Application Research on Prefabricated Construction Promoting Modernization Development of Construction Industry

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Abstract. Prefabricated construction as a new type of building which can save resources and effectively improve the ecological environment, conforms to the requirements of national strategic development, and it is the main direction of transformation and upgrading of Chinese construction industry. This paper starts with the technical difficulties that prefabricated construction faces in the process of propulsion. The technical system, design concept, industrial development and talent demand of prefabricated construction are systematically studied, and coping strategies to solve problems are explored. Besides, it presents the overall framework of application research on talent training mechanism, and analyze key technical points. The multiple element collaborative scheme is put forward. In the process of modernization of the construction industry, how to promote the transformation and upgrading of the construction industry in a more standardized, safe, efficient and environmentally friendly way is our further research direction and the significance of this paper.

1. Introduction

As the pace of urbanization continues to accelerate, the demand of national construction industry from all aspects is increasing. In recent years, to vigorously promote the modernization of the construction industry, a series of policies and regulations have been issued at the national and local levels. The central state council put forward the guidelines on further strengthening the administration of urban planning and construction in February 2016, it will take about 10 years for prefabricated construction to account for 30 percent of new construction. The ministry of housing and urban-rural development has formulated the outline for the modernization of the construction industry, it requires that the prefabricated construction to account for more than 20 percent of new construction by 2020, by 2025 the proportion should be more than 50 percent[1]. However, compared with the current development rate of prefabricated construction, the gap of technical expertise in this area will continue to grow, the form of talent pool is not optimistic[2-3]. In hence, it is a key problem for the development of the construction industry to train the professional skilled and innovative prefabricated construction practitioners.

The state and local governments have introduced corresponding measures and suggestions to ensure the steady development of prefabricated construction. In September 2016, one of the guidelines for developing prefabricated construction said to strengthen the team building, and to vigorously train prefabricated architectural design, production, construction, management and other professionals[4].
will encourage institutions of higher learning and vocational schools to set up prefabricated
construction related courses, and promote school-enterprise cooperation among prefabricated
construction enterprises to make innovations in the mode of personnel training. Chongqing
municipality issued the implementation opinions on vigorously developing prefabricated construction
in December 2017. It was mentioned to establish a long-term mechanism conducive to the
development of modern construction workers. It will support enterprises in running schools jointly
with institutions of higher learning and vocational schools to train prefabricated construction
teachers, to strengthen skills and safety education and to help rural migrant workers transform into
prefabricated construction workers. Based on national and local policies and industry changes, this
paper studies the development trend and main problems of prefabricated construction. Meanwhile,
combining with the specific examples of vocational colleges, the idea of constructing talent training
base based on the teaching concept of combination of production, learning and research is expounded.
It is of great practical significance for higher vocational colleges to explore the cultivation mechanism
of innovative talents conformed to the demand of the development in prefabricated construction
industry.

2. Overview of Prefabricated Construction
Prefabricated construction refers to building components prefabricated in factories, and the finished
components are transported to the construction site by traffic, finally, the building is assembled on site
according to the feasibility design[5]. Compared with the traditional cast-in-place building model,
prefabricated construction has three distinct advantages.

1) Prefabricated buildings can greatly improve labor productivity. A large number of construction
workers shift from open work to factory workers. This not only reduces labor costs, greatly shortens
the production cycle, but also enables all-weather construction.

2) Prefabricated buildings can reduce environmental pollution. The data shows that the
prefabricated construction can reduce the construction water consumption by 60%, the consumption of
wood, scaffold, formwork, material, concrete, electricity, steel and on-site garbage can reduce by 80%,
50%, 80%, 60%, 7%, 10%, 2%, 83%. And the material recycling rate is up to 66%.

3) Prefabricated buildings can comprehensively improve the integrated quality and quality of
housing. The use of prefabricated assembly technology, on-site assembly standard construction, can
strive to achieve an accurate construction level. Besides, it can basically eliminate the common quality
problems of traditional construction, such as leakage, cracking, empty drum, room size deviation.

3. Major Problems in Prefabricated Construction
In order to actively promote the development of prefabricated construction, change the way of
building construction, promote the transformation and upgrading of construction industrialization, and
take the road of green development. The prefabricated construction industry still faces many key
problems to be solved.

1) The advanced technology of prefabricated construction is not fully applied. Prefabricated
buildings cannot keep going without the support of advanced applied technology on the road of
industrialization development. However, prefabricated construction in China has just started, and the
technical specifications are not perfect, local enterprises, design and research institutes and
construction units seldom systematically master the application technology of prefabricated buildings.
Therefore, it is necessary to form the practical application technology of building assembly, and
establish the application technology system of prefabricated building with Chinese characteristics. It
will be fully transformed and popularized to promote the smooth development of construction
industrialization in China.

2) The cooperation of production, learning and research in application technology of prefabricated
construction is insufficient. The industrial development of prefabricated construction needs the joint
efforts of talents, enterprises and universities, it can comprehensively support the modernization
demand of construction industry in our country. At present, although some local research institutes and
construction enterprises in China are actively exploring the industrial chain cooperation of prefabricated buildings, the cooperation based on the integration of industry, university and research institutes is still less, and the cooperation model has not been established yet. Therefore, it is urgent to establish a prefabricated building alliance based on the integration of production, learning and research institute through joint efforts of various parties, and to do a good job in training professional and technical personnel, so as to solve the problem of the lack of prefabricated construction industry chain talents.

