang and the south bank of Liwan River. As shown on the 1907 *Map of Guangdong Province* by F. Schnock (Figure 4-8), the Fengyuan district has taken shape, and the Xiguan residential area has developed from the initial Baohua district to the west and north into a more complete residential area, but the area from the west to Xiguan River is still undeveloped land. In the early 20th century, Liu Garden declined and was sold by Liu Xuexun in 1922. From the *"Guangzhou City Area Map"* of 1923 and the *"Latest Guangzhou City Road Full Map"* of 1924 (Figure 4-9), it can be seen that the eastern half of Changhua district was already a built-up area of the city, while the western half was mostly undeveloped, with only a few buildings in the area, which would be the last state of Liu Garden. And after more than 10 years of development, the built-up area of Xiguan is basically built-up except for the plots in the original part of Liu Garden within Changhua district.

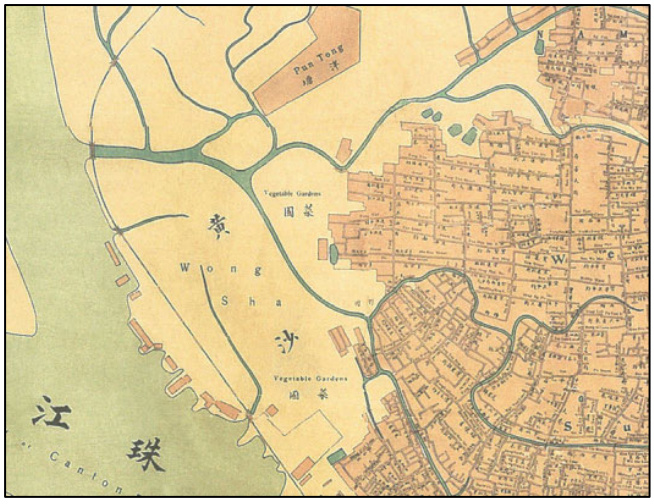


Fig. 4- 8 Map of Guangdong Province by F. Schnock（1907）
（Source：Guangzhou Municipal Government Preparation）

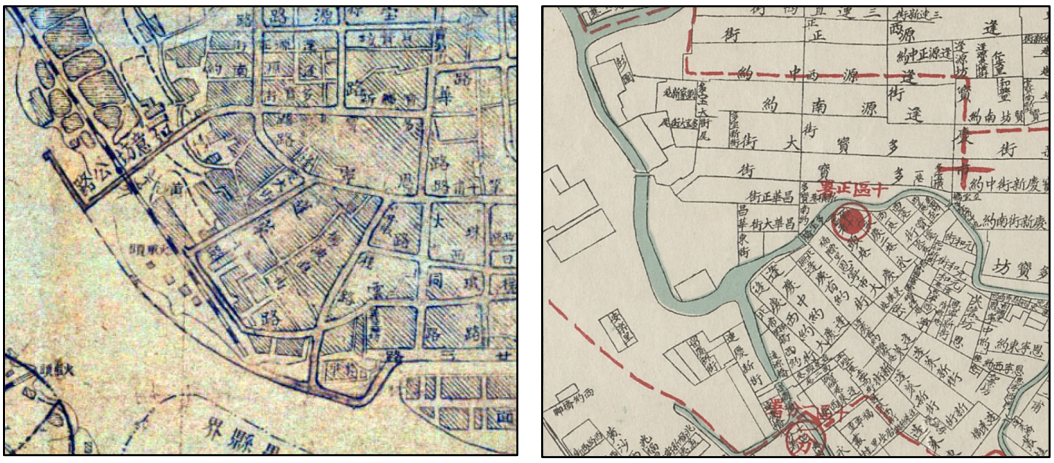


Fig. 4- 9 Right: Guangzhou City Area Map (1923)，Left: Latest Guangzhou City Road Full Map (1924)

（Source：Guangzhou Municipal Government Preparation）

With the gradual construction of the Xiguan area, the Changhua district during this period no longer served only as an extension of the Dobao district k to the west, but was increasingly influenced by the Fengyuan district to the north (Figure 4-10). At this time, the structure of the Changhua districtchanged somewhat and the vertical Enning Road became another matrix route that coordinated the built-up area of Xiguan on the west side from south to north. Dobao street developed a planning route as a matrix route, namely Dobao Cross Street on the north side of the street, but it was not yet built in Changhua Street. The development of Dobao South Cross Street and Changhua Street is influenced by the boundary of Liu Garden on the southwest side, where a connecting route is developed, namely the vertical Changhua East Street. With the sale of Liu Garden site, Dobao South Cross Street and Changhua Street and the related strips gradually developed towards the west.

Due to the changing nature of the road caused by the emergence of Enning Road as a north-south link, Enning Road on the Changhua Street side gained influence and the related strips began to develop. As a result of the residual value, the former vertical north-south plots along the road were divided into several horizontal plots. At that time, the pertinent strip of Changhua East Street could not develop towards the west side because of the presence of Liu Garden, and since this street was adjacent to the

private garden with better view, the residual value emerged, so the pertinent strip on the east side emerged. The pertinent strips of remaining route are still mainly single width, with a few multi-wide plots mixed in.

Fig. 4- 10 The morphology of Changhua district between 1907-7924
(Source：Self-drawn from historical sources)

4.1.4 Third phase: 1936

As shown in the *"Road Map of Guangzhou City"* (Figure 4-11), prepared by the Guangzhou Municipal Bureau of Public Works in 1936, the construction of Changhua Street was essentially completed at that time. The construction of Changhua Street at this stage was mainly influenced by the Guangzhou Municipal Improvement Plan. The so-called urban improvement plan was a campaign to upgrade the city's roads under the direction of municipal authorities in the early years of the Republic of China, including road widening, new road construction, water and sewage infrastructure and so on. In 1929, Cheng Tiangu took charge of the Guangzhou Municipal Public Works

Bureau and prepared the *"Guangzhou Public Works Execution Plan"* (1930) and issued the *"Guangzhou Road Plan"* (Figure 4-11) in 1931, which included Dobao Road, Enning Road, Longjin West Road, and so on. Through the construction of the new roads, the spatial boundaries of Changhua district were formed, namely Changhua River in the west and south, Dobao Road in the north and Enning Road in the east. At the same time, under the influence of the construction of the new roads, merchants began to set up stores along Dobao Road and Enning Road, and the former Liu Garden land in the street was quickly built up with various garden-style houses.

Fig. 4- 11 Left: Road Map of Guangzhou City (1936)
(Source：Guangzhou Municipal Public Works Bureau)
Right: Guangzhou Road Plan
（Source：Guangzhou Public Works Execution Plan by Chengtiangu）

The street system of Changhua district at that time was similar to today's street system. As the planning route of the matrix route Dobao Road, Changhua Cross Street was further extended in the block, and Dobao South Cross Street and Changhua Street were extended westward to the river, forming an orthogonal grid-like street system with Changhua Main Street. In addition, Changhua New Street, which is orthogonal to Changhua Main Street, appears as a connecting street, so the road construction of Changhua Main Street has been completed.

Fig. 4- 12 The morphology of Changhua district in 1936
(Source：Self-drawn from historical sources)

As a result of the urban improvement plan, the north-south character of the widened Enning Road became even more pronounced, and with the additional construction of stores and rides, a mature strip of Enning Road eventually emerged. With the introduction of garden-style detached houses, the pertinent strips of the new route in the district became more mixed with single-wide houses, multi-wide houses, and detached houses. Changhua Street, which is a planning route, does not form a complete strip due to the influence of garden -style detached houses. At the intersection of Changhua Street and Changhua main street, the north-south plots are redefined into an infill tissue due to the higher polarity.

4.2 Building surveys

Through a general analysis of the morphology of the Changhua district, based on the understanding of the origin and development of the structure of the district. Two periods, 1936 and the current situation, are selected for building surveys, and ground floor plans

are drawn for both periods. This kind of research approach, in which the ground floor plan of a building is embedded in the urban environment or site, can reveal the relationship between the building and the city more intuitively, such as the floor plan design, the type of access, the distribution of public and private space, etc., and can bridge the two scale levels of urban morphology and tissue, and building type and construction characteristics.

Since there is not enough historical information on Chinese historic districts, the author combines literature research and speculation with on-site building inspections, and finally draws floor plans of all buildings of the current and older eras in Changhua district to express the physical space elements and living patterns.

4.2.1 Building surveys of current situation

In 2022, after three months of building surveys, the author had essentially mapped more than 200 buildings in the Changhua district. Except for a few buildings that could not be surveyed, the author recorded the age, structure, style, materials and functional distribution of the buildings. Finally, the autor drew the floor plan of Changhua district (Figure 4-13) and distinguished the public street space, semi-public courtyard space, and completely private interior space.

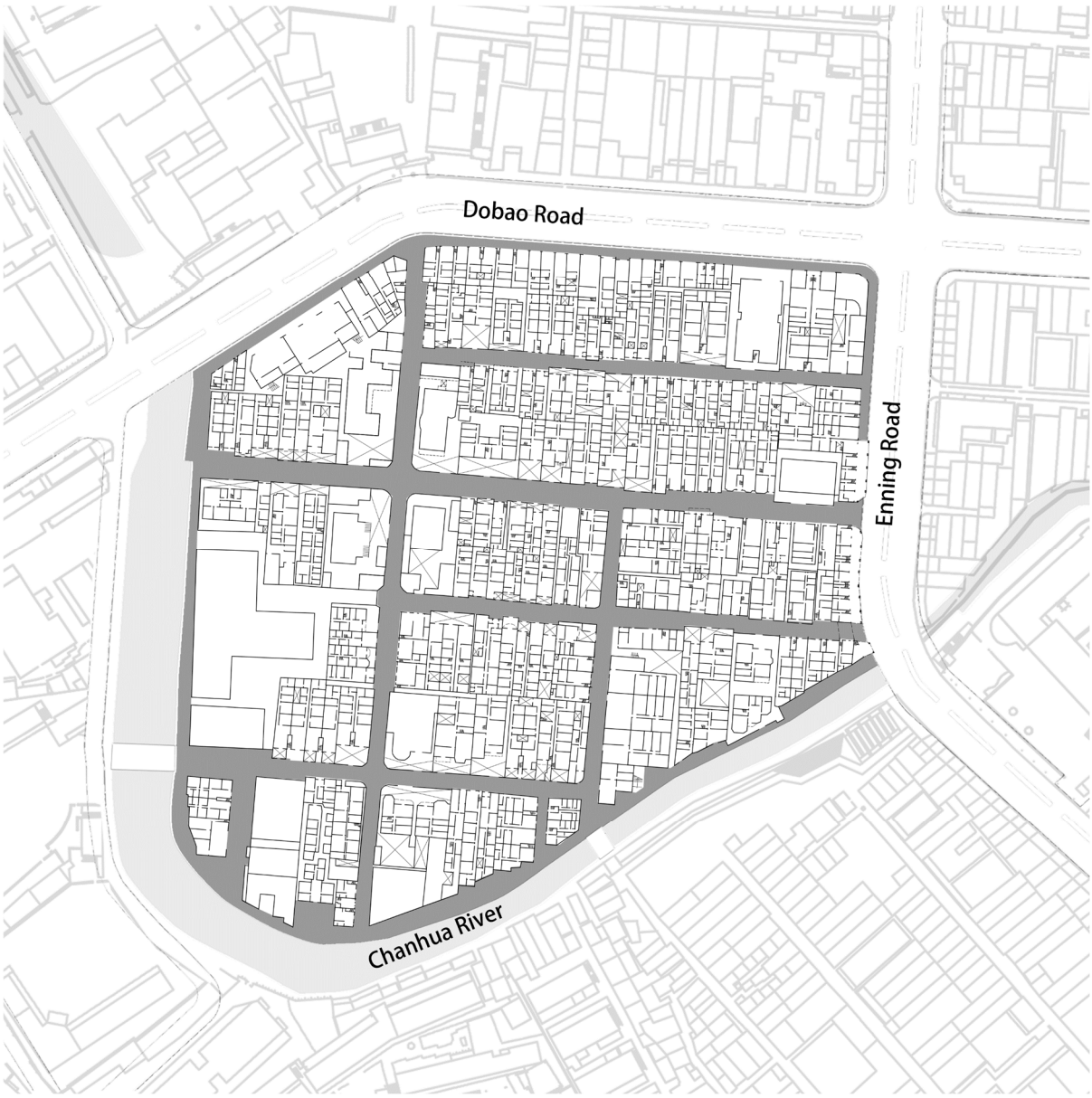


Fig. 4- 13 Ground floor plan of Changhua district in 2022 (Source: By the author)

4.2.2 Conjectural building surveys of 1936

On the other hand, one of the important goals of Muratori-Caniggia's typo-morphological study is to find the links between history, present and future, and maps and documentary sources are an important basis for historical conjectural building surveys. On this basis, the evolution is studied by comparison with the ground floor plans.

In pre-modern China, however, there was no research tradition for interpreting cities, and there were few accurate sources for urban and architectural mapping, and most

maps were drawn with an accuracy that was not directly usable. Most maps were drawn with an accuracy that was not directly usable. However, the maps produced by Italian scholars did not require absolute accuracy in drawing the size[46]. Therefore, a reasonable speculation on the layout of Changhua district in the mature period can be made for the Changhua district by using the existing historical maps and documentary materials and a series of research results on Guangzhou Xiguan for support. The specific working method consists of two elements.

First, based on the cadastral maps from the Republican period and related documents, the relationship between streets, plots and buildings in the Changhua district at that time can be essentially recovered. Knowing the main features of the floor plan of the traditional Lingnan buildings also helps in redrawing the plans. The building types are mainly Zhutongwu and their variants with Lingnan character. The one-room Zhutongwu have relatively fixed width dimensions, usually 15, 17 and 19 trusses[47]; the buildings usually occupy the entire plot, usually have closed thick walls on the outside, and rely on patios, open halls and corridors to organize space and solve the need for ventilation and light, while there is no excessive restriction in the direction of depth.

Second, in terms of the architectural design of each plot, although there are rarely any designs or floor plans for the traditional dwellings in Lingnan, there are clear typological characteristics that are even more evident for the block on Changhua district, which was built relatively late in Xiguan. In general, the rooms and courtyards in the traditional Lingnan dwellings are arranged in a compact and orderly manner, and the buildings usually have 1-3 stories. *Guangdong Residences* summarize the typical floor plan design based on the surviving Guangdong houses from the Qing Dynasty and the Republic of China, such as the group of traditional Zhutongwu shown in the figure, which consists of components such as halls, rooms, kitchens, toilets, corridors and patios[48]. This typical floor plan feature helps drawing of the conjectural ground floor plan.

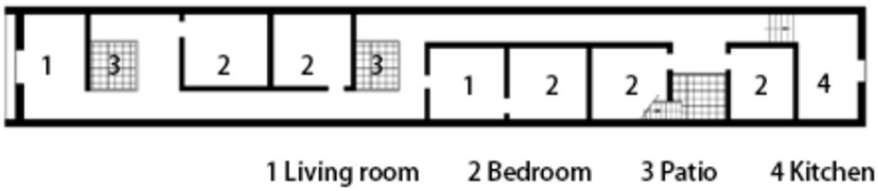


Fig. 4- 14 Interior layout of traditional Lingnan architecture
（Source：Lu Qi, Guangdong Residences）

Finally, some of the maps and documentary materials from the Qing Dynasty and the Republic of China period mentioned in the previous section also contain much discussion about the Changhua district, and the translation of the documentary materials and historical maps can also be used as evidence for the speculations. In this way, the building surveys of the historical speculations combined with the building outlines of the historical maps, the general rules for the layout of traditional residential buildings and the records of the historical materials can draw the conjectural ground floor plan of Changhua district in the Republican period (Figure 4-15). By comparing it with the present situation, we can further investigate the evolution process and the internal motivation of the street, plot and the building type at different levels.

Fig. 4- 15 Conjectural ground floor plan of Changhua district in 1936 (Source: By the author)

4.3 Streets

The street is the boundary and the main structure that makes up a city or block, a structural element that is relatively stable during the evolution of the urban morphology. Caniggia takes the percorso (route) as a starting point for understanding the tissue. Through the successive development of different types of routes and their pertinent strips, the tissue is formd and developed. It expresses the route as a structure that offers the possibility of reaching a place, and it emphasizes the structural and functional character of the route, as well as its connection to the plot of land. Street, on the other

hand, refers to the route's imaginary space and its implicit concept of physical space, which includes both the functional qualities that the route carries and the actual sense of space and experience. Therefore, this section analyzes the street from three aspects: the street system that characterizes the properties of the route, the street interface that characterizes the relationship with the plot, and the spatial perception of the street by comparing the building surveys of the two periods.

4.3.1 Street system

Comparing the 1936 and 2022 building surveys for the Changhua district (Figure 4-16), we find that the street system has not changed much in terms of the two figures. Dobao Road and Enning Road, which are the outer streets of the city, have already taken shape in 1931, and the inner streets are still interspersed in a horizontal and vertical pattern. The vertical streets run in the north-south direction and mainly include Changhua Cross Street, Changhua East Street and Changhua South Street. The horizontal streets run in an east-west direction from north to south and include Dobao Street, Dobao South Cross Street, Changhua Main Street and Changhua New Street. The only change is that Changhua Street was originally supposed to go to the west side of the river, but because of the construction of the nursing home, it ends at Changhua Cross Street and forms a D intersection.

Fig. 4- 16 Comparison of street system between 1936 and 2022 (Source: By the author)

4.3.2 Street interface

After analyzing the street system, another important element of the street hierarchy is the relationship between the street and the plot. The relationship between the two directly affects the interface properties of each street, which in turn affects the street space. In general, the street interface with more front facades is more active than the street interface with more gables. Caniggia uses the concept of route and its pertinent strip to describe how the route serves the built plot, i.e., the pertinent strip consists of the built plots for which the route provides entrances and exits. Therefore, the analysis of the route and its pertinent strip can be used to understand the relationship between the street and the plot.

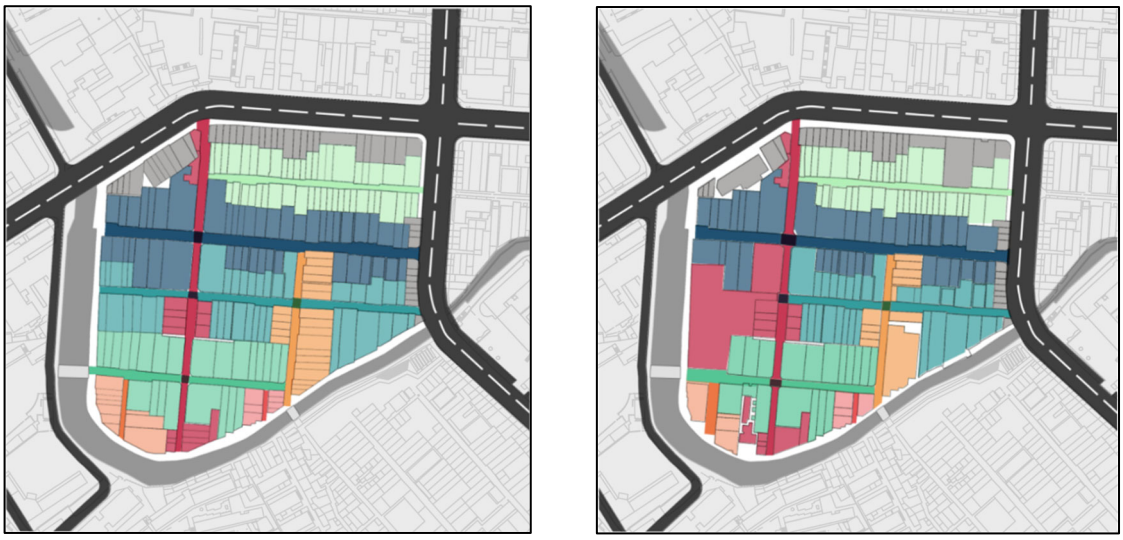


Fig. 4- 17 Comparison of route and pertinent strip between 1936 and 2022

(Source: By the author)

Due to the strong north-south orientation of the building, the short side of the plot where the entrance/exit is located is mostly on the east-west street, so the horizontal routes all form a more complete pertinent strip that provides a more neat interface. The vertical route, on the other hand, did not form a complete strip due to the construction and building type at the time, but only connected to some of the plots near points of high polarity, such as the intersections between Changhua Street and Changhua South Street.

And as can be seen from the comparison between 1936 and 2022 (Figure 4-17), the

relationship between street and plot in the Changhua district has generally not changed much. Although plot mergers and divisions do occur, most plots have not changed their relationship to the street after merging. Only the west side of the nursing home has a greater impact on the relationship between street and plot due to the merging of several plots, and the interface on the west side of Changhua New Street has become a fully street-like street. The few remaining changes are mostly due to the change of living conditions within a plot as the residents transformed independently, such as the division of one household on the first floor into two or three households on the first floor, so that additional entrances and exits were added, resulting in a change in the relationship between the street and the plot.

4.3.3 Street space

Although the street system and the pertinent strip have not changed much, the proportions and scale of the street space have. The scale of the street space is mainly based on the morphological structure to influence people's visual and therefore psychological perception. When the height H and width D of the streetscape and buildings change, the spatial structure of the district is also perceived differently by people.

The width D of the street has not changed significantly (Figure 4-18). Dobao Street and Changhua Street are the narrowest streets in the Changhua district from the intersection with Changhua South Street to the east with an average width of 4-5 m, while Dobao South Cross Street from the intersection with Enning to the intersection with Changhua East Street, which was built in the same period, is slightly wider than Dobao Street. Influenced on the one hand by the municipal improvements and the improvement of the residential environment at the beginning of the "Republic of China", and on the other hand by the driveway introduced by the garden-style detached houses, Dobao South Cross Street and Changhua Cross Street, Changhua New Street,

Changhua East Street, Changhua South Street from the intersection Changhua East Street to the west have been widened compared to the traditional rod, and have an average width of 5-7 meters.

Fig. 4- 18 The width of the street in current situation (Source: By the author)

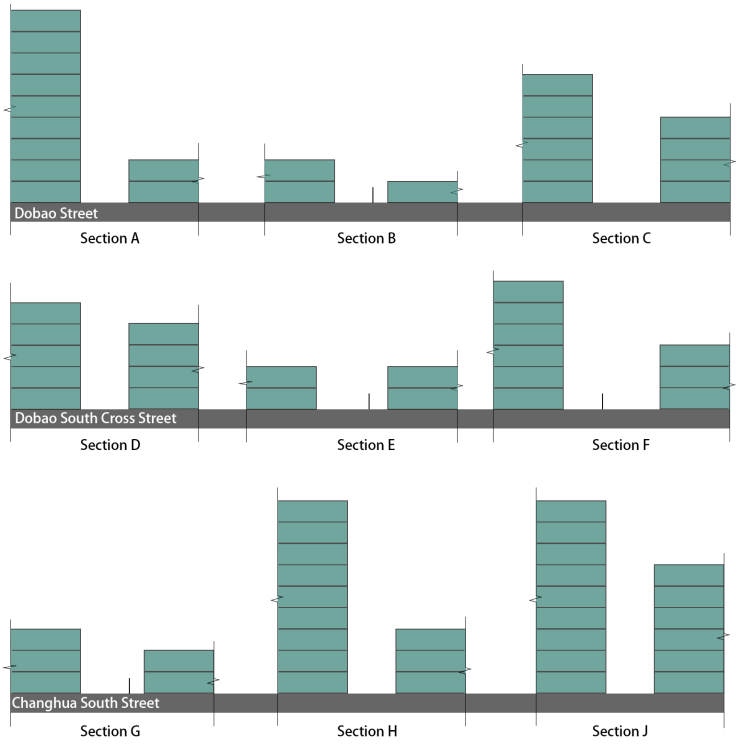


Fig. 4- 19 The sections of the streets in current situation (Source: By the author)

The height H of the buildings on both sides has changed considerably with the rebuilding and reconstruction of the buildings. During the Republican period, the buildings in the Changhua district were mainly 2-3 stories high, with a few 1- and 4-story buildings. And with the decay of buildings and the construction of multi-story buildings, buildings with 5-9 stories were built. In order to have a larger living space, some of the residents built a shed by combining the space recessed in the front façade at the entrance with the open space within 1 m in front of the door. As a result, the proportions and scales of the street space in the district have changed, which is most evident in Dobao Street, Dobao South Cross Street, and Changhua South Street (Figure 4-19). The typical street sections in the Changhua district are Section B, Section E, and Section G. However, the renovation of buildings has created street spaces in Section A, Section C, and even Section J. The street space in the Changhua district is now more intimate. The originally intimate streetscape has become oppressive due to the excessively tall new buildings, which also reduces the continuity of the streetscape experience in the district.

4.3.4 Evolution rules

At the street level, the street system, the street interface, and the street space are analyzed based on the results of building surveys of two periods. As for the street system, the street in Changhua district has hardly changed between 1936 and 2022. The only change concerns the section from Changhua Street to Changhua River, which disappeared due to the construction of the nursing home. The analysis of the pertinent strip shows that the main change of the street interface also due to the construction of the nursing home, which causes the decrease of the vitality of the section from Changhua New Street to Changhua River.

Although there are few changes in the first two aspects of the street, the experience of the street space in the Changhua district becomes discontinuous and oppressive due to the construction of excessively tall buildings that are incompatible with the original

environment in terms of the proportions and scale of the street space, which is most evident in Dobao Street, Dobao South Cross Street and Changhua South Cross Street.

4.4 Plots

Plot is one of the most important concepts of typo-morphology. Expressed through plotto edificato (built plot), Caniglia considers plot as a module that forms the urban tissue, composed of the area occupied by the buildings and the pertinent area (courtyard). By comparing the building surveys from the Republican period and the present, the characteristics and evolution rules of the plot organization of the Changhua district can be identified.

4.4.1 Quantity of the plot

Fig. 4- 20 Comparison of plot quantity between 1936 and 2022
(Source: By the author)

In terms of the number of plots (Figure 4-20), the number of plots in Changhua district shrank from 256 in 1936 during the Republican period to 196 in 2022, a decrease of nearly one-quarter. The pattern of changes in plots can be divided into three types: unchanged plots, combined plots, and subdivided or disappearing plots. Statistics show that by 2022 (Figure 4-21), most plots are unchanged; 19 plots have been merged from small plots, but occupy 24.6% of the area with 9.69% of the number of

plots; very few plots are the result of subdivision, with 4.08% of the number and only 1.72% of the area. It can be seen that the number of plots mainly shows the trend of combined plots, and the area of combined plots has reached a quarter of the area of the district, which has a non-negligible impact on the morphology of

the district.

Plot change mode	Quantity of plots	Quantity share	Floor space share
Combined plots	19	**9.69%**	**24.6%**
Subdivided plots	8	4.08%	1.72%
Unchanged plots	169	86.22%	73.68%

Fig. 4- 21 Statistics of the plot change in 2022

(Source: By the author)

4.4.2 Size and shape of the plot

In addition to the quantity of plots, the shape and size of the plots also changed. The shape and size of the plots in the 1936 Changhua district organizaiton map showed a strong regularity, with the exception of some plots along Dobao Road and Changhua River, most of the plots were roughly rectangular, with short sides facing the street in a side-by-side layout. From the statistical results (Figure 4-22), the width of the plots in the district is mostly 4 m, the depth is mostly 15-25 m, while the area is mostly 80-**15**0 ㎡.

