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Application research of prefabricated buildings in improving the construction efficiency of construction projects

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Abstract: Against the background of the construction industry's transformation towards greenization and intelligence, the efficiency shortcomings of the traditional construction mode have become increasingly prominent. Problems such as cumbersome procedures and poor connection have been difficult to meet the construction needs of construction projects in the new era. With its core mode of factory prefabrication and on-site assembly, prefabricated buildings have broken the time and space limitations of traditional construction and become a key path to improve construction efficiency. Based on the application status of prefabricated buildings and combined with the industry development trend, this paper explores its application logic in optimizing construction processes and simplifying operation links, analyzes the obstacles in application and puts forward optimization strategies, so as to provide ideas for its wide application and help the construction industry achieve efficient and intensive development.

Key words: prefabricated buildings; construction projects; construction efficiency; application strategies; resource integration

1 Introduction

With the acceleration of the transformation and upgrading of the construction industry, improving construction efficiency, reducing construction costs and ensuring construction quality have become the core goals of engineering construction. The traditional cast-in-place construction mode has disadvantages such as large on-site workload, obvious impact by the natural environment and cumbersome connection of procedures, which not only prolongs the construction period but also increases the consumption of manpower and material resources. As the core carrier of construction industrialization, prefabricated buildings effectively avoid many pain points of traditional construction through factory standardized prefabricated components and on-site assembly construction, and can realize the optimization of construction processes and the improvement of efficiency. At present, its integration with intelligent construction technology is constantly deepened, but there are still problems such as insufficient technical adaptation in promotion. In-depth study of its application path is of great practical significance for promoting the high-quality development of the construction industry.

2 Core characteristics of prefabricated buildings and their internal relationship with construction efficiency

2.1 Core characteristics

Prefabricated buildings take standardized design as the core foundation. By unifying component specifications and promoting modular production, they effectively reduce redundant costs in the design and production process and ensure the versatility and interchangeability of components. Its core production mode is factory prefabrication, where major components such as walls, stairs and composite slabs are processed in the factory, which greatly reduces the on-site workload and avoids the uncertainty caused by the influence of environment and personnel operation in on-site construction. Prefabricated buildings adopt assembly construction mode, with concise and clear construction procedures and smooth connection of various links. It can realize synchronous operation in multiple regions and multiple processes, break the time sequence limitation of traditional construction, and provide basic conditions for the improvement of construction efficiency [1]. The characteristics of standardization, industrialization and assembly support each other, which together constitute the core advantages of prefabricated buildings different from traditional buildings, and also lay a solid foundation for improving their construction efficiency.

2.2 Efficiency improvement logic

The core logic of prefabricated buildings to improve construction efficiency lies in division of labor and cooperation as well as process optimization. Through the clear division of labor between factory prefabrication and on-site assembly, a large number of wet operations are transferred to the factory for completion, which effectively reduces the on-site wet operation volume, shortens the operation time of a single process, and avoids the construction period delay caused by the influence of weather on traditional on-site wet operations. The standardized production mode greatly improves the precision of components, effectively reduces on-site rectification and rework links, ensures the smooth progress of the construction process, and avoids efficiency loss caused by component quality problems. At the same time, prefabricated buildings can realize the collaborative linkage of all links such as design, production, construction and transportation. Through efficient cooperation of all links, resource allocation is optimized, and waiting time between links is reduced, thus comprehensively improving the overall construction efficiency of construction projects.

2.3 Efficiency differences from traditional construction

There are obvious differences in construction efficiency between prefabricated buildings and traditional cast-in-place construction mode. The traditional construction mode is greatly affected by the natural environment and weather conditions. Rainy days, high temperatures and other weather are likely to cause construction suspension, while most components of prefabricated buildings are prefabricated in the factory, which is less affected by the external environment and can ensure the stability of the construction progress. Traditional construction requires a large number of on-site operators, with high labor management costs and low efficiency [2]. Prefabricated buildings greatly reduce on-site labor input, and the professional division of labor among operators is clear, which can effectively improve operation efficiency. In addition, prefabricated buildings simplify the construction procedures, reduce the waiting time in the connection of procedures, avoid the inefficiency caused by the confusion of cross procedures in traditional construction, realize the efficient progress of construction progress, and shorten the overall construction period.

3 Key application points of prefabricated buildings in improving construction efficiency

3.1 Design stage optimization

The design stage is the primary link for prefabricated buildings to improve construction efficiency, and it is necessary to focus on efficiency optimization. Promote modular and standardized design, unify the specifications and sizes of components, reduce repetitive work in the design process, improve design efficiency, and lay a good foundation for the subsequent production and construction links [3]. Integrate digital design technology, use relevant design software to realize visual simulation of design schemes, check the connection problems between design and construction in advance,

and avoid efficiency loss caused by design changes in the later stage. Strengthen the collaborative cooperation between design, production and construction links, fully consider the actual needs of prefabricated production and on-site assembly in the design process, strengthen communication and docking between various links, ensure the feasibility of the design scheme, reduce the construction period delay caused by the disconnection between design and actual construction, and improve the overall construction efficiency.

