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Abstract: Since 2020, with the globalization of the COVID-19 epidemic, collective housing in China, have formed a corresponding personalized and emergency planning and management model for the normalization of the epidemic, in order to cope with the adverse effects and changes of the epidemic prevention and control on the living environment. Mukden City in Shenyang, China, as an example, which has been basically shaped since the early Qing Dynasty, was dominated by residential area and the commercial area also influence the city planning profoundly meantime, and the living environment is old and incomplete. This paper starts with the research on the historical formation and the distribution and characteristics of various functional spaces in Mukden City. Combined with the post-epidemic era, the adjustment and update strategy of the residential area layout led by epidemic prevention measures, the concept of "Daily Living Cluster", as well as specific strategies and methods for the improvement of the living environment in Mukden City to a certain extent, and provide for the elderly in the post-epidemic era. The renewal of the old town offers new ideas and new approaches.

Key words: Mukden City, living environment, renewal strategy, daily living cluster, post-pandemic era

# 1. Introduction

## 1.1 Scope and History of Mukden City

Mukden City is located in the east-central part of the old city center by square, with the 1<sup>st</sup> traffic loop line passing through the east side (Fig. 1a). And Mukden City was formed divided into 9 areas with the "#" shape central road network inside composed with the Centre Street and Shenyang Street (E-W), Zhengyang Street and Chaoyang Street (N-S) as well as square road network outside composed with East Shuncheng Street, West Shuncheng Street, North Shuncheng Road and South Shuncheng Road (Fig. 1b) and the total area of the Mukden City is about 169 hm<sup>2</sup>.



Fig. 1 (a) Scope and location of Shenyang and (b) Mukden City.

And before early 1600s, urban functional system of Mukden City presented a binary structure of "Military-Administration" with the resident population related to military and administration function. And the during 1600s-1800s, as the military and administrative functions further consolidated, necessary residential and commercial functions appeared in Mukden City and gradually occupied the

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main position. At last 1912, due to the urban expansion of Shenyang, the military and administrative functions moved westward gradually. And urban functions of Mukden City were dominated by cultural and artistic functions, residential functions and commercial functions because of the existing of ancient buildings in Mukden City (Fig. 2).



Fig. 2 Urban function evolution of Mukden City.

# 1.2 Status Quo of Urban Planning in Mukden City

The current situation of residential area in Mukden

te traffic loop lin West Railway Station North Railway Station (the Old C City Hall(EX) East Railway Sta 2 Shenyang Railway Station icheug Stre City Hall (New) Manchurian Railway Affiliate (EX) th Railway Station Airport 10 15km





Fig. 4 Distribution of Mixed Commercial and Residential Streets in Mukden City.

City shows a dominant position (Fig. 3a). And the road network system can be divided city road and residential area road by road width according to Fig. 3b. But because of the process of residential area opening up from 2000, the city road and the residential area road with the same road width as well as the whole road network system were tending to be the same and homogeneous gradually.

The commercial space in Mukden City that complements residential function forms a mixed commercial and residential street as shown in Fig. 4. The commercial-residential complex road system in Mukden City presents a state of single commercial function type centrally arranging which makes the existing residential areas closely related, and even merged with each other.



### 1.3 Concept Definition of "Post-Pandemic Era"

It has been more than 3 years since the COVID-19 began to rage around the world at the beginning of 2020. At present, many countries in the world, including China, had entered a period when the epidemic situation had been relatively stable, but preventive measures and behaviours were still gradually normalized. And Forbes has also mentioned the period by the word of "The New Normal" [1]. But Post-Pandemic Era in China can be mentioned by a new era in which epidemics are one after another in various places, and epidemic prevention and anti-epidemic have become a part of citizens' daily life in the post-epidemic era [2]. And people's concept of consumption, health, education, etc. has changed. The instability of the epidemic outbreak will also prompt the government to pay attention to the emergency management awareness of epidemic emergencies during this period [3]. So that all of research and conclusion in this paper will be based on this concept of period and will be also focused on the resident behaviour and residential well-being during the Post-Pandemic Era.

#### 1.4 Research Purpose

Based on the above discussion on the history and the Status Quo of urban planning in Mukden City, the purpose of this paper is put forward as follows.

- 1) The concept of "Daily living Cluster" will be established.
- Personalized urban detail renewal strategy will be proposed.
- Overall urban renewal strategy for Mukden City during the Post-Pandemic Era will be formulated.

# 2 Methods

2.1 Current Regulations and Characteristics of Chinese Residential Area Planning and Design

Current regulations on the planning and design of residential areas can be mainly summarized into two categories in China, which are the regulations for new construction or for living environment renewal. Among them, the current regulation named "Code for Urban Residential Areas Planning & Design" concept of "Pedestrian-scale proposes the Neighborhood (Ps-N)" shown in the Table 1 which can emphasize the concept of daily living area reached only by walking and can also emphasize the importance of residents' personal wishes [4]. In addition, public facilities which are related to living environment closely, were also mentioned by making limitation of setting radius and facility scale.

