Yesterday, Today, Tomorrow—Problems and Countermeasures of Housing Industrialization in China

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Abstract. Considerable progress has been made in China's housing industrialization in aspects of policy guidance, standards development and technical system. However, there still remain some problems and difficulties. This paper puts forward a series of suggestions and countermeasures based on studies on the present situation.

1. Introduction

Housing industrialization refers to the use of industrial means to build homes, which exerts advantages of high quality, high efficiency, low energy consumption, sustainability that traditional ways of home construction can never compete with. Industrialized housing is to adopt the approach of mass production to manufacture and manage housing. Since the beginning of the 21st century, the housing supply system with Chinese characteristics has been gradually established and perfected. The industrialization of housing has entered into a period of scientific development: advancing at faster speed, quality steadily improving and product performance considerably enhanced. Over the past 20 years, China's housing industrialization has made dramatic achievement in terms of production capacity, scientific and technical progress, product quality and so on. However, when compared with other countries in the global arena, China still has a long way to go. Therefore, to explore a mode of housing industrialization matching Chinese conditions is of critical importance to build a harmonious sustainable society that is resource-saving and environmentally friendly.

2. The Development History of China’s housing Industrialization

1st stage. The mid-20th century is the embryonic stage of China's housing industrialization and technology development in which the idea of housing industrialization was introduced from the former Soviet Union and the practice of “three-changes and one reform” was implemented nationwide (design standardization, factory production of components, construction mechanization and wall body transformation) [1].

2nd stage. The period from 1980s to 1990 represents the exploration stage of housing industrialization and technology. Driven by policies of housing industrialization and the development of housing construction technology, the production, research and practice of housing industry has entered a new period of development: large modular system, frame light board system, prefabricated large board system, small and medium sized building block system were rapidly promoted. During this period, problems such as water leakage, poor sound
insulation, poor seismic performance brought by traditional large-board buildings once cast doubt on industrialization by the whole society.

3rd stage. From the beginning of 21st century, China's housing industrialization marched into the stage of scientific development. Forty-seven national housing industrial bases, including Vanke, Qingdao Haier, Beixin Group, Nantong Huaxin, Changsha Broad Homes Industrial and Shenzhen Huayang, play an exemplary role, driving the whole industry forward with their individual successes. Policy guidance, technology advancement and enhanced social awareness of resources conservation and environment protection, promote the dramatic changes in housing construction in terms of both ideas and practice. All of this helps usher the construction industry into the scientific and sustainable development stage and China's housing industrialization into the scientific development period.

3. Current Situation of Industrialized Housing in China

3.1 The Guidance of Industry Policy and the Support of Technical Standards

Since 2010, in order to speed up the development of housing industrialization, the state and many local provinces and cities have issued their own level of industrial policies and technical standards, norms, procedures and atlas to encourage and support the development and innovation of housing industrialization, put forward requirements on quantity and quality, which play a positive and effective role in the development of housing industrialization.

The development of housing industrialization has risen to become part of national strategy. In "Several Opinions of Central Committee of CPC and State Council on Further Strengthening Urban Planning, Construction and Management" issued in February 2016, it is proposed that with ten years of efforts, prefabricated projects account for 30% of newly built buildings. In addition, in order to guide and promote sustained and healthy development of construction industry during the 13th Five-Year Plan period, based on the "Outline of the 13th Five-Year Plan for National Economic and Social Development of the People's Republic of China", "Opinions of the General Office of the State Council on Promoting Healthy and Sustained Development of the Construction Industry"(GOSC issued [2017] No.19) and other related documents, Ministry of Building and Housing included promoting the modernization of construction industry in "13th Five Year Plan for Construction Industry Development " which was officially printed and released in April 26, 2017, proposing a series of requirements on expanding intelligent and prefabricated architecture.

