

A Study on the Improvement of Living Environment in Exterior Space of Jixiang Housing Complex in Shenyang, China

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Abstract: Since the Reform and Opening in the late 1970s in China, social mass construction has progressed rapidly in Shenyang. The housing complexes built during this time were aged and the living environment became worse as well as the residential satisfaction. Although unit households were being remodeled personally to improve the residential performance and satisfaction until now and the open space and community space was provided, as well as the importance of the space for convenience, such as parking or trash processing space, included in exterior space of residential complex was also growing, improvement was necessary but still hard to be carried out. So in this study, investigation on the exterior space was made focused on Jixiang Housing Complex in Shenyang. Improvement strategies and implications for the living environment were also suggested. As a result, for solving the problems, 2nd floor public space and semi-underground space can be used for separating public space and parking space as well as the 3D parking and greening for the sustainability of these old housing complexes and the urban regeneration of old city center in Shenyang.

Key words: improvement, living environment, exterior space, old housing complex, Shenyang

1. Introduction

1.1 Background and Purpose of the Study

In the late 1970s, mass construction for social housing had progressed rapidly for meeting the basic living standards because of the Reform and Opening beginning nationally in China. Compared with 1980, the completed area of architecture and housing had increased 5 times in 2000 and the main part of the construction is housing because of the growth in residential demand before 1995 (Fig. 1).

This trend also occurred in Shenyang, the northern city of China. As these housing complexes aged, the living environment and residential satisfaction were also worsening gradually. And because redevelopments on old housing complexes will not be

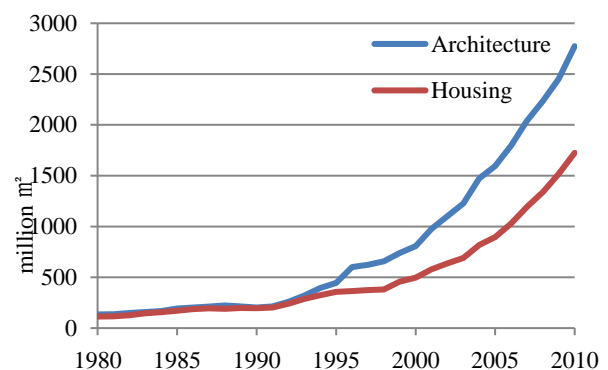


Fig. 1 Completed Area Change State of Buildings and Residence in China (1980-2010) [1].

recommended in Shenyang according to Master Plan of Shenyang City 2011-2020 [2]. Although the unit households were remodeling privately to improve the residential performance, the improvement for exterior space was still hard to be carried out substantially.

Therefore, in this study, Jixiang Housing Complex was chosen as an object based on the investigation of 10 housing complexes during 1970s-1990s and

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purpose of the study is to improve the living environment for sustainable housing complexes as well as to propose better remodelling strategies for exterior space in these old housing complexes for urban regeneration.

1.2 Content and Method of the Study

Prior to the main research, review of the relevant literature and analysis of the present state data will be

made to grasp the exterior spatial elements in the housing complex. Then an analysis will be made for the situation of Jixiang Housing Complex. Then, problems occurring in exterior space will also be found out and discussed in detail. At last, the improvement strategy for exterior space will be put forward with feasibility analysis (Fig. 2).

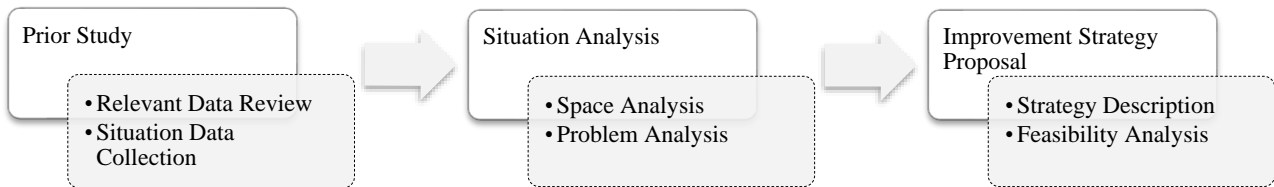


Fig. 2 Research process description.

2. General Considerations

2.1 Exterior Spatial Elements of Housing Complex

In general, traffic would be the main element including parking space compared with other elements shown in Table 1. In addition, the open space and green space would be designed together and with the

increase in the size of residence, the ratio of open space and green space would also increase. So the traffic problems would be the primary optimization object during the exterior space remodeling for old housing complexes.

Table 1 Exterior spatial elements composition of apartment house for multi-story buildings¹.