Regarding the special regulations and policies for living environment and facilities renewal, the national level regulations that are in the state of demonstration and solicitation of opinions include "Technical standard for environment renewal of existing urban residential area" which are followed the renewal business-related processes shown in Fig. 5 [5] as well as "Technical Specification for Public Facility Renovation of Existing Residential Quarters" which are followed the detailed transformation implementation strategy shown in Fig. 6 [6].

Through the inspection of the regulations related to living environment renewal at all levels, it is clear that the development direction of residential area planning and design at the national level is a more humanized residential grade division, a more detailed residential area renewal strategy formulation and a more Formulation of the actualized renewal and renovation business plan.

Table 1 Residential classification.

Name	15 min Ps-N	10 min Ps-N	5 min Ps-N	NB*		
Household s	17000~3200 0	5000~8000	1500~4000	300~1000		
Population	50 k~100 k	15 k~25 k	5 k~12 k	1 k~3 k		
*NB: Neighborhood Block						



Fig. 5 Renewal business-related processes.



Fig. 6 Detailed transformation implementation strategy.

### 2.2 Modern Development of the Concept of Life Zone

Since the beginning of the 20th century, the concept and theory of "Life Zone" had shown a trend of diversification, subdivision and regional characteristics around the world, and had derived such as "Neighborhood Unit Theory" (C. Arthur Perry in 1930s), "Daily Living Area" (G. Feder in 1940s) and "Hierarchical Organization Theory" (Higasa Tadashi in 1960s) and other well-known theories related to the Life Zone that will be discussed and developed into "Daily Living Cluster" in this paper later.

Among them, Perry's "Neighborhood Unit Theory" can be mentioned to be a concept that started as a unit

community planning regenerate of to social organizations through the improvement of the physical environment [7]. And Feder's "Daily Living Area" confirmed the possibility of creating a systematic residential spatial structure by dividing daily life behavior into "Centered on 1 Day", "Centered on 1 Week", and "Centered on 1 Month" [8]. And Tadashi's "Hierarchical Organization Theory" can be evaluated as having a significant impact on the establishment of a step-by-step method by proposing a method of dividing the residential area into "District", "Neighborhood District" and "Joint District" [8], so it can also be mentioned by "Step Construction Theory" emphasized the strict constraints which restrictions on the setting standards of living facilities in residential areas based on a strict regional division system.

Of course, no matter what kind of theories about Life Zone, they all tried to limit the living environment quality and facilities within the scope through the division of residential scale and area size. And it has also contributed to the development and maturity of the modern life zone theory, and also has a certain guiding significance for the concept of xx-minute life zone proposed in the relevant regulations of residential area planning and design in China in recent years. Based on the above, this paper plans to further explore the possibility of adaptive development of the life zone theory in the planning and development for medium and large cities of China through a new design of the concept of life zone applicable to the Mukden City later in the text.

# 2.3 Investigation and Summary of Residential Area in Mukden City

Based on a two-year comprehensive survey on Mukden City from 2019 to 2020, and combined with the response strategies and phenomena related to epidemic prevention in the residential area from 2020, a summary was made shown below.

1) Urban roads and residential area road network

was divided by grades and road width clearly. An urban branch line loop system surrounding Mukden City according to the city wall site area is formed.

- 2) Part of residential area and commercial space have been transformed into urban squares or green spaces after 2000, forming an "Urban Landscape Belt" that runs through the city in the north-south direction.
- 3) The residential parking spaces which are usually free parking on the ground, show a serious shortage and lead to the problem of occupying the adjacent city road. And the non-motor parking spaces and other public facilities are usually in independent buildings, being abandoned or old and making the waste of public space.
- 4) Commercial facilities closely integrated with urban commercial space, have declined the quality and convenience of the living environment due to the aging and serious uneven distribution problem.
- 5) The residential environmental quality and safety were reduced, and the comprehensive management difficulty is increased due to the influence from residential commercial spaces. Affected by the opening of residential areas, the connection between residential and urban public space is insufficient with an ambiguous boundary.
- 6) The division of epidemic prevention areas was shown in Mukden City area, not taking the convenience of public facilities and commercial facilities into account during epidemic prevention.
- Additional Normalized nucleic acid detection points show the features of uneven distribution, poor location selection and insufficient quantity setting. Additional public facilities are insufficiently integrated with existing public facilities occupying the public spaces.

# 3. Discussion

## 3.1 Living Environment Analysis of Mukden City

3.1.1 Epidemic Prevention Living Area Division

During the post-epidemic era, Mukden City has artificially delineated an emergency closed area for epidemic prevention in response to the requirements of epidemic prevention, shown in Fig. 7. It is clear that the epidemic prevention living area division follows the principle of the original residential area generally, while taking the trend of opening up residential areas since 2000 into account. The regional shape and volume show the features of intensification and completion for efficiency of regional sealing and control management.

