Analysis of the Obstacle and Route of China's Construction Industrialization

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ABSTRACT

Industrialization of construction industry can improve housing quality and production efficiency, reduce resources and energy consumption, it is the inevitable trend of construction industry development. However, it is not successful in the progress of the various places. There are many obstacles, including the technology system, industrial form, traditional concept and the distribution of benefits. This paper puts forward the way to promote the development of construction industrialization through analysis of theoretical and practical.

KEYWORDS
Construction industrialization; integrated construction system; industrial standardization; prefabricated construction

INTRODUCTION

The State Council proposed the guiding ideology of promoting the modernization and sustainable development of housing industry since 1999; China has made some progress in promoting the research and practice of construction industrialization. But in general, the development speed is slow, and the industrialization level and labor productivity are far from developed countries. Construction industrialization was mentioned at a very important height from the national level in 2016; Premier Li Keqiang proposed to vigorously develop steel structures and prefabricated construction in the Report on the Work of the Government. With the issue of "Consumption Quota of Prefabricated Construction Engineering", it marks construction industrialization in the actual implementation stage in China; the local government's incentive measures for prefabricated construction have been issued as well. However, because construction industrialization is not only a change in technology, it also needs to change the production mode of traditional constructions, recombine production factors. The division of labor and collaboration mode of construction systems needs to be fundamentally changed. This paper analyzes the barriers in the process of construction industrialization and puts forward the solutions.
ADVANTAGES OF CONSTRUCTION INDUSTRIALIZATION

Construction industrialization is to improve the construction product quality and construction efficiency through standardized design, factory production, mechanized construction and integrated decoration, and reduce the consumption of resources and energy. Vigorously developing construction industrialization is an inevitable requirement of green, recycle and low-carbon development, and it is an important means to raise green construction and energy-saving construction level.

Social Benefits of Construction Industrialization

Construction industrialization is beneficial to promote the transformation of peasant workers to industrial workers

   The prefabricated components are produced in the prefabricated components factory and mechanized and assembled on the site, which reduces the on-site construction process and the labor demand on the construction site. Peasant workers can be transformed into industrial workers, whose working conditions and labor conditions are improved, the technical content of labor is improved, and it is beneficial to stable employment and population urbanization.

Construction industrialization is beneficial to improve performance of construction products and living experience

   Prefabricated components have high precision and reliable quality. For example, prefabricated external wallboard has decoration, enclosure, insulation, waterproof and other functions, which does not need wet construction after installation, and it can fundamentally solve the external wall leakage, thermal cracking and other quality problems.

Construction industrialization is beneficial to energy conservation and emission reduction, and achieves the goal of green construction

   Mechanized assembly can change the traditional construction site conditions; reduce dust, noise, waste and construction waste. The data shows that the prefabricated residential rate reach 37% once, you can save 36% water and 31% electricity consumption, waste reduce by 83%, material loss reduce by 60% and energy conservation is more than 50%.

Construction industrialization is beneficial to the popularization of information technology applications and promotes technological progress of industry

   The construction industrialization requires to deeply integrate information, which will surely promote the development of the equipment manufacturing industry, raise the industrialization level, enhance the production efficiency, promote the transformation and upgrading of the production mode, and enhance the international competitiveness.
Economic Benefits of Construction Industrialization

Construction industrialization can cultivate new industrial clusters, reduce excess capacity.

Construction industrialization are conducive to form industrial chain and directly induce the development of other service industries such as construction industry, construction materials, manufacturing and transportation industry, it is conducive to eliminate excess capacity of steel, cement and machinery equipment. It is an effective way to stabilize growth and mediate policies.

Construction industrialization save cost of time and capital, reduce financial expenditures

Because the prefabricated components are produced at the factory, the on-site construction can be greatly reduced; the settlement time can be reduced in the process of urban reconstruction, so as to effectively reduce the financial expenditure.

Therefore, industrialization is the development direction of the construction industry, which is an important way to promote energy conservation of construction industry, reduce material consumption, reduce pressure on the environment and achieve cyclic utilization, and it is the only way to achieve the transformation and upgrading of the construction industry.

EXISTING OBSTACLES IN THE PROMOTING PROCESS OF CONSTRUCTION INDUSTRIALIZATION

Although the pilot projects have achieved some results in some areas under the promotion of policy, the process of construction industrialization is still very slow in China. By the end of 2016, the proportion of prefabricated constructions was less than 10% in new construction, more than 90% of PC component enterprises were operating at low load, few enterprises actively applied fabricated technology in commodity house projects, and the implementation of standard was delayed. What factors is hindering the promoting progress of construction industrialization?

There Are Contradictions between the Characteristics of Individuality and Diversity of Constructions and Industrial Standardization

The construction is solidified music from the aesthetic perspective, which is a three-dimensional art form, the construction need to meet the needs of different owners from a functional angle, industrial standardization requires mass production to achieve low cost. The contradiction between users' diversified needs and standardized production has hindered the development construction industrialization.