Elements Category		Elements Contents	Land Use Ratio (%) [3]		
			5-min Ped. ²	10-min Ped.	15-min Ped.
Traffic Space		Car Road, Non-motorized Road, Pedestrian Road	15~20	15~20	15~20
		Parking Lot, Parking Garage, Public Transportation Site			
Public Space	Functional Space	Business Service Facility, Conservation Education Facility, Sports and Entertainment Facilities	I ³ :4~5 II ⁴ :5~6	I:8~9 II:9~12	I:12~16 II:13~20
		Sports and Entertainment Facilities			
	Open Space	Square, Public Event Space, Playground			
		Wall Boundary, Fence Boundary, Green Border, Bottom Business Border	I:2~3 II:3~4	I:4~6 II:6~8	I:7~11 II:9~13
	Green Space	Green Space between Residential Buildings, Courtyard Group Green Space, Community Green Space, District Green Space			
	Landscape Lighting, Rest Seat, Landscape Sketch				

¹ ref. Study on the Elements Composing and Optimization of the External Space of Shenzhen Opening Residential Area [4]; ² "Ped.": Abbreviation of "Pedestrian-scale Neighborhood" and the Residential Land is also calculated in the ratio; ³ Multi-story Buildings with 4-6 Floors; ⁴ Multi-story Buildings with 7-9 Floors.

2.2 Legal Elements of Exterior Space Planning in China

Table 2 shows the legal elements for exterior space planning of the housing complex in China. We can know that the planning control indicators can be

lowered appropriately when making renovation for housing complexes and functional space like parking space, open space or waste treatment space would be set according to the service radius compared with green space.

Table 2 Legal elements of exterior space planning of housing complex in China [3].

Category		Detail
Parking		Multi-level Parking Garages or Mechanical Parking Facilities on Ground, Ratio of Ground Parking Space $\leq 10\%$
		Setting Temporary Parking Space in Neighborhood Block
		Parking Space Service Radius in Neighborhood Block ≤ 150 m
Public Space	Green Space	Per Capita Indicators of Public Green Space: 5 Minutes Living Area ≥ 1.0 m ²
		When making Old District Renovation, Per Capita Indicators of Public Green Space \geq Corresponding Indicator $\times 70\%$
		Per Capita Indicators of Green Space in Neighborhood Block: Construction of New District ≥ 0.50 m ² , Renovation of Old District ≥ 0.35 m ²
	Open Space	Service Radius ≤ 300 m; Land Area: 5 Minutes Living Area ≥ 150 m ² ; Neighborhood Block ≥ 170 m ²
		Setting Rest Facility, Public Toilet and Avoiding Disturbing People
Waste Treatment		Independently Setting Garbage Collection Station in 5 Minutes Living Area, Service Radius: Artificial ≤ 1 km; Motor Vehicle ≤ 2 km

3. Situation Analysis of Exterior Space in Jixiang Housing Complex

3.1 Overview of the Housing Complex

Jixiang Housing Complex is located in Jixiang 2nd Road, Dadong District, Shenyang of China. And in view of the information of the housing complex shown in Table 3, the greening rate of 15% and the per capita green area of 0.48 m² can't meet the demand of existing code for planning [3].

Because there were only industrial facilities and single-floor residence widely around the Jixiang

Housing Complex before 2000 (Fig. 3a), there were no redevelopment but only renovations for living environment progressing in part of the housing complex. Thus, it can be divided into 2 parts that are Area A without renovations since 1985 and Area B with renovations for roads, public facilities or building façade between 1985 and 1999 (Fig. 3c). Therefore, Area A will be the main discussion object below because of the preservation of the original exterior space.

Table 3 Jixiang housing complex information overview.

Location	Jixiang 2nd Road, Dadong District, Shenyang, China
Time	1985
Area	51,331 m ² (4587 Households)
Total Area of Building Base	12,266 m ² (40 Buildings, Coverage Ratio: 23.9%)
Construction Area	102,661 m ² (Floor Area Ratio: 2)
Greening Rate	15% (0.48 m ² per person)
Building Type	Flat Low Rise Building; 8 Stories Above Ground (No Basement, No Elevator)
Parking Type and Number	Random Parking, No Designated Parking Space