Fig. 4- 22 Statistics of the size and shape of the plots1936 (Source: By the author)

In terms of plot size and dimensions, the plots in the block can be roughly divided into four types. The first three types are influenced by the construction method and have relatively fixed widths and depths. 52.3% of the plots① are long in the north-south direction and have a width between 3 and 5 meters, while most of the plots have a depth between 15 and 25 meters, with a few as deep as 35 meters and a depth between 0.12 and 0.3, with an area between 50 and 100 square meters. While the long east-west direction between 3-8m wide plots②, the size and area is smaller than the first, the depth is relatively small, between 8-22m, the ratio of depth to width is between 0.3-1, and the area is between 20-100, this type of plots are fewer, the number accounts for 15.9%. The number of plots③ along the street with a width of 9-12m is 22.9%, with a relatively larger range of depth variation between 12-37m, a ratio of width to depth between 0.2-1, and a correspondingly larger area between 140-400 square meters. The smallest number, 8.9%, of plots where both width and depth are not constrained by creation method4 have widths between 15-22m and depths between 20-40m, with areas between 300-700 ㎡.

By 2022, most of the plots have not changed and the four types of plots mentioned above are still the main features of the tissue. However, combined plots, which account

for 24.6% of the area, have had a significant impact on the block and have resulted in a greater variety of plot sizes, shapes, and arrangements, with the largest plot (the nursing home) measuring more than 2,300 ㎡ and, in addition, the construction of new building types, such as slab apartments, resulting in plots whose width is much greater than their depth.

4.4.3 Evolution rules

At the plot level, the number of plots and their shape and size were analyzed based on the results of the building surveys of two periods. In the comparison between 1936 and 2022, most of the rectangular plots remained unchanged. The short side of the plots faces the street, the width of the plots is mostly 4 m, the depth is mostly 15-25 m, and the area is mostly 80-150 ㎡. The rest of the plots has changed mainly due to the consolidation of plots, which has reduced the number of plots in 2022 by a quarter compared to 1936. The consolidated plots are typically used for the construction of large public service buildings and multi-story apartments, which are often no longer subject to traditional restrictions on plot size, shape, and layout, which has impacted the morphology of the district.

Taken together, street and plot hierarchies have evolved more slowly in western cities where private land ownership has long existed. The street is the most stable element because the change in a street affects many adjacent plots; and properties change more slowly because of the relative stability of the land system and property rights. However, in Chinese cities, with the public land ownership and urban construction, the phenomenon of plots merger is common in various cities, which is an important factor leading to sudden changes in urban morphology. Therefore, the first factors to be considered in the conservation and regeneration of historic conservation area are the structure and scale of the street, as well as the plot organization.

4.5 Buildings and rooms

Fig. 4- 23 Diagram of the distribution of building types in Changhua district
(Source: By the author)

Street and plot determine the boundaries, structure and internal ordering features of tissue. And the next level is the building and room. By classifying the building types in Changhua historic district in different periods and observing the development of morphological and tissue features, the author finally classifies the residential buildings in Changhua district into several main types and their variants(Figure 4-23). In the late Qing and early Ming Dynasties, type A the traditional single-family row house is the basic type in the district; in the Republican period, type B the improved multi-family row house and type C the western-style row house with front yard, which adopt some

features of type A, while type D the garden-style detached house mutated into the Changhua district; after 1949, to meet the demand for housing, Type E, a diachronic variant of Type B, and Type F multi-story and small high-rise buildings (less than 10 stories), and Type G public building[49].

4.5.1 Type A：Traditional row houses for single-family

Guangzhou is located in the central part of Guangdong Province. Due to the climate and topography, the traditional residential houses from ancient times have become the core of the interior through patios and corridors connecting functional rooms such as halls, houses and kitchens, and the whole courtyard and rooms are smaller than those in northern houses. The "room" is the basic unit of the dwelling, and different types of residential floor plans have evolved from it.

The traditional single-family row house, Zhutongwu, was the most common building type in the Changhua district during the late Qing Dynasty and the early Republic of China. It was the basic type of the block and usually had 1 to 2 stories for simple residents. It is called "Zhutongwu" because the width of the houses is narrow and the depth of the houses depends on the length of the plot. Usually there are five houses with depth from 1:3 to 1:5, and the layout is like a bamboo. The main reason for this layout is that there are many people and little land in the Changhua district, and land prices are high, so residential plots can only be developed in depth. At the same time, the local climate was hot and humid, so ventilation, light, drainage and traffic could be solved by open halls, patios and corridors.

The traditional Zhutongwu in the Changhua district are arranged in rows, usually with a depth of 15 meters or even 20 meters or even 25 meters. The central part is the hall or vestibule(Figure 4-24), which may be long or short and is bounded by the terrain. The space behind the hall is equipped with a sacred building with a high floor, and due to local customs, the sacred building is not accessible. There are usually at least two courtyards per house, a front one that is outdoors and a back one that is open or closed

and covered. There are many types of traditional Zhutongwu in the block, both large and small, with two or three floors and many different floor plans, mainly because of the location of the staircase, which is usually placed at the back, but also in the hall, so you can go directly to the second floor after entering the hall. Some tenants place the stairs in the back patio, making the back patio into a stairwell with ventilation windows or skylights overhead. The key to creating this housing pattern with a small width and great depth is the function of ventilation and lighting of the patio[48].

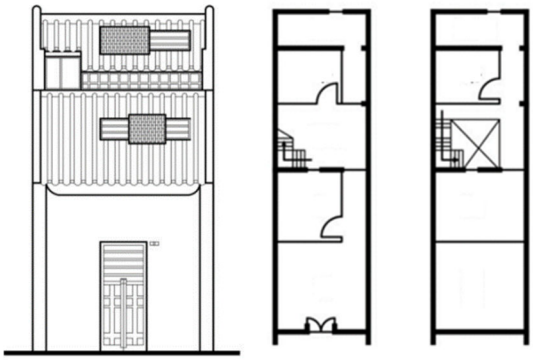


Fig. 4- 24 Typical façade and plan of Type A（Source：Lu Qi, Guangdong Residences）

House No. 51 on Dobao Street belongs to the typical type A1 (Figure 4-25). According to the owner's recollection and on-site research, the original building was a regular traditional Zhutongwu with a floor plan in which the main door, entrance hall, room, main hall, bedroom, back patio, and kitchen were arranged in order from outside to inside, with the staircase in the main hall and two patios and a skylight. Although the floor plan was too long and the ground floor was humid, it was still cool and comfortable inside. However, as the number of occupants increased and the ritual idea of the room gave way to the function of living, more rooms were divided in the present situation, and the sequence of the room developed into the main door, the main hall, three rooms, the back patio and the kitchen, reducing the ritual consideration. At the same time, the whole house is dark and poorly ventilated because only a small patio is preserved.

Fig. 4- 25 Current situation of House No. 51 on Dobao Street & Ground floor plan in 1936 and 2022 (Source: By the author)

4.5.2 Type B：Improved row houses for multi-family

During the Republican period, the climatic, landscape and economic conditions in the Changhua district did not change significantly, so the "Zhutongwu" building type proved its vitality and adaptability and continued to be inherited during this period. From the point of view of the residents of the houses, new, smaller family units were formed as families increased in size and split up, stacking the old houses on top of each other in the process of reconstruction. From the real estate development perspective, the housing model was intentionally used in real estate development to achieve high rents or to meet the demand for investment and housing for small family units. For these two reasons, three different forms of modified Zhutongwu have emerged in the Changhua district, two types of single-story Zhutongwu apartments, B1 and B2, and a variant of B1, type B3, which are doubling Zhutongwu apartments.

Due to the influence of Western architectural concepts and decorative styles, as well as the popularity of concrete technology, traditional Zhutongwu have changed into modified Zhutongwu in terms of construction techniques, architectural structures and architectural forms. Since these modified Zhutongwu are still arranged in close proximity, they are called row houses.

（1）Type B1：Zhutongwu apartment-Ⅰ

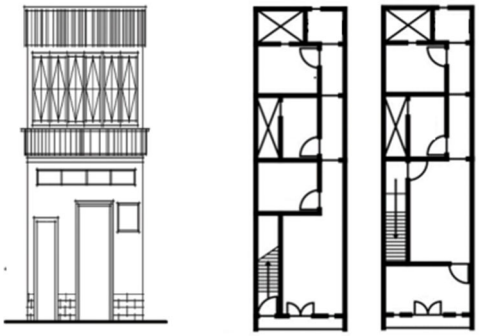


Fig. 4- 26 Typical façade and plan of Type B1（Source：Lu Qi, Guangdong Residences）

The Zhutongwu apartments of the Republican period were similar in plan layout to the traditional Zhutongwu of the late Qing Dynasty: rooms with only one opening, with each functional room connected by a patio and corridor, forming a pattern of long, deep, and open houses. During this period, the number of stories was generally increased from one to three or four due to further population growth and advances in construction techniques. One of the differences between the multi-story Zhutongwu of the Republic of China period and the Qing Dynasty is as follows (Figure 4-26): During the Qing Dynasty, there was still a standard building with one suite, so the staircase was in the middle or at the end of the room, and there was no separate entrance or exit; while during the Republic of China period, there was one floor with one suite, and each suite was used by different families, and some houses were even formed by multiple families, so there was a separate entrance or exit. The staircase was then moved from the middle or end of the building to the front, directly onto the street outside. In order to save space and take up as little as possible of the already narrow width of the openings, the staircases are designed to be narrow and straight. In this way, residents on the second floor enter the apartment through the front door, and residents on the second floor and above enter through the quiet platform on each level of the staircase, so that residents on each level do not disturb each other, which increases privacy and improves space utilization. Take House No.2-2 Changhua Street as an example (Figure 4-27). According to the owner's idea and on-site research, the original floor plan of the building is the standard Zhutongwu apartment Ⅰ, but now, due to the

increase of residential population, a mezzanine floor has been added to the first floor and more rooms have been divided at the same time.

Fig. 4- 27 Current situation of House No.2-2 Changhua Street & Ground floor plan in 1936 and 2022 (Source: By the author)

（2）Type B2：Zhutongwu apartment-Ⅱ

The Zhutongwu apartment-II of the Republican period evolved from the "double-sided" Xiguan house of the late Qing Dynasty (Figure 4-28), which has a width of two rooms and can also be regarded as two duplex Zhutongwu, but the width of the two openings is different, The interior is asymmetrically laid out, but the two sides have a clear division of functions, and the floor plan is different and compact according to the function. On the façade, one of the openings is a recessed main entrance, while the other is a solid wall with windows.

Fig. 4- 28 Typical façade and plan of Type B2（Source：Lu Qi, Guangdong Residences）

The Zhutongwu apartment-Ⅱ of the Republican period was mainly increased in the

number of floors and changed in the style of the facade. On the second floor, the main entrance is on the concave side and the floor plan is "gate - hall - courtyard - room - stairs - toilet", while on the side with solid walls, it is "balcony - room - hall - room - courtyard - kitchen" and the two parts are connected by a corridor. The advantages of this floor plan are clear function, compact layout, convenient use, better ventilation and more light, especially the courtyard can be converted into a patio to create a more quiet and comfortable environment. The disadvantage is that it cannot be divided into two independent openings for use, which also leads to many houses being divided again later and the architectural interior becomes more confusing. A typical example is the House No. 15 Changhua New Street (Figure 4-29), whose exterior is still well preserved and its historical appearance has been basically maintained. However, the internal layout and use have been completely changed. Three households on one floor were separated from the original house, and the courtyard was completely converted into a room, making the original clear and compact layout narrow and dark. In addition, the front yard and attic were greatly expanded and a cottage was added to the back yard for stacking various items.

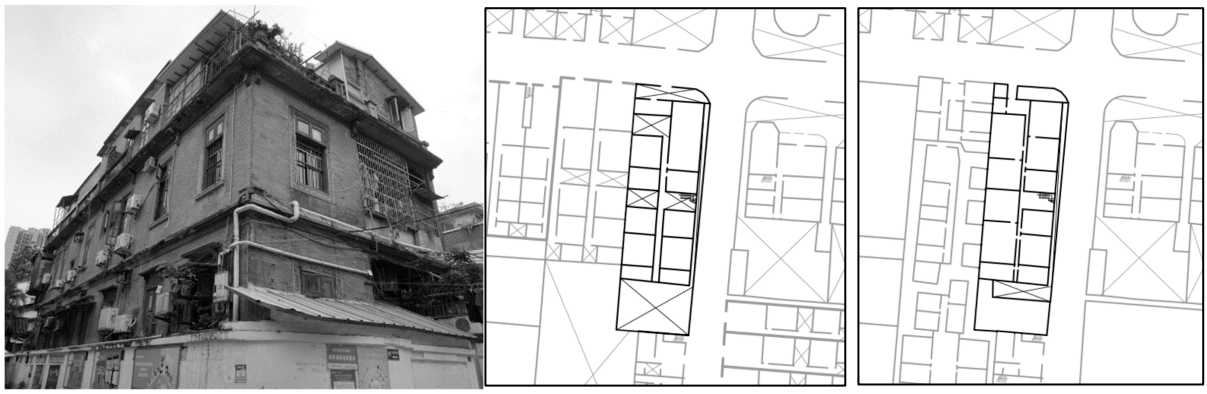


Fig. 4- 29 Current situation of House No. 15 Changhua New Street & Ground floor plan in 1936 and 2022 (Source: By the author)

（3）Type B3：Doubling Zhutongwu apartment

An evolutionary process can be seen by comparing the floor plans of a large number of apartment buildings built between the early 20th century and 1949 with those of Zhutongwu apartment-Ⅰ, which was built in the 19th century. The one-room

Zhutongwu apartment was "doubling", i.e., a dwelling with a common interior staircase and patio on a two-room wide plot. The doubling Zhutongwu apartment (Figure 4-30) is a more intensive modification of the Zhutongwu model. It is a combination of two adjacent Zhutongwu that share a common staircase, and each floor is occupied by a different user. The typical floor plan pattern can be described as "Zhutongwu + straight staircase + Zhutongwu", which was a very common housing pattern in the Republic of China[50]. Most buildings are three stories or higher and have a large building depth. The second floor is entered through the main entrance at the front of the Zhutongwu, and the second floor and higher are reached by stairs.

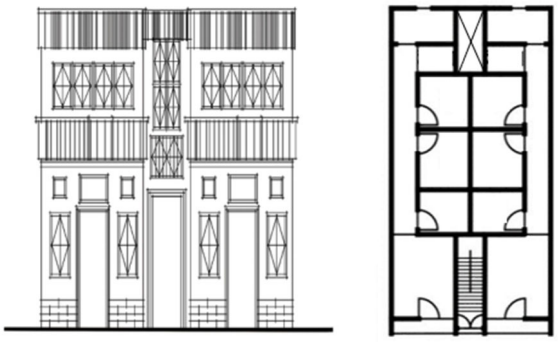


Fig. 4- 30 Typical façade and plan of Type B3（Source：Lu Qi, Guangdong Residences）

According to on-site research, the House No. 6-1 on Dobao Cross Street (Figure 4-31) was built around 1910. It is a three-story building, a staircase, and two households, symmetrically on the left and right, in the form of a doubling Zhutongwu apartment, with a total width of only 9.57 m and a depth of 19.3 m, with an inverse width-to-depth ratio of 1:2. All rooms face the long and narrow patio shared by two households for light. The overall floor plan and shape of the building have been essentially preserved, except for the modification of the internal spacing by individual householders.

Fig. 4- 31 Current situation of the House No. 6-1 on Dobao Cross Street & Ground floor plan in 1936 and 2022 (Source: By the author)

4.5.3 Type C：Western-style row houses with front yard

A large number of residential buildings in Guangzhou were built in the form of Western-style buildings after the development of Dongshan in the early 20th century. Due to the early pioneering work of the church and the construction of the Guangzhou-Kowloon Railway, church people and overseas Chinese began to establish residential communities in the Dongshan area from the early 20th century. As a result of the influence of the Western lifestyle, the residential development in Dongshan adopted the Western model. The term "Dongshan houses" became a specific term for the development of modern urban residential architecture in Guangzhou, that is, it refers to the independent houses with good ventilation and lighting that met the needs of the new lifestyle and were built in the Dongshan area in the early 20th century[51]. Under the influence of Dongshan houses, the period of "Western-style building" began for residential construction in Guangzhou.

Changhua historic district is one of the areas with the most preserved houses in the Xiguan area. In the traditional Zhutongwu plots, the development is 100% and the courtyard is basically in the middle of the house in combination with the patio, while the houses in Changhua Street are still closely arranged, followed by small gardens for the entrance, so they are called western-style row houses with front yards to distinguish the building types.

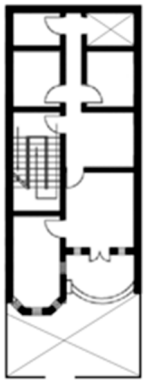


Fig. 4- 32 Typical plan of Type C

（Source：The implementation plan of Guangzhou City Public Works, the author redraws）

The western-style row house with front yard in the Changhua district combines two important features of traditional Zhutongwu and Western architectural styles (Figure 4-32). The architectural layout shows the characteristics of the Zhutongwu plan. Most of the aggregates in Xiguan were built on the model of narrow width and great depth, and the restrictions on private property led to the adoption of this "bamboo cane" floor plan in the early 20th century. Unlike traditional Zhutongwu, front-garden row houses often had small front gardens as a transition from the street to the interior. The width of Changhua Street western-style row houses with front yards ranges from 4 m for a single room to 9 m for a double room, while the depth ranges from 15 m to 25 m. In the layout of the interior spaces, the patio and staircase are still an integral part of the floor plan. The row house with one room in the front yard is more similar to the Zhutongwu, but more oriented to the needs of modern life, the living room is placed at the front, facing the entrance or the garden, and the traditional ceremonial sequence of rooms is replaced by a more functional layout, while the row house with two rooms in the front yard bears some resemblance to the layout of the Dongshan house, with a walkway organizing the sequence of rooms. A walkway organizes the spatial sequence and the rooms are arranged in a "fishbone" combination. On the façade, the row house with front garden shows a variety of western architectural styles, with western columns, hills, linear feet or geometric lines as the main facade details.

For example, the residence at No. 20, South Cross Street, Dobao (Figure 4-33) is

unoccupied in its present condition, except for the second floor, which is partially subdivided into new rooms. It is three stories, has a double-opening floor plan, and a spatial sequence of courtyard gate, garden, living room, and hallway, with the staircase located behind the first bedroom. The staircase is located behind the first bedroom. Behind the hall, a corridor connects the rooms on the left and right, and at the end of the corridor there is a kitchen and a bathroom. In addition to the front garden, there is also a 1 m wide cold alley between it and the neighbor on the right.

Fig. 4- 33 Current situation of the HouseNo. 20, South Cross Street, Dobao & Ground floor plan in 1936 and 2022 (Source: By the author)

4.5.4 Type D：Garden-style detached houses

The introduction of garden-style detached houses in Guangzhou was partly due to the Chinese community, but it was mainly advocated and promoted by the Guangzhou Municipal Government. In 1923, the Guangzhou Municipal Government adopted the "*Measures for the Development of Guanyinshan Park and Residential Area*", the first implementation plan for a garden-style residential area in the modern era in Lingnan, to improve the living environment and guide the development of the new style of housing. This was followed by a series of government documents with more detailed regulations on garden-style houses and the implementation of a number of exemplary residential areas.

The Changhua district is one of the few blocks in the Xiguan area with garden-style

detached houses. All these houses are located on both sides of Changhua Cross Street and Changhua New Street, which were finally built by Liu Garden's sale. The garden-style houses in the block occupy a large area, but are in line with the block plan. The detached garden-style houses are different from the row houses with front gardens and small gardens. The latter are arranged side by side in a row, with adjacent units sharing a common partition or standing side by side without partitions and having courtyards and skylights for ventilation and light. In contrast, independent garden-style houses are built independently in gardens surrounded by courtyard walls. In the larger houses, there are main buildings and auxiliary buildings, leaving large open spaces as gardens and lawns on the plots as far as possible, with a west-facing interior layout and no patios.

The garden-style detached houses in the Changhua district have different layouts and architectural forms depending on the owner and the period of construction, including classical Chinese revival style, Western style, modern architectural style, etc. According to the information, the house No. 28 at Dobao Cross Street (Figure 4-34) is the earliest independent garden style house in the district. It is the former residence of the father of the first Chief Executive of Macau, Edmund Ho Hauwah, and the former residence of the famous Cantonese opera singer Lo Kapo. The entrance is on Dobao South Cross Street and has a front garden. The main building has a three-sided, enclosed plan, and the part of the garden facing the fence has a columned veranda, which has the characteristics of early colonial veranda-style architecture. The building is Western style, with columns on the outer corridor, decorated with pediments and linear feet[42]. The entrance gate was built in a later period and has the characteristics of early modern architecture. The current condition is a vacant house and the exterior walls, porch and terrace are all in disrepair.

Fig. 4- 34 Current situation of the House No. 28 at Dobao Cross Street & Ground floor plan in 1936and 2022 (Source: By the author)

4.5.5 Type E：Row houses after 1949

The traditional row houses in the elongated plots are in the process of regeneration, and renovation is inevitable due to the aging of the houses and the changing population.

The post-1949 Changhua district has long ceased to be a place where middle- and high-income people congregate, but rather an "old block," and the large number of transients who rent here also poses a major security risk. A Zhutongwu is often occupied by more than a dozen families, and in order to accommodate the use, the building is make shiftly remodeled, creating a pathological pattern of living in high-density Zhutongwu. According to the author's surveys, some of the houses for rent are not only occupied by themselves, but also used as dormitories for enterprises. In general, the use of row houses is very confusing, and the original "one family, one house" pattern of land and building arrangement is completely overturned, which eventually leads to a jumble of building forms and new building types, but they do not have much to do with traditional Lingnan architecture. To meet the needs of more unit

workers and aborigines, patios are no longer retained in the floor plan, living space is increased, and larger rooms are finely divided to meet the living needs of multiple families while ignoring ventilation and lighting problems. The higher first floor is usually divided into two floors to create more living space. This is typically the case at No. 4 Changhua Street, for example(Figure 4-35).

Fig. 4- 35 Current situation of the House No. 4 at Changhua Street & Ground floor plan in 1936 and 2022 (Source: By the author)

4.5.6 Type F：Multi-storey housing after 1949 (below 10 storeys)

In the late Qing and Republican periods, there were also multi-story residential buildings, but the number of stories was small, usually 2 to 4, and the size of the plot and building volume were small, so that the architectural tissueof the surrounding row houses was not affected. The architectural style also changed from traditional style to modern style. The formation of multi-storey residential buildings after the establishment of the Republic of China is mainly due to the fact that some government units and factories took over some of the residential plots for reconstruction, and the buildings of several plots were demolished and merged into larger plots.

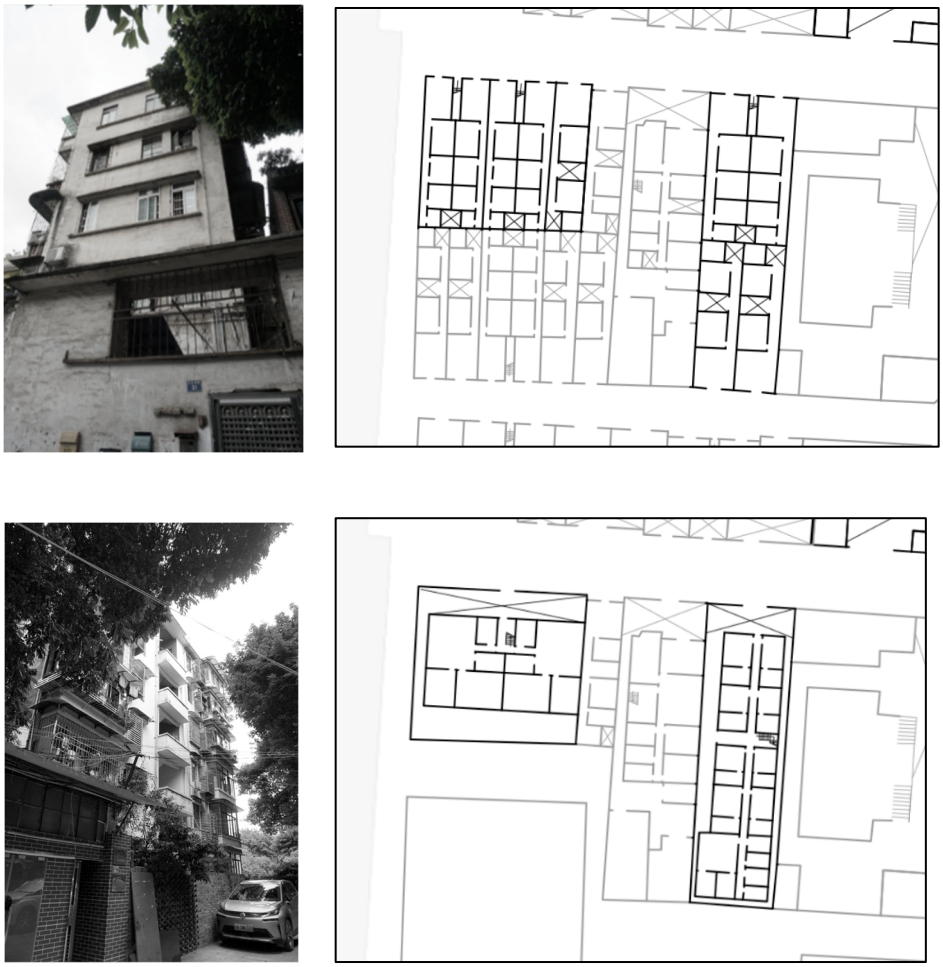


Fig. 4- 36 Left-up: Current situation of No.31 at Dobao Cross streer Left-down: No.35 at Dobao Cross streer Right: Ground floor plan in 1936 and 2022 (Source: By the author)

The floor plan can be divided into two categories (Figure 4-36). One is the interior corridor type such as No. 31 Dobao South Cross Street, which is connected by a corridor in a row with adjacent households on either side, with the staircase in the middle and poor ventilation and lighting. The bathroom and kitchen are at either end of the corridor, but for convenience, many households place small stoves in the corridor in front of their apartments, making the already dark and damp corridor even dirtier and the living environment even worse. Another type of house is the staircase, such as House No. 35 Dobao South Cross Street, where the staircase is the center of the arrangement of households and generally built in strip construction. Compared with the houses of the corridor type, the houses of the staircase type from this period are more complete in terms of household type. Each household has a complete living room,

bedroom, kitchen, bathroom, mainly with two bedrooms, plus a balcony, with a more reasonable household type and better privacy.

4.5.7 Type G：Public buildings

Type G includes buildings such as kindergartens, nursing homes, block committees, and combined commercial and residential buildings in the Changhua district, in addition to the six building types mentioned above. These buildings are less numerous in Changhua Street, but they are larger than the traditional residential buildings, were built after 1949, and have a significant impact on the form, tissue, and appearance of the historic district due to their large volume and high number of stories. Among them, the Fushouyuan Nursing Home (Figure 4-37) is the largest. In the Republican period, the site was essentially a traditional elongated plot. After 1949, industry developed in Xiguan, and since the site was adjacent to Changhua River and some residential buildings were vacant after the war, the original buildings were demolished and new factories were built. In the 1990s, the factory was closed due to the pollution of the river caused by industrial development, and was abandoned by 2000 after the new nursing home was built here. The nursing home consists of two 6-7-story inpatient buildings, the façade and architectural structure are entirely focused on modern, functional considerations and have no relation to the Changhua district.

