Innovative Research on Renovation Projects of Old Residential Areas under EPC Mode

——Taking the renovation project of a community in Panjin, Liaoning Province as an example

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Abstract. This article takes the renovation project of old residential areas in Panjin, Liaoning as an example to explore the innovation and practice of renovation projects in old residential areas under the EPC model. Through in-depth analysis of the renovation mode, renovation concept, and renovation content in the implementation process of the EPC model in old residential areas, a series of innovative strategies and methods have been explored and proposed, aiming to reduce government funding costs, shorten project construction cycles, improve the effectiveness of district renovation, and meet the immediate needs of residents. And with the help of green, low-carbon, energy-saving and emission reduction related technologies, achieve sustainable development of old residential areas.

Keywords: EPC Mode, Renovation of Old Residential Areas, Green and Low-carbon, Sustainable Development.

1 Overview

Against the backdrop of accelerating urbanization, the renovation of old residential areas has become an important task in the process of urban renewal [1]. In 2021, strengthening the renovation of old urban residential areas is an important task in the 14th Five Year Plan. Under policy guidance, various regions actively promote the renovation of old residential areas, and the scale of the project has been increasing year by year, as shown in Figure 1.

For the Northeast region, this task is more urgent and unique. Most of the old residential areas in Northeast China were built before 2000. Due to low construction standards, outdated public facilities, aging infrastructure, incomplete supporting facilities, and lack of long-term management mechanisms, it seriously affects the quality of life of residents [2]. Due to factors such as the economic level during the construction period, relatively backward construction techniques, and insufficient supervision, these old residential areas have many thorny problems. In the Northeast region, the winter is long and cold, and some old residential areas have poor thermal insulation performance. The phenomenon of unauthorized construction not only affects the overall layout of the

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community, but may also damage the original thermal insulation structure of the buildings; Underground pipelines frequently experience malfunctions due to low temperatures and aging issues; The road is severely damaged due to long-term freeze-thaw cycles; Unreasonable parking space planning leads to disorderly parking; After years of use, the structure of the house has aged, and coupled with concentrated summer rainfall in Northeast China, the roof and walls are prone to water seepage and leakage. These problems greatly disrupt the daily lives of residents in old residential areas in Northeast China, significantly reducing their quality of life [3].

Moreover, old residential areas are mainly located in the city center, and due to historical reasons and cost limitations, demolition is difficult. Therefore, renovation has become the best choice to improve the quality of housing. In order to solve the many problems existing in old urban communities, the government has taken multiple measures, one of which is to introduce EPC (Engineering Procedure Construction) engineering general contracting, which is an integrated model of "engineering design procurement construction", to promote the transformation of old communities.

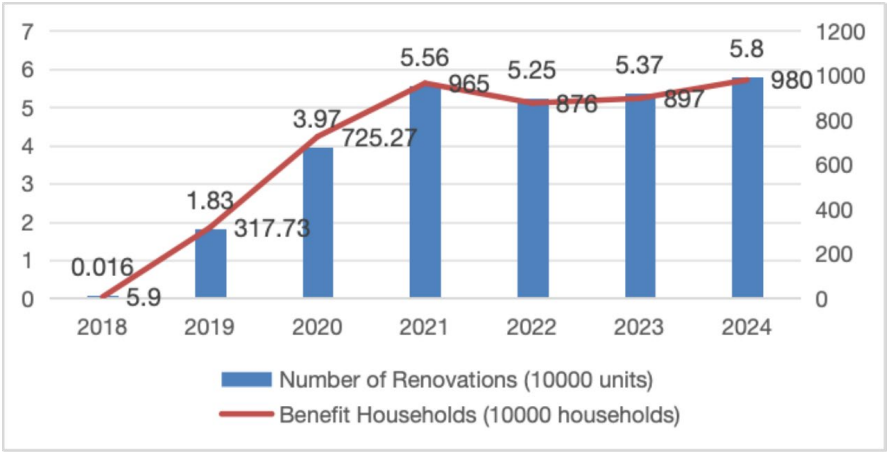

Fig. 1. Scale of National Renovation Projects for Old Residential Areas

2 Application of EPC Mode

The renovation of old residential areas plays an important role in China's urbanization process, and improving urban quality and living environment has become an urgent requirement for current work, with significant social and economic significance. The EPC model [4] is an integrated engineering contracting model that combines engineering design, procurement, and construction. In the application of renovation projects in old residential areas, it has the following necessity and advantages.