According to incomplete statistics, more than 30 provinces and cities in China have issued specific guidance and related technical standards, norms and regulations. Shanghai, Beijing and some other cities have even proposed specific requirement on prefabricated buildings development. By the beginning of 2017, the state government has promulgated a total of 16 technical standards, norms, regulations and demo picture collection for prefabricated buildings while local governments proposed 67. More and more market players began to join the construction of prefabricated buildings. Thanks to efforts by all parties, in 2015, newly built prefabricated buildings covered an area between 35 million square meters to 45 million square meters. In the recent three years, the number of newly established prefabricated component plants reached around a hundred. At present, China has entered a stage of sound development for housing industrialization in which government pushes forward, business readily participates and the whole industry advances with strong momentum.
3.2 Critical Period of Transition

Till now, China has formed market basis required for the implementation and promotion of housing industrialization. Beijing, Shanghai and other first-tier cities have formed a market with stable supply and demand and housing industrialization is being promoted in full swing. Industrialized and standardized production system of housing construction material and components have been preliminarily established and under sustained improvement. Housing industrialization has entered the critical stage of transition in aspects of design, production, construction and supervision by enterprises as well as technology and talents.

3.3 Difficulties in China's housing industrialization

3.3.1 Sound Supporting Technical System not yet Established

At present, despite that China's industrialized housing construction has received high attention of governments at all levels, due to lack of technical system and mature design technology which provide technical support for constructing high quality residential buildings, a series of problems occur in design, construction and maintenance that make it hard to ensure the quality of the buildings[2]. Issues related to standardization and technological transformation remain major hurdles in housing construction industrialization in China.

3.3.2 Complete Housing Construction Industrialization Production System not yet Established

After 20-odd years of development of housing industrialization in China, quite a large number of components can now be produced through our own supply chains. However, there is still a large gap towards the establishment of mature housing industrialization system. The concept of housing industrialization is still new to average consumers. The components already manufactured are of little variety and have few specifications. The current residential building construction industry is a labor intense one dominated by on site wet construction. There is still a far way to go before China achieves the ideal housing construction industry that is technology-intense.

3.3.3 Backward Production and Construction Method and Low Level of Production Collaboration resulting in Poor Overall Quality

China's housing construction is in high demand and completed in short time. Low entry threshold into housing industry allows enterprises of all sizes to jump in with each one operating on its own, thus lowering the cohesion of the whole housing industry. It also leads to low product quality, low integration level and lack of sound technical control measures. Failure in establishing production and supply chain of construction components is negative to both improving production efficiency and lowering production cost. This represents a serious obstacle to industrializing housing as it requires high level of collaboration.

3.3.4 Construction Causing Outstanding Environment and Energy Issues, a Long Way to Go to Achieve Sustainable Development

Through many field visits by the author, it is found that industrialized housing in China is still dominated by extensive construction approaches (too much wet construction): structural components cast-in-place, maintenance components prefabricated, component manufacturers using low-efficiency labor and low mechanization. The constructed residential buildings have
problems such as long construction cycle, poor durability, difficulties in maintenance and replacement, high maintenance costs, which go against the principle of sustainable development advocated by the government.

Mass scale construction needs to realize the objective of "intensive and high efficiency", implement the principle of land saving, materials saving, environment protection and carry out all technical measures to save energy and reduce emission. Construction and maintenance with low cost is a task faced by all. Apart from asking all industry participants to raise environment protection awareness, much funding and research and application of all innovative technologies are required. The long time that will be consumed and great difficulties that need to be overcome during this process need to be realized fully.

4. Countermeasures to Promote the Development of China's housing Industrialization

It takes slight efforts of study to realize that the restraint on the development of housing industrialization in China still stands out markedly. To enhance the level of housing industrialization remains a long and strenuous journey.

4.1 Increase Policy Support

Housing industrialization is a huge, complex and systematic project involving multi layers and specialties. In addition, due to uneven economic development in various regions, many places do not have the conditions for implementing housing industrialization. Hence it is appropriate to start pilot project before rolling it out gradually. Through policies, form housing industry development setup featuring governmental guidance, enterprise taking charge, societal participation and market orientation. Provide preferential treatment to enterprises in terms of financing, tax, land usage and other aspects to improve competitiveness of industrialized production methods. In the mean time, subsidize customers who are at the receiving end of housing industrialization chain in order to boost market demand.