Fig. 4- 37 Current situation of Fushouyuan Nursing Home & Ground floor plan in 1936 and 2022 (Source: By the author)

4.5.8 Evolution rules

The distribution of the above building types throughout the district is indicated by different colors so that you can read the distribution of building types in the Changhua district. In conjunction with the arrangement and development of the main building types described in the previous section, the evolution rules of the building and room in the Changhua district can be summarized by the following three characteristics.

First, the continuity and the volatility of the typological process coexist. The identification and classification of existing building types in the Changhua Street historic district provides a framework for understanding the diversity of housing in the area. It suggests that simple forms gradually evolve into complex forms that incorporate new features while retaining inherited characteristics. Based on the above study, a hypothesis can be made for the typological process in the Changhua district (Figure 4-38). In this hypothesis, Type A the traditional single-family row house, which emerged in the late Qing and early Republican periods, serves as the basic type in the area. In the Republican period, due to further population growth, firstly, t type B he improved multi-family row house, the diachronic variant of type A, including the three synchronic variants of the Zhutongwu apartment, emerged; secondly, the western-style houses merged with the features of the traditional Zhutongwu in the Changhua district to form the type C western-style row houses with front yard; and the type D garden-style detached house emerged. After 1949, in order to meet the demand for housing, the morbidly high-density type E row house, a volatile variant of type B, emerged alongside the block jump. In addition, multi-story buildings of type F (up to 10 stories) and public buildings of type G, which are not associated with the district type, emerged.

Second, the collage of building types. With the emergence of new types and the constant regeneration of buildings, the building types that appear in different eras constitute a kind of tissue collage in the district. From the statistical results of the area occupied by different building types (Figure 4-39), it can be seen that the building types of the Republican period account for nearly half (49.54%) of the Changhua district. The

dominant building types are Type B and Type C of the Republican period, occupying 16.3% and 19.6% of the area, respectively, and together they form the basic features of the tissue of the district. However, the area of post-1949 buildings and public buildings also reaches 30%. These buildings often retain the scale and organization of traditional buildings in the myriad of sites, but the building density, layout, and construction methods have changed significantly. Therefore, the site retains some traditional urban structural and tissue features in the overall layout, but lacks uniformity and continuity.

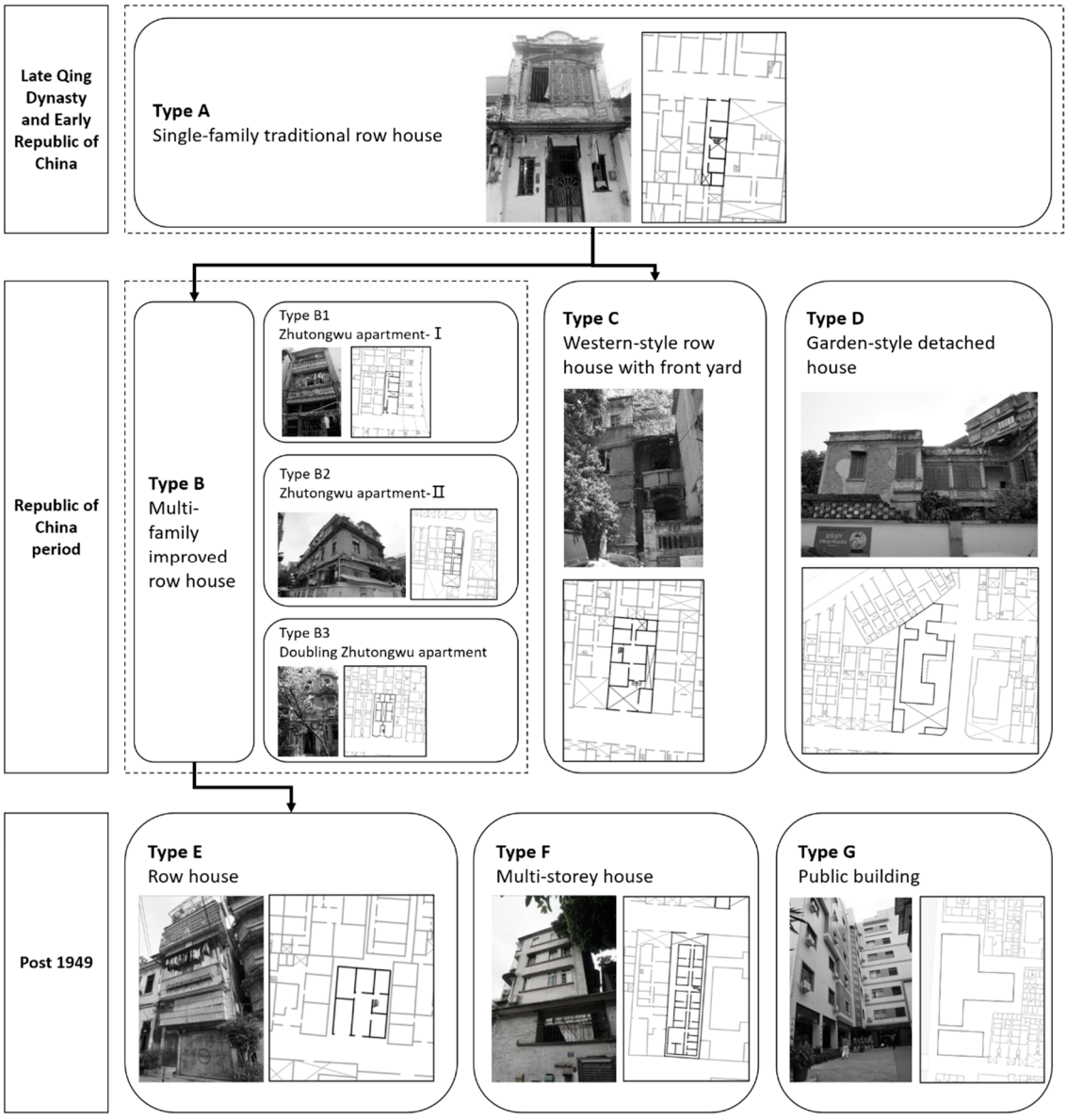


Fig. 4- 38 Typological process hypothesis for the Changhua district

(Source: By the author)

Late Qing Dynasty and Early Republic of China	Type A	9.46%	9.46%
Republic of China	Type B	16.34%	49.54%
	Type C	19.63%	
	Type D	13.58%	
Post 1949	Type E	7.67%	20.02%
	Type F	12.35%	
	Type G	10.60%	10.60%
Residential-Commercial buildings		10.37%	10.37%

Fig. 4- 39 Distribution of building types in the Changhua district

(Source: By the author)

Third, the decay of living pattern. Although there is some continuity in the development of building types, the author has found through field research that the disintegration of

the housing pattern with the patio as the key element can be observed in the different periods of building types when it comes to living and using. The Zhutongwu as the basic type has contributed to the development of residential architecture in Changhua Street in almost all processes and aspects, and its variants, Zhutongwu apartments and western-style row houses with front yards, are the main components of the Changhua district. This narrow and deep housing pattern is due to the key element of the patio. In the Zhutongwu type and its variants, it combines the functions of ventilation, lighting, rainwater collection and drainage, and greenery, and serves as a place for human activities and a channel for communication and integration between the house and nature. Nowadays, however, the pressure of residential population has led to a large number of conversions, and most of the patios of different building types from different periods in the Changhua district are now being converted into houses, and the traditional housing pattern suitable for the Lingnan area is gradually dissolving. Even most of the row houses built after 1949 ignore the problems of ventilation and lighting to meet housing needs, and no longer retain patios in the floor plan for additional living space. With the changing times, the key elements of the residential structure in the Changhua district have gradually disintegrated, and the current living environment has become increasingly chaotic and simple.

4.6 Structures and materials

In the Caniggia residential sequence, materials correspond to elements and structures to elemental structures. More specifically, materials are the comprehensive products of a combination of natural materials and various cultural and regional construction methods, including brick, tile, wood, etc.; structures are combinations of one or more elements, such as floor slabs, walls, partitions, roofs, etc.

Due to different cultural and regional conditions, Chinese traditional architecture uses wood and masonry as the main materials to combine a series of unique components. Since Changhua district is located in Guangdong area and the construction period

covers two periods: the Qing Dynasty and the Republic of China, the architectural style combines the various features of traditional Lingnan architecture and Western architecture to form the unique style and taste of Changhua district. In order to analyze the architecture of each period and type, this section analyzes the characteristics of structures and materials and the development process of different periods in four parts: construction methods, roofs, gables and facade, which helps to grasp historic features of the district and provide inspiration for new designs.

4.6.1 Construction methods

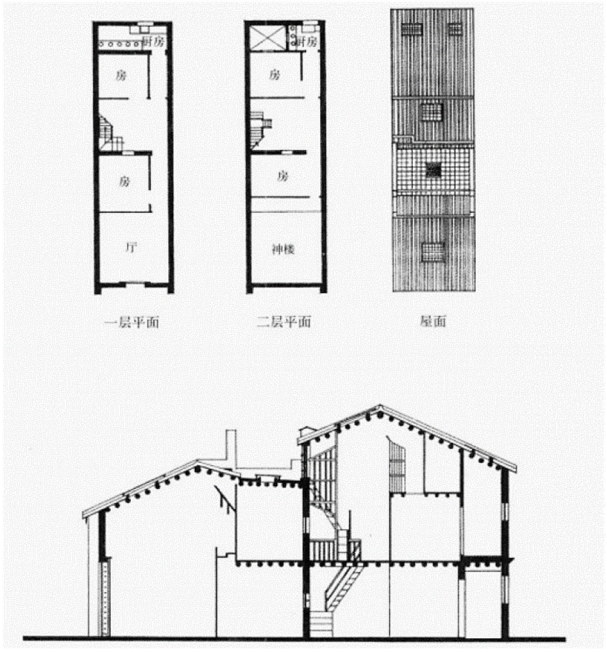


Fig. 4- 40 Typical structure of Lingnan Zhutongwu（Source：Lu Qi, Guangdong Residences）

When it comes to traditional Chinese building systems, elucidating the construction methods is a prerequisite for studying the structures and materials. As the mainstream of traditional Chinese architecture, the wood framing system, which continued for thousands of years, quietly underwent some changes in the Ming and Qing dynasties. During the Ming and Qing dynasties, with the development of the brick-making industry, the use of folk brick walls became popular. In the traditional Chinese wood frame system, rammed earth walls, masonry walls have been used only as maintenance structures or horizontal shear walls, not to bear the vertical gravity of the building. From

the Qing Dynasty onward, load-bearing hill walls and hard hill roof forms appeared in buildings, especially in the folk architecture of Lingnan, with the most representative Zhutongwu in Guangdong[48].

Zhutongwu in the Changhua district were built in the late Qing and Republican periods, when brick and wood structures were mature (Figure 4-40). The Zhutongwu is built with a single room as the basic unit, using the pediments as the supporting structure, with the walls on both sides about 4 meters apart. The walls must be sufficiently thick (30-40 cm) to meet compressive strength and stability requirements; the horizontal structure uses densely placed wooden beams and purlins between the walls to support the floor and roof loads. Depending on the scale of the plot, the depth of the building can be 15-25 meters, and the interior is a column-free space that can be divided into several halls around a flexible patio to form a multi-story small courtyard. Although the supporting structure has been changed from wood to brick, the interior rooms are still divided with wood. In order to connect the patio with the street and enhance the ventilation effect of the bedroom while ensuring the privacy of the bedroom, the partition wall of the bedroom consists of a 2.6 m high wooden panel barrier and a screen door, a separating ventilator and a 1.5 m high openwork grille above the panel barrier, so that the window openings of the street and the patio continuous in space. This effectively improves the ventilation effect of the indoor space.

With the introduction of new materials such as cement, the original wooden structure beams and columns of the wooden structure were gradually replaced by concrete elements in the Republican period, and the number of floors of the building was increased to three or four. Some variants of the traditional row house - the Zhutongwu apartment, western-style row houses with front yard, and the garden-style detached houses, which were more influenced by Western architectural styles, further elaborated the brick structure, using brick masonry for load-bearing capacity, and the columns and beams and floor slabs were usually made of reinforced concrete and cement as binders. This is reflected in a series of administrative regulations issued by

the Nationalist government for the municipal government in the early years of the Republic of China, especially some regulations that specifically regulated the materials and construction methods used in the construction of houses, such as the *"Regulations on the Prohibition of Construction and Implementing Rules"* in 1912, the *"Provisional Regulations on the Prohibition of Construction" i*n 1918, and the *"New Regulations on the Prohibition of Construction in Guangzhou"* in 1924. As construction technology continued to develop and spread, individual heads of households and real estate developers in the block with stronger economic power also began to construct residential buildings using pure reinforced concrete structures, such as House No. 2-2 at Changhua Street (Figure 4-41).

Fig. 4- 41 The front façade of 2-2 Changhua Street fell off, exposing the reinforced concrete frame (Source: By the author)

The above construction methods have not changed significantly over time, but show a slow transition of construction methods. Although reinforced concrete technology was introduced in Guangzhou at the beginning of the 20th century, it did not gain widespread use due to its higher cost compared to traditional materials. As mentioned earlier, most early houses were built with brick walls and wooden trusses to support the floor and roof. However, with the introduction of Western technology and the shortage of traditional lumber, Western building materials and technologies were sometimes used in homes. Concrete columns were placed at the corners of the exterior

walls, but they did not run vertically through the entire wall, which saved costs and increased the stability of the building structure.

4.6.2 Roofs

It is estimated that the roofs of traditional Lingnan buildings originated no later than the late Ming and early Qing dynasties in the form of straight sloping roofs on the front and back in combination with pointed volcanic walls on both sides (Figure 4-42) and were used in large numbers from the late Qing dynasty onward. The roofs of traditional Lingnan houses in the Changhua district are of this type. First of all, hard sloping roofs were mostly used for green tile houses because the tiles themselves were waterproof and did not need overhanging roofs to keep the rain off. Moreover, this straight sloped roof is different from the traditional Chinese concave curved roof. The reason for the introduction of this roof is: to adapt to the meteorological characteristics of the sharp increase of wind and rain disasters in Lingnan from the Ming Dynasty to more than 500 years in modern times. Lingnan several wind and rain to prevent the role of frontal typhoons rainwater backflow on the infiltration of the tile gap, that is, the "backwater" phenomenon. Lingnan ceramic roof easy to grow grass, long grass is conducive to thermal insulation, but not conducive to the prevention of leakage, so it is necessary to often pull grass on people. People need to put the sky ladder, and the slope should not be too steep. A concave roof is steep at the top and slow at the bottom, the upper slope angle is more than 30°, the lower slope angle is less than 30°. More than 30° to hang tiles, to prevent slipping, but also not easy to climb; less than 30°, not conducive to waterproofing. So keep a slope angle of about 30° for the straight roof slope, to prevent typhoons and rain storms, while the slope of the concave curved roof changes.

Fig. 4- 42 Straight-sloped roof with a hard hill slope of about 30° (Source: By the author)

The tiles of traditional houses in Lingnan are basically divided into two categories: curved tiles and book tiles (Figure 4-43). The structure of the roof is that the hard roof is framed with wooden trusses. The diameter of the purlins depends on the span and ranges from 12 cm to 40 cm, and the purlins are covered with boards, generally 10-11 cm wide and 2.5-3.5 cm thick. In order to achieve better rain protection effect, the overlapping of the boards is usually carried out by the method of "overlap seven, three" and "overlap five, five". The "overlap seven, overlap three" refers to the top block overlapping the bottom block 70% and uncovering 30%, that is, three layers of stacked tiles. The method of "overlap five and show five" is a simple practice, that is, the upper block overlaps the lower block 50% and shows 50% to achieve the effect of two layers of stacked tiles. The formation of tile ridge and tile pit on the roof is not only the need for organized rain drainage, but also the result of the construction method "small on large". The shadows created by the tile ridge and tile pit in the sunlight are light and dark stripes arranged longitudinally, creating an architectural beauty. In addition, the roof is often skylight or bright tile (Figure 4-43) to increase the interior lighting, early materials are mostly oyster shell sheet, skylight is mostly push-pull type, available to pull the rope to control the opening and closing, after opening can support interior ventilation and heat dissipation.

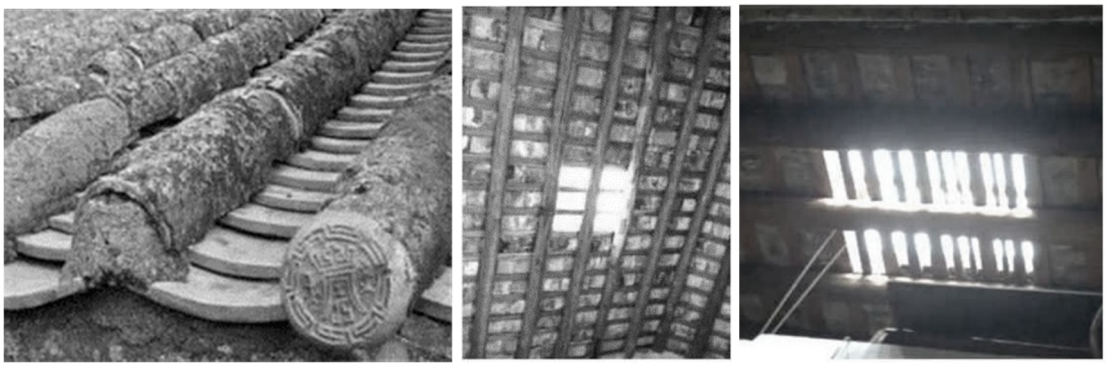


Fig. 4- 43 Curved tile/ book tile/ skylight/ bright tile (Source: By the author)

During the late Qing and early Ming dynasties, this straight sloped roof evolved into the partial flat roof of traditional Lingnan architecture (Figure 4-44). At that time, due to the increasing number of residences and pavilions with more than two stories, residents on the upper floors could no longer go downstairs to participate in outdoor activities, so the "flat roof", an outdoor area on the roof-emerged. First, the sloping roof facing the street was converted into a flat roof, with a parapet at the edge so people can move around. Residents can sunbathe during the day and enjoy the coolness at night. Once the problem of drainage and leakage was solved, flat roofs became a common form of modern architecture in Lingnan. The earliest flat roofs were combined with pitched roofs, and flat roofs occupied very little area. The roof structure of traditional houses usually consists of wooden trusses covered with wooden planks, and the wooden planks are covered with clay tiles. The slope of the roof is very clear, so that rainwater can drain quickly. With the spread of concrete technology, reinforced concrete with better waterproofing properties was increasingly used for roofs in the open air, which led to a more mature form of the roof with a combination of shallow slopes.

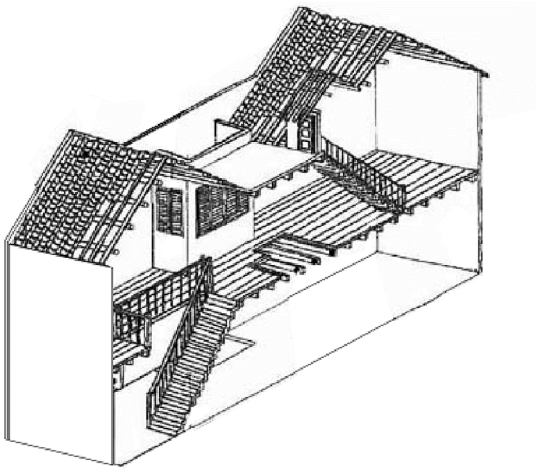


Fig. 4- 44 Partial flat roof of traditional Lingnan architecture (Source: By the author)

Fig. 4- 45 The parapet and the eaves in Changhua district (Source: By the author)

In the Republican period, when brick construction prevailed, roofs began to adopt more flat roof structures made of reinforced concrete. There is nothing special about the construction of flat roofs, but the special elements are the parapet and the eaves (Figure 4-45). The parapet is not only a perimeter structure, but also has the important function of facade modelling. Unlike sloped roofs, the eaves of flat roofs made of

reinforced concrete are also flat, and their supporting structures are necessarily also made of reinforced concrete, divided into beam and slab and plate types. The structural slab, which protrudes from the roof slab, has a very good load-bearing capacity and better stiffness if a stem, beam or serrated strut (a dense small short beam) is added to the bottom of the slab[52].

With the development of productivity and regeneration of building materials, the decline of traditional hand-made tile production and the public's preference for the waterproof and robust properties of modern materials, traditional green roof tiles have gradually been replaced by machine flat tiles. The basic structure of machine flat roof tiles can be divided into two categories: Wooden roof tiles and concrete tiles. The former is mostly used for renovation of old buildings. In this case, the broken tiles are first replaced with new wooden roof tiles, then linoleum is laid on the wooden roof tiles to play a waterproof role, and then the machine flat roof tiles are laid tightly on the roof in the form of a seam on the wooden roof tiles. For concrete roofs, the tiles are usually glued together with cement mortar to achieve the purpose of laying and fixing the tiles. Because the machine flat roof tile itself has a certain concave and convex shape in the production process, the colour and roof tissue are different from the small green tile. There are also many new buildings with flat roof shapes.

In addition, many building roofs are built with asbestos tiles, colour tiles, sun roofs and other modern materials. These materials are relatively cheap, and with the expansion of illegal construction areas, the proportion has gradually increased, which has caused great damage to the overall appearance of the historic district.

4.6.3 Pediments

Unlike in European architecture, where the pediment is usually used as a façade, pediments in traditional Chinese architecture are usually continuous, thick brick walls used to separate adjacent properties, with fewer openings for windows and doors. The pediment is an important element of structural control in the Changhua district, which

is mainly characterized by row houses.

Due to the hot and humid climate in the Lingnan region, most traditional residential houses are built with solid brick walls. Green brick (Figure 4-46) is usually used for the masonry, which has good waterproofing against wind and rain and good moisture insulation. The size of traditional brick is 240*115*70 mm, which is one of the characteristics of traditional Chinese architecture, and some of them are decorated with beautiful carvings on the large apartment green-gray walls, which gives people a peaceful and quiet feeling. Green brick walls are usually unplastered on the outside, with bare brick joints; on the inside, they are either plastered or whitewashed, or kept in clear water. The brickwork has one smooth one, three smooth one, five smooth one or seven smooth one, and so on.

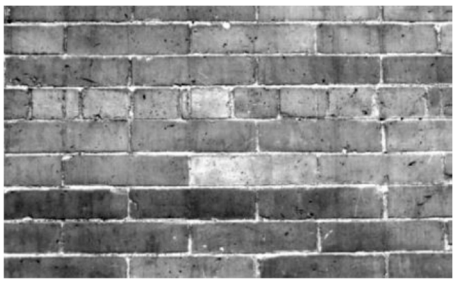


Fig. 4- 46 Traditional green brick pediment (Source: By the author)

And in the Republican period, with the introduction of Western building technology, the use of Western-style red bricks became one of the features of modern architecture in Lingnan. The specifications of western style red bricks are slightly different from those of domestic green bricks, generally 228*115*63, 220*105*52mm, etc. The red brick buildings in Changhua district, such as the house No. 24 Changhua Street (Figure 4-47), mostly use Gothic brickwork (also known as Dutch brickwork), which was first used by the Germans and is often called Dutch brickwork in North America and England. Each brick course is alternated with the ding bricks, with the two adjacent bricks aligned at the centerline of the ding bricks, forming a vertical, staggered lap joint.

Fig. 4- 47 The wall of No.24 at Changhua Street (Source: By the author)

4.6.4 Exterior walls

The street exterior wall is the only entrance and exit of the building, and it is also the only surface that shows the image of the building. The wall differs from the pediment in two main aspects: First, there are differences in the basic shape and materials used, and second, there are more exciting facade elements because the exterior wall performs more functions.

（1）Basic form

The traditional buildings in the Lingnan area are all translucent walls, and the exterior walls as the front façade are more elaborate in terms of wall construction and masonry techniques. Some of the more elaborate buildings use water rubbed green bricks with silk joints on the outside of the front wall (Figure 4-48). Compared to ordinary bricks, water-ground bricks are made of highly developed clay and must be adjusted with fine grinding. The concave surface is scooped out of the top and bottom of the bricks during construction, leaving a clean and sharp edge and an apartment and clean side, so that the outlines of the bricks fit tightly together during masonry, and then the gaps are closed with white gypsum adhesive to give the appearance of a tight seam. The height of the base varies according to the specifications of the building, and some are slightly thicker than the brick wall[53]. Few of the traditional Lingnan buildings in the Changhua district retain this wall construction, and most of the traditional residential walls have been painted with modern exterior paint, such as House No. 62 at Dobao Street (Figure

4-48).

Fig. 4- 48 Left to right: water rubbed green bricks wall/ the intersection part of water rubbed green bricks and original green bricks (Source: By the author)

With the advancement of building technology and the spread of Western architectural concepts, the front facade facades of buildings with brick and concrete structures and reinforced concrete structures in the Chang Hua Street block during the Republican period saw a large number of additions of brushed stone or terrazzo finishes, yellow or white paint with simple horizontal or vertical decorative lines, in addition to clear water walls. This reflects the popularity of the Moderne early modern architectural style in the block at that time (Figure 4-49).

Fig. 4- 49 Early modern style front façade in Changhua district (Source: By the author)

There are generally two practices for the walls of new or renovated post-1949 buildings: In newer, higher quality residential buildings, the walls are generally faced with facing brick, while in lower quality buildings, the walls are decorated by painting (Figure 4-50). There is no decoration for esthetic reasons other than the need for function, and the color of some facing bricks does not match at all with the surrounding preserved row houses from the late Qing and Republican periods.

Fig. 4- 50 Walls of new or renovated buildings in the Changhua district after 1949
(Source: By the author)

（2）Façade elements

Besides the difference in shape and material between the exterior wall and the pediment, the most important thing is that the exterior wall has more exciting elements. In this section, the elements of the facade are divided into window and door elements and other decorative elements. For the window and door elements, the buildings in the Changhua district have experienced the transition from the traditional closed "triple doors" and small openings to the more modern function-oriented window and door designs, while for the decorative elements, all building types in the Changhua district show a stronger influence of Western architectural culture.