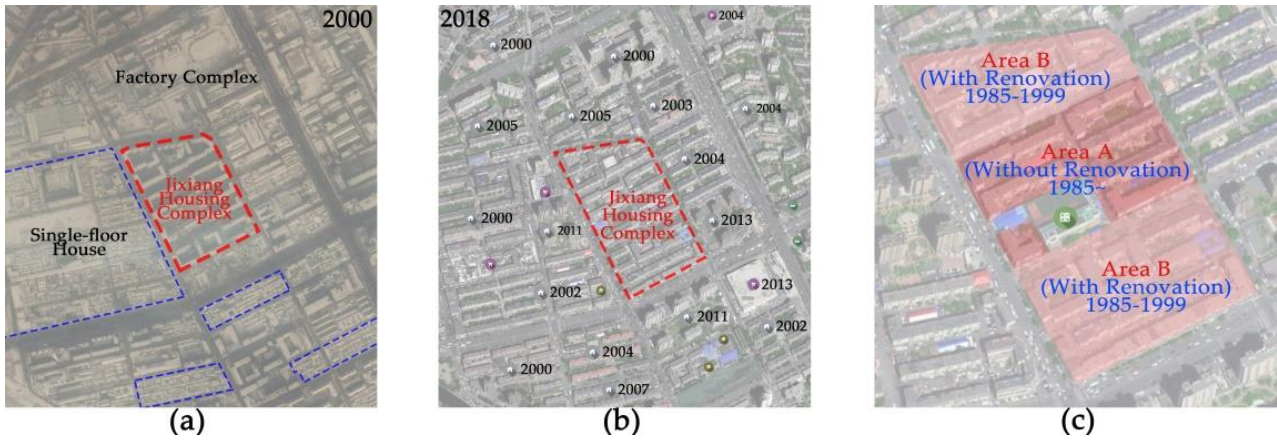


Fig. 3 Layout situation and plane scale description on area A.

3.2 Spatial Scale and Mode Analysis

Area A can be divided into 2 parts with the west part and the east part (Fig. 4). The courtyard ratios of length to width in the west part are all under 2.0 so that a larger proportion of exterior space has been obtained from the floor plan in Fig. 4. Contrariwise, the exterior space scale in the east part is so large that the ratio of length to width is raised for obtaining higher space utilization.

From the section, the west part is designed for a mixed-use residential mode shaped like stairs shown in

Fig. 5a. The residential space on the 1st floor is designed for commerce and expanded into the inside of the site so that the 2nd floor can be set for open space. Parking space is set on the ground open space outside the residence. On the east part, buildings with 8 floors on both sides surround the open space or public buildings in the middle (Fig. 5b). Although the courtyard forms are similar in the east part, the space experience is still different because of the difference of the exterior spatial elements and the width of roads.

