The Regeneration of Traditional Residential Block with Typological Approach-Taking Zhongnongli in Nanjing as an Example

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Abstract. With the rapid development of urbanization in China, the conservation and renewal of old cities face a huge challenge from a large amount of demolition and construction without reasonable urban planning, which have been a widely discussed topic. As one of the most representative traditional residential blocks built in the period of the Republic of China (1912-1949), Zhongnongli has a great value in culture and plays a significant role in sustaining the continuity of history and maintaining the characteristics of the city in Nanjing. Taking Zhongnongli block as an example, based on the approach of architectural typology, this study aims to explore an organic renewal path to solve main problems in the process of regeneration, such as the confusion in space structure, the lack of public communication space and the protection of historical scene. Specifically, the research can be divided into two stages: typological extraction and typological transformation. Firstly, the thesis analyses and summarizes regional elements and deep structure of the block and buildings, trying to simplify and abstract them into prototypes like linear spatial pattern, pleasant spatial scale and patio house. Secondly, according to the traditional cultural connotation and modern life needs, these prototypes are appropriately transformed into new block morphology and building forms by means of reconstruction and translation. The experimental design we have done suggests that the application of the typological approach in contemporary urban planning and architectural design can contribute to realizing the harmonious coexistence of old and new buildings as well as the balance between inheritance and innovation, which serves as a model for the sustainable development of traditional residential blocks.

1. Introduction
With the acceleration of urbanization and economic transition in China, the contradiction between old constructions and modern demands in the regeneration of urban morphology has become increasingly prominent. The issue about how to adapt traditional blocks to the contemporary urban environment and retain their unique cultural connotation has aroused extensive attention. In particular, a large amount of original distinctive neighbourhoods that reflect the life of residents and local history become main targets in urban regeneration due to their material, structural and functional decline over a long period of time. However, it is noteworthy that the phenomenon of total demolition or thorough reconstruction in many regions exerts a negative influence on the sustainable development of traditional residential blocks, making material elements and spiritual elements difficult to remain. Therefore, the guidance of scientific theory is urgently needed for the conservation and renewal of traditional residential blocks.
2. The current situation and main problems of Zhongnongli residential block

The architecture of the Republic of China (1912-1949) is an indispensable part of Chinese early modern architecture as well as a major element of urban culture in Nanjing. As one of the most representative traditional residential blocks built in this period, Zhongnongli is located on the west side of Taiping South Road, a north-south main road in the centre of Nanjing city. Taiping South Road district, which originated in the late Qing dynasty, was once the most prosperous commercial centre, where many time-honoured brands and shopping malls gathered. However, with the transformation of urban economic centre and commercial activities, the vitality of the block gradually declined, and now it has become a settlement for residents at the bottom of the society [1]. The research scope extends east to Taiping South Road, west to the former site of the capital telephone office, south to Youfu West Street, north to the Palace Hotel (Figure 1). The buildings are concentrated in distribution and abundant in types, with a large time span, complex house ownership, and various preservation situations (Figure 2) [2]. In terms of building function, the block is mainly composed of low-rise residential buildings, including eleven historic buildings constructed in the period of the Republic of China, most of which are rented by low-income migrant workers. As one part of immovable cultural heritage in Nanjing, these buildings contain specific material and spiritual elements accumulated over time, which are of great value in the historical scene, cultural connotation and practical function. Therefore, it is significant to explore its regional characteristics and architectural forms.

However, due to the ageing of construction and environment, the conservation and renewal of Zhongnongli residential block face three main problems:

1) The confusion in space structure. The Zhongnongli block is relatively complete in the preservation of the space texture. However, the original space structure of the neighbourhood is greatly weakened as a result of complex house ownership, chaotic management, and unordered extensions in various periods, leading to the phenomenon of dead ends (Figure 3). Accordingly, it is necessary to integrate small space, optimize the circulation of alleys, and improve the accessibility and convenience of road systems between blocks.

2) The lack of public communication space. In Zhongnongli residential block, both indoor patio and street alleys are the spatial carrier of communicative behaviours among residents, recording the development of the neighbourhood and habitation culture. However, the chaotic status of space use and the high-density building environment result in the reduction of public space and the decline of spatial quality (Figure 4). In addition, the monofunctional residential block is deficient in public open places for people to stay and socialize together, making it difficult to meet the diverse needs of residents.
3) The protection of historical scene. Historic buildings carry collective memory and urban characteristics over a long history. Only by fully considering the context and paying attention to the coordination between the old and the new, can the buildings in the traditional block promote the sustainable growth of the city. In the process of regeneration, cultural heritages should be appropriately preserved, and the design of new buildings also needs to actively take the historical environment as the starting point of innovation, so as to facilitate the harmonious coexistence of old and new buildings.