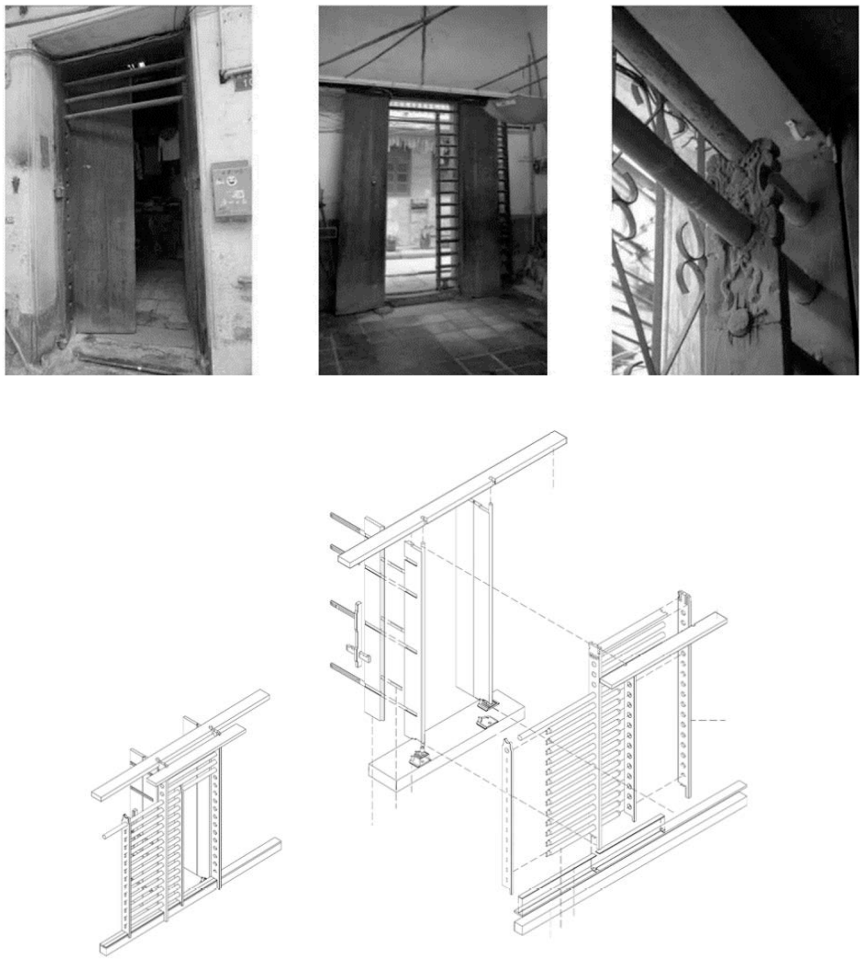


Fig. 4- 51 The triple door in Changhua district (Source: By the author)

Due to the hot and humid climate and introverted social character, the traditional houses in Lingnan area are very closed to the outside world, with few windows on the exterior walls except the main door, and the size of the window openings is also very small. The design of the entrance door is particularly beautiful, and the form of "triple door" (Figure 4-51) is commonly used, i.e. "screen door, lattice door and main door", and the "main door" is usually made of wood. The "main door" is usually made of wood, red, double open, higher, the "screen door" is placed outside the "main door", the outermost layer of the "screen door" to ensure safety. This "triple door" design is convenient for the ventilation of the building, is a unique architectural form of Lingnan architecture, but also because of the sultry climate in the south[47]. The windows are mostly made of wood without sills, but some buildings are also influenced by Western culture by using iron burglar-proof iron branch windows and stained-glass windows on

the sills (Figure 4-52), gradually showing the decorative features of Western architecture.

Fig. 4- 52 Iron branch windows and stained-glass in Changhua district (Source: By the author)

In terms of the window and door elements on the front facade, the Republican-era Zhutongwu variant already differs greatly from the traditional Zhutongwu of the late Qing Dynasty: the center of the second floor façade already continues the "triple door" design of the late Qing Dynasty, with windows on the left and right sides of the door. A "vent window" was left in the upper part of the door frame for ventilation, and the windows essentially had window frames made of white or gray stone. From the second floor onward, open balconies with reinforced concrete railings were generally constructed in the western style, and there was a door and two windows behind the railings. As the population grew, two separate entrances were created on the second floor to accommodate multiple families in one house. The "triple doors" of the second floor entrance were located in the center and the windows on one side were converted into staircase entrances, ideal for multiple generations to live together, which has been preserved to this day (Figure 4-53).

Fig. 4- 53 Façade of the variant of Zhutongwu (Source: By the author)

In the Republican period, the design of the "triple doors" did not remain very well, but was mostly an ordinary wooden door. As the independent garden style houses were influenced by the deeper western architectural culture, the architectural character was no longer closed and conservative as in the traditional houses. As the interior layout was different from the traditional houses in Lingnan, the arrangement of windows was more flexible and free, and even the continuous horizontal windows of No. 16 Chang Hua New Street appeared (Figure 4-54).

Fig. 4- 54 Continuous horizontal windows of No. 16 Changhua New Street (Source: By the author)

Western-style decorative elements found in the Changhua district include mainly arched bells, pilasters, and balustrades (Figure 4-55). The arches are an important modeling element of the modern building facades in the Changhua Street block and are colorful in both their overall form and detailed execution. Most of the arches in the Changhua district are made of stone, with the surface in the form of line feet, cupon

stones and other components, giving it a three-dimensional and classical appearance, such as the residence at No. 20 Dobao South Cross Street. Pilasters, on the other hand, are widely used in modern Lingnan architecture to express the kinship with Western architecture, and these pilasters are mainly decorated at the entrances or corridors. The columns protrude from the walls, sometimes supporting weight, sometimes not, but they only have a decorative function, such as at the residence at 51 Dobao Street. Western-style balustrades are found in large numbers in the Changhua Street block. They basically copy the typical western balustrade style of that time, which can be roughly geometric, vase-shaped and some others.

Fig. 4- 55 Left to right: Arches (No. 20 Dobao South Cross Street)，Pilasters (No. 28 Dobao South Cross Street) and western style balustrades (Source: By the author)

Although productivity and construction techniques have improved, the door and window elements of new buildings constructed after 1949 are primarily functional, with no decorative elements and no connection to the district's original materials and construction techniques. In recent years, most of the doors and windows of buildings of any kind in the block are sheathed in aluminum alloy, with iron safety nets on the outside, while the porches are made of plastic, with pipes and wires directly on the facade, and some of the residential buildings also have illegal attachments on top, which are extremely incongruous with the late Qing and Republican periods preserved in the district and destroy the original appearance of the district (Figure 4-56).

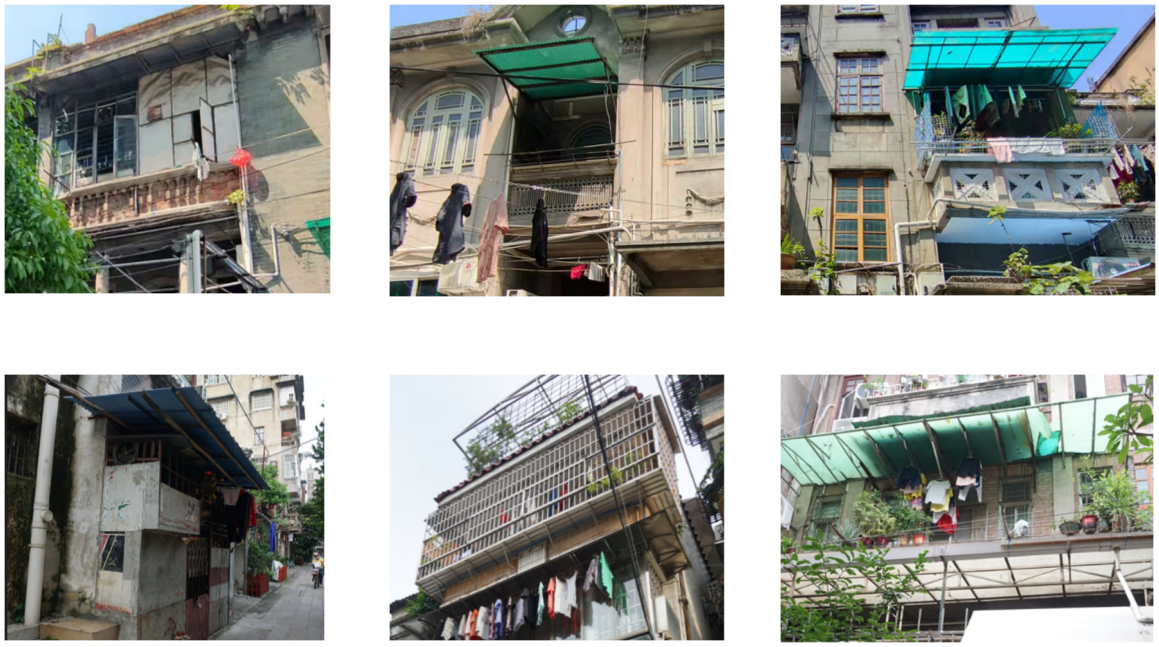


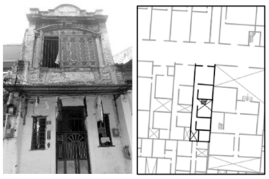
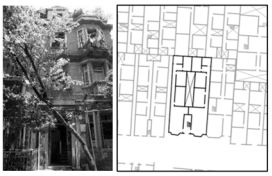
Fig. 4- 56 The façade in Changhua district in current situation (Source: By the author)

4.6.5 Evolution rules

In summary, the interpretation of the morphological types of the main structures and materials of each type of building in the Changhua district should be made from four aspects: construction methods, roofs, pediments and exterior walls, which are of great significance in shaping the overall pattern and style characteristics of the historical site. First of all, construction methods, structures and materials influence and determine each other. The building materials of different periods determine different construction methods, which naturally leads to different materials of the building elements and exterior walls. Finally, the exterior wall, as the only figurehead of the building, is more elaborate than the vertical walls in terms of the basic shapes and façade elements such as windows, doors and decorative elements, which define the character of the Changhua Street district.

In the different eras and building types of the Changhua district, the traditional structures and materials have also undergone a series of changes (Figure 4-57). The materials of the walls also change, from pure brick walls to walls with decorative bricks

and then to walls with facing bricks, which have nothing to do with the traditional materials; and the components of the front facade gradually disappear while the functional orientation of modern architecture prevails. Overall, it seems that the development at the level of structures and materials has increased the disorganization of the morphology of the Changhua district.

	Type A Traditional row houses for single-family	**Type B** Improved row houses for multi-family	**Type C** Western-style row houses with front yard
Example			
Construction method	Brick and timber structure	Masonry structure Reinforced concrete structure	Masonry structure Reinforced concrete structure
Roof	Grey tiles Straight-sloped roof Combination of flat and sloped roofs Skylight, bright tile Brick stack with short eaves	Grey tiles Flat roof/ combination of flat and sloped roofs Western styled parapet Reinforced concrete eaves	Flat roof Western styled parapet Reinforced concrete eaves
Pediment	Gable: green brick, Façade: water rubbed green brick	Red brick, green brick, pebbledash	Red brick, green brick, pebbledash, Yellow painted
Exterior wall	"Triple door", small window Iron grilles, colored windows	"Triple door", big window Iron grilles, colored windows Open balcony with western style balustrade	Free-form window Arches Pilasters Open balcony with western style balustrade

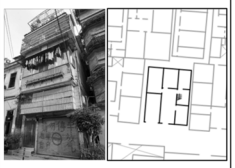
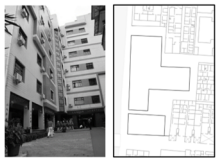
	Type D Garden-style detached houses	**Type E** Row houses after 1949	**Type F** Multi-storey housing after 1949	**Type G** Pubilc buildings
Example				
Construction method	Masonry structure Reinforced concrete structure	Masonry structure Reinforced concrete structure	Reinforced concrete structure	Reinforced concrete structure
Roof	Flat roof; glazed tile sloped roof Western styled parapet Reinforced concrete eaves	Color steel plate Flat roof; combination of flat and sloped roofs	Flat roof	Flat roof
Pediment	White or yellow painted, pebbledash, red brick	Paint or tile	Paint or tile	Paint or tile
Exterior wall	Free-form window Arches Pilasters Open balcony with western style balustrade	Functional door & window Iron security fence Plastic canopy	Functional door & window Iron security fence Plastic canopy	Functional door & window Iron security fence Plastic canopy

Fig. 4- 57 The typical evolution of building construction and material in Changhua district (Source: By the author)

4.7 Simple tissue

By analyzing the typo-morphology of the above four levels of street, plot, building and room, structure and material, integrating street, plot and building type can divide the whole district into different single tissue. As the Changhua district, since it developed and matured in the late Qing Dynasty and the Republic of China, when the concept of urban construction and the concept of housing changed drastically, the single tissue of the Changhua district in 1936 represents a collage but an ordered condition (Figure 4-58). This collage of orderly conditions testifies to the important historical value of the Changhua district as a "living museum of modern housing in Guangzhou." Later, when the merging of plots and the buildings were renovated independently, the relationship between the street and plot changed, and new types of building layouts emerged, making the division of the single tissue more complex and fragmented than the original collaged state. When we superimpose the relationship between the street and its pertinent strip and the distribution of building types shown above, we obtain the distribution of single tissue in the Changhua district today (Figure 4-59).

The concept of simple tissue is derived from the Caniggia definition of a route which refers to the same route (imaginary) and a sequence of identical or similar plots (real) on either side of it, i.e., a combination of the same urban elements, i.e., the relationship between the plots and the route must be consistent and the building layout patterns within the plots must be similar to form the same simple tissue[3]. The different types of simple tissues are combined together to form a more complex block and urban tissue. In the traditional planning method, the plots are usually divided according to the street boundaries, which does not consider the actual morphological elements and leads to poor planning results. This problem can be avoided because the simple tissue division takes into account all urban elements. It should therefore be used as an important basis for classifying plots in planning and design.

Fig. 4- 58 Distribution of simple tissue of Changhua district in the Republic of China (Source: By the author)

Fig. 4- 59 Distribution of simple tissue of Changhua district today (Source: By the author)

4.8 Summary of this chapter

In this chapter, the Italian typo-morphological study of Changhua district is conducted. First, the three phases of Changhua district are identified based on the historical information. Then the building surveys in the mature period and the current situation are carried out. And the ground floor plans of the two periods are used to carry out typo-morphological analysis in the five research levels: simple tissue, streets, plots, buildings and rooms, structures and materials.

First of all, the street defines the boundary of the historic conservation area and establishes the inner tissue structure, while the way the plot is organized represents the hidden order of the district tissue. At this level of study, not only the characteristics and evolution of the street and the plot themselves are considered, but also the relationship between them. In Changhua district, there are not many changes in streets and plots, but the most significant changes are the merging of plots due to the construction of nursing homes and the disappearance of the section from Changhua Street to Changhua River, which greatly affects the morphology and historical features of the district.

Secondly, the buildings and rooms reflect the tissue characteristics of the district and internally accommodate different use functions and living patterns, so understanding the living habits of residents in the historic conservation area can provide clues for conservation design and renewal. In Changhua district, the building types are both continuous and erratic in time, and the building types in different periods present a tissue collage in space, but in actual life and use, the building types in different periods show the decay of the residential pattern with the patio as the key element.

Third, the structures and materials are the concrete reflection of the characteristics of the historic conservation area, and the construction method is the basis for understanding the building types, while the distinction between pediment and façade helps explain their different roles in controlling the overall tissue and utilitarian functions;

the construction method, roof, pediment and exterior wall of Changhua district have undergone a series of transformations, which enhance the confusion of the morphology and historic features of Changhua district.

The entire historic conservation area can be divided into different simple tissues by combining the analysis of the previous layers. The distribution of the different types of tissues and their typo-morphological characteristics will also be an important theoretical basis for the conservation and regeneration design of the historic conservation area. In 1936, the simple tissue of Changhua district showed a collagenous but ordered state, which proved the important historical value of Changhua district. Later, with the merging of plots, the change of relationships between streets and plots brought by the independent renovation of buildings and the emergence of new types of building types, the division of the simple tissue became more complicated and fragmented from the original collage and orderly state, and the morphology of the district also became chaotic and disorderly.

CHAPTER 5: THE CONSERVATION AND REGENERATION DESIGN OF CHANGHUA DISTRICT BASED ON TYPO-MORPHOLOGICAL ANALYSIS

As China's economy transitions from high-speed growth to high-quality development, urban development is gradually shifting from the mode of "gradual expansion" to the mode of "stock optimization," and "micro-renewal" is becoming the main development direction for historic cities and neighborhoods. In the course of this change, the lack of appropriate design strategies has led to a disconnection between theoretical research and project practice.

The goal of the Italian school of typo-morphology research is not only to identify and interpret the different layers of physical morphology of urban space, but also, and more importantly, to propose control guidelines and design methods to guide the construction of new urban areas and the regeneration of old cities. These efforts are well represented in the research and design practices of scholars in Florence and Bologna, Italy. Due to the peculiarities of urban morphology and building types in Guangzhou, the conservation and regeneration design based on typo-morphological analysis needs to be adapted to the Chinese context.

Through the analysis in the previous chapter, we have obtained the typo-morphological characteristics and evolution rules of Changhua district in terms of simple tissue, streets, plots, buildings and rooms, structures and materials. In this chapter, we will use the results of this analysis to establish the planning principles under the guidance of the existing planning context, and then carry out the detailed design of the typical area under the control of the overall design combined with specific design guidelines at different levels to verify the operability of the design strategies analyzed by the Italian school of typo-morphology interpretation.

5.1 Design background

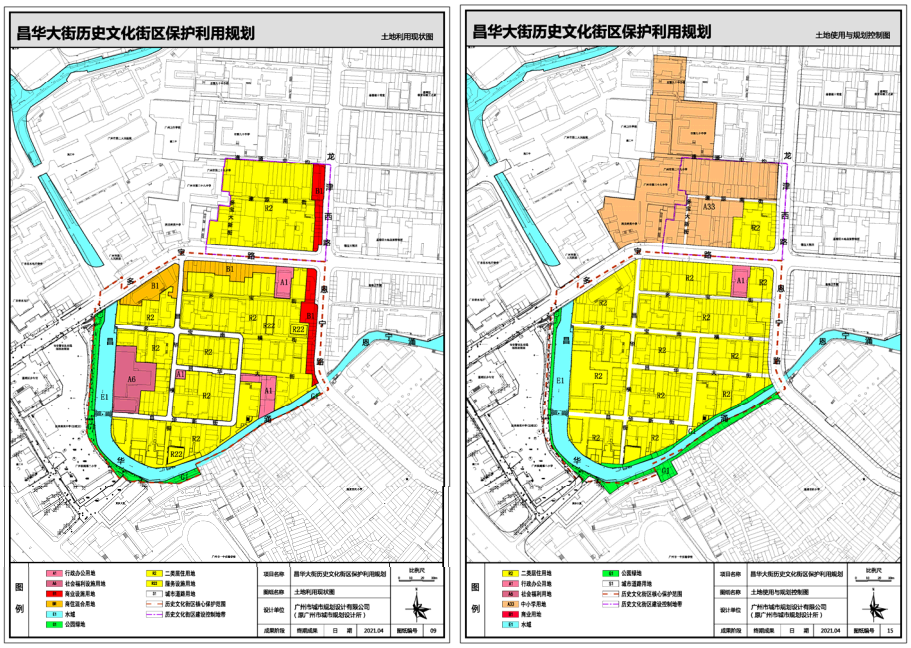


Fig. 5- 1 Land use status and land use planning in Changhua district

(Source：Conservation and Use Planning of Changhua Historic Conservation Area)

Based on the typo-morphological analysis, the design for the conservation and regeneration of Changhua district is based on the "Conservation and Use Planning of Changhua Historic Conservation Area" (2021) as the design background. Based on the orientation of planning functions, it is proposed that the functions of traditional residence, special commercial and cultural tourism are the most important, and the mode of "micro-renovation" is used to protect and revitalize the historical resources and form a historical district that shows and transmits the regional characteristics and traditional Xiguan culture. As for the land use planning (Figure 5-1), it is based on the principles of respecting the current situation and functions, promoting mixed-use with multiple functions, and outsourcing the existing nursing homes in the district to residential use. As for the building renovation guidelines, it allows the protection and revitalization of buildings in the district by type, requires the rational use of historical and cultural heritage through acquisition and replacement of property rights under the premise of protection, optimizes the interior space of buildings, and corresponds to the use of modern life. It also encourages social and market forces to participate in building

renovation and adaptive use to improve the vitality of the district.

In this design context, the design for the conservation and regeneration of Changhua district is mainly based on the results of typo-morphological analysis. The streets and plots are designed for restoration on the premise of respecting the original district tissue. The buildings are designed according to the types, such as renewal of historic buildings and improvement of basic buildings. In addition, the design is combined with functional planning to make full use of the historical and cultural resources of the district and create the Changhua district that inherits the historical culture and integrates with modern urban life.

5.2 Design principle

The term "integrated conservation" was first proposed at the 1973 Bologna's Il Piano per l'Edilizia Economica e Popolare (PEEP) and is now internationally considered the only valid guideline for the conservation and development of historic urban areas. It is now internationally considered the only valid guideline for the conservation and development of historic urban areas and is widely used in the conservation and development of historic districts. Faced with decaying post-war urban centers and an influx of people, the ruling party in Bologna, the left-wing communist government, must address not only the technical aspects of restoring historic buildings, but more importantly the social question of for whom historic urban centers should be preserved and revitalized.

The conservation and regeneration of the Changhua district must also respond to similar social problems: the deterioration of historic buildings, the low quality of housing, the inconsistent composition of property rights, and the diverse desires of residents. However, practice and reflection in China over the past decade have also shown that large-scale renovation and redevelopment driven by the government or developers cannot adapt to the new development model and people's demands. In contrast, typo-morphology not only analyzes the changes in the physical and spatial forms of historic

districts, but also focuses on the changes in the composition of population and living habits, and their role in the development of forms and building types; Therefore, the design of conservation and regeneration of historic district based on typo-morphology also emphasizes the idea of integrated conservation, which emphasizes "human and architectural conservation together" as the principle of research and design, and whose main elements are authenticity, people-oriented and sustainability.

5.2.1 Authenticity

The principle of authenticity is an internationally recognized fundamental factor in the evaluation, protection, and monitoring of cultural heritage and is an important principle in the review of the World Heritage Site. However, in the preservation of historic districts, the principle of authenticity should be applied flexibly. Since the situation of historic districts is different from that of buildings, different methods of conservation and use should be allowed. Regardless of the preservation method, the continuation of historic authenticity may be partial and relative, and some historic authenticity may not be preserved at all. Therefore, it is not desirable to sacrifice the comfort and creativity of the urban environment to preserve old buildings as taught in Western countries.

In the case of the Changhua Street Historic District, planning and design should pay equal attention to the tangible and intangible heritage of different eras. Based on typo-morphological analysis, we can see that the buildings and other material spatial elements of different eras, as well as the customs and lifestyles in the historic district, overlap, which together make up the richness of the form and appearance of the historic district, and it is this richness that determines the value of the historic district. Therefore, the conservation and regeneration of historic districts cannot simply restore them to their original or most magnificent state, but should treat history as an evolving process that respects the tangible and intangible remains of different eras and gives them new vitality to adapt them to new functional needs.

5.2.2 People-oriented

This principle comes from the plan for the preservation of the historic centre of Bologna, which is an important part of the concept of integrated conservation: "preserving people and buildings together". This is because preserving a historic district is an important way to preserve a city's memory, to preserve its urban tissue, to preserve it in its entirety, but also to protect the people who live in those memories. Without people, historic buildings will quickly age and lose their original interest and charm. This principle of preserving "people and buildings together" is a fundamental principle of the modern concept of historic preservation. To realise this principle, it is necessary to pay attention to the functional design and living environment of the historic district to meet the socio-economic needs of people and housing needs.

On the one hand, the preservation and regeneration of historic district is a complex social project closely related to the social economy. And in order to preserve the people and social life in the historic district, it is necessary to develop the social economy of the historic district through the functional design in the renewal. Since historic cities, as material and spiritual wealth created in history, are part of today's cultural background and human environment, and are important resources for social development, their appropriate use to meet the needs of material and cultural life in today's society can give them economic significance. If economic development, residents' income, and the source of funds for conservation are secured, the style of the historic district can be sustainably improved and restored.

On the other hand, improving people's livelihood is the basic requirement to improve local residents' life, enhance the quality of life, promote vitality and integrate into modern life. Under the premise of improving municipal infrastructure, designing public street space, repairing or building new public facilities to improve the living environment, social resources and residents are guided to participate and carry out independent renewal. In this way, the vitality of the traditional district and the diverse material and cultural needs of modern life are met.

5.2.3 Sustainability

Over the past decade, China has mainly adopted a "top-down" approach to planning and design, with the government or developers as the main players. After numerous demolition and construction projects, the appearance of the district has improved for a short period of time, but once the main players stop investing resources in the historic district, the district will deteriorate a second time. While conserving historic districts is a long and ever-changing job, this unsustainable intervention ignores the dynamic nature of historic district conservation and regeneration[54].

Therefore, sustainable regeneration serves as the fundamental model of action for design and implementation. The accumulation process of history is slow and gradual, so the conservation and regeneration of historical districts should also be a gradual and continuous progress process. In actual implementation, it is necessary to combine "top-down" planning and design with "bottom-up" independent renewal. "Top-down" control includes the street system, lot layout, community infrastructure, public service facilities, public space, and other aspects affecting the public interest, as well as control and direction proposals for the overall business layout and appearance of the district. Such sustainable, incremental regeneration can allow all kinds of new ideas and situations to be incorporated into the conservation development, so that the historic district is in a dynamic process, keeping pace with social and economic development.

The specific approach to the design of a historic district is inextricably linked to typo-morphological analysis. The planning and architectural design strategies based on different levels of analysis must not only coordinate and solve various problems, but also effectively promote coordination between top-down planning and design and bottom-up spontaneous construction.

5.3 General design based on typo-morphological analysis

Through the typo-morphological analysis of the five elements and the establishment of design principles, Changhua district can be designed in terms of streets, plots,

buildings and planning functions to create the overall framework. Sorting out the street system, restoring Changhua Street and the waterfront to strengthen the square street pattern. Identifying the plot tissue, combining it with the current built environment, re-subdividing some of the reorganized plots that seriously affects the morphology of the district, and further dividing the plot management units according to the simple tissue to improve the effect of the plot guidelines. Classifying buildings into special and basic buildings and integrating the results of the typo-morphological analysis in order to take appropriate measures. The planning function is to continue the residential-oriented function of the block and integrate the historical resources, establish special commercial and creative offices that reflect the traditional culture of the Xiguan area, improve the public service of the community, and bring new vitality to the historical district.

5.3.1 Street system adjustment

According to the typo-morphological analysis, the current situation is similar to the street structure of Changhua district in the Republic of China, which is "four horizontal and two vertical streets"; and due to the spread of the new settlement concept in the Republic of China, the width of the streets in the district is greater than 5m, which can meet the basic needs of motor vehicles, non-motorised vehicles, pedestrians and fire evacuation.

Therefore, the existing streets in Changhua District will be respected and protected, and the western section of Changhua Street to Changhua River will be restored according to the street structure in the Republic of China, the square street system will be strengthened, and the riverside path along Changhua River in Changhua district to improve the slow walking system in the district (Figure 5-2).

Fig. 5- 2 Street system adjustment (Source: by the author)

Based on the improvement of the street structure, the street level is divided, with the 5-7 m wide Dobao South Cross Street and Changhua Cross Street as major streets, Dobao Street, Changhua Street, Changhua New Street and Changhua South Street as secondary streets, and the 1-3 m wide waterfront as tertiary streets (Figure 5-3). In Changhua District, pedestrian-oriented traffic is encouraged, but some sections are also reserved for automobile traffic. Since the district is still mainly residential and the existence of the current roadway in the district is affected by the garden-style detached houses, the roadway of Changhua Cross Street and part of Dobao South Cross Street will be maintained for authenticity and function, with the narrowest cross-section width of 5 m and the minimum turning radius of 3 m. The minimum turning radius is 3 meters. However, the streetscape design of the street space is necessary to regulate motor vehicle traffic and improve the overall pedestrian experience of the district.