Independent Forms of Architectural Design and Construction Hinder the Promotion of Construction Industrialization

The architectural design and construction are basically independent are independent in our country. Designers have long been engaged in professional design and lack direct understanding for construction technology, technological progress and
development, on the other hand, considering their own practice safety, under the condition that the owners and government departments do not have specific requirements, designers tend to use relatively conservative design plan. The construction side must be based on the construction plan, the cast-in-situ components are provided by architectural drawing is generally not allowed to be converted to prefabricated components, so that construction process of every construction has become a case, construction industrialization technology cannot be promoted.

**Design Theory of Traditional Construction Structure Has Cognitive Deviation for Prefabricated Assembly System**

Because the prefabricated floor slab fracture accidents occurred in practice, the traditional structural design theory thinks that there are shortcomings in the integrity, seismic resistance, anti-leaking, anti-housing differential settlement of prefabricated concrete structures. After the beginning of 1999, many provinces and municipalities successively restricted or prohibited the use of prefabricated hollow slabs and demanded the use of cast-in-situ concrete component, since 2000, the prefabricated structure factories have contracted again and again because they cannot receive the order. The research and application of prefabricated construction basically disappeared in the construction field in our country. The development concept based on cast-in-situ concrete structures is deeply rooted in the industry; in addition, the general publics have vague sense of non-identity for safety of prefabricated construction. These cognitive deviations have played a reverse role in promoting industrialized housing.

**Real Estate Development Enterprises Lack the Motivation to Take the Initiative to Carry Out Industrialization Reform**

Development enterprises are the main body to promote the residential industrialization, the enthusiasm of development enterprises is the key to construction industrialization. In the early stage of research and development of construction industrialization, the purchase of production base construction of components, large-scale transportation and hoisting equipment all require a large investment, and the cost is 20%-30% higher than the traditional construction without forming scale effect. Development companies lack the motivation to take the initiative to carry out industrialization reforms.

Technology system, industrial form, traditional theory and the benefit distribution are consciously or unconsciously hindering the promotion of constructions industrialization; then whether construction industrialization is feasible in our country?

**TECHNICAL FEASIBILITY ANALYSIS OF CONSTRUCTION INDUSTRIALIZATION**

**Micro-components Standardization of Construction Is Not Inconsistent with the Uniqueness That Construction Appearance Pursue**

Construction uniqueness is mainly reflected in the appearance, and the uniqueness of appearance and the standardization of micro-components are not contradictory. The span, height, load mode, materials, structural systems and other key parameters of indemnificatory apartment, teaching construction, dormitory construction and so on
have become standardized or at least quasi-standardized. Moreover, the design experience shows that under the influence of climate characteristics, aesthetic tendencies and traditional habits, the similar constructions in the same area tend to have similar characteristics in the microscopic structure. Therefore, for a particular construction category, standardized components are achieved, and then the achievement of prefabrication can be done.

**Technical Defect Theory of Prefabricated Structure Is Not True**

The development of China's prefabricated construction structure system is slow, the theoretical circle is greatly affected by the viewpoint of "prefabricated structure with poor integrity and poor seismic resistance," both the design and construction lag behind other fields of civil engineering, and lag far behind other countries. In fact, in Japan, Taiwan and other earthquake-prone countries, regions, in practice, the integrity and seismic resistance of prefabricated structure are not obvious compared with cast-in-situ structure, it can be seen from the earthquake damage survey that the stability of prefabricated concrete mainly appears on the link structure, if the link form of steel structure can be borrowed in the link structure, then seismic resistance, ductility and bearing capacity of the prefabricated structure meet the safety requirements.

**The High Cost of Prefabricated Construction is only the Characteristics of the Initial Stage of Industrial Development**

At present, the cost of China's industrialized construction projects is generally higher than cast-in-situ, the reasons are low assembly rate, the PC component factories run with low load, and the imperfect upstream and downstream industry chains. The application assembly rate of Western Europe, North America and Japan are as high as 50% to 70%, the experience of developed countries have shown that the prefabricated assembly rate is 50% or more, the cost will be effectively controlled.

Therefore, the obstacle in the promotion process of construction industrialization can be overcome by changing the top-level design, technical guidance, industrial support, propaganda and education and other aspects.

**PROMOTE THE PATH CHOICE OF CONSTRUCTION INDUSTRIALIZATION**

**Establish "Integrated Construction System" of Building Trade**

Industrialization of construction industry should learn from integrated manufacturing systems of manufacturing industry and build integrated construction system of construction industry. Manufacturing industry, industrial organization model has made amazing achievements based on integrated manufacturing system in the industrialization process; integration has become the basic path choice that manufacturing industry achieves modernization. Then the integrated system learns from manufacturing industry, how construction industry builds "integrated construction system?"

First of all, the system integration of the construction industry should be constructed. As mentioned above, at present, the independent industrial forms of architectural design and construction hinder the smooth development of construction
industrialization. The construction system integration needs to change the mode that existing design and construction separation cause research and development subject of construction technology to be missing, by integration process of industrial systems, in order to achieve the construction side as the core, extends forward to the construction technology design, extends back to industrial integration system of prefabricated component design. Redefine the work content of the design unit; the design unit proposes design plan for the appearance, functional layout, load distribution, energy-saving grade of construction. The builders make micro-level construction technology in accordance with the design plan, then form cutting list of prefabricated components, the prefabricated components are outsourced to specialized prefabricated components enterprise to produce, and the construction unit is responsible for the assembly after transport to the site. To get rid of the current scattered mode, reorganize the production process and division of labor, and make the design, construction and research and development have integrated system.