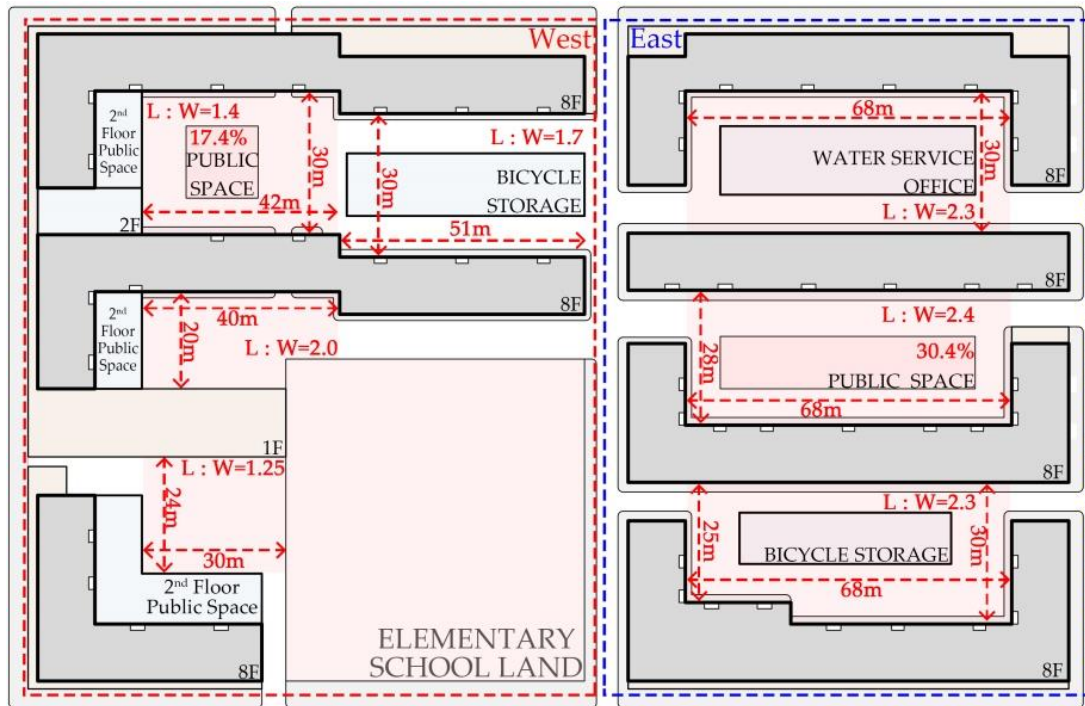


Fig. 4 (a) Situation of Jixiang housing complex in 2000; (b) Situation of Jixiang housing complex in 2018; (c) Zoning description of Jixiang housing complex.

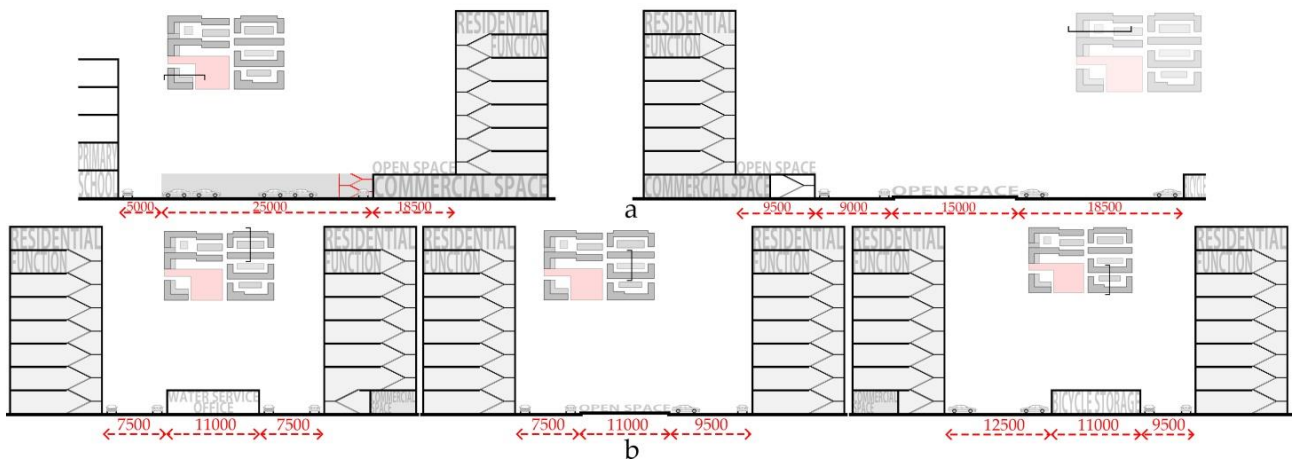


Fig. 5 (a) Section description of east part of area A; (b) Section description of west part of area A.

3.3 Problem and Cause Analysis in Exterior Space

Problems occurring in Jixiang Housing Complex as the housing complex getting old and the living level increasing can be divided into 3 kinds: Parking problem, Waste treatment problem and Mixed-used space problem.

First is the parking problem. Parking space in Jixiang Housing Complex can be divided into 2 kinds: Personal indoor garage and Public parking space. And because the roads between Area A and B were changed from internal roads to city roads since 2000 with the opening of housing complexes, the personal indoor garages in the northeast of the site were opened towards the city road (Fig. 6a). Therefore the security of the garages and city road, as well as the commercial value of 1st floor, reduced because of the setting of external garages. Next, although the parking space was set in the exterior space, random parking was still the main parking mode so that the public green space, the open space even the entrance of the housing complex had been occupied seriously (Fig. 6b). In the meantime,

the exterior space was also occupied by personal modified temporary housing seriously.

Waste problem in the public space caused the public space to be occupied by a large area and the green space attached to the public space was damaged seriously in the meantime. The reason why these wastes such as the city bicycles and broken public facilities were abandoned (Fig. 6c) is that the housing complexes like Jixiang Housing Complex were given up for management from the late 1990s gradually so a systematic residential area management was missing, and these main kinds of waste is not owned by the individual so that the waste treatment is also not personal burden in these housing complexes. And because of the proliferation of city sharing bicycles in the old city center of large cities like Shenyang in recent years, the broken bicycles were abandoned in a housing complex for a long time without further treatment. In addition, the snow staying for a long time in a year is another large problem because of the low average temperature and long winter in northeast China.