3. Theoretical Basis of Research—Architectural Typology

Architectural typology originated in the 18th century as a discipline of classifying architectural types and forms, which aims to abstract “prototypes” from traditional forms and apply them to contemporary design [3]. It not only provides a rational way of thinking about the essence of architecture, but also enables buildings to have a solid foundation with cultural characteristics [4]. Nowadays, the protection and renewal of traditional blocks in China tend to focus on the utilization of functional space but ignore the importance of urban environment and architectural forms, which result in the loss of unique regional characteristics [5]. By introducing the typology theory into the regeneration of traditional residential blocks, it is beneficial to understand the relationship between inheritance and innovation from perspectives of synchrony and diachrony, stimulate the vitality of historic places, and avoid the homogenization of cities.

In terms of the design method, typology mainly consists of the following two stages: typological extraction and typological transformation. Firstly, the designers simplify and abstract rich and varied existing architectural forms according to the urban history or regional characteristics, and find prototypes or “meta design”. Secondly, typological transformation is transforming these prototypes by modern architecture languages like reconstruction and translation, endowing them with organic architectural forms and specific cultural connotations. To be brief, it can be summarized as a regeneration process of “form-type-form (new)” (Figure 5) [6]. In two stages of the process, we carry on concrete analysis of prototypes from block level and architectural level. The former one focuses on the public space in the neighbourhood, and the latter one emphasizes the interior architectural space. Generally speaking, the typological approach is often used as guidelines in the renewal of traditional residential blocks to explore the deep structure of the block and present the traditional images. Therefore, this process contains both material and spiritual meanings, which not only reflects the historical continuity and urban coordination in the aspect of spatial forms, but also maintains the memory of the blocks and buildings in terms of cultural connotation.
4. Typological extraction

Typological extraction is the first step of regeneration, and it also affects the image of the overall environment. From the perspectives of typology, the forms of block and architecture are both fragments of city structure that reflect fundamental life style and collective memory, and thus they naturally become research samples and inspiration sources for creating new places.

4.1. The street grid system

The street grid system is the framework of traditional residential blocks as well as the crucial component of urban images, including elements like spatial texture, level and scale. Unlike traditional residential blocks in southern China that develop naturally, Zhongnongli block presents a distinct linear layout by urban planning. The street grid system consists of north-south main streets and east-west alleys, fully demonstrating the initial design concept (Figure 6). In terms of spatial levels, the basic spatial sequence “main streets-secondary alleys-patio space” indicates the progressive relationship of transition from public outdoors to private indoors, while the block satisfies diverse requirements of activities through different spatial levels. As for spatial scale, the width of streets and alleys varies from 3 to 4 meters, and the ratio of distance to height (D/H) is 0.6 to 0.8 (Figure 7). The compact spatial pattern has a certain sense of cohesion and privacy, which not only adapts to pedestrians but also creates an intimate and comfortable interpersonal environment. Moreover, landscape nodes like trees and potted plants also play an important role in improving spatial quality of the street grid system, because they are attractive places where residents stay and communicate with each other most frequently.

As an identifiable structure of urban public space, the form of traditional blocks contains material elements and non-material elements like social network and function components. The former one is the basis of traditional blocks and the latter one is the connotation of traditional blocks. They are closely linked to each other to become the carrier of urban culture and collective memory, such as Hutong culture in Beijing and the alley culture in Shanghai. Therefore, the extraction of the street grid system in Zhongnongli block is conducive to the exploration of the essence of the external space, the interpretation of traditional living modes, and the guidance of its contemporary adaptive renovation.
4.2. Residential building types

Although the architectural forms are complex and diverse in Zhongnongli block, they are connected as an organic whole. Through field investigation and mapping, we classify the residential buildings in the block into three types according to the architectural forms and internal spatial patterns: patio house, terrace house and multiunit housing (Table 1).