2.1 Necessity

Old residential renovation projects are usually large-scale, involving cooperation between many homeowners and relevant departments, and involving multiple professions and technologies. The traditional design and construction mode has problems such as complex project management, difficult coordination, and low efficiency. Adopting the EPC model can integrate the design, procurement, and construction of the entire project, reduce links and repetitive work, lower management and construction costs, and improve project efficiency and quality.

Table 1. Comparison between EPC mode and traditional mode in cost management of renovation projects in old residential areas

Cost Management	EPC Mode	Traditional Mode
Economic Benefit Evaluation	Better evaluate the economic benefits of the entire project	It requires joint coordination and evaluation by all partners, resulting in low efficiency
Purchasing Cost Management	Reduce procurement costs through economies of scale and resource advantages	Each partner needs to purchase on their own, resulting in poor cost management effectiveness
Construction Period Management	Efficient management of project schedule	Need for joint coordination among all partners, low efficiency
Fund Management	Can better manage risks	All partners need to share the risk together
Risk Management	Can achieve unified management and distribution of funds	Each partner needs to manage their own funds, resulting in low management efficiency

2.2 Advantage

Cost reduction: The EPC model can reduce the procurement and construction costs of each process through the economies of scale and resource advantages of the project general contractor, thereby lowering the overall project cost [5]. In the renovation project of old residential areas, adopting the EPC model can reduce the burden on owners and improve the quality of life of residents. The comparison between EPC mode and traditional mode in cost management of renovation projects in old residential areas is shown in Table 1.

Improving efficiency: The EPC model requires contractors to be responsible for engineering design, procurement, and construction throughout the entire project cycle, enabling efficient collaboration and information sharing, thereby accelerating construction progress and improving project efficiency and quality. Meanwhile, the EPC model can better coordinate the relationships between various processes, reducing project cycles and costs.

Reduce risks: The EPC model requires contractors to take responsibility for the entire project process, thus reducing the risks faced by owners and other cooperative parties. The renovation project of old residential areas usually involves cooperation between many owners and relevant departments. The EPC model can minimize these risks, avoid disputes and accountability.

Environmental protection and energy conservation: Renovation projects for old residential areas usually require achieving environmental and energy conservation goals. The EPC model can improve project quality from multiple aspects such as engineering design, construction quality, and environmental protection. The EPC mode can better meet the needs of environmental protection and energy conservation, reduce environmental pollution, and improve the quality of life of residents in the community.

3 Case Analysis

3.1 Project Overview

35 residential buildings in a certain community in Panjin, including 21 residential buildings in the north building area of the community and 14 residential buildings in front of the factory; 1222 households (excluding 4 apartment buildings); The building area is approximately 87000 square meters; Covering an area of approximately 78000 square meters, the asphalt pavement covers an area of 12783 square meters; Permeable brick paving area of 23300 square meters; Leisure Square 1210 ㎡; 171 parking spaces; Landscape area of 10818 square meters; Due to severe damage to the main building of the community, the original building lacks insulation, and the waterproofing has aged severely over time, resulting in large white areas falling off in the stairwell; The railing is made of iron, which has rusted and aged over time, and its safety cannot be guaranteed; Therefore, the main body will be renovated. The main contents that need to be modified are shown in Table 2.

3.2 Analysis and Summary

After conducting in-depth investigation and research on the EPC projects for the renovation of multiple old residential areas in Panjin region, the following problems were summarized in the renovation projects of old residential areas in the cities and counties under the jurisdiction of Panjin region:

(1) At the infrastructure level, the internal pipeline network of the community is severely aging, with large number of isolated households, outdated and damaged radiators and doors and windows, poor wall insulation performance, and 30% of the community has not yet connected to gas. These problems directly affect the basic daily needs and living comfort of residents.

(2) At the public supporting level: The municipal supporting facilities in the community are not perfect, and many communities lack green landscapes, parking lots, and leisure squares, which cannot meet the leisure and living needs of residents and limit the improvement of their quality of life.