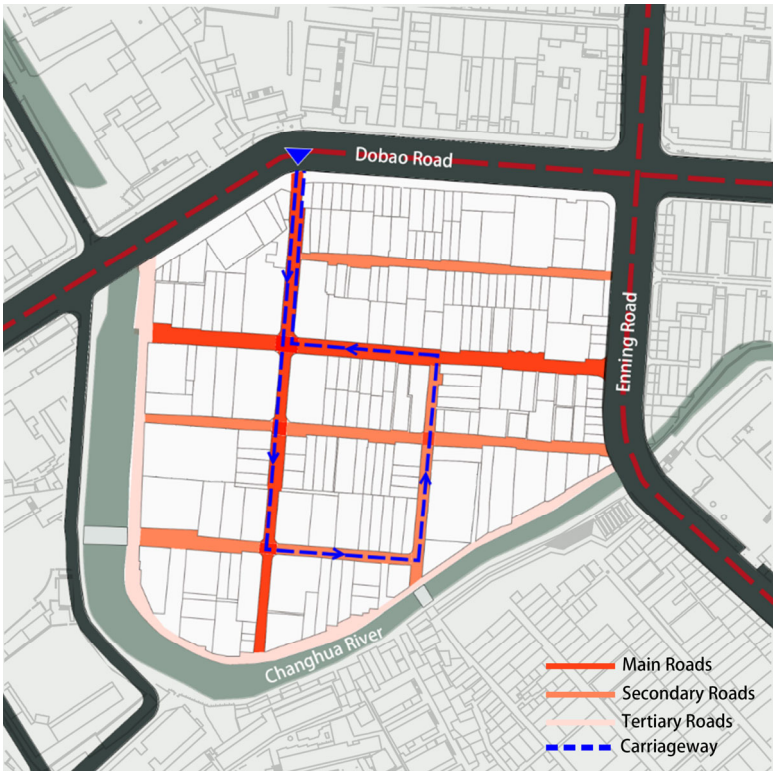


Fig. 5- 3 Street level (Source: by the author)

5.3.2 Plot organization

Through the typo-morphological analysis comparing the plot divisions of Changhua district in the Republic of China and the current situation (Figure 5-4), three evolutionary trends can be identified. Since Zhutongwu was originally already the result of land conservation and use, most of the plots were kept in the original division and were not changed; some plots were merged for historical reasons and because of the deterioration of buildings, and most of the merged plots were used for the construction of multi-story residential houses of factories; very few plots were divided into smaller plots, and houses that did not conform to the tissue at all were created.

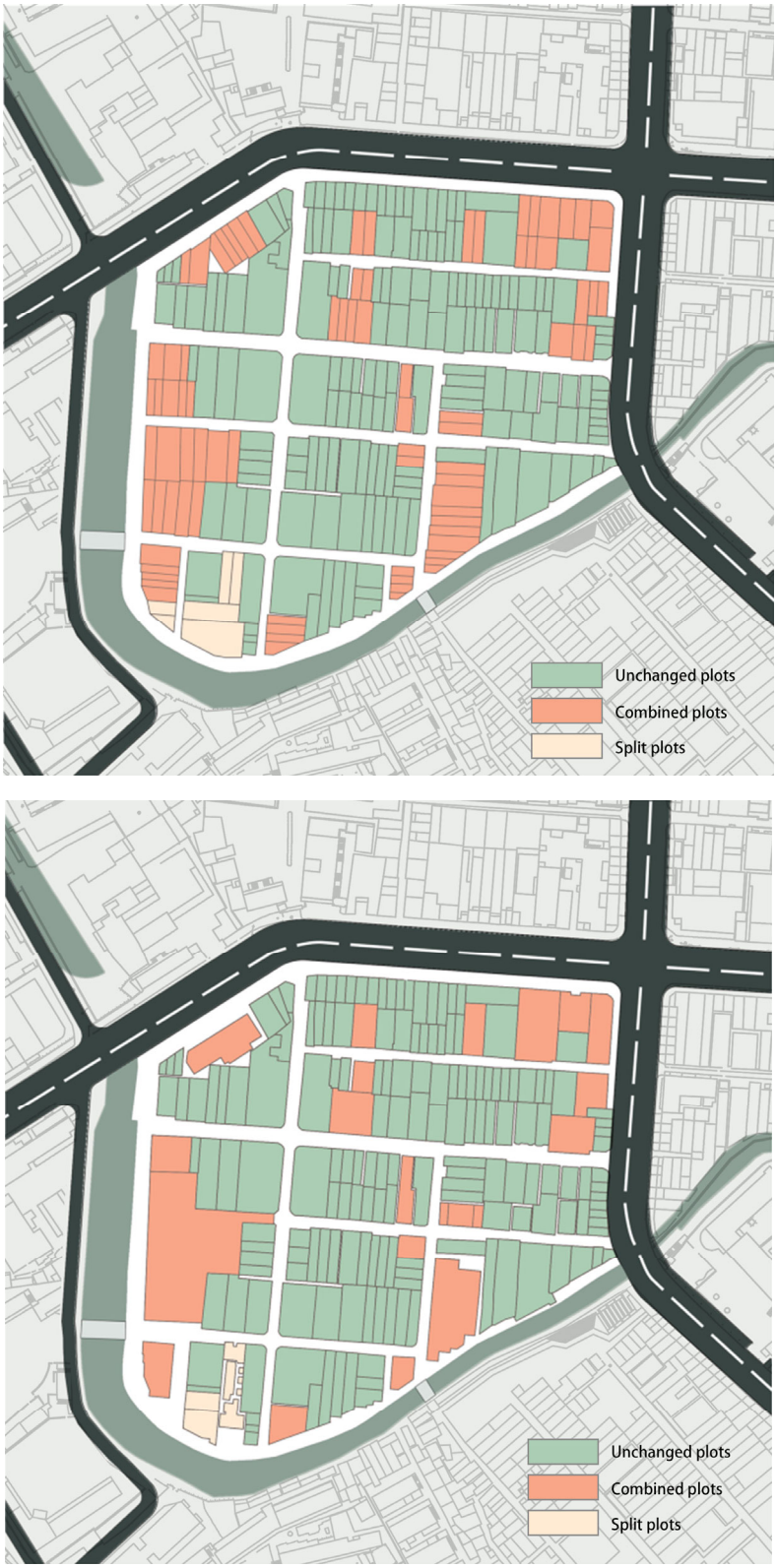


Fig. 5- 4 1936 and 2022 plot tissue (Source: by the author)

Based on the principle of integrated conservation, in view of the changes in these tissues, not all the altered tissues should be demolished to fully restore the mature or glorious period, but one by one should be analyzed in a rational way according to the

current situation and the future functional planning of the district. After superimposing the current elevation map on the current tissue map, we can see that the original tissue of the district is mainly 2-3-story buildings and a few are more than 4-story buildings, but most of the merged plots are built as 7-9-story buildings, and the volume is very different from the original tissue, which has a greater impact on the morphology of the district (Figure 5-5).

Fig. 5- 5 Overlay of building height and plot tissue (Source: by the author)

Considering the tissue and the morphology of district, as well as the adjusted street system, the red plots in the figure are re-divided, and the re-divided plots are considered for new residential areas, public areas, and areas for public services (Figure 5-6).

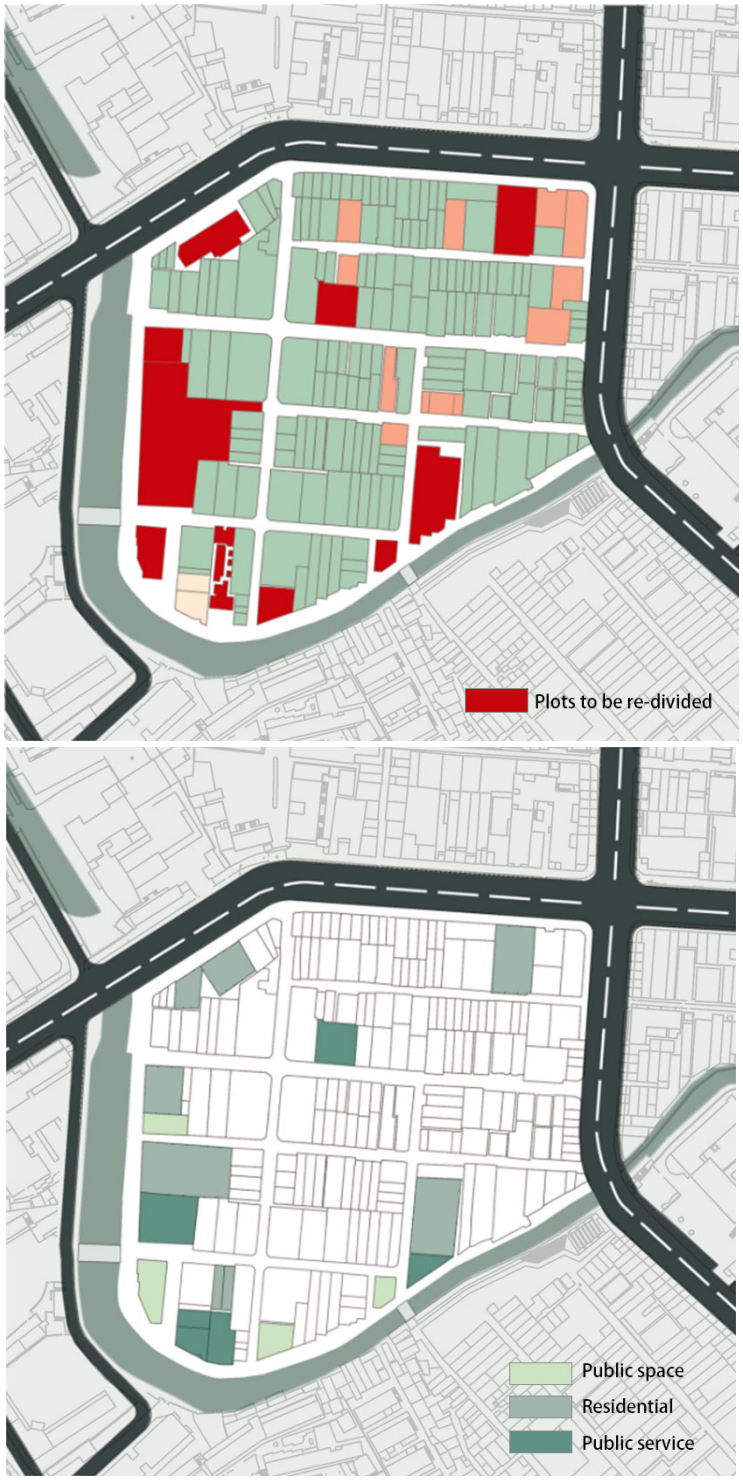


Fig. 5- 6 Redividing plots (Source: by the author)

Once the streets system and plots organization have been designed, the plots in the district can be divided into the following 11 plot management units according to the boundaries of the streets (Figure 5-7). Based on this, by combining the results of typo-morphological analysis (Figure 5-8), the plot management units can be further divided according to simple tissue, which can be used as an important basis for developing the plot guidelines. Since the simple tissue includes all the elements of streets, plots, buildings, etc., it can greatly improve the fineness and effectiveness of the guidelines for controlling district morphology compared to the traditional plot management units, which can only express the relationship between street outline and street.

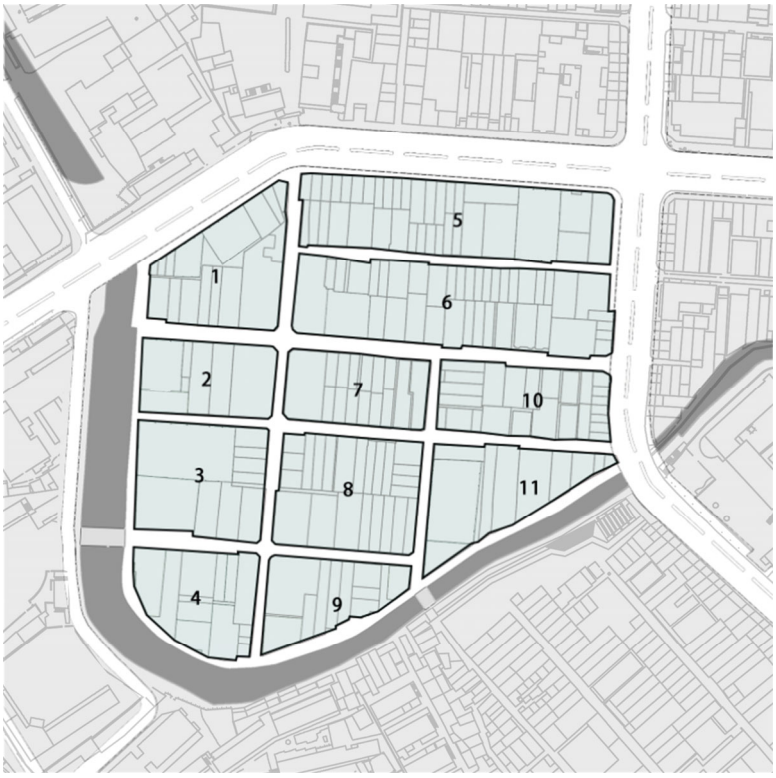


Fig. 5- 7 Plot management units (Source: by the author)

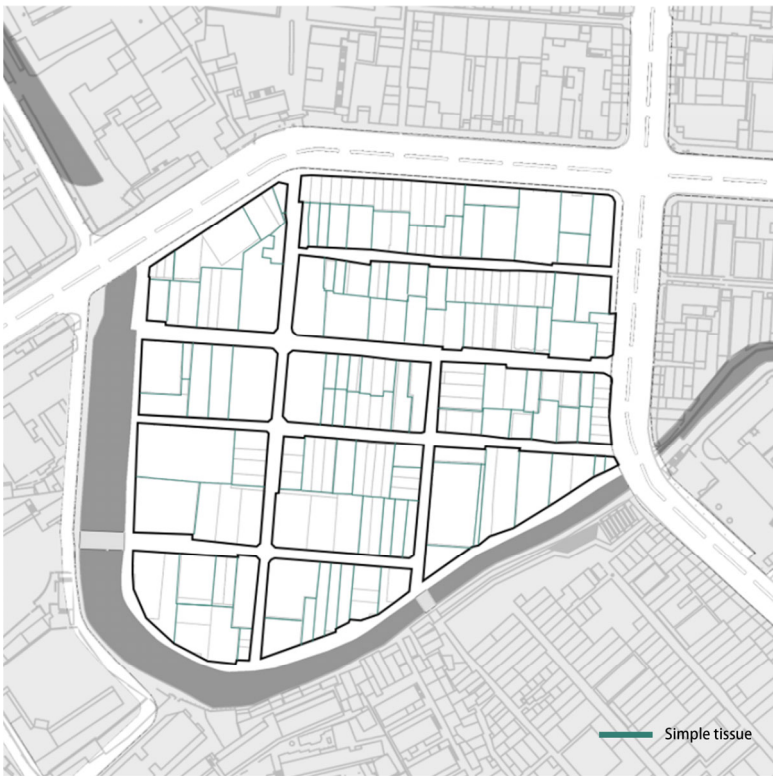


Fig. 5- 8 Further division based on simple tissue on the basis of the plot management units (Source: by the author)

5.3.3 Building regeneration classification

According to Caniggia, urban buildings can be divided into two categories: basic buildings and special buildings. The former usually takes the form of points lined up in the urban street network, forming the main public areas, where important monumental buildings continue to participate in the urban evolution process, shaping the historical value of the city with their permanence, while private housing often takes the planar form that form the urban substrate, reflecting the urban morphology and the characteristics of the social grouping with their different typo-morphological features.

Such a classification is entirely consistent with the principle of sustainability. On the one hand, the special building can not only supplement the lack of public service functions in the historic district, but also serve as a vehicle for adjusting the industrial structure of the district. This is an important part of improving people's livelihood related to the common interests of all residents, and should be invested by the government and relevant development units in conjunction with the important cultural relics and

historic buildings in the historic district to carry out "top-down" renovation. On the other hand, the construction of these particular buildings also has a certain demonstrative significance, as good public service facilities and a good living environment can encourage the intervention of private capital and support the "bottom-up" self-renovation of private residential buildings by residents.

Fig. 5- 9 Building regeneration classification (Source: by the author)

Changhua district has been a private residential district with no public facilities and a single industrial structure since the construction of the late Qing Dynasty. Over time, some basic buildings with high historical value have become historical buildings, and some vacant historical buildings have become an opportunity to increase public services in the historical district and introduce new industrial structures, which can become "special buildings" in the historical district with proper functional planning. According to the theory of typo-morphology and the principle of sustainability, this section divides the design strategies into two categories: special buildings and basic buildings, with special buildings divided into conversion and reuse of historic building,

and New Public Service, and basic buildings divided into divided into retention, renovation, refurbishment and new residence (Figure 5-9). The former mainly involves important historic buildings and is implemented by the government to restore the form and features of traditional buildings and introduce new functions based on relevant historic research. The latter explores the heritage of traditional culture and the renovation strategy to adapt to modern life in terms of volume control, spatial layout, and materials and materials.

5.3.4 Function design

As mentioned in Chapter 3, Changhua district is rich in tangible and intangible historical and cultural resources. According to the *Conservation and Use Planning of Changhua Historic Conservation Area* (2021), there are 34 protected historic sites and historic buildings in Changhua district. Many of them are vacant and in disrepair. The intangible cultural heritage mainly includes the former residences of famous Cantonese opera singers and revolutionary industrialist Liu Xuexun.

In functional design, vacant or high-value historic buildings are selected as the main objects of adaptive reuse. After conversion, they will be used primarily for creative commercial, business office, museum, and cultural exhibition functions (Figure 5-10). The streets connected to the city street with rich historical heritage, Chang Hua Cross Street, Dobao South Cross Street and Chang Hua New Street, are mainly open to the city. With plenty of outdoor space and stores converted from ground-floor apartments, a good commercial and cultural atmosphere is created (Figure 5-11).

Fig. 5- 10 Distribution of historic buildings (Source: by the author)

Fig. 5- 11 Commercial and cultural network (Source: by the author)

As mentioned in Chapter 3, Changhua district has a significant shortage of public services and public spaces. Especially in the context of the district's aging trend, there

is no space for the elderly in the district. Therefore, in designing the functions, it is important not only to take advantage of the original historical and cultural resources of the district, but also to improve the quality of the human living environment by expanding public services and public spaces in a historical district that still consists mainly of residential buildings and applying the planning principle of "people-oriented". The planning principle of "people-oriented" is put into practice.

As for the public space, in addition to the new public space after the re-dividing of the plot, it is also advisable to set back the renovated buildings with poor historical features by a certain distance to create some small public spaces. In addition, the street intersections should also be set back by a certain distance to create small public spaces that give a better sense of space for the district (Figure 5-12). As for public services, in addition to the new and revitalized public services, the first floors of the renovated buildings in the district with poor historic features can be converted into public services (Figure 5-12) to improve the overall public service network of the district (Figure 5-13).

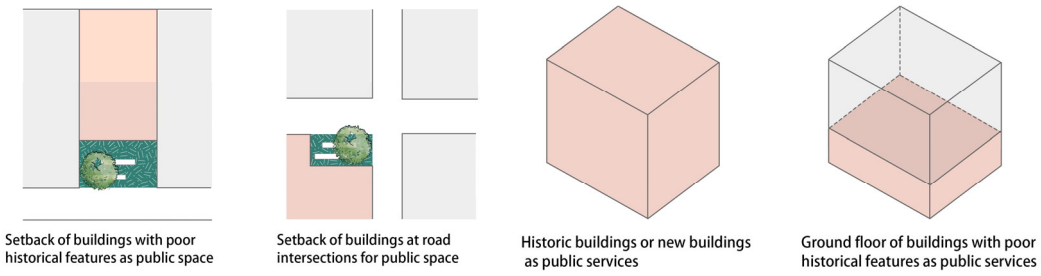


Fig. 5- 12 Opportunities for more public space and public services (Source: by the author)

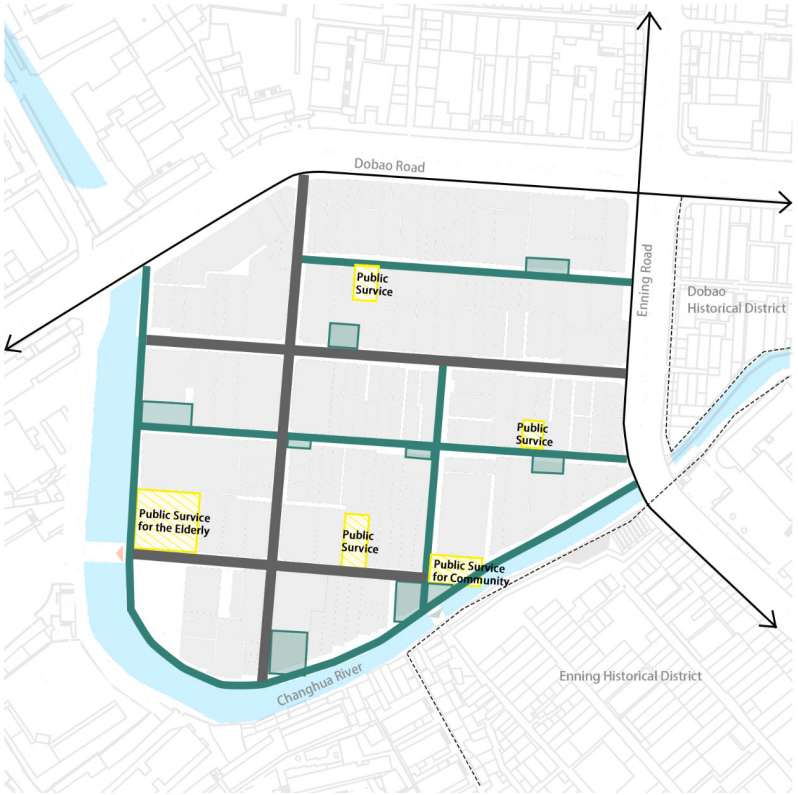


Fig. 5- 13 Public service network (Source: by the author)

By superimposing the above two aspects of functional planning, the final functional plan can be obtained (Figure 5-14). Changhua Cross Street, Dobao South Cross Street, and Changhua New Street are used as commercial and cultural streets. The revitalized historic buildings, abundant outdoor spaces, and stores converted from first floor apartments provide a good commercial and cultural atmosphere for the district and take full advantage of the district's historic and cultural resources. The rest of the streets are used as residential streets to improve the residential environment and original residential atmosphere by providing more public space and public services. In this way, Changhua's historic district is created and integrated with modern city life[56] (Figure 5-15).

Fig. 5- 14 Function design of Changhua district (Source: by the author)

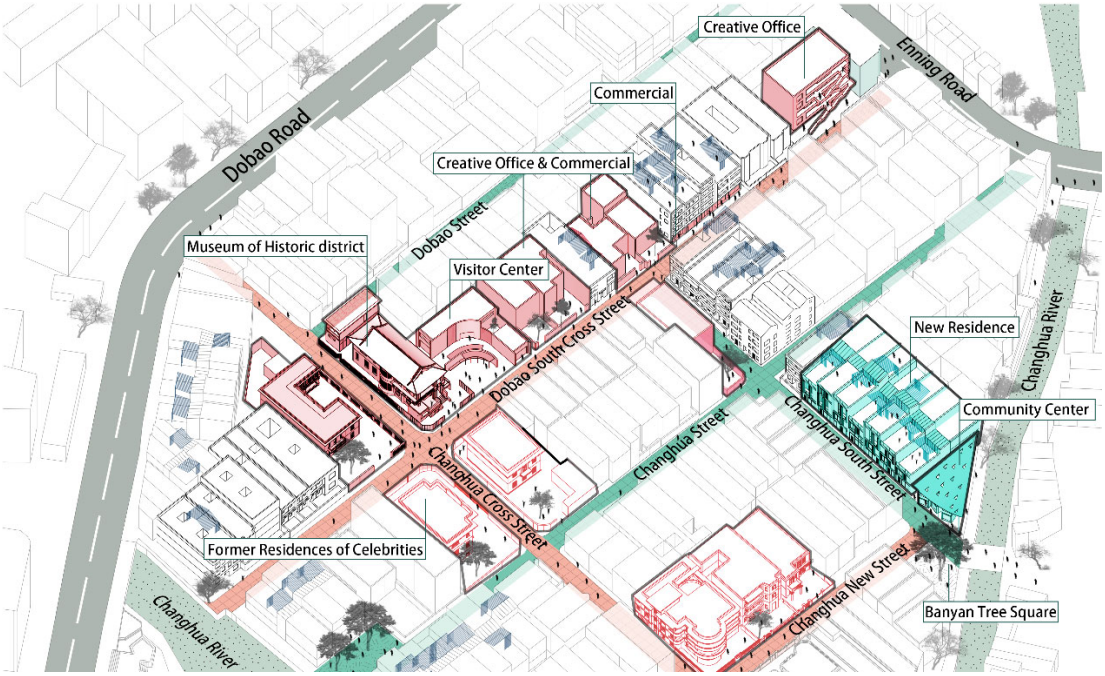


Fig. 5- 15 Commercial and livable atmosphere of district (Source: by the author)

5.3.5 Master plan

Based on typo-morphological analysis, after adjusting street system, organizing plots,

classifying buildings and designing function，the master plan for the conservation and regeneration of Changhua district can be obtained (Figure 5-16) .

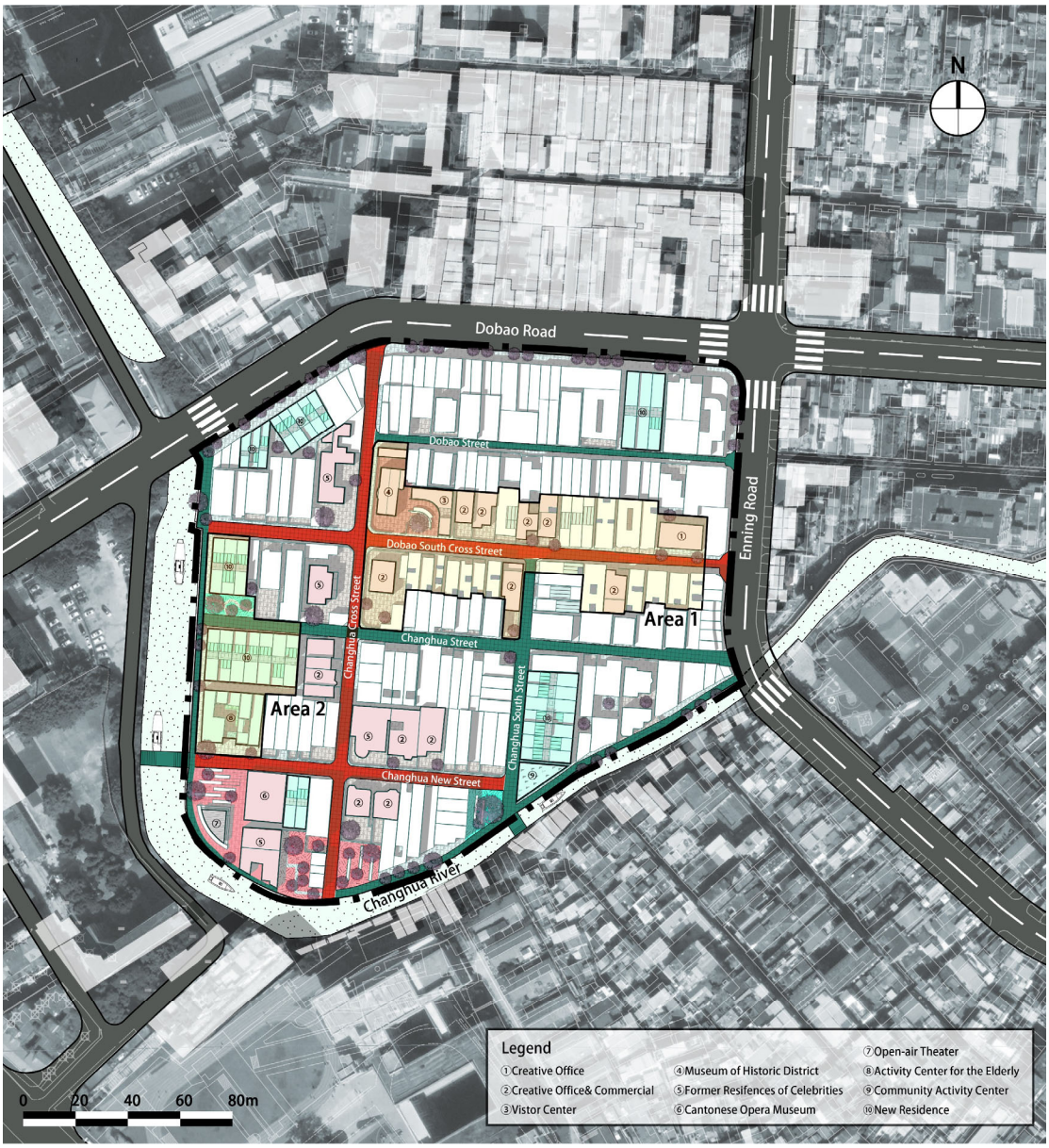


Fig. 5- 16 Master plan for the conservation and regeneration of Changhua district (Source: by the author)

5.4 Design guidelines based on typo-morphological analysis

5.4.1 Framework of design guidelines

Based on the typo-morphological analysis, the previous section provided the general design of the district's street, plot, building, and function design, and established the

overall framework for the district's conservation and regeneration. However, the overall morphology of the district requires more detailed design guidelines to truly translate the essence of the traditional district morphology into the modern district morphology. This tradition of design guidelines as an important design outcome is also a characteristic of the Italian school of typo-morphology, reflected in the practice of Bologna and other examples[57].