3) There is a serious shortage of applied technical personnel for prefabricated construction. Compared with the conventional construction, prefabricated buildings have realized four major changes in product production: production process from manual to mechanization, production site from work site into factory, construction method from site construction into site assembly, construction personnel from migrant workers into industrial workers and operators. Industrial production needs to form a whole in all industrial chain, the construction of professional personnel team is the cornerstone and guarantee of building industrialization, but up to now such talent team remains a scarce resource in the domestic. For enterprises, it will take lots of resources to train prefabricated construction professionals by themselves. The motive power of enterprises to train such talents by themselves is seriously insufficient, so universities need to assist enterprises to cultivate talents. Under the general situation of industrial reform, the research on industrial structure of architecture major in higher vocational colleges is not thorough, and relevant majors have not been timely transformed and upgraded[6-7]. In this situation, relevant personnel training institutions should not only have the concept of keeping pace with the times, but also promote the construction of professional personnel delivery channels. Therefore, it is necessary for the government, enterprises and universities to conduct timely communication and exchange, work out a scientific personnel training plan, and do a good job in trade teaching reform and major construction, so as to promote the organic combination of major construction and occupation, and promote professional construction and development.

4. Construction Idea of Talent Training Mechanism In Higher Vocational Colleges
In response to the call of the national talent strategy, faced with the shortage of talents in the prefabricated construction industry, higher vocational colleges should spare no effort to speed up their own construction, take the initiative to provide high-quality education services for the development of the construction industry, and train excellent prefabricated construction applied technical talents according to the industry demand to meet the needs of the industry. Based on this, our unit has made adequate preparations and constructed a set of perfect prefabricated construction personnel training mode, the construction process is shown in figure 1. The purpose is to meet the prefabricated construction industry oriented demand, it is expected to provide enterprises with a large number of high-quality talents, so as to promote the development of prefabricated construction industry in China.

1) Strengthen the faculty. Due to the design and construction methods between prefabricated building and traditional construction are very different, higher requirements are put forward for the construction of teaching staff. Therefore, strengthening teacher training of prefabricated building education has become an indispensable task. Improvements can be made in two ways. First, regularly organize higher vocational colleges teachers to conduct in-depth research and study each link of the prefabricated building industry chain, meanwhile, determine quality standards and implementation plans, and strengthen the understanding of prefabricated construction personnel. Second, carry out training and course development around core main courses, enrich teaching methods and increase teachers motivation and creativity through the combination of Internet education and classroom teaching.

2) Establish a talent training system integrating production, learning and research through school-enterprise cooperation. Through cooperation with enterprises, higher vocational colleges can develop their application skills of prefabricated construction from three aspects: curriculum design, graduation design and in-post practice. It can also occasionally invite the enterprise backbone engineer to carry
out the teaching work in the university, at the same time, students can make use of their vacation and internship time to practice themselves in enterprises, apply theories to practice, and accumulate working experience related to prefabricated construction. Taking advantage of two different educational environments and resources from schools and enterprises, combining classroom teaching with practical operation, it is the best teaching mode to cultivate application-oriented talents suitable for different employers.

![Diagram](attachment:Diagram.png)

Figure 1. Construction process of prefabricated construction personnel training system.

3) Establish a comprehensive training base. Our unit will adopt the design idea that use intelligent prefabricated building construction and BIM technology to operation and maintenance, in order to build the first prefabricated training base in China. It can realize the functions of talent training, management and technical training, teacher training, skill training, assessment and appraisal, continuing education training, popular science education training and so on. The base is mainly composed of seven regions, they are key technology training area, one-stop experience area, prefabricated building, new technology demonstration area, smart classroom, BIM operation and maintenance room and virtual simulation training room, scene diagrams of each area are shown in figures 2-8. According to the characteristics of architectural teaching activities, the base uses advanced intelligent hardware facilities to achieve the integration of teaching and practice, and help teachers and students to complete related courses of prefabricated construction with the teaching concept of combining virtual and real. It can really achieve a comprehensive-level training on skills and management.
Figure 2. Key technology training area.

Figure 3. One-stop experience area.

Figure 4. Prefabricated building.

Figure 5. New technology demonstration area.

Figure 6. Smart classroom.
5. Conclusion
Vigorously develop prefabricated construction, and promote the upgrading and transformation of the construction industry chain is in line with our development principle of building a low-carbon energy system and taking a sustainable development path. However, relying on the development of prefabricated construction industry, it is urgent to cultivate talents that adapt to the development of enterprises, market and future industries. Higher vocational colleges serve as the main base for transferring talents, they should respond to the national and local policies, and combine with their own actual situation and enterprise development, establish a complete training mechanism for prefabricated construction personnel from three aspects, respectively, strengthening the faculty, school-enterprise cooperation and establishing training base. Only in this way can they take the initiative to transport high-quality skilled talents for the prefabricated construction industry. At the same time, they must actively serve for the construction industrialization, provide technical support for improving the construction quality, achieving the intensive utilization of resources and eliminating environmental pollution, in order to practically promote the development of energy conservation, emission reduction and ecological civilization construction in architecture field in China.

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