3.2 Component production improvement

The efficiency of the prefabricated component production stage directly affects the overall construction progress, and various methods need to be adopted to improve production efficiency. Adopt intelligent production equipment, introduce automatic pouring, welding and other equipment to realize automatic operation of component production, which can not only improve production efficiency but also ensure the stability of component quality. Establish a standardized process for component production, standardize each production process, clarify the operation requirements of each link, reduce redundant links and quality hazards in the production process, and avoid rework and waste caused by non-standard processes and unqualified quality. Optimize the component production plan, reasonably arrange the production sequence according to the on-site construction progress, accurately control the links such as component production, acceptance and storage, ensure the seamless connection between component production and on-site assembly, avoid the problems of delayed or overstocked component supply, and ensure the smooth progress of construction.

3.3 On-site assembly optimization

The on-site assembly stage is a key link in the construction of prefabricated buildings. Optimizing the assembly process can effectively improve construction efficiency. Reasonably divide the on-site operation area, clarify the operation tasks and division of labor of each area, realize synchronous operation in multiple regions and multiple processes, and improve the utilization rate of on-site operations. Adopt professional assembly equipment and technology, introduce large-scale hoisting equipment, precision positioning equipment, etc., improve the accuracy and speed of component assembly, reduce on-site adjustment time, and avoid rework caused by assembly deviation. Strengthen on-site personnel management and training, improve the professional level and operational skills of operators, standardize the operation of assembly procedures, clarify the responsibility requirements of each post, ensure the standardized and efficient progress of assembly procedures, and at the same time strengthen on-site safety management and control, avoid construction suspension caused by safety accidents, and ensure construction efficiency.

4 Main problems restricting efficiency in the application of prefabricated buildings

4.1 Technical constraints

Insufficient technical level is an important factor restricting the improvement of construction efficiency of prefabricated buildings. The adaptability of some prefabricated building technologies to on-site construction needs is insufficient, and some technologies are too theoretical and lack practical application feasibility, leading to problems such as poor connection and inconvenient operation in the assembly process, which affect the construction progress. The application scope of intelligent assembly technology is limited. Most projects still mainly adopt traditional assembly methods, which fail to give full play to the role of intelligent technology in improving construction efficiency and fail to realize the automation and precision of the assembly process.

4.2 Collaborative constraints

The imperfect collaborative mechanism seriously affects the construction efficiency of prefabricated buildings. There is a lack of effective collaborative mechanisms in design, production, construction, transportation and other links. Each link acts independently, lacking unified planning and coordination, leading to poor connection of each link, such as

asynchrony between component production and on-site construction, delays in transportation links, etc., which affect the construction progress. The communication and docking between relevant participants are not timely. There is a lack of a regular communication mechanism between design units, production enterprises and construction units, and information transmission is delayed, which is prone to problems such as design changes and inconsistent component specifications. In addition, the division of responsibilities is not clear, and parties pass the buck to each other after problems occur, which further affects construction efficiency.

4.3 Management constraints

The imperfect management system is one of the key factors restricting the construction efficiency of prefabricated buildings. The construction management system of prefabricated buildings is not perfect, lacking targeted management norms and processes. The traditional construction management mode is still used, which is difficult to adapt to the standardized and assembled construction characteristics of prefabricated buildings, leading to chaotic on-site management and affecting construction efficiency. The professional level of operators is uneven. Some operators lack systematic training on prefabricated construction skills, are not familiar with prefabricated construction processes and operation specifications, and have non-standard operations and low efficiency, which restricts the improvement of assembly efficiency. The connection between on-site safety management and schedule management is not sufficient. Some projects pay too much attention to schedule progress and ignore safety management and control, which is prone to potential safety hazards and requires construction suspension for rectification; some projects have too cumbersome safety management and control, which affects the construction progress, and it is difficult to coordinate and unify the two.

5 Conclusion

This paper focuses on the application of prefabricated buildings in improving the construction efficiency of construction projects. Combined with the current situation of industry development and practical application, it clarifies the core characteristics of prefabricated buildings and their internal relationship with construction efficiency, sorts out the key application points in the three key stages of design, prefabricated component production and on-site assembly, and analyzes the main problems restricting the improvement of construction efficiency in three aspects: technology, collaboration and management. The research shows that with the core advantages of standardization, industrialization and assembly, prefabricated buildings can effectively optimize construction processes, reduce operation links and improve resource utilization efficiency, and are an important path to promote the improvement of construction efficiency of construction projects.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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