The patio house located in the west of the block is a basic prototype of traditional Chinese houses with profound history and unique cultural connotations. Influenced by regional differences, patio houses have various architectural forms, such as Huizhou-style folk dwelling houses and Hakka architecture [7]. In terms of internal space, the rooms are arranged around the patio space, so the enclosure is the main feature of the patio house. From the point of function, patio space could not only improve daylighting, organize natural ventilation, and eliminate boundaries between indoor and outdoor, but also provide space with comfortable scale to accommodate activities in daily life. Secondly, the two-story terrace house in the centre of the block is an important building type in the early-modern period of Nanjing. Each building is made up of four residential units arranged in a row along the horizontal direction. The material of red bricks and the shape of the slope roof still keep the architectural appearance of the Japanese occupation period (1940-1945). The floor plan with narrow width and deep depth is similar to Japanese long house, and it linearly connects different functions such as bedroom, living room and kitchen from private to public. To some extent, the economical and practical spatial organization reveals the formation of collective living mode [8]. Furthermore, the multiunit housing near Youfu West Street is one of the most popular architectural types in modern residential buildings. Compared with patio house and terrace house, the multiunit housing was not introduced into China from the Soviet Union until the founding of New China in 1949 and gradually became the mainstream of urban residential construction [9]. This kind of standardized residential mode with staircases as the centre and each household independent conforms to the situation of China with more people and less land. It not only effectively satisfies the requirement of privacy for every household, but also provides a material base for neighbourhood communication through public space like staircases.

| Building distribution | Figure-ground relation | First floor plan | Type extraction | Type analysis | Pictures |
|-----------------------|------------------------|-----------------|----------------|--------------|----------|
| Patio house           | ![Patio House](image)   | ![Patio House](image) | patio+enclosure |              | ![Patio House](image) |
| Terrace house         | ![Terrace House](image) | ![Terrace House](image) | linear unit    |              | ![Terrace House](image) |
| Multiunit housing     | ![Multiunit House](image) | ![Multiunit House](image) | traffic+unit   |              | ![Multiunit House](image) |

In comparison, it can be found that the three architectural types above reflect productive force and lifestyles in different periods of social development. The patio house emphasizes the sense of domain and privacy of indoor space, the multiunit housing highlights the efficient utilization of public space, and the terrace house is somewhere in between. With the transformation of living mode and residential architectural design in modern society, the traditional patio house has shown a variety of inadaptability to
urban development and modern life needs, and thus it has been gradually replaced by terrace house and multiunit housing. However, the architectural mode of “patio” has not lost its significance. Therefore, a large amount of contemporary architectural design based on traditional residential building types spring up, among which the “Ju’er Hutong Renovation Project” presided by a famous Chinese architect Liangyong Wu is an excellent case of early exploration. Based on the deep structure of the traditional quadrangle, the “New-quadrangle” is not simply to repeat the existing architectural pattern, but to create a new pattern that adjusts to the spatial texture of old Beijing and modern lifestyle under the guidance of “organic renewal theory” [10]. Accordingly, considering the current situation of insufficient energy and comfort in Zhongnongli, experimental design with traditional patio houses as prototypes is an important way to activate the traditional block and promote the sustainability of urban morphology.

5. Typological transformation

Typological transformation is a creative process on the basis of typological extraction, and it is also the key to make prototypes gain vivacity. In typological transformation, due to cognitive differences of designers on the historical environment, expressions of design can be generally summarized into three basic methods: (1) Reconstruction, removing old elements or adding new elements on the basis of preserving spatial structure. (2) Translation, reinterpreting the type in the contemporary architectural context. (3) Analogy, referring to direct inheritance and reproduction of types [11].

5.1. Reconstruction of the street grid system

In order to continue the spirit of place, the typological transformation at the block level is based on the extracted street grid system in Zhongnongli, which is embodied in the demolition of old buildings and the filling of new buildings (Figure 8).

First of all, the measures of classified protection are adopted in the regeneration of Zhongnongli block according to architectural quality and historic value. The buildings with good quality and great value should be retained, such as eleven dwelling houses built in the period of the Republic of China. Besides, buildings with acceptable quality should be repaired, such as multi-storey houses along Youfu West Street. Moreover, as for unordered extensions that affect the historical scene of the block, they should be removed and replaced. The demolition of the old buildings and constructions not only restores the original appearance of the historic buildings, but also optimizes the internal streamline and connects various blocks, further improving the readability and integrity of the spatial structure. In addition, the plot on the north side of the block (Figure 8 blue frame) where the jewellery business, workshops and a parking lot are located is relatively weak in the commercial atmosphere compared with that of shops along the street, and it is difficult to integrate itself into the surrounding areas. Therefore, this plot is selected as the main object of the subsequent design process.