3.1.2 Public Facilities for Normalized Epidemic Protection

According to the normalization of nucleic acid testing, normal nucleic acid testing sites had been set up in Mukden City shown in Fig.7 usually in movable container structures, which have problems such as poor mobility, low sampling carrying capacity, and poor integration with existing residential public facilities. In addition, temporary public service facilities such as temporary isolation points and material supply points setting in epidemic prevention area for emergency epidemic prevention affairs such as lockdown and full-staff screening show the problems of mobility, irrationality poor and uncertainty.



Fig. 7 Epidemic prevention living area division.

3.1.3 Residential Area Business during Post-Pandemic Era

The residential area business located in the city center of big city like Shenyang, always plays an important roll that can well improve the living problems such as insufficient commercial facilities, poor space quality and unscientific space layout in old residential areas, so that it had improved fast in the old residential areas of city center in big city, especially the city center in big city of China. In the early construction of these residential areas. the consumption behaviours required by residents in their daily life were not considered at the initial stage of construction, resulting in inconvenient life for residents. And with the continuous construction of the market economy after the "Reform and Opening in China", in order to fill the gaps in commercial facilities in old residential areas, residents began to create commercial stores spontaneously. And this kind of spontaneous commerce is a commercial form in which residents use their own houses to open stores and engage in commercial activities in the form of "breaking the wall to open stores" and illegal buildings [9].

And during the Pandemic Era (2020-2022), in order to ensure the supply of materials in the temporarily sealed residential area in Mukden City, a triangle supply relationship named "Community-Management Organization-Commerce" has been established, and needs to be realized through corresponding public facilities or spaces, but for now (Post-Pandemic Era) they are often lacking or unreasonable. In addition, additional forms such as express delivery and takeaway also require physical space or facilities as carriers, but there are large differences between epidemic prevention areas, and the layout and maintenance of facilities have problems such as lack of rationality, unclear goals, and insufficient intensification.

# 3.2 "Daily Living Cluster" Concept Establishing

Based on the above discussion on the status quo of the living environment in Mukden City as well as the introduction and discussion about the concept of Life Zone above, combined with the current regulation for urban residential area planning and design, "Daily Living Cluster" that is suitable for the initial stage of the renovation of the old urban area like Mukden City or similar medium and large cities in China, was proposed in this paper next.

In response to the phenomenon of opening up of old residential area in city centre, "Daily Living Cluster" can consider the basic characteristics and status quo of the existing residential areas, as well as the relevant living environment problems and their causes obtained from "Problem Evaluation System", and then can divided the residential areas into different cluster by personalized residential class. According to concept of "Daily Living Cluster", the main characteristic elements were summarized in Table 2.

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Main Category	Elements	Main Category	Elements
Basic Features	Residential Density		Commercial Public Facilities
	Road Network	Commercial Features	Commercial and Residential Complex
	Entrance and Exit		Type of Business
	Public Buildings	Survey Evolution Eastures	Residence Satisfaction
	Public Space	- Survey Evaluation Features	Facility Addition Order

 Table 2
 Main characteristic elements for "daily living cluster".

Based on the first two categories in Table 2, and the preparatory survey and evaluation state was envisaged, the residential area of Mukden City was divided by "Daily Living Cluster", as shown in Fig. 8. According

to the evaluation and scoring from Problem Evaluation System, the "Daily Living Cluster" in Mukden City can be further divided into Type A-C, which correspond to the data ranges of their average



Fig. 8 "Daily living cluster" division for Mukden City.

comprehensive scores. This "Daily living Cluster" will play a certain guiding role in the formulation of subsequent batches of urban renewal implementation plans. In addition, the "Problem Evaluation System" mentioned above will be discussed in 3.4, and will not be repeated here.

## 3.3 Design Strategy of Urban Detail Renewal

3.3.1 Reuse of Underground and Semi-underground Spaces

Aiming at the design strategy of reusing the existing floor height difference in the area, the status analysis diagram and design schematic diagram shown in Fig. 9 show a semi-underground public parking space is created by using a height difference of 1m, and it is compared with the existing floor space. The combination of the vertical traffic space of the collective housing maximizes the parking space, but does not take up the public outdoor space as a cost.

3.3.2 Redesign of Road Section Space of Commercial and Residential Complex

Aiming at the problems existing in the commercial and residential complex commercial street, a " $\Upsilon$ " shaped structure is added in the center of the commercial street, so as to be vertically layered and horizontally connected with double angles to achieve the layered area of the roadway and the commercial pedestrian path. In addition, a soothing transition and orderly connection will be created by connecting the commercial street with the rooftop public spaces on both sides (Fig. 10).

