Analysis on prefabricated construction technology of residence

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Abstract: After going through the initial, sustainable development and low tide stages, prefabricated buildings have ushered in a new development stage. In this paper, the development history, characteristics and advantages of prefabricated buildings are briefly summarized, and combined with the current construction technical points of residential prefabricated buildings, the key parts that construction enterprises should focus on in prefabricated construction are emphasized. At the end of this article, measures to improve the quality of prefabricated buildings are proposed from the macro perspective of the social environment and the micro perspective of the enterprise's own development, so as to make a positive outlook for the development prospects of residential prefabricated construction.

1. Introduction
With the development of market economy and the improvement of people's material living standard, the demand for housing is increasing day by day. In order to meet the People's housing demand, the construction industry is facing the "better and faster" development requirements, and in order to adapt to this development needs, prefabricated housing emerged. In the process of implementing the construction of the fabricated residence, we inevitably encounter difficulties in the application of the new technology, and the analysis of the construction technology of the fabricated residence, we can deeply discuss some technical problems in the field of technology application, which will lay a solid foundation for the development of fabricated residence.

2. Key construction technology of prefabricated house

2.1. Preparation, acceptance and storage of prefabricated components
At present, the prefabricated monolithic concrete structure is more popular in China, and it is widely used in standardized residential buildings[1]. It is defined from the perspective of construction technology rather than structural performance, which reflects the characteristics of prefabricated residential buildings. Precast concrete components are connected with post cast concrete and cement-based grouting materials on site[2]. As the building components are prefabricated by the production workshop, the role of the construction unit in the preparation process of precast components is to communicate with the production workshop in time according to the construction technology. The key work is to carry out strict on-site acceptance of prefabricated components when they arrive. For example, according to 9.2.1 of Code for Acceptance of Construction Quality of Concrete Structure Engineering (GB50204-2015), the quality certificates of prefabricated components produced by specialized enterprises of concrete prefabricated components should be checked when they enter the site. According to the provisions of Article 9.2.2, for prefabricated components that do not undergo structural performance inspection when entering the site, the quality certification documents shall also include the...
key acceptance records during the production process of prefabricated components [2]. When doing the structural performance inspection of prefabricated components, it should usually be carried out when the components enter the site. However, due to the convenience of engineering practice and inspection, the current project is usually carried out at the production site of the prefabricated components with the participation of all parties to complete the inspection jobs. For reinforced concrete components and prestressed concrete components that allow cracks, the bearing capacity, deflection, and crack width must be tested, and for prestressed concrete components that do not allow cracks, the bearing capacity, deflection and crack resistance must be tested. (As shown in Table 1)

| Stress condition | Inspection mark of reaching the limit state of bearing capacity | $\gamma_u$ |
|------------------|---------------------------------------------------------------|----------|
| Bending          | The maximum crack width at the main tensile reinforcement is 1.5mm; Or the deflection reaches 1/50 of the span | Hot rolled steel bar with yield point | 1.2 |
|                  |                                                               | Reinforcement without yield point (steel wire, steel strand, cold worked reinforcement, hot rolled reinforcement without yield point) | 1.35 |
|                  | Concrete failure in compression zone                           | Hot rolled steel bar with yield point | 1.3 |
|                  |                                                               | Reinforcement without yield point (steel wire, steel strand, cold worked reinforcement, hot rolled reinforcement without yield point) | 1.5 |
|                  | Breaking of main tension bar                                    | 1.5      |

Table 1 Structural Performance Inspection Standards of Bending Concrete Members (Excerpts)

After the components have passed the acceptance, the construction unit must do a good job of stacking and warehousing in order to arrange the construction site and construction process reasonably. The stacking process should also be implemented with reference to relevant domestic regulations. For example, for the stacking of some prestressed components, corresponding measures should be taken according to the impact of inverted arch. And for the convenience of installation and construction, the stacking site of prefabricated components should be arranged according to the order of installation, and the construction scope of the crane should be suitable for the construction scope of the crane and cannot be affected by other construction operations or affect other construction procedures. These works require the construction unit to refine and arrange in advance the construction organization design and construction scheme in combination with its own experience. For example, wall panels with complex appearance are generally stacked vertically, and can be placed with the help of inserting frame or leaning frame. The force should be balanced and placed symmetrically. In order to maintain the integrity of wall panel facing, the facing should be outward, and the inclination angle should not be less than 80° (As shown in Figure 1)

Figure 1 Schematic diagram of vertical stacking of walls
2.2. Component lifting
The lifting and transportation of prefabricated residential structures should strengthen the awareness of safety, and strictly abide by the relevant regulations of the current national standards and product application manuals[3]. Before lifting the prefabricated components, the economic and reasonable lifting tools and lifting equipment should be selected according to the parameters of the prefabricated components. The safety factor of the embedded carving should be paid attention to, and the bearing capacity test should be strengthened. At present, the transportation methods of prefabricated components include horizontal crane (suitable for flexural members), direct crane (suitable for vertical members such as walls) and turnover crane. (As shown in Figure 2)