Therefore, as part of the general design, this section proposes design guidelines for the street, plot, and building levels based on a typo-morphological analysis. It should be clear, however, that the design guidelines for each level are not isolated, but are interrelated.

Based on the typo-morphological analysis, at the street level, the focus is on the control of the section, paving, borderline and interface; at the plot level, the simple tissue of the plot can be roughly divided into six types to control the corresponding tissue, the relationship between buildings and courtyards; at the building level, each building type is controlled according to the classification of the general design in terms of volume, spatial layout, structures and materials (Figure 5-17).

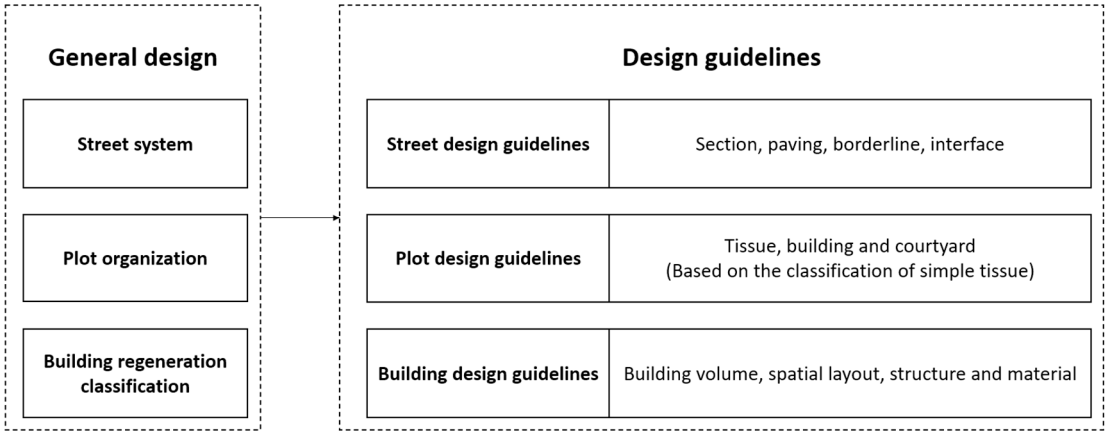


Fig. 5- 17 Framework of design guidelines (Source: by the author)

5.4.2 Street design guidelines

After adjusting the street system according to the typo-morphological analysis, the street design guidelines focus on controlling the basic elements of the street such as

road section, paving, borderlines and interfaces.

（1）Street sections

Fig. 5- 18 Street section classification (Source: by the author)

Based on the classification of streets, the road sections in Changhua district can be divided into four categories (Figures 5-18 and 19). They are 5-7 m wide streets with mixed pedestrian and vehicular traffic, mainly sections of Changhua Cross Street and Changhua New Street; 5-7 m wide pedestrian streets, mainly Dobao South Cross Street; 4-5 m wide pedestrian streets, such as Dobao Street and Changhua Street; and 3 m wide pedestrian streets, mainly riverside walkways.

Section of roads with a width of 5-7m for mixed traffic

Section of roads with a width of 4-5m for pedestrain

Section of roads with a width of 5-7m for pedestrain

Section of roads with a width of 3m for pedestrain

Fig. 5- 19 Street section design guidelines (Source: by the author)

（2）Pavings

Under the principle of authenticity and function of the district, some of the vehicular roads are preserved within Changhua district, but the district continues to rely on pedestrian traffic as the main feature. Therefore, in order to promote pedestrian traffic in the streets of the district, there are four main types of pavings in the district (Figures 5-20, 21). Granite slabs are the traditional pedestrian paving in the district, which is still preserved in some sections of Dobao Street and Dobao South Cross Street and should be maintained in most pedestrain in the district. The vehicular roads are paved with square bricks to distinguish the boundary between pedestrian and vehicular traffic. Striped bricks are used as paving at the intersection of pedestrian and vehicular traffic, and speed limits are installed to remind vehicles to slow down and give way to pedestrians to improve the pedestrian experience in the district. At the waterfront

walking paths, striped landscape paving is installed.

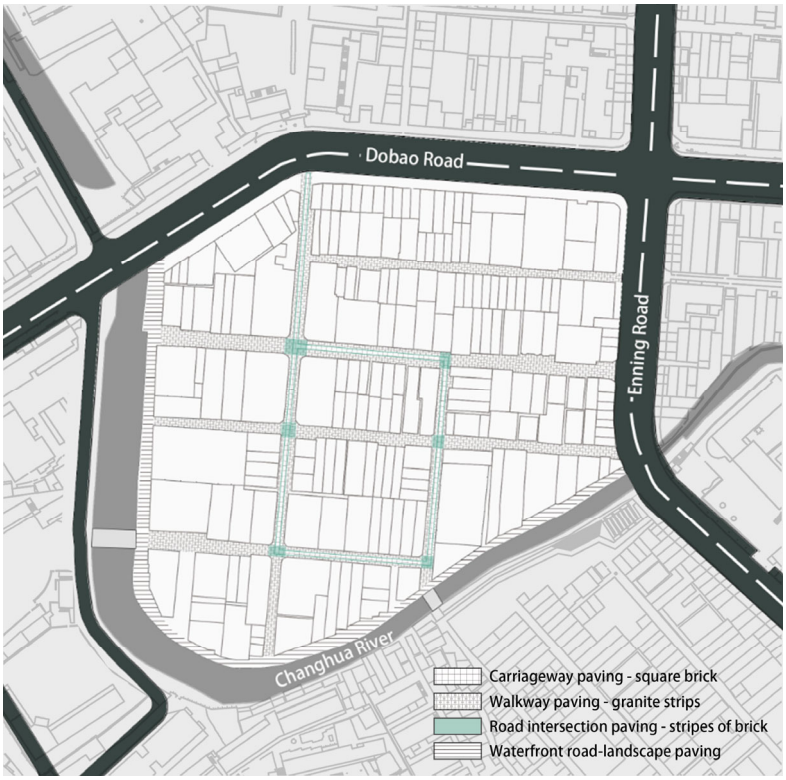


Fig. 5- 20 Paving design guidelines (Source: by the author)

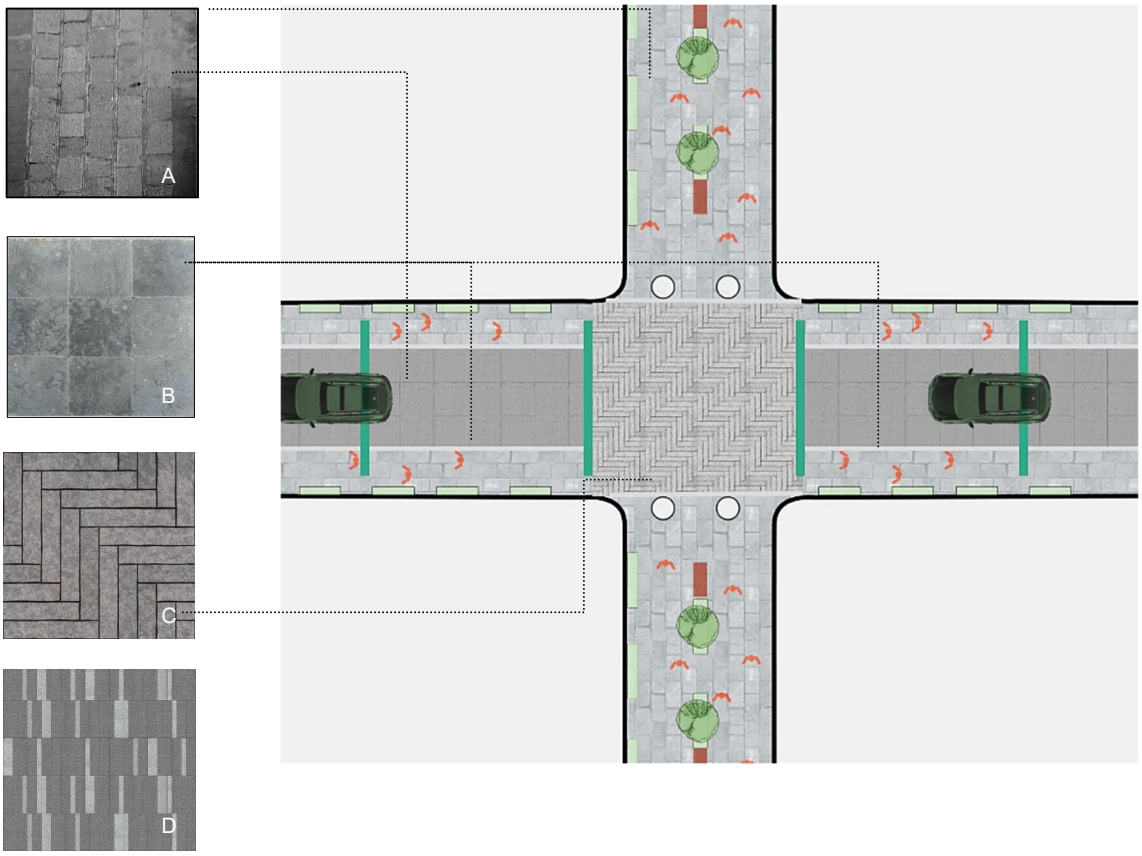


Fig. 5- 21 Illustration of street pavings (Source: by the author)

（3）Borderlines

Borderlines are the basic controlling elements of the street. Based on typo-morphological analysis, the borderlines of existing steps and pavements should be repaired, and the borderlines of existing buildings or front yards should be maintained; any illegal structures in the street should be demolished and their original borderlines restored; and the setback building borderlines should be landscaped to improve the continuity of the street (Figure 5-22).

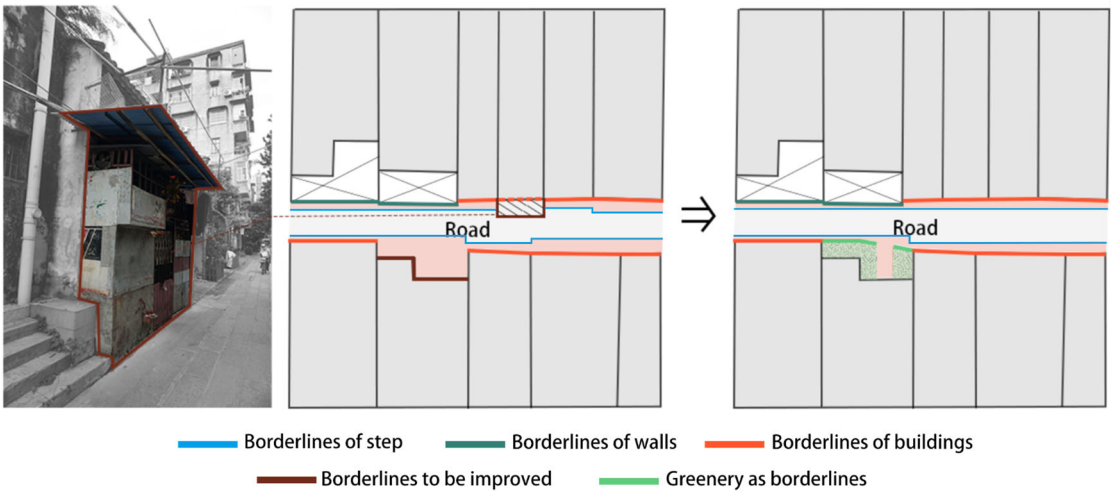


Fig. 5- 22 Street borderline design guidelines (Source: by the author)

（4）Interfaces

The street interface is an important element of the public space of the historic district and is the main carrier of the form of the district. Typo-morphological analysis shows that nearly 40% of the buildings in Changhua district have front yards, so the street interface can be roughly divided into two types: courtyard walls and buildings. Since the interface is a direct reflection of the building type, the type of interface between the courtyard wall and the building should not be changed, and the shape of the interface that does not match the original building type should not appear.

The buildings with front yard in the district are mainly garden style detached houses and western-style row houses with front yard, among which there are more historic buildings. The courtyard walls of historic buildings should be restored to the original

style as much as possible and can be altered in a reasonable manner without conflicting with the original style. And courtyard walls of non-historic buildings should not exceed 2 m in height and coordinate the use of permeable interfaces that are compatible with the traditional style. Semi-public gardens should be advocated, especially for revitalized building uses, to increase public space within the district (Figure 5-23).

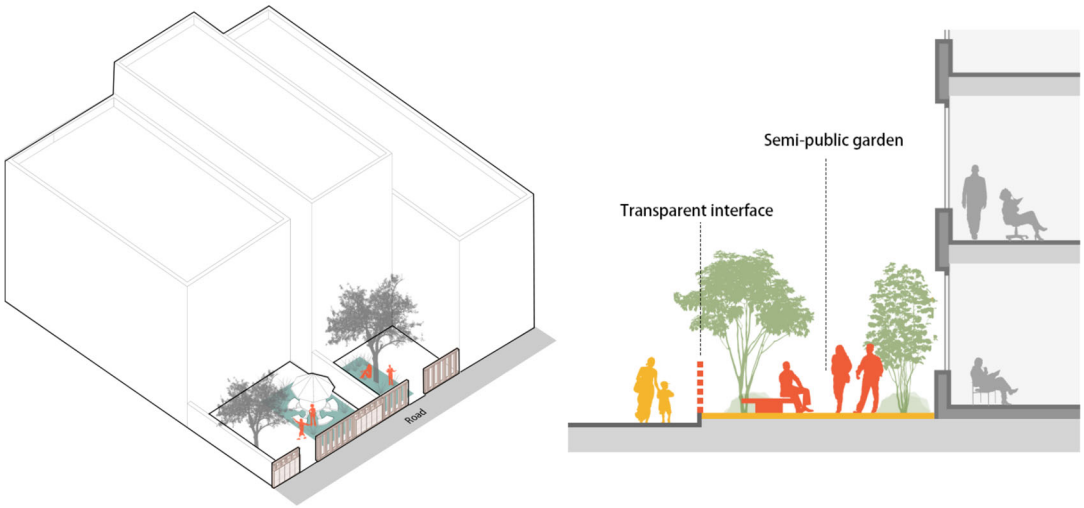


Fig. 5- 23 Illustration of the interface of the courtyard wall of a non-historic building (Source: by the author)

And the building interface is determined primarily by the requirements of the function (Figure 5-24). For residential buildings, canopies can be placed at the entrance of the ground floor, but they must not exceed the boundary of the entrance stairs. The style of the canopies must be consistent with the historic style of the district, and structures above the second floor must not exceed the building line. The interface of the commercial function on the first floor of the building may be retracted 1-3m, and the retracted space may be used for swinging out, and its canopy shall not exceed the boundary of the front steps of the entrance.

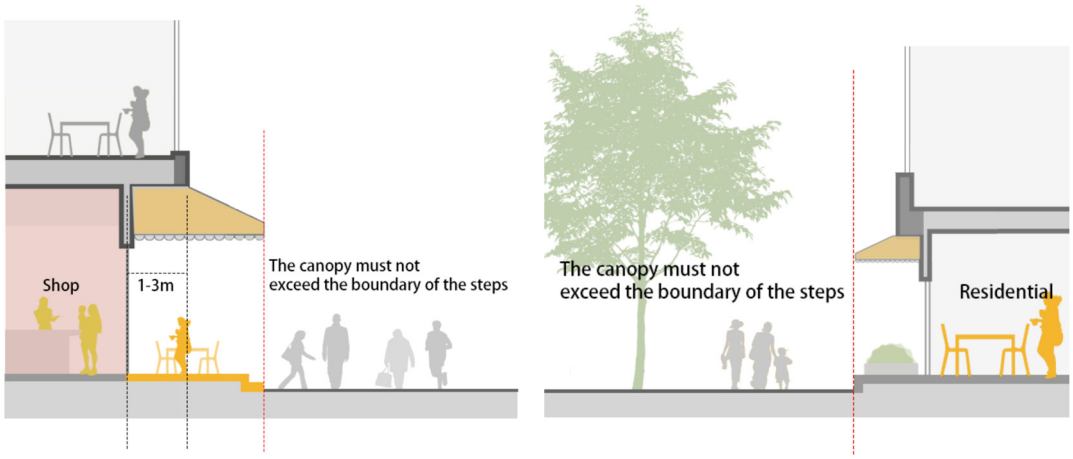


Fig. 5- 24 Illustration of street interfaces of commercial and residential (Source: by the author)

5.4.3 Plot design guidelines

Based on the plot management unit determined by the road, we can combine the typo-morphological analysis to further subdivide the plot management unit according to simple tissue, which is an important basis for establishing plot guidelines. Due to the long construction period and numerous building types, the simple tissue of Changhua district itself has a certain collage, but now the distribution of the simple tissue is more complex and difficult to understand due to the independent construction of residents without guidance. Therefore, the aim of the design guidelines for plots based on the simple tissue is to arrange the distribution of the simple tissue and improve the continuity and unity of the whole district morphology at the plot level. The simple tissue of the entire district can be broadly divided into the following six types (Figure 5-25).

Fig. 5- 25 Simple tissue classification (Source: by the author)

（1）Simple tissue of traditional row houses

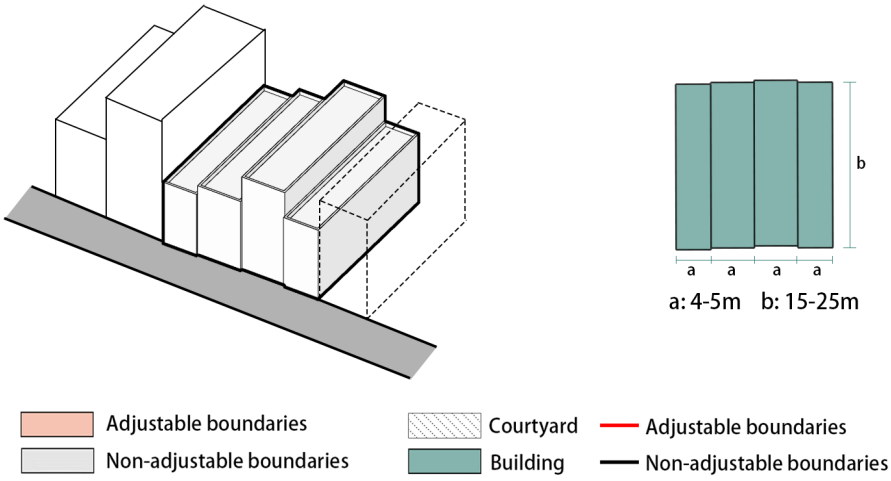


Fig. 5- 26 Plot guidelines of simple tissue of traditional row houses (Source: by the author)

The width of the plot is usually 4-5 m and the depth is usually 15-25 m. Regardless of whether it is the renewal of a single building or the combined development of several buildings, the tissue of the original building should be fully preserved, that is, the boundary of the pediment of the plot and the boundary of exterior wall along the street should not be changed. The original entrance directions of the building should not be

altered. The height should be in line with the height of the surrounding buildings, and the height of the renovated buildings should be up to 12 m (Figure 5-26).

（2）Simple tissue of multi-family improved row houses

The width of the plot is usually 4-9 m and the depth is usually 15-25 m. Regardless of whether it is the renewal of a single building or the combined development of several buildings, the tissue of the original building should be fully preserved, that is, the boundary of the pediment of the plot and the boundary along the street should not be changed. The original entrance directions of the building should not be altered. The height should be in line with the height of the surrounding buildings, and the height of the renovated buildings should be up to 12 m (Figure 5-27).

The original front yard in the plot should be maintained, and no front yard may be added to the plot without a front yard. No additional building should be constructed in the front yard, and the additional building should be removed to restore the front yard. The front yard should have a regular shape and the boundary of the building should be between 2-6 m from the wall.

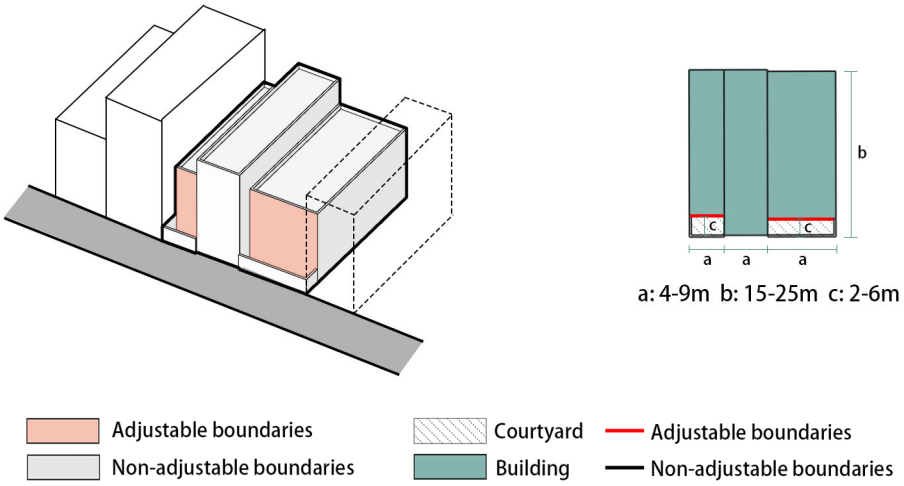


Fig. 5- 27 Plot guidelines of simple tissue of multi-family improved row houses (Source: by the author)

（3）Simple tissue of western-style row houses with front yard

Western-style row houses with front yard are the main building types with high historical value in Changhua district. The width is usually 4-10 metres and the depth is

usually 10-30 metres. When renovating and renewing the building, the original plot tissue, that is, the pediment boundary of the plot and the boundary along the street should not be changed. The direction of the original entrance and exit of the building should not be changed. The height should be coordinated with the height of the surrounding buildings, and the maximum height of the renovated building is 12 m (Figure 5-28).

The original front yard in the plot must be maintained, and no front yard may be added to the plot without a front yard. No additional building may be constructed in the front yard, and the additional building should be removed to restore the front yard. The basic shape of the original front yard, i.e. rectangular or L-shaped, shall not be changed. The boundary of the rectangular front yard wall to the building must be between 2-6 m, and the boundary of the L-shaped front garden wall to the building must be between 0-4 m and 3-8 m.

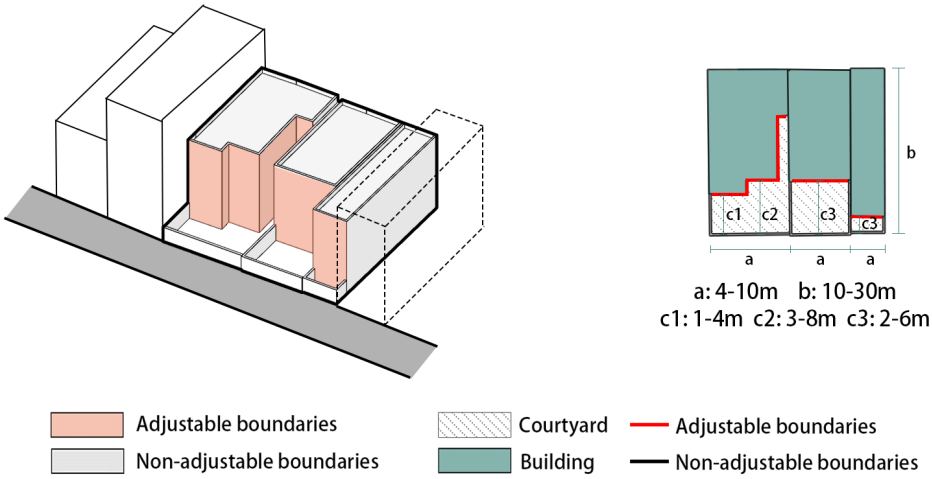


Fig. 5- 28 Plot guidelines of western-style row houses with front yard (Source: by the author)

（4）Simple tissue of post-1949 residences

This type of tissue is often a new building erected on the original plot, or a new building created by combining a few plots. Although the present situation is very different from the original building, it cannot simply be restored to its 1936 condition for reasons of authenticity. Such plots are often the primary cause of the fragmented collage of simple tissue and confusion of district morphology, and are the focus of plot design guidelines.

The design guidelines for the plot of such tissue should take the adjacent tissue type as the main reference point to improve the continuity and intelligibility of the tissue of the district. the boundary of the plot should not be altered, i.e., the pediment line and the boundary along the street should not be altered. The renovation and reconstruction of the building should be based on the first three types of tissue control scale as reference. The maximum building height for renovation and reconstruction is 12 m. Courtyards are not mandatory, but if a front yard is built, the scale of the first three types of front yards should be used. In the following figure, the simple tissue in the centre is oriented to the surrounding tissue types, and the corresponding front yard is divided into the plot, which reduces the collage sense of morphology in the district (Figure 5-29).

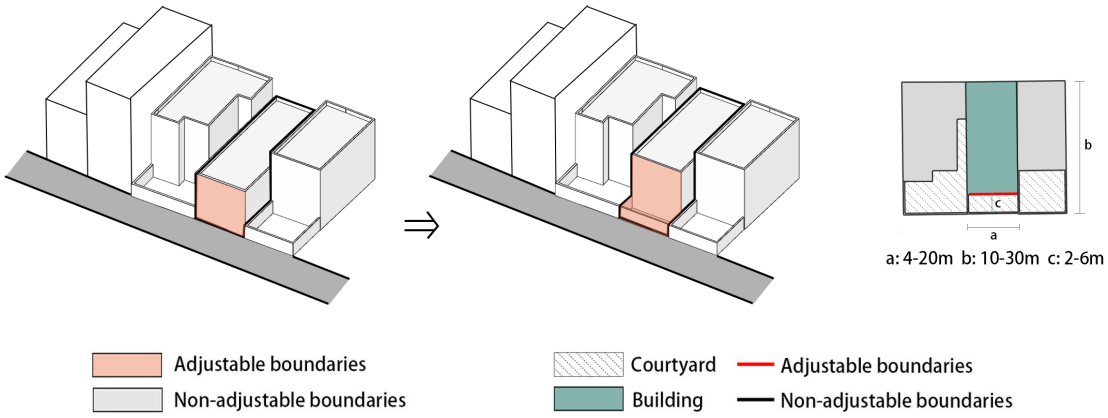


Fig. 5- 29 Plot guidelines of simple tissue of post-1949 residences (Source: by the author)

（5）Simple tissue of garden-style detached houses

The garden-style detached houses are all historic buildings, which are important historical and cultural resources in Changhua district. Therefore, the boundaries and relationship between buildings and gardens on the plot of this type of tissue, and the unauthorized buildings in the garden should be removed. The original entrance direction of the plot should not be changed (Figure 5-30).