![Figure 8. Typological transformation at the block level](image-url)

Secondly, the filling of new buildings on the exploitable land also needs to consider the original spatial order, such as texture and scale. In terms of spatial texture, the boundary of the new building is parallel to that of surrounding existing buildings, continuing the linear spatial pattern of the traditional...
block and making them highly consistent. The adaptability of spatial scale is shown in two aspects: on the one hand, the distance between the old and new buildings follows the original pleasant scale of alleys, and on the other hand, the lower building height further preserves the skyline of the traditional block. In addition, the design of leisure squares and green plants forms some landscape nodes, which makes up for the insufficiency of public space and provides suitable places for the gathering and communication among residents. Through the demolition of old buildings and the filling of new buildings, the form of block maintains the harmony and promotes the diversity.

5.2. Translation of the residential building types
The transformation of architecture is a process of integration and innovation. Based on the analysis of the block form, the new residential building combines the characteristics of patio house, terrace house and multiunit housing. Consequently, the extracted prototypes are appropriately merged into the contemporary architectural context through translation and combination, which leads to a new spatial order and residential pattern (Figure 9).

![Figure 9. Typological transformation at the architectural level](image)

1) The architectural function. Considering the insufficiency of public communication space in the block, we learn from traditional mixed-function residence (Figure 10) and take the first floor of the new residential building as a community service centre (Figure 11) to satisfy the need of surrounding residents including a coffee bar, teahouse, bookstores and exhibition halls, while private living space is on the upper floors. Such spatial organization not only keeps the essential characteristic of the residence-led block, but also enhances the vivacity of the block by promoting economic and cultural activities.
2) The architectural scale. In order to create a harmonious relationship between old and new buildings, the architectural scale is a fundamental factor in the renewal of the block. In the form generation, the volume of the new building is divided into seven elongated fundamental living units by creating reference lines according to living units of terrace houses in the south (Figure 12). On the one hand, the consistency of space logic enables the old and new buildings to establish a connection on the spatial scale and present the visual continuity. On the other hand, it makes the new building absorb the features of terrace house and transform the linear units into a new architectural form.

3) The patio space. In the typological transformation of buildings, the traditional patio space is endowed with multiple meanings, which can be regarded as both the extension of the internal space and the inner structure of the external space (Figure 13-14). Within the living unit, the patio is divided into functional patio and landscape courtyard according to different scales and locations. The indoor patio can not only effectively deal with problems of natural lighting and ventilation caused by the deep depth of living units, but also achieve harmony between human and nature by introducing natural elements to enrich the interest of leisure space (Figure 15). In addition, the diverse relationship between the patio space and other rooms improves the adaptability of living units. Specifically, three different housing types are able to meet the requirements of various living modes, such as a single tenant and a family of three or four (Figure 16). As for the outdoor patio space located in the centre of the building, it draws on the characteristics of a patio house and multiunit housing, combining functions of transportation and communication together. In this way, it can be not only used as staircases for residents to enter their houses, but also served as an open courtyard to provide public communication space and create a harmonious neighbourhood environment. Furthermore, the reconstruction of the patio space in the new building is an evolution of the original spatial sequence, which consists of the corner square, alleys, public courtyard and the indoor patio (Figure 17). The separate alleys and indoor patio are connected by the public courtyard, making the form of the block gradually open.
4) Other architectural elements. The new architectural form also extracts elements such as the modelling, materials and colours of traditional buildings to blend with its surroundings. Slope roof is a typical feature of residential buildings in the block, so the new building adopts slope roof to remain coherent as a whole. From the fifth elevation, the patio and the roof reach void-solid combination effect, and thus the original large-scale building volume is visually broken up into smaller units. As for building materials and colours, we select cement, blue brick and grey tile which are commonly used in traditional Chinese architecture. Consequently, the blue-grey facade corresponds to the red brick wall of the terrace house to jointly create the historic atmosphere of the block.

After the typological transformation, the new architectural form with vitality and beauty is produced on the basis of inheriting the traditional connotation. It not only appropriately responds to the surrounding historical environment, but also enriches the architectural function and spatial order through modern design methods. As the transitional space between outside and inside of buildings, the patio space can be served as an indoor space in the traditional sense as well as a public place for communication and sharing among residents, which is developmental and referential for modern residence design.

6. Conclusions
Faced with the homogenization of the urban appearance and the loss of regional characteristics in a modern city, the typology theory advocates that design should return to rationality, seeks the essence of architecture, and promotes the continuation of historical context. In the experimental design of Zhongnongli residential block, the new architectural form with logical coherence is created through typological extraction and typological transformation, which realizes the dialogue between historical area and new buildings, the balance between traditional cultural connotation and modern life demands. Therefore, as a tool to analyse the relationship between architecture and the city, typology theory can
not only provide a rational research perspective for the long-term debate on inheritance and innovation, but also play a guiding role in the exploration and practice of the urban form.

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