![Figure 2](a) Flat crane (b) Straight crane (c) Overturn crane

The hoisting plan needs to be confirmed through the calculation of the construction. The calculation of the relevant hoisting model should be combined with the actual hoisting method, and some technical means should be adjusted in time. (As shown in Figure 3)

![Figure 3](a) Unbalanced lifting rope (b) Use the balance ring to divide the force equally

2.3. On-site installation and connection of components
At present, there are many installation methods for prefabricated components at home and abroad, which can be selected according to the specific situation of the project[4][5]. For example, the high-rise building adopts the building system of cast-in-place inner tube and prefabricated outer wall, the floor beam is connected with the inner tube and outer wall by hinge, and the vertical connection of some prefabricated outer walls is connected by sleeve grouting. On the reinforcement sleeve grouting connection technology, China has also issued a series of relevant standards, specifications and Atlas (as shown in Figure 4 below). For example: "Grouting Sleeve for Steel Bar Connection" (JG/T 398-2012), "Grouting Material for Steel Bar Connection" (JG/T 408-2013), "Technical Specification for Assembled Concrete Structures" (JGJ 1-2014), "Technical Specification for Application of Grouting Connection of Steel Bar Sleeve" (JGJ 355-2015) and so on. The construction and inspection of the joints in strict
accordance with the current standards and specifications of our country can effectively prevent quality problems caused by the construction process. In the process of installation and construction, it is necessary to take temporary fixing measures in time. On the one hand, for the smooth progress of the next hoisting and installation work, on the other hand, it can also ensure the safety of construction. Standards are carried out in order to avoid quality or safety accidents.

![Figure 4 reinforcement sleeve grouting connection technology](image)

2.4. Safety and quality assurance

At present, the main relevant standards related to the construction and acceptance of prefabricated concrete structures include the national standards "Construction Code for Concrete Structure Engineering", "Specification for Construction Quality Acceptance of Concrete Structure Engineering", "Technical Standard for Prefabricated Concrete Buildings" and so on. And the industry standard "technical specification for prefabricated concrete structure", "technical specification for application of steel sleeve grouting connection" and so on. Through a series of relevant norms and standards, as well as constantly improving laws and regulations and policies, we can effectively improve the quality and safety of prefabricated residential buildings, and make a strong guarantee for the development of prefabricated residential buildings.

3. Measures to improve the construction technology level of assembly housing project

3.1. Absorbing advanced experience at home and abroad

Prefabricated buildings started late in China. Although they were used in 1950s, they were temporarily dormant on the stage of Chinese architectural history due to earthquake resistance and other reasons[5]. The developed countries, including the United States, Germany, Singapore and Japan, have been carrying out technological transformation and upgrading of prefabricated buildings, so the development of prefabricated buildings in China is relatively backward compared with the international ones. As a construction company, we must pay more attention to the improvement of its own construction technology. Through the development of prefabricated prestress technology, structural system and construction methods are adjusted, the prefabricated construction technology is not only suitable for residential, apartment and other building types, but also extended to parking lots, Various types of buildings such as office buildings and schools. For example, appropriately expanding the dry connection process, applying dry nodes to different structural needs and modeling needs, and increasing the diversification of dry nodes.

3.2. Attach importance to personnel training

As five key factors affecting construction quality, people, materials, machines, environment and methods are familiar to construction practitioners, and "people" is the core content of construction quality assurance. The technical level of construction workers will be directly reflected in the quality level of prefabricated buildings, and the uncontrollable risk of "people" is the biggest among the factors
affecting prefabricated buildings. Therefore, construction companies must strengthen the management of technical personnel, strengthen the ideological and moral education of relevant technical personnel through various activities such as safety education at all levels, improve the personnel’s sense of responsibility, attach importance to quality, attach importance to safety, and increase technology The subjective initiative of personnel. At the same time, we should strengthen the continuing education and pre job training, and consolidate and improve the technical level of technical personnel through technical training and technical assessment. In addition, it can also be transformed into internal motivation of personnel through certain incentive or reward and punishment mechanism, which can effectively reduce the uncontrollable risk of "human" and improve the quality and safety assurance of assembly building.

3.3. Improve their own management level
In the construction process of prefabricated houses, the construction enterprises should have global awareness, make relevant plans and emergency plans in advance, carry out orderly construction in strict accordance with the operating rules, control before, during and after, check and record relevant construction processes in time, form engineering data, and complete the acceptance procedures according to the standards. In the increasingly fierce construction market, construction companies want to achieve stable and substantial development, they cannot do without the company's own management level. Construction enterprises should improve their own management level by strengthening organization and management, attaching importance to management processes, etc., so as to enable enterprises to go upstream in the torrent of competition and forge ahead.

4. Conclusions
With the acceleration of China's construction industrialization and informatization process, the construction standards for prefabricated housing will be more and more perfect, and the construction technology will also tend to be mature and stable. For today's huge demand for housing, what construction enterprises should do is to actively carry out technological transformation, improve their technological innovation ability, master key technologies, and strengthen their technical strength on the premise of ensuring the safety and comfort of people's living.

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