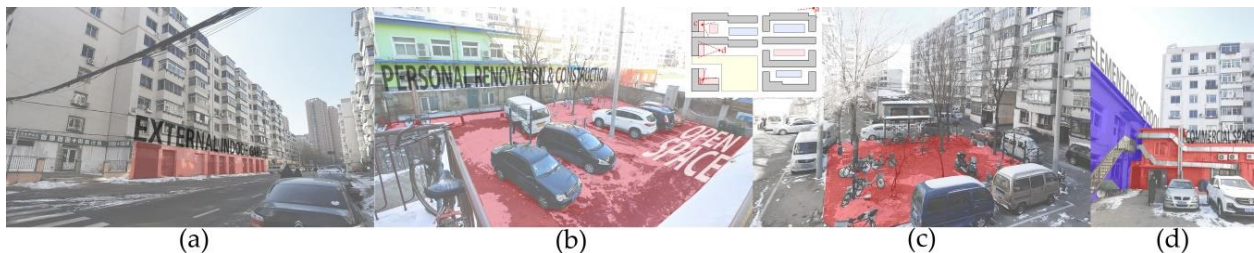


Fig. 6 (a) Indoor garage along the street; (b) Parking situation at open space; situation of public space (c) Open space and (d) the mixed-used space.

At last, the problem of mixed-used space usually occurs like Fig. 6d. Because of the expansion of the external commercial space, the auxiliary space extended to the inside site naturally. The resulting problem is that the pipe system was exposed outside because of the personal remodeling for commerce, and the safety of the entrance of buildings was also reduced in the meantime. In addition, waste from commercial activities is also a big problem.

4. Improvement Strategy Proposal

In view of the problems mentioned above, the main problem is parking. Because of random parking,



Fig. 7 (a) Profile analysis for west part of area A; (b) Profile analysis for east part of area A.

On the east part of the site, 1st floor was not used for commerce so that parking space can be set semi-underground by making full use of the indoor and outdoor height difference of about 500 mm in the buildings. So that the height of the underground parking space is only 1.8 m for meeting the minimum parking space height of 2.2 m [5] (Fig. 7b).

Although the improvement mentioned above may not be a better way to solve the problems because the opening of underground space will be limited by the original building foundation and overhead slabs and the coverage of vegetation on them will bring about structural and technical problems, overhead slab and semi-underground parking will be a new thinking direction of remodelling for these old housing complexes. In addition, 3D parking or 3D greening can be also used for saving space in these old housing complexes.

existing open space and green space have seriously encroached. So the improvement to solve it is to distinguish parking space from other public spaces clearly by using 2nd floor space and semi-underground space (Fig. 7). Because of the commercial space on the 1st floor on the west part, public space can be placed on the 2nd floor platform uniformly with the parking space under the platform (Fig. 7a). Thus, the entrances of buildings are all on the 2nd floor so that open space and green space can be created. And parking space, as well as a public facility, can be fully arranged on the 1st floor. It is beneficial to make full use of the exterior space.

5. Conclusion

Because it can be confirmed that there will be just only renovation for the living environment to keep the original residential mode instead of redevelopment, improvement for the living environment is necessary for solving the problems occurring in the housing complex. And the reason for the problems such as Parking, Waste treatment, and Mixed-used space occurred in Jixiang Housing Complex is that parking, open and commercial space was in conflict without a reasonable arrangement in exterior space. To solve these problems, the use of 2nd floor space and semi-underground space would be a new way to solve parking problems and create more public space. In addition, 3D parking and 3D greening will be progressed for saving space. These improvements of the living environment will be not only used for the

sustainable improvement of old housing complexes but also for the urban regeneration in the old city center of Shenyang.

References

- [1] Statistics Division of Fixed Assets Investment, *National Bureau of Statistics: China Building Almanac*, China Statistics Press: Beijing, China, 1981–2011.
- [2] Shenyang Bureau of Planning and Land Resources, *Master Plan of Shenyang City 2011–2020*, Shenyang Geographic Information Bureau: Shenyang, China, 2012.
- [3] Ministry of Housing and Urban-Rural Development of the PRC, *Code of Urban Residential Areas Planning & Design*, China Architecture & Building Press: Beijing, China, 2018.
- [4] Kang Xin, Study on the elements composing and optimization of the external space of Shenzhen Opening Residential Area, Master's Thesis, Harbin Institute of Technology, Harbin, China, 2017.
- [5] Ministry of Housing and Urban-Rural Development of the PRC, *Code for Design of Parking Garage Building*, China Architecture & Building Press: Beijing, China, 2015.