4.2 Perfecting Comprehensive Guarantee System

First, housing technology guarantee system. Technical support does not merely include housing construction related standards, technology and specification system, but also supply of talents in professions of material science, concrete prefabrication, mechanical equipment and others to constitute comprehensive technical control measures.

Second, Housing Construction System. Encourage the development of construction systems suitable for China's conditions such as light steel structure system, steel and wood structure system, so as to meet the consumer demand for large space, multi-functions and solid sustainability.

Third, Housing Component System. Increase the types and quality of construction components, perfecting the industrial chain of parts and components, improve production efficiency and reduce production costs.

Fourth, Housing Quality Control System. In addition to the above technical support system, quality evaluation system, liability determination system, insurance and compensation system, housing market entry system, quality accreditation and product elimination system as well as laws, regulations, codes and specifications on project quality supervision and project inspection-acceptance must be instituted.
Fifth, Housing Property Evaluation System. Improve the scientific and technical investment in accreditation and combine the qualitative and quantitative methods to make an overall evaluation of residential buildings after individually testing their applicability, safety, durability, environmental performance and appraising costs in order to facilitate the promotion of industrialized housing[3].

Sixth, Computerized system. Information exchange within China's current construction industry is still dependent on paper media. The future development of housing industry needs to increase the application of BIM and other information technology in management, technology, construction, integration and other aspects to achieve innovation in both management and technology (Fig. 1).

![Sound whole-process & whole cycle maintenance system](image)

Figure 1. Sound whole-process & whole cycle maintenance system.

4.3 Encourage the Research and Development of New Building Systems and Impose Strict Quality Control

At present, China puts forward a series of incentive policies, driving massive capital influx and gaining sound development momentum. However, residential building construction requires a long time for research, development and quality inspection. Therefore, the long life cycle of building construction should be realized and all development quality-oriented. Advanced and tested new materials, technology, equipment and workmanship should be promoted. Adhere to the principle of conservation of land, energy, material and water; enhance
the housing technology, research on high durability housing, construction and structure system that features innovation, improvement and suitability to promote healthy development of housing industrialization.

4.4 Multi-pronged Approach to Lower Cost

Compared with limits on technology and quality, the factor of cost imposes an even stronger constraint on promotion of housing industrialization. For industrialized housing, costs can be saved in labor, construction time and decoration but expanded on prefabricated components. According to incomplete statistics, compared with the traditional cast-in-place components, the cost of prefabricated concrete components increases by 100 to 200 yuan per square meter depend on the percentage of prefabrication. The disadvantage in cost has a lot to with the scale of the city, technological level, management skills, construction scale and policy support. Therefore, a multi-pronged approach is needed to overcome this disadvantage with reasonable scale of project, scientific management and skilled construction team as well as supportive policies.

4.5 Increase the Promotion Efforts to Benefit the General Public

At present, large-scale industrial housing construction is concentrated in the first and second tier cities. Most of them are result of pilot demonstration projects and incentive land transfer policies offered by the government. Promotion at the grassroots level across townships has barely started, leading to urban residents’ low awareness of industrialized housing. Governmental promotion with demonstration projects as media should be adopted as the major approach to enhancing awareness and such efforts should be strengthened. Only when the general public understand, embrace and benefit from industrialized housing can sound development of the industry chain with profound meanings and values be achieved.

5. Conclusion

In summary, China's housing industrialization starts late, faces heavy tasks, undertakes major responsibility and encounters many problems. Industrialized housing unique of situations in China should be built based on full study of actual conditions in China, drawing on experiences of countries with advanced housing industrialization and exploring a development path that suits China. Yesterday’s lesson must be learned and today’s problems must be overcome to realize tomorrow’s ideals which is to build China’s industrialized housing projects into world class paradigm that is green, intelligent, comprehensive and people oriented.

Reference