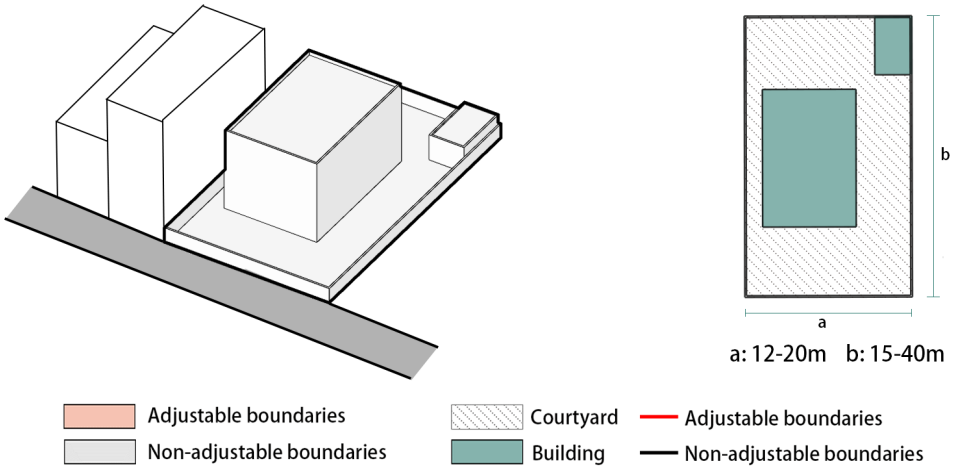


Fig. 5- 30 Plot guidelines of simple tissue of garden-style detached houses (Source: by the author)

（6）Simple tissue of new buildings

New buildings are mainly divided into residential and public service buildings. The plots of public buildings should be equipped with certain squares to increase the public space in the district. It is recommended to use 4-8 m wide strips to form groups with courtyards or create a public space in the corner of the plots facing the street. The maximum building height is 12 m. The entrance boundary may be set back a certain distance, but the rest of the boundary should not be changed. The street boundary of the residential lot may be set back up to 1 m to form a vivid district morphology (Figure 5-31).

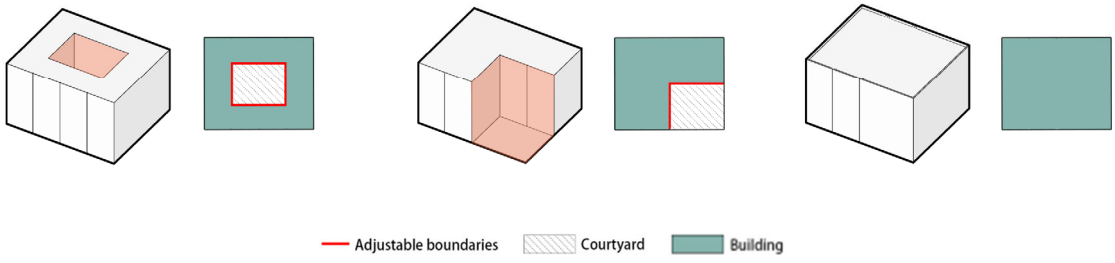


Fig. 5- 31 Plot guidelines of simple tissue of new buildings (Source: by the author)

5.4.4 Building design guidelines

（1）Special building design guidelines

Fig. 5- 32 Special building classification (Source: by the author)

Special buildings can be divided into two categories: conversion and reuse of historic buildings and new public service buildings (Figure 5-32). Historic buildings are important material and cultural relics in historic districts. These special buildings should be preserved and reused in combination with community public services and new industrial functions, while new public service buildings can provide concentrated public service facilities that are lacking in the district. These two types of special buildings can enhance the vitality and cultural significance of the historic district.

Special buildings: conversion and reuse

According to the "*Conservation and Use Planning of Changhua Historic Conservation Area*" (2021), there are 8 immovable cultural heritage sites in Changhua district, including 1 district protected historic sites (the former residences of the famous Cantonese opera singers Liang Shaojia and Lang Yunyu) and 7 district registered protected historic sites. (the former residences of famous Cantonese opera singer Liang Shaojia and Lang Yunyu), 7 district -registered protected historic sites, in addition

to the government-listed "historic buildings" In addition, there are 18 government-licensed "historical buildings".

Among the above buildings with historic value, some were selected based on the two principles of strong functional compatibility of the tangible body and rich intangible cultural significance. Most of them are garden-style detached houses and western-style row houses with front yards. The conservation and reuse of the historic buildings are combined with public support functions and new industrial functions such as creative offices and commerce.

First of all, it is necessary to properly understand the meaning of revitalization. Revitalization is not an arbitrary reconstruction or renovation, but a creative participation, and it is necessary to promote the participation of private capital in the adaptive reuse of historic buildings under the guidance of the government. While preserving the historic significance of the building, it is important to adapt the building to the characteristics of a modern use so that it can be used longer. When considering how the building should be restored and used, the most important thing is to preserve and respect the ideological value and historical culture contained in the building[58]. The original appearance, structure, flooring, doors and windows of the buildings should not be changed during the revitalization process, and the original appearance of the buildings should be restored as much as possible, but the process and traces of restoration and revitalization should be clearly readable, so that the restored and revitalized parts harmonize with the historic parts, but with some differences. This not only preserves the historical appearance and architectural tissue of the Changhua district, but also updates the community's supporting facilities and commercial areas and improves the living environment. A typical example is the revitalization of the Enning historic conservation area, where Bahe Hall and Bruce Lee's ancestral home are located (Figure 5-33).

Fig. 5- 33 Ennin historic conservation area's Bahe Hall and Bruce Lee's Ancestral Home (Source: by the author)

②Special buildings: new built

The volume of the new public service building should meet the plot control requirements and be controlled within the building line, and the entrance on the street side should be appropriately set back 1-3m along the building line to create a good atmosphere of public space. The continuous building interface shall not exceed 12m, and the building height shall be in accordance with the planning requirements of the historic district, i.e. up to 12m. The building must blend well with the public space provided in the design guidelines for the site (Figure 5-34).

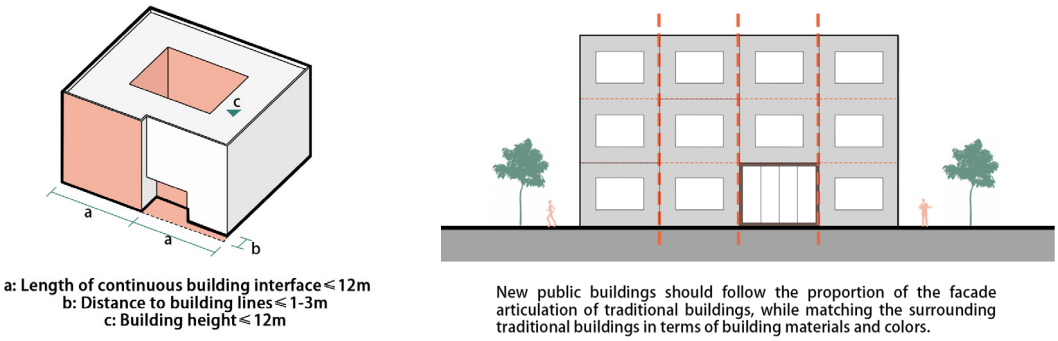


Fig. 5- 34 Design guidelines of new public service buildings (Source: by the author)

The style and appearance of new public buildings should be coordinated with the traditional buildings in the street. For the exterior wall, it is appropriate to adopt the traditional proportion of horizontal or 4-6m vertical articulation, and it is appropriate to use colors, materials and structures that harmonize with the buildings in the street, and

locally use steel and transparent, low-reflective glass to reflect the characteristics of the time.

（2）Basic building design guidelines

According to the principle of sustainability, the renovation of the basic residential buildings in the historic district can be carried out by the government, developers or private individuals, and different subjects have their own requirements for the renovation plan in terms of function, cost and appearance. The plot design guidelines, based on simple tissue are intended to control and guide the various building types from the overall perspective of preserving the historic district. At the same time, typo-morphological analysis also promotes the formation of architectural design guidelines in terms of volume control, spatial layout, and structures and materials. Taking into account the history and adapting to the needs of modern urban life, the basic buildings can be divided into four categories: retention, renovation, refurbishment and new residence.

Fig. 5- 35 Basic building classification (Source: by the author)

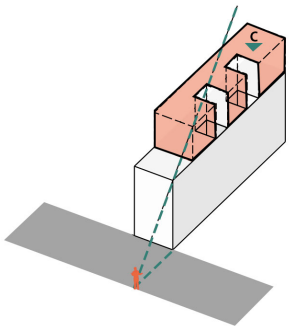
Basic building: retention

This category refers to "protected historic sites" that still retain their residential function, "historic buildings" that have been listed by the municipality, references to the preservation of immovable cultural heritage, and other buildings with conservation value, for a total of 23 buildings. These are 23 buildings. These buildings should be restored from three aspects: Volume, spatial layout, and structures and materials. They should be repaired and strengthened, and the components that affect the historic style should be removed. The originality of the historical relics can be protected by making a distinction. Secondly, without affecting the authenticity, the living facilities in the houses can be updated to improve the comfort of the living environment.

Basic building: renovation

This type of housing is traditional row houses, multi-family row houses and western-style row houses with front yard, where the historic style is well preserved and the quality is good. Apart from protected historic sites and historical buildings, these buildings can best reflect the historical style of Changhua district and should be protected and improved.

In terms of volume control, these houses should meet the requirements of the building lines of the plot design guidelines and can be partially increased without changing the visible volume and spatial layout of the street, but the building height should meet the planning requirements of the historic district, with a maximum of 12 m (Figure 5-36).



Such residential buildings can be partially raised without changing their sense of visible volume and building layout, but the building height should be in accordance with the planning regulations of the historic district and should not exceed 12 metres.
c (Building height) ⩽ 12m

Fig. 5- 36 Building volume control of renovated basic buildings (Source: by the author)

As for the spatial layout, this category of buildings focuses on the preservation and improvement of the original patio of the residence, as well as the organization of traffic. The utility rooms, kitchens and façade elements that are not consistent with the historic style should be removed, and the courtyard should be restored and paved with masonry materials. Functionally, basic functions such as bathrooms should be added to meet the needs of modern life (Figure 5-37).

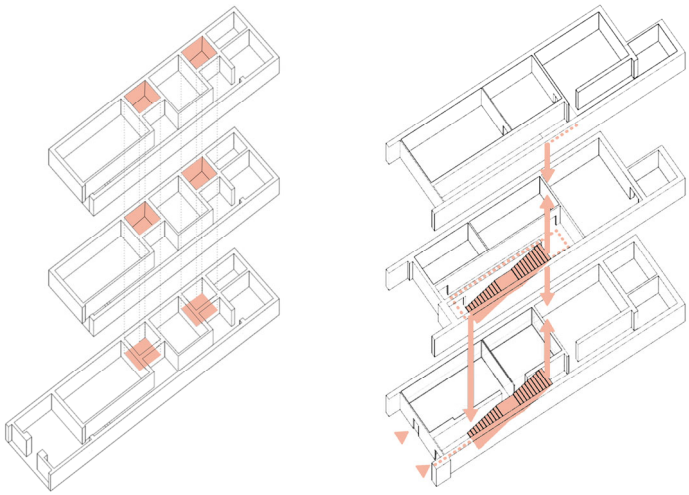


Fig. 5- 37 Spatial layout control of renovated basic buildings (Source: by the author)

Structure and material should be restored on the basis of respecting the original appearance as much as possible in terms of façade proportion as well as color, material and components, and at the same time, a certain degree of architectural

language translation can be made considering the needs of modern life, such as the green brick and stone foot wall surface and triple doors in traditional row houses, and balconies, balustrades and parapets in multi-family row houses (Figure 5-38).

Fig. 5- 38 Typical structures and materials of renovated basic buildings (Source: by the author)

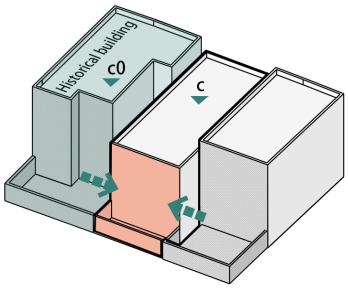
③ Basic buildings: refurbishment

This category refers to row houses with poor historic style and non-row houses with 4-7 stories built after 1949. The focus of measures for these two categories is different. To show the integrity of the development process of the row houses in the district and to preserve the richness of the historic style of the district, the spatial layout and architectural style of the poorly designed row houses in the historic district should be controlled. For the non-row houses built after 1949, the spatial layout is less related to the row houses in terms of typological process, so the control is mainly on two levels: volume, and structure and material.

a. Row houses with poor historic style

Volume control: when this category of residential is refurbishing, it should meet the requirements of plot control based on the simple tissue and not exceed the building line established after coordination with the adjacent simple tissue type, in order to improve the sense of coherence of the historically shaped street. To preserve the overall morphology of the district, building height should meet the planning requirements of the historic conservation area not exceed 12 feet. And if the refurbished building is adjacent to a historic building, the building height should not

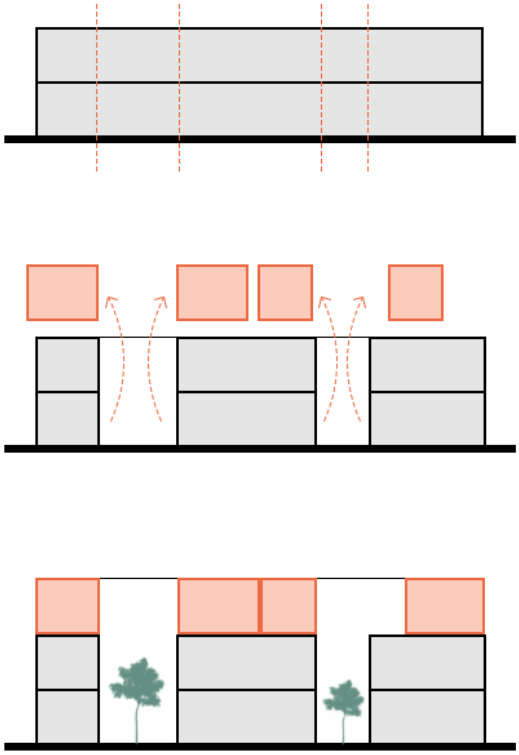
exceed the building height of the historic building (Figure 5-39).



Such residential buildings should meet the requirements of plot control based on single tissue, and should not exceed the building line determined in coordination with the adjacent single tissue type, in order to improve the sense of coherence of the historically shaped street.
c (Building height) ⩽ c0 (Height of historical building) ⩽ 12m

Fig. 5- 39 Building volume control of row houses with poor historic style (Source: by the author)

Spatial layout: the spatial layout of traditional row houses is often changed due to the increasing number of residents, especially in the key element of patio. The patio is a spatial component of traditional row houses in Guangzhou, which is used for ventilation, lighting, rainwater collection and drainage, and greenery. Through the patio, the environment can meet the basic requirements of human life. However, the lack of patios in these houses has led to poor ventilation and lighting, fire hazard, lack of outdoor space, and an overall poor environment that in many respects does not meet the basic requirements of human living environment. Therefore, the core of controlling such residential buildings in terms of spatial layout is to demolish the disappearing patio again and superimpose the demolished floor area on the upper part of the zhutongwu, leaving the total floor area basically unchanged[59] (Figure 5-40). The number of floors increases after demolition, and the new patio must take into account the function of vertical traffic, so firstly there may be some changes in location and it is not necessary to stick to the original location. The glass windows in the rooms facing the patio can not only greatly increase the usable area, but also make the space inside and outside more transparent and reduce the feeling of confinement (Figure 5-41).



Restoration of the vanished patio, while superimposing the demolished floor space on the upper part of Zhutongwu, basically keeping the total area unchanged

Fig. 5- 40 Spatial layout generation of row houses with poor historic style (Source: by the author)

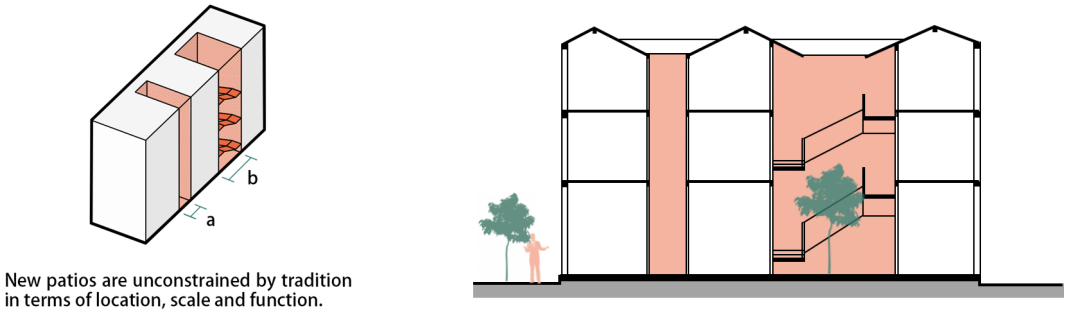


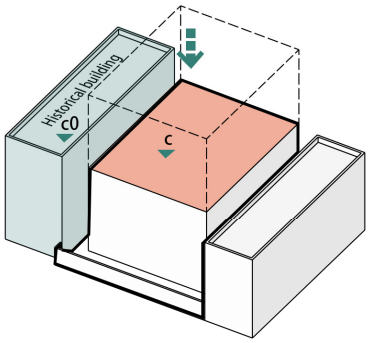
Fig. 5- 41 Spatial layout of row houses with poor historic style (Source: by the author)

Structure and material: these buildings should be harmonized with the traditional buildings on the same street in terms of façade articulation, color, material and components during the refurbishment. First of all, it is advisable to articulate the exterior wall in relation to the traditional houses to create a unified style of the neighborhood. As for the color, material and components, in this kind of buildings should avoid colorful tiles and instead use warm shades of gray with low purity. Wooden windows, doors, railings and walls under the windows should be in maroon

color to coordinate with the historic buildings. As for façade materials, water-brushed stone, brick masonry, wood, etc. are the most important, and steel and transparent, low-reflective glass can be used locally to reflect period features. The existing building materials can be reused in the refurbished buildings.

b. Post-1949 non-row houses

Since the building volume of such residences is different from the original historic district, refurbishment should be mainly adopted. In terms of volume control, the residences that have a great influence on the appearance of the historic district, especially those in the vicinity of the historic buildings, should be lowered in height to improve the morphology of the historic district (Figure 5-42).



Excessively tall non-row houses near important historic buildings should be lowered in height.
c(Building height)≤c0(Height of historic building)

Fig. 5- 42 Building volume control of post-1949 non-row houses (Source: by the author)

In terms of structure and material, this category of buildings should harmonize with the traditional buildings on the same street in the refurbishment. In the horizontal direction of the exterior wall, it is advisable to make a subdivision of 1-2 stories to reduce the oppressive feeling of volume on the street, and in the vertical direction of the exterior wall, it is advisable to make a subdivision of 4-6 m to coordinate the overall architectural appearance of the district (Figure 5-43).

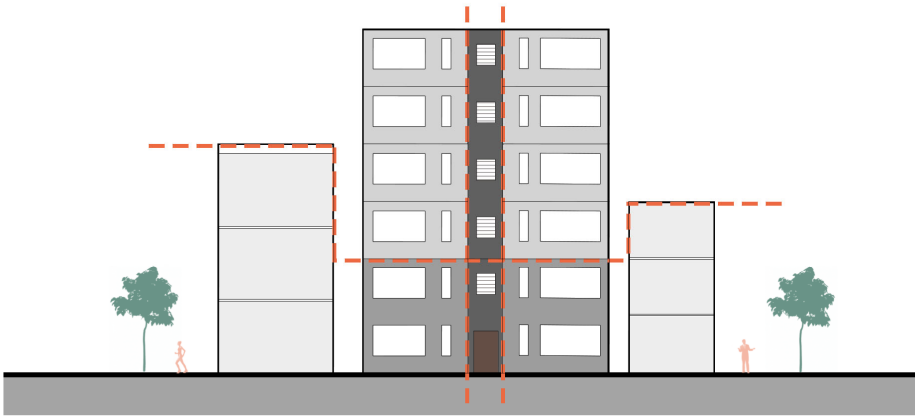


Fig. 5- 43 Structures and materials of post-1949 non-row houses (Source: by the author)

④ Basic building: new built

New residences are built after the demolition of the plots that seriously destroy the integrity of district tissue and historic style. New construction should be coordinated with the surrounding houses and restored for the purpose of tissue. As for the style, it is not necessary to imitate the traditional Zhutongwu, but it should be considered to take advantage of the spatial pattern of traditional row houses and make new creations based on this model to reflect the characteristics of the times and maintain the richness of the district.

Volume control: new residences should be controlled within the building line, and the street side can be set back 1m along the building line, but the maximum continuous building interface is 12m to ensure the richness and coherence of the street boundary. According to the planning requirements of the historic conservation area, the building height should not exceed 12m (Figure 5-44).

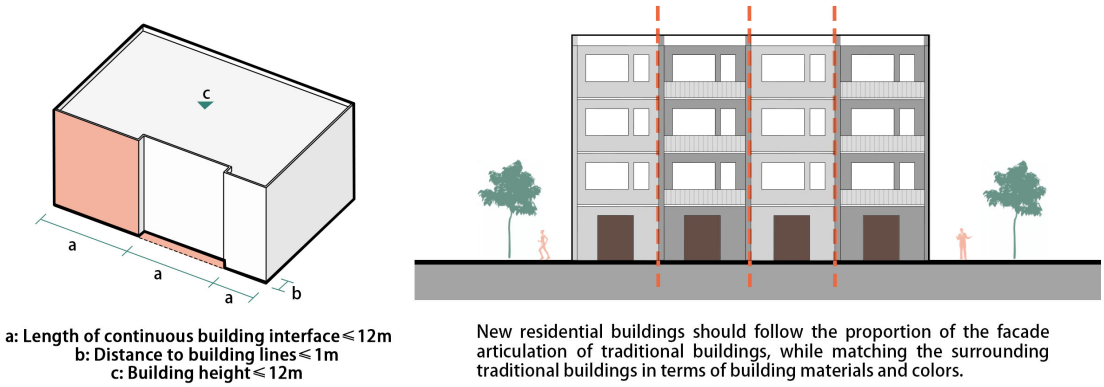


Fig. 5- 44 Design guidelines of new residences (Source: by the author)

Spatial layout: the new houses should reflect the heritage of the traditional houses of the district, adopting the characteristics of the spatial layout of the traditional row houses, such as patios and cold alleys, and adopting their excellent climate adaptation in terms of ventilation, solar control and thermal insulation, as well as the traditional philosophy of living. With the concept of "critical reconstruction", the new building is designed to meet the real needs of the time and the characteristics of the era, so that the new building meets the real needs of the present and is inseparable from the historical prototype, rather than simply imitating the style. For a historic district, the juxtaposition and integration of old and new buildings can reveal the value of historic buildings, and the constant repetition of a certain feature of the past will form a boring future.

The structure and material should harmonize with the traditional buildings in the same street. On the exterior wall, the horizontal and vertical divisions of 4-6 m should be reproduced in accordance with the traditional proportions. The color, materials and components should also be in harmony with the traditional buildings in the street and translated and adopted in a modern way to meet the function (Figure 5-44).

5.5 Specific design

Within the general design, two typical areas of the district are selected for the specific design with the design guidelines to verify the operability of the design strategy from

the Italian school of typo-morphological analysis.

Area 1 is a typical area representing the morphology of the current district and the mixed condition of the simple tissue collage, while Area 2 is a typical new area in the district after the restoration of streets and plot tissue. In the detailed design, we first compare the ground floor plan of these two areas separately to clarify the typo-morphological evolution of each level of the selected area. Based on the typo-morphological analysis, the designs of the street, plot and building levels are combined with the design guidelines of each level.

5.5.1 Area 1

Fig. 5- 45 Master plan of Area 1 (Source: by the author)

Area 1 is connected to Ennin Road, which has a high pedestrian flow, and contains Dobao South Cross Street and the buildings on both sides, which is the key area in the district to create the commercial and cultural atmosphere of the district (Figure 5-45). From the building surveys of the Republican period and the current situation, it can be seen from the ground level plan (Figure 5-46) of the two periods in District 1 that at the street level, a few buildings have been added to the street resulting in the change of the street boundary, and a few buildings have been changed from the courtyard wall

interface to the building interface. At the plot level, two of the larger plots are merged from the previous plots.

At the building level, most of the buildings have added houses to the patio, and some of the buildings have been altered to create a spatial layout that is completely unrelated to the original type. Therefore, the design will be carried out from each of these three aspects in conjunction with the functional planning.

Fig. 5- 46 Comparison of the 1936 and 2022 ground floor plan of Area 1 (Source: by the author)

At the street level, the borderlines of the district were first leveled and restored, maintaining the existing borderlines of the buildings or front yards (Figure 5-47). In the design of the interface, based on the results of typo-morphological analysis, the nature of the corresponding interface of the building (building/yard wall) was respected and

maintained. Based on the specific functional planning, the street interface is divided into four types according to the street design guidelines: ground floor commercial interface, permeable courtyard wall interface, green open interface and historical building interface (Figure 5-48). The final result is a street design that respects the typo-morphological features of the original street and meets the modern spatial experience of Dobao South Cross Street.