Systematic integration of the construction industry is beneficial to isolate the microscopic components of the building from the macroscopic building, make it possible to mass produce prefabricated components. At the same time, the quality and the people who is responsible safety of buildings are clearer than traditional models, and can effectively promote the progress of construction technology.

Secondly, integrated systems of industrial organizations are established. There are a large number of enterprises that provide components for construction enterprises in the integrated system of industrial organization, the construction enterprises are no longer the undertakers of the vertical industrial chain of construction products, the working contents of construction enterprises are similar to the current decoration construction enterprises, most components can find suppliers in the system, most components are manufactured in the numerical control processing factory. The general contractor as the core in construction projects, which is responsible for the construction technology design, technical standards design of components, and site management. Other participants and the general contractor form a subcontracting or supply relationship, and bear the specialized construction or production of components. The integration of production and organization is the key link in construction industrialization, mature organization and integrated production mode can effectively improve systematic energy conservation and emission reduction, reduce construction pollution, and effectively reduce construction cost.

Third, information integration system is built. Because even standardization of construction micro-structures is achieved, the number of purchases and the supply progress must be linked with the on-site construction progress for single buildings, the on-site assembly sequence also needs to be designed in advance and is carried out according to the process, so the integration of construction information is especially important. Now the entity buildings are information through the information technology, BIM (5D) technology which achieves full information management in the construction process has matured. In the information integration construction system, the constructor, the owner, the component suppliers, subcontractors and regulators can share the dynamic construction model information in real time, and ensure the effective transmission of information in the system.

The construction of integrated construction system is the key path to promote construction industrialization in China, which is also the most difficult link to complete. It relates to the reconstruction of the entire existing construction
management and supervision system, and the change of the main business of enterprises in the traditional construction industry chain.

The Government Establishes Industrial Support Policies to Promote the Development of Construction Industrialization

It can be seen from the experience of foreign countries that all countries with developed construction industrialization, the government have invested heavily in the initial stage of construction industrialization. At present, the supports of various provincial and municipal governments for building industrialization are different, and the governmental supportive policies for industrialization basically determine the development level of local construction industrialization.

The government through R&D expenditure subsidy, tax incentives, interest rate discount and other financial policies, including loose up building height restrictions, the calculation rule of Plot Ratio and other non-fiscal policies, and opening up green channels, reduce the approval cycle of industrialized projects, and other administrative measures share the cost increase of enterprises caused by industrialization to a certain extent, and the enthusiasm of the enterprises is enhanced. However, it is still difficult to solve the development enterprises' misgiving of market acceptance on cost, technologies and construction products solely by policy support, we must overcome the obstacles of construction industrialization in cooperation with compulsory means and propaganda efforts.

Indemnificatory Housing as a Mandatory Construction Industrialization Pilot Project to Build the Industry Chain of Construction Industrialization

Indemnificatory housing is that the governments invest and construct, lease or targeted sales to special subjects. It usually requires a shorter construction period, classic apartment layout, and a certain degree of reproducibility. The government mandatory indemnificatory housing as a pilot project for industrialization, which will cooperate with the industry supportive policies, the government encourages those enterprises with market foresight to enter emerging markets and promotes the effective integration of the industrial chain as the enterprises' capabilities are strengthened. The cooperation level among the enterprises has been strengthened through industrial chain integration, the system standardization of the upstream and downstream of the industrial chain has been promoted, and the module of residential buildings has been coordinated. The Indemnificatory housing promote construction industrialization path, which cannot only foster the industrial base of construction industrialization which can be widely applied to other construction, without affecting the current industrial ecology. It can yet be regarded as the optimal path in the process of construction industrialization.

Increase Propaganda and Guidance of Construction Industrialization to Promote the Construction Industry with Demonstration Projects

At present, ordinary consumers are still not familiar with the prefabricated construction, who have no real feelings about the improvement of housing quality and the housing overall performance it brings, and they do not know the value of the whole life cycle of construction products. It is necessary to strengthen publicity efforts,
strengthen exchange training, and enhance social awareness. The demonstration project can be used to enhance the consumers' experience, develop large-scale market demand, consumer-oriented mechanism is formed to promote the construction industrialization to the track of sound development, and truly play and ensure project quality, improve efficiency, reduce energy consumption and environmental impact, and improve the living environment.

CONCLUSION

The construction industrialization is the inevitable trend of residential industry development, but there are many obstacles in the promotion process. Construction needs to learn from the manufacturing integrated system for achieving industrialization, which changes the production and organization current construction industry from the top design. Through governmental support and indemnificatory housing compulsory execution and other measures, demonstration projects are used to enhance the users' experience and propagate to develop market demand, and then construction industrialization can be driven to the track of sound development.

REFERENCES