BIM Platform—An Effective Approach for Implementing Housing Industrialization Postprint

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Abstract

BIM technology has become an essential pathway for housing industrialization in China. However, its correct application requires the entire industry—including government, owners, design institutes, contractors, and sales departments—to jointly formulate appropriate standards and systems adapted to national conditions. The development model combining foreign housing industrialization with BIM technology is increasingly mature, and BIM technology can already serve as the primary driving force for housing industrialization development. The objective of implementing housing industrialization is to maximize time and cost savings, and a qualified Building Information Model can benefit the entire industrialized housing design team and provide better control over the entire project. Therefore, BIM technology and building industrialization are important approaches for achieving "green, environmentally friendly, and low-carbon" development in China's construction engineering industry, and they also represent the key direction of the national "Twelfth Five-Year Plan" for construction projects regarding "informatization" and "industrialization".

Full Text

BIM Platform: An Effective Approach to Implementing Residential Industrialization

BIM technology has become an essential pathway for residential industrialization in China. However, its proper application requires the entire industry—including government, owners, design institutes, construction contractors, and sales departments—to jointly formulate appropriate regulations and systems adapted to China's national conditions. The integrated development model of residential industrialization and BIM technology has matured abroad, where BIM serves as a primary driver for residential industrialization. The goal of promoting residential industrialization is to maximize savings in time and cost, and

a qualified building information model can benefit the entire industrialized housing design team by providing better project control. Therefore, BIM technology and building industrialization represent important pathways to achieve "green, environmentally friendly, and low-carbon" development in China' s construction engineering industry, and constitute the main orientation of the national "Twelfth Five-Year Plan" for construction projects in terms of "informatization" and "industrialization."

Analysis of BIM Technology Application in Residential Industrialization at Home and Abroad

The integrated development model of residential industrialization and BIM technology has matured abroad, where BIM serves as a primary driver for residential industrialization. It provides main technical support from three perspectives: design requirements, manufacturing requirements, and installation requirements, jointly delivering building information models that incorporate cost and project scheduling information. Based on foreign experience in developing BIM-based residential industrialization, we can derive the following lessons:

1. Establish application standards for BIM in residential industrialization design;
2. Formulate industry standards for the design, manufacturing, and assembly of industrialized housing;
3. Construction enterprises should develop residential product catalogs for client selection to better meet market demands;
4. The product platform designated by construction enterprises should be shared with relevant construction stakeholders, including design, production, construction, and sales departments.

Problems Encountered in Promoting Residential Industrialization in China

To transition from extensive growth to intensive production models, China' s Architecture, Engineering, and Construction (AEC) industry began promoting residential industrialization in 1993, accumulating over two decades of experience. However, numerous problems have emerged during implementation, attributable primarily to the following aspects:

1) Construction Production Organization Form Does Not Meet Industrialization Requirements

China' s residential construction still generally follows the production organization model of conventional real estate development projects: developers or construction entities invest, commission design institutes for planning and design, then commission construction companies for building, and finally sell to consumers. This production organization involves numerous departments and

personnel with divergent business objectives, technical philosophies, and interest relationships, making it difficult to integrate them consistently for industrialized production. Additionally, the proportion of factory-based production in residential construction remains low, with high on-site labor requirements and labor productivity far below that of developed countries. Moreover, China still permits roughcast houses to pass completion acceptance and enter the market, requiring homebuyers to organize interior decoration themselves. This plunges the latter half of the construction process into a chaotic manual production model, severely hindering the advancement of residential industrialization. The industrialized production organization form can be simply summarized as "parallel development rather than sequential progression."

2) Residential Industrialization and Enterprise Economics

Promoting residential industrialization production methods can achieve design standardization, production factoryization, construction mechanization, and management scientization within the industry. The benefit of this intensive production model is the shortened design and production cycle of residential products, improving capital turnover efficiency for real estate enterprises. Since capital flow rate is directly proportional to investment returns, this means capital can be recovered more rapidly, playing a significant role in enterprise development and risk mitigation. Currently, profits from residential industrialization in China can only be compensated by either raising housing prices or reducing component production standards. Given equivalent returns, developers prefer cost reduction, thus more frequently adopting the latter approach and