(3) At the level of community management: The order of community management is chaotic, with 90% of communities lacking property management departments and public water and electricity facilities, resulting in a basic disorderly state of community management and a lack of guarantee for residents' lives.

(4) At the level of financial support: There is a gap in the special funds provided by governments at all levels, with an average cost of 10000 to 20000 yuan per household for renovation. Insufficient funds have become a major obstacle to the progress of renovation work.

Based on the current problems, there is an urgent need to create a new model for renovating old residential areas. We should fully leverage the advantages of government supporting conditions, reasonably integrate and effectively utilize internal resources of old residential areas, eliminate various safety hazards, create and activate new public spaces, always take residents' needs as the core, and effectively improve the quality of life of residents in the community.

Table 2. The main content of the renovation

Category	Serial Number	Renovation Content
Main Building (4 items)	1	Roof Insulation and Waterproofing
	2	Building Exterior Wall Insulation
	3	Staircase Wall White and Handrail
	4	Unit Door Maintenance
Road Landscape (4 items)	5	Asphalt Pavement Maintenance and Renovation
	6	Ground Hardening Maintenance and Renovation
	7	Square Maintenance and Renovation
	8	New Parking Space
Electrical (4 items)	9	Street Lamps and Their Supporting Facilities
	10	Surveillance Cameras and Their Supporting Facilities
	11	Weak Current Monitoring Pipeline
	12	New Charging Station
Water (2 items)	13	Fire Hydrants and Their Supporting Facilities
	14	Rainwater and Sewage Pipelines and Corresponding Shafts

4 Objectives and Principles of Transformation

4.1 The Goal of the Renovation

The renovation of old residential areas aims to achieve multiple goals. Its core lies in comprehensively improving the quality of life of residents, thoroughly investigating and eliminating various safety hazards in the community, comprehensively improving the functions of infrastructure, vigorously strengthening the level of property services, and significantly enhancing the overall image and quality of the city. Ultimately, by creating a beautiful living environment and creating happy living conditions, we can effectively stimulate the internal vitality of the community, focus on creating a livable and secure living environment, contribute to promoting social harmony and stability, and continuously enhance the happiness, identity, and sense of achievement of the people.

4.2 Principles of Transformation

During the renovation process, it is necessary to fully respect the wishes of the residents in the community and effectively meet their actual needs. At the same time, we attach great importance to the protection of the original characteristics of the community, deeply explore the cultural connotations of the community, uphold the concept of sustainable development, make reasonable and full use of existing resources, and achieve scientific and orderly progress in the renovation of old communities.

5 Theory of Renovating Old Residential Areas

5.1 Urban Planning Theory

The theory of urban renewal advocates for the renovation and regeneration of old areas in order to improve the overall environmental quality of the city and the quality of life for residents. In the practice of renovating old residential areas, this theory emphasizes the efficient use of existing resources through methods such as functional replacement and facility improvement. In the process of renovating old residential areas, a series of guidelines for urban planning and design must be followed. It covers key points such as the protection of residents' cultural customs, emphasis on the livability and functionality of space, and the implementation of sustainable development planning principles [6].

5.2 Sustainable Development Theory

In the process of modern urban planning, green ecology and sustainable development have become core directions, among which green and low-carbon are key points. Its scope is broad, involving coordinated development and improvement in multiple fields such as economy, society, and environment.

In the process of energy conservation and emission reduction, vigorously promote energy-saving lamps, replace old high-energy consumption lamps and corridor lights with energy-saving LED lights, and reduce electricity consumption; Thermal insulation renovation of building exterior walls, using new insulation materials, reducing winter heating energy consumption, lowering carbon emissions, and effectively reducing negative impacts on the environment. In addition, residents are encouraged to install solar water heaters, utilizing solar energy as a clean energy source to meet their daily hot water needs and further achieve green energy transformation [7].