In general, the core of the detailed design strategy proposed for the current situation of floor height difference, commercial and residential complex, etc. is to solve the problem of mixed functional streamlines by opening up the vertical layers; through the reconstruction design of road sections, Feedback is given to the improvement of public outdoor space, and finally a more stylized method is expected to be popularized and applied in a wider range.

# 3.4 Discussion on Overall Strategy of Urban Renewal in Mukden City

## 3.4.1 "Problem Evaluation System"

The "Problem Evaluation System" in this paper came from the theory of "Post Occupancy Evaluation (POE)", which is opposite to the theory of "Pre-design Evaluation (PDE)". And the theoretical research on POE began in European and American countries in the 1960s. It was originally expanded from the architectural environment design by scholars in the field of environmental behaviour, focusing on people's evaluation and attitude of the built environment such as built buildings and related environmental facilities [10].

But in this paper, in view of the implementation needs of the concept of "Daily living Cluster" proposed above, "Problem Evaluation System" based on expert evaluation and residential satisfaction evaluation survey were proposed shown in Fig. 11 that there is a big difference with POE theory to some extent. The whole evaluation process needs to go through three stages: "initial questionnaire setting and evaluation", "intermediate multi-stage and multi-level expert evaluation and satisfaction evaluation in "calculation and processing parallel". and of later-stage human settlement evaluation scores and additional consideration factor ranking scores" to expand. Then, the expert assessment results of the human settlement environment and the order of



Fig. 9 Road section space redesign-a.



Fig. 10 Road section space redesign-b.



Fig. 11 Model of "problem evaluation system".

additional factors to be considered will be used in the formulation of the subsequent "Daily living Cluster" division plan and the design of the relevant update business cycle. In addition, under the background of the post-epidemic era, on-site research and evaluation in Mukden City, is conducive to obtaining direct and timely feedback data in the process of epidemic prevention and control, so as to serve the further epidemic prevention and control in residential areas and urban renewal. realization and assurance.

3.4.2 Overall Road Network System Renewal Design

Combining the demolished city wall area in Mukden City as the core, a regional trunk road is set up, and then a secondary regional branch road is extended at the center of the main residential area. The main road and the branch road in the sub-region of the city are physically connected to form a three-level residential road system (Fig. 12).

Under the premise of not affecting the established block division results, this new road system actively starts from the urban renewal level, and uses the ancient city wall site area with special historical and cultural value as a link, which is also beneficial to urban residential areas to a certain extent. In the process of epidemic prevention and control, the implementation of comprehensive, flexible and reasonable epidemic prevention measures needs to be considered.

3.4.3 Staged and Diversified Living Environment Update Strategy Formulation

For the whole residential area of Mukden City, it is suggested that the area regeneration and renewal should be carried out in the order of Daily living Cluster' division, road space improvement, parking space expansion, public space and facilities securing, and commercial space (facilities) re-improvement (Fig. 13).



Fig. 12 Overall road network system renewal design.

Division by Living Cluster	Road Space Maintenance	Creation of Parking Space
Practice of Ideology	Residential Complex Road Space Maintenance	Renewal of Parking Spac Supply Policy
¥ (1	v	· · · · · · · · · · · · · · · · · · ·
Cluster Division	<ul> <li>Integrated Reorganization of the Main Road Network in Residential Areas</li> </ul>	Diverse Creation of Parking Type
Establishment of Business	¥	
Promotion Procedures by Living Cluster	Reorganization of Road Space inside Living clusters	Reorganization of Parkin Space by Living Cluste
·····		
Physical Condition Assessment	Commercial Space (Facility) Relocation	Ensuring Public Facility(Space
and Residential Satisfaction Survey	Commercial Placement and Department Type Statistics	Public Space Integrated Arrangement Maintenance b
		Living Cluster
	Arrangement of Commercial Facilities	×.
	according to Living Cluster needs	Improvement and Expansio
*	v	- or Fublic facilities
Modifications and Adjustments through Feedback during	Demolition or Renovation of Polluted and Inefficient Commercial Facilities	Renewal and Expansion of Affiliated Facilities
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Fig. 13 Public facilities (space) renewal process.

# 4. Conclusion

In summary, concept of "Daily Living Cluster" which can meet the current regulations and at the same time take into account the real status quo of the target's residential area, will be beneficial to the development of human settlements renewal business. Urban detail renewal strategy in view of the urban detail problem will make a personalised regeneration plan for Mukden City which will also be beneficial to make sure of the detail of rural living environment renewal. Overall Strategy of Urban Renewal in Mukden City will make a universal urban renewal strategy that will be beneficial to spread the strategy to other urban areas like Mukden City. All of the concept and strategy above will also provide new methods and ideas for rural living environment renewal during the post-epidemic era.

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