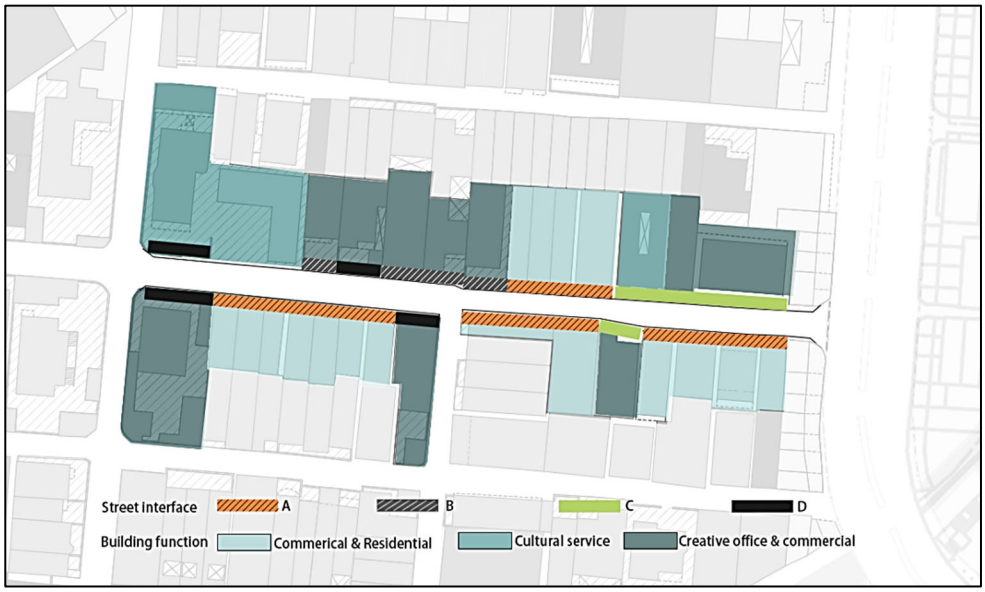


Fig. 5- 47 Street interface design of Area 1 (Source: by the author)

Fig. 5- 48 Area 1 Four street interfaces of Area 1 (Source: by the author)

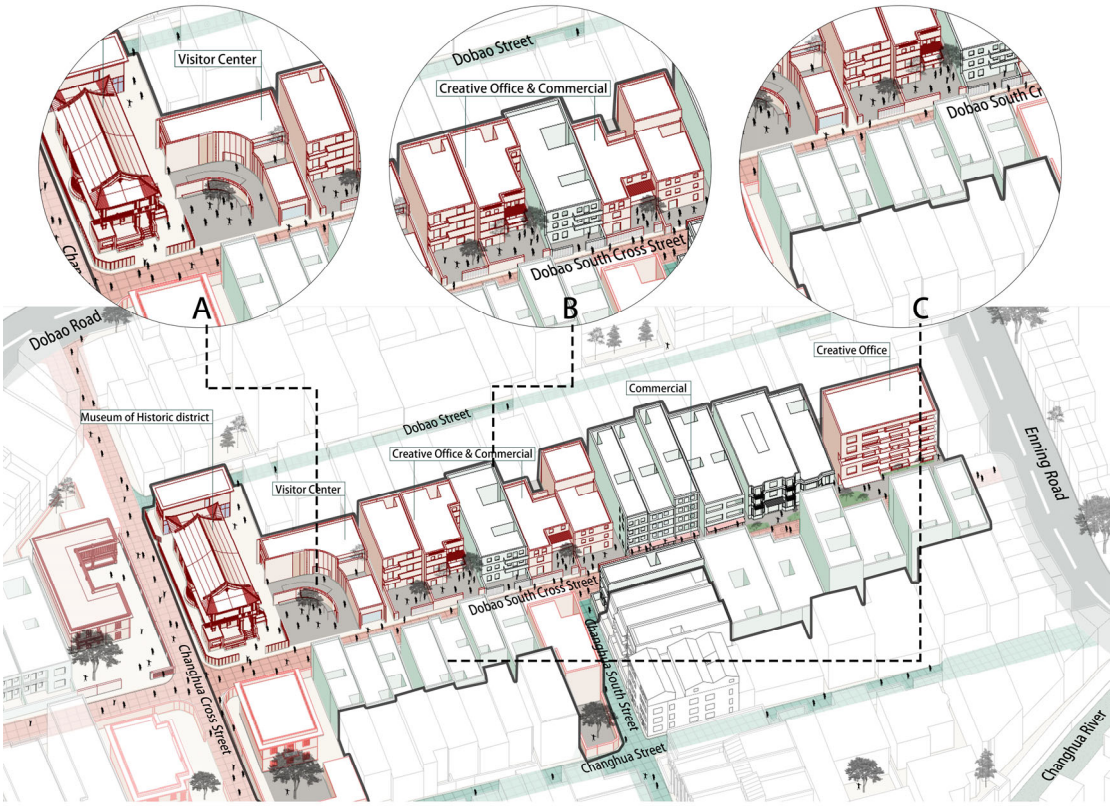
And at the plot level, the plot control guidelines for this area should be based on the simple tissue distribution map of Area 1 (Figure 5-50). From the simple tissue distribution map of this area (Figure 5-49), it can be seen that the continuity of the simple fabric is broken by the post-1949 development and the current situation is a collage of fragments. Therefore, special attention should be paid to the simple tissue of the post-1949 houses when preparing the site guidelines based on the simple fabric, and the relationship between boundaries, courtyards and buildings should be controlled in cooperation with the surrounding simple tissue. The pediment boundary of the houses should be maintained, and the plot control line of the exterior wall should be set back in detail according to the plot design guidelines of the simple tissue, and the entrance/exit direction of the plot should not be changed.

Fig. 5- 49 Simple tissue classification of Area 1 (Source: by the author)

Fig. 5- 50 Plot control guidelines of Area 1 (Source: by the author)

At the building level, different interventions should be taken depending on the specific classification of the buildings (Figure 5-51). Area 1 should be renovated and used for the special building with strong spatial compatibility to accommodate creative office or commercial functions, with special attention to restoration and protection of the original buildings. The new special building visitor center should be combined with the existing site conditions, and public space should be reserved on the street side for people's activities, and attention should be paid to the continuity of components and materials with the district building type (Figure 5-52). Regarding the measures for the basic building, for historic buildings, the intervention of preservation should be chosen. For the renovation category, the original room pattern should be preserved and the original components and materials should be used as much as possible. In contrast, the refurbishment category should redesign the patio and adopt the housing pattern of the row houses (Figure 5-52), and the components and materials should be harmonized with the surrounding buildings.

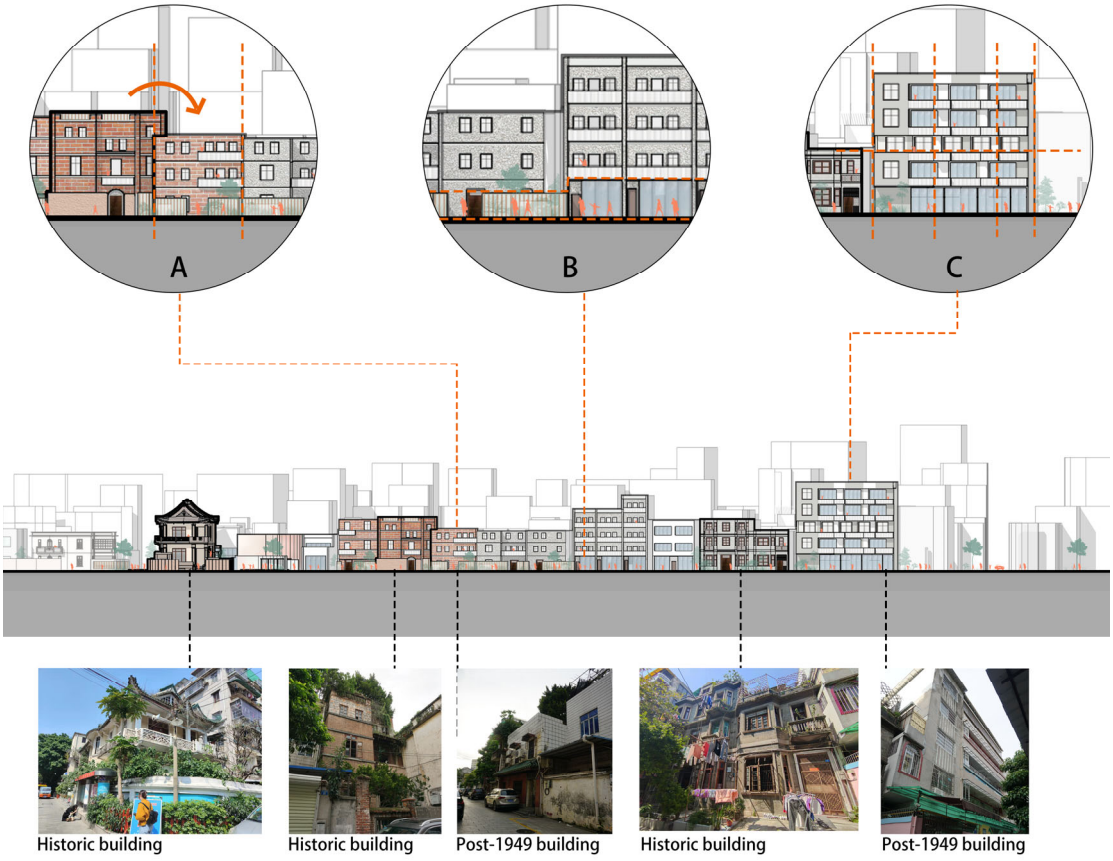
Fig. 5- 51 Building classification of Area 1 (Source: by the author)



A is a new special building Visitor center, B is a post-1949 row house with a front yard in harmony with the surrounding buildings, and C are basic buildings with patios after renovation and refurbishment.

Fig. 5- 52 Axonometric view of Area 1 (Source: by the author)

After the above three levels of design, we finally obtain the axonometric plan and street elevation of Area 1 (Figure 5-52, 53). Based on the typo-morphological analysis, we can conclude that Area 1 has achieved the two goals of adopting the morphological features of the district and integrating the modern living needs, and it has increased the vitality of the district and shaped the good commercial and cultural atmosphere of Dobao South Cross Street.



A is the post-1949 row house, the plot is controlled by separating the front yard according to the surrounding buildings, and the building façade is mainly in line with the adjacent historical buildings; B are the transparent courtyard wall interface and the ground floor commercial interface; C is the façade renovation of the post-1949 non-row house, which is mainly controlled horizontally and horizontally, and is in line with the surrounding historical buildings in terms of materials.

Fig. 5- 53 Street elevation of Area 1 (Source: by the author)

5.5.2 Area 2

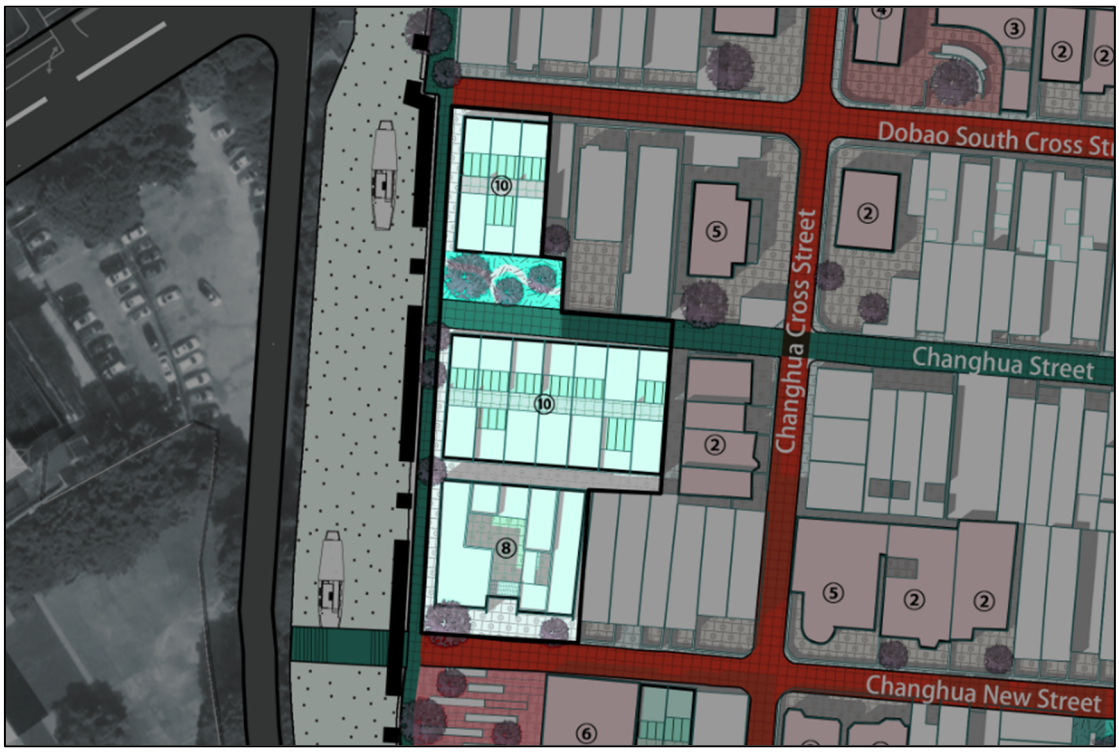


Fig. 5- 54 Master plan of Area 2 (Source: by the author)

Area 2 consists primarily of new residences and public facilities on the plot after the removal of the current nursing home (Figure 5-54). The construction of the nursing home has caused many lots to be merged and the section from Changhua Street to the river has disappeared, as can be seen from the ground floor plans of the two periods in Area 2 (Figure 5-55) based on the building surveys of the Republican period and the current situation. Therefore, after the nursing home moved out, the specific design was mainly done in terms of the restoration of streets and plot tissue and the type of new buildings in conjunction with the functional planning.

At the plot level, Area 2 is the simple tissue of the new building (Figure 5-56), but because the functional planning of residential and public facilities is different, the pediment boundary of the building should not be changed in the plot control guidelines, but the perimeter of the plot control line setting back the exterior wall is different, and the new public facilities should be separated from the interior of the building by a certain courtyard for public activities.

Fig. 5- 55 Comparison of the 1936 and 2022 ground floor plan of Area 2 (Source: by the author)

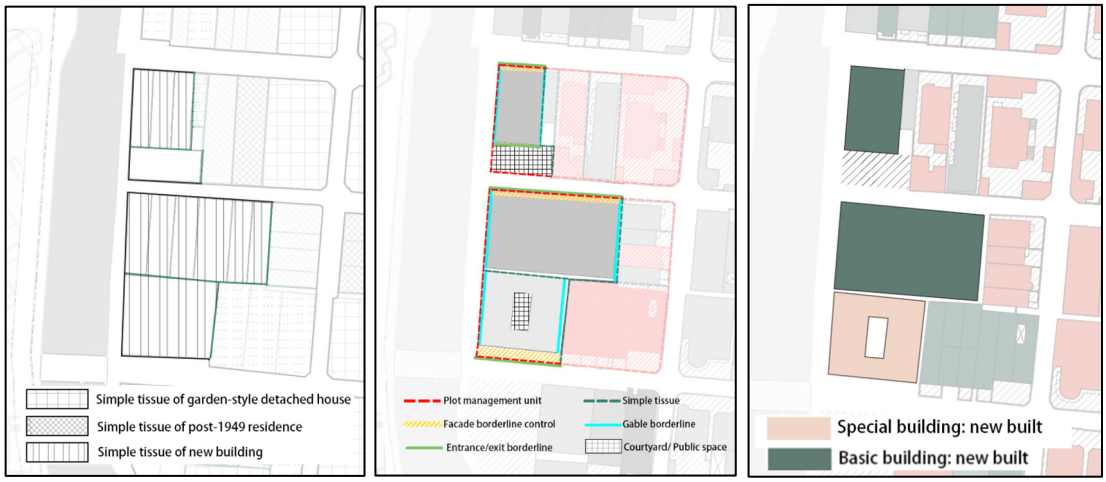


Fig. 5- 56 Simple tissue, plot control guidelines and building classification of Area 2 (Source: by the author)

At the building level, there are two categories in Area 2: new residential and new public facilities (Figure 5-56). 57). According to the architectural design guidelines, the design of the new residential building is in line with the buildings of the district in terms of scale and volume, and the large plot is still divided into a row-like tissue for further building design (Figure 5-57). Adopting the features of traditional Zhutongwu spatial layout and its excellent climate adaptability in terms of ventilation, shading, and thermal insulation (Figure 5-58), the traditional design of courtyards, backyards, and cold alleys is maintained in the new houses[60]. However, the spaces are divided into a series of small apartments and a public space on the first floor, so that the new building can meet the real housing needs of the present while being inseparable from the historic

prototype (Figures 5-59 and 60).

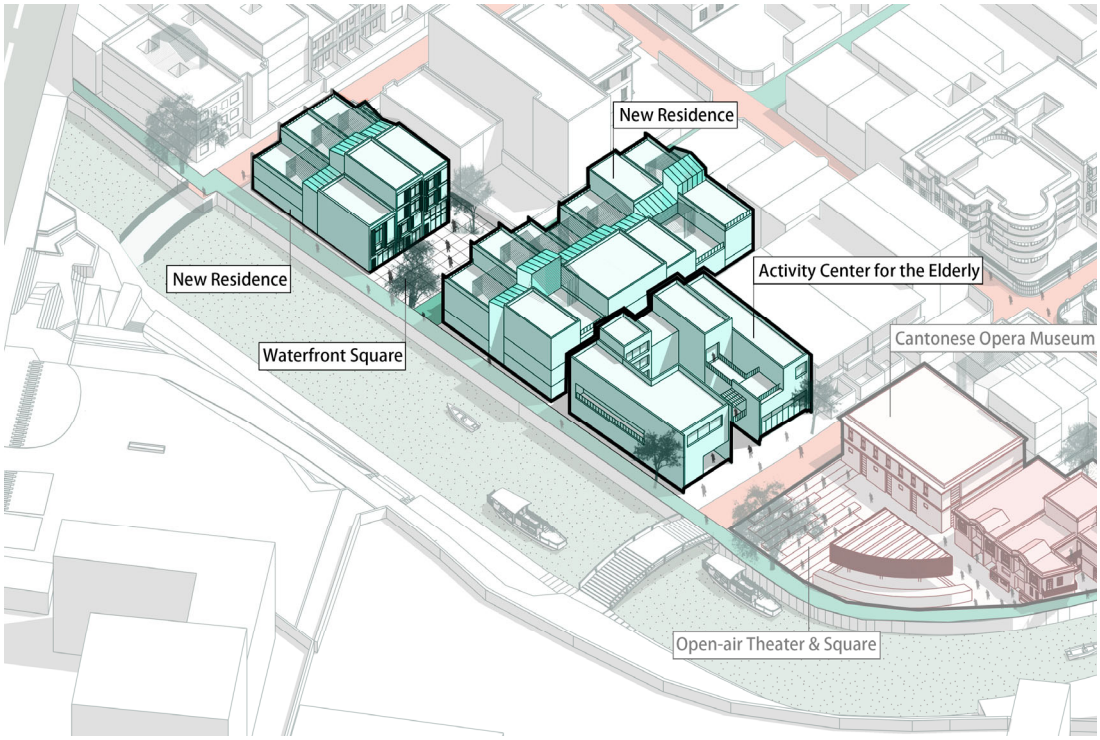


Fig. 5- 57 Axonometric view of Area 2 (Source: by the author)

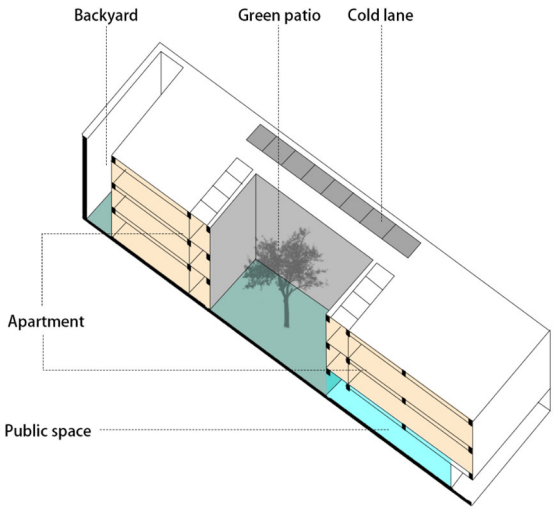


Fig. 5- 58 Spatial layout of the new residence (Source: by the author)

Fig. 5- 59 Plans of the new residence (Source: by the author)

Fig. 5- 60 Section of the new residence (Source: by the author)

5.6 Summary of this chapter

The aim of the Italian school of typo-morphology is not only to record the history and evolution of the city, but also to provide an operational reference point for future design work. It has an important methodological significance for the repair of the morphology and tissue in historic conservation areas.

There are many problems in the conservation and regeneration of Changhua district. On the one hand, the existing historical buildings, traditional tissue and related intangible elements of cultural heritage are in urgent need of proper conservation and transmission; on the other hand, in view of the current urban development and living

needs, there is also a need to transform the tradition buildings appropriately through design. This chapter summarizes typo-morphological analysis of the five research levels of Changhua district from the previous chapter and applies them to the design of the conservation and regeneration design of Changhua district by establishing a design strategy based on the Italian typo-morphological analysis. In the context of planning for the relocation of the nursing home in Changhua district and the planning principle of "integrated conservation", this chapter proposes three levels of general design and design guidelines, as well as detailed design practices for two typical areas.

First, in the general design, the street system is adjusted and the square street pattern is strengthened on the premise of respecting and protecting the historic street pattern. Based on the analysis of typo-morphological evolution of the plot, some of the plots that seriously affect the district morphology are reorganised, and the plot management units will be further divided according to the simple tissue to improve the effect of the plot guidelines. The buildings are divided into special buildings and basic buildings, and the results of typo-morphological analysis are integrated to take appropriate measures to improve the quality of human living environment. The function design continues the function of the district, which is mainly residential, and integrates the historical resources. It inserts the characteristic commercial and creative office reflecting the traditional culture of Xiguan area, improves the functional layout of the community, and gives new vitality to the historic district.

Second, the typo-morphological analysis of the five research levels is summarized in three specific design guidelines for the streets, plots, and buildings of Changhua district. These include the basic typo-morphological features such as street boundaries and interfaces, simple tissue-based plot control, building layout and materials and structures.

Third, in the specific design based on the framework of the general design, two typical areas of the district are selected to apply three levels of design guidelines to carry out the proposed specific design, which visually demonstrates how the Italian school of

typo-morphology plays a role in the conservation and regeneration process of the district. It can be seen that the basic research of the Italian school of typo-morphology strengthens the designer's understanding of the built environment and provides guidelines for new building projects in the historical process of the typo-morphological evolution, how to continue the traditional culture and integrate it into the new environment.

CONCLUSION

This thesis takes the Changhua historic conservation area Guangzhou as the research object and the Italian school of typo-morphology as the research perspective. From the study of the theory and practice of the Italian school of typo-morphology, to the establishment of the framework of typo-morphology for the Changhua district, to the typo-morphological analysis of five elements of the Changhua district: simple tissue, street, plot, building and room, and structure and material, and finally to the corresponding conservation and regeneration design of the Changhua district. The whole process is progressive. The conclusion can be summarized into three parts: research summary, research innovation and research gaps.

6.1 Research summary

6.1.1 Theoretical Research Summary

With the perspective of the Italian school of typo-morphology, this paper discusses the conservation and regeneration of Changhua historical conservation area in depth. The theory is summarized and organized throughout the research phase, and three characteristics of the theory are summarized.

First, the research elements have an obvious hierarchy. The research elements of typo-morphology are based on the concept of scale of Muratori and Caniggia, such as simple tissue, streets, plots, buildings, rooms, structures and materials in this study is a hierarchical system from large to small, and each element has an obvious hierarchical characteristics. In addition, each element, although hierarchical, does not exist independently, but is always connected to other elements of the same or a neighbouring hierarchical level.

Second, typo-morphological research is open-ended. The typo-morphological research of Changhua district is based on the classification and understanding of the development phase of district. However, the classification is inevitably influenced by

many external factors, such as the geographical environment, economic development and human history of the study area. Therefore, it is clear that the classification of development phases in the typomorphological research is open-enden, subject to a certain subjective will.

In this paper, the historical information of Changhua district and the development background of Xiguan area are considered. On this basis, the general analysis of morphological evolution is elaborated, and finally the 1936 maturity period is chosen as the main reference point for the current situation. However, different cities or districts have different periods of morphological evolution, so it is necessary to make a reasonable classification and selection according to the specific historical development of the research object.

Third, typo-morphology helps to transmit the culture of the region. Typo-morphological features are a historical snapshot of the natural environment and socio-economic development of a region. When continuing to use the morphological elements that have gone through the typological process in regeneration design, it helps the new design to match the old morphology. Then it can be integrated into the built environment while adapting to the culture of the whole region, realizing the connection between the past, the present and the future of a city or region.

6.1.2 Case study summary

Based on the adapted research framework of typo-morphology, this study starts from the general analysis of the morphological evolution of Changhua district, draws the ground floor plan of two periods through building surveys, and selects simple tissue, streets, plots, buildings and rooms, structures and materials as the main elements of the study, from which the typo-morphological characteristics and evolution rules of the district at each level are obtained, in order to propose effective design strategies for the conservation and regeneration of Changhua district. The conclusions of the case study are as follows.

First, the evolution rule of the general morphology of Changhua district, which is a late construction area in Xiguan district, can be roughly divided into three phases based on the historical information. In the second phase, from 1907 to 1924, Changhua district was influenced by the completion of Fengyuan district in the north, and the pattern of square grid began to appear in the fabric. In the third phase, under the influence of Guangzhou city's urban improvement plan and garden-style houses, Changhua district was basically brought to maturity in 1936.

Second, the typo-morphological characteristics and evolution rules of each elements in Changhua district. The street defines the boundary of the historic conservation area and establishes the inner tissue structure, while the organization of the plot constitutes the hidden order of the district tissue. The biggest change is the disappearance of the section from Changhua Street to Changhua River and the merging of the plots due to the construction of the nursing home, which greatly affect the morphology of the district. The buildings and rooms reflect the tissue characteristics of the district externally, while internally they accommodate different use functions and residential patterns. The building types in Changhua district coexist with continuity and time jumps, and the building types appearing in different periods represent a collage of tissues in the space of the district, but the building types from different periods all show a decay of settlement patterns. The structures and materials are the concrete reflection of the characteristics of the style of the historic reserve. The construction method, roofs, pediments and exterior walls have undergone a series of changes, adding to the damage of morphology of the Changhua district. The analysis of the previous levels can divide the whole district into different simple tissues. The simple tissue of Changhua district in 1936 shows a collagenous but orderly state, which confirms the important historical value of district. Later, with the merging of plots and independent renovation of buildings, the relationship between streets and plots changed and new types of building layouts emerged, the division of the simple tissue became more complicated and fragmented from the original state.

Third, the design guidelines for the conservation and regeneration of Changhua district. The design guidelines for Changhua district are based on the typo-morphological characteristics and evolution rules that have developed in the district over time. The five research elements are grouped into three levels: streets, plots, and buildings. Design guidelines include basic morphological features such as street boundaries and interfaces, a simple tissue-based plot control, and a classified building regeneration control.

6.2 Research innovation

（1）This study is an active and useful exploration and an attempt to study the applicability of the classical theory of the Italian school of typo-morphology in the Chinese urban context.

（2）This study developed and explored the general analysis of morphological evolution and building survey as the main research approaches of typo-morphology.

（3）This study systematically analyzes each element and extracts the typo-morphological characteristics and evolutionary rules, which are of direct reference value to the conservation and regeneration of historic conservation areas.

6.3 Research gaps

This paper analyzes the historical conservation area of Guangzhou Changhua with the theory of typo-morphology of Italian school, but the research method is still insufficient. The detailed maps of different periods are the most important way to study the Italian school of typo-morphology, and the mapping accuracy of most foreign city maps reaches the level of plot and buildings, while most of the traditional Chinese city maps cannot meet the requirements of research in terms of drawing method and accuracy, so drawing the above drawings through detailed site surveys and reasonable historical speculation is the first work to be started. However, due to the lack of historical maps and the ambiguity of the specific construction process, the determination of the

morphological types of some elements must be done by observation and speculation, which inevitably leads to subjectivity and errors and omissions, which affects the study of this paper to some extent.

The purpose of research on the typo-morphology of the historic conservation area is to promote its conservation and regeneration，which is a complex and holistic issue that includes the revitalization of the physical structure, economic activities and social public. The typo-morphological character of the district is a part of the physical structure, and it is difficult to deal with the revitalization of the other two areas. This part must be accumulated and improved in the future work and study to compensate for the lack of research.

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