6 Innovation and Exploration in the Renovation of Old Residential Areas

6.1 Innovation in Transformation Mode

In the new model, the role of designers is crucial, and the workflow is more refined and scientific. Designers need to conduct a comprehensive survey of the community's buildings, infrastructure, and surrounding transportation, commercial, and cultural environments to provide information for the design; To participate in resident surveys through face-to-face interviews, questionnaires, and other methods, and to deeply explore real needs [8]; Finally, integrate residents' needs and opinions from all parties to draft a preliminary plan. When reporting, fully communicate with residents and the government, optimize based on feedback, and ensure that the plan meets both residents' needs and professional standards and urban planning.

6.2 Innovation in the Transformation of Content

During the implementation of the renovation, we strictly follow the national policy guidance and focus on innovative practices in areas such as aging friendly upgrading, green and low-carbon transformation, and cultural confidence cultivation.

At the level of aging adaptation, according to the data of the seventh national population census, the proportion of people aged 60 and over in China has exceeded 18%, and the aging trend of the population is becoming increasingly obvious. In old residential areas, the proportion of elderly population is relatively higher, so it is urgent to implement necessary aging friendly renovations to meet the living needs of the elderly. Adaptation to aging [9] The renovation mainly focuses on the following aspects: firstly, setting up barrier free ramps at key locations such as the junction of community roads and municipal roads, unit entrances and exits, and rest squares to create a coherent barrier free environment, allowing elderly people with limited mobility to move freely within the community; Secondly, at the rest platform in the stairwell, install wall mounted foldable rest benches with pull rods to provide convenient rest facilities for elderly people climbing stairs; Thirdly, for some eligible residential areas, after communication and negotiation with residents, carry out elevator installation work; Fourthly, plan the area reasonably within the community, place fitness equipment suitable for aging, and assist the elderly in moderate fitness and rehabilitation training.

At the level of green and low-carbon transformation, the country has clearly set the goals of achieving "carbon peak" by 2030 and "carbon neutrality" by 2060. Currently, various fields and industries in China are actively taking action to save energy and reduce emissions [10]. In the process of renovating old residential areas, exploration of green and low-carbon transformation can be carried out from the following aspects:

1. Using roof space to install photovoltaic power generation systems: The roofs of buildings in old residential areas are mostly non accessible. Installing photovoltaic power generation systems on roofs not only effectively utilizes idle roof space, but also converts solar energy into electrical energy, achieving multiple benefits in one fell swoop.
2. Setting up HTU-DL: Many residential areas lack public electricity. Installing HTU-DL in residential areas can meet the basic lighting needs of the community and provide convenience for residents' nighttime travel.
3. Implementing energy-saving renovation of buildings: Based on the characteristics of different climate zones, measures such as external wall and roof insulation renovation, replacement of external windows, and addition of shading facilities can be taken to improve the energy-saving performance of buildings.
4. Construction of charging facilities: Install car charging stations and centralized charging devices for electric bicycles in the community to effectively solve the charging problem of residents' daily transportation and promote green travel.

At the level of enhancing residents' cultural identity and cultural confidence, cultural confidence means that a nation or a country highly recognizes its own cultural values and actively practices them, while having a firm belief in the lasting vitality of its own culture [11]. Fully exploring and showcasing the traditional culture of a certain region or community can enable residents to understand the cultural content closely related to themselves. This not only helps to inherit and develop traditional culture, but also enhances residents' sense of identity with traditional culture and improves their sense of happiness.

During the renovation process, the designer conducted in-depth research to understand the local historical changes from residents and relevant departments, extensively collected historical photos from different periods, and then carefully designed and produced these materials into a cultural wall for display.

7 Conclusion

The renovation of old residential areas is a livelihood project that is highly valued by governments at all levels and has received support from residents. However, with the expansion of the renovation scale of old residential areas, the traditional government led renovation model is no longer sustainable due to factors such as spatial quality and urban finance. This article takes the renovation project of an old residential area in Panjin, Liaoning as an example, and adopts innovative practices in various aspects of the renovation project under the EPC mode according to local conditions. By fully consult-

ing residents' opinions, considering various factors such as funding and on-site conditions, and continuously practicing and summarizing, innovative explorations have been made in the aspects of renovation mode, renovation concept, and renovation content, achieving the reduction of government funding costs and the improvement of the efficiency and quality of renovation projects. The innovative practice of renovating old residential areas under the EPC model will be applied and promoted in more cities, making greater contributions to urban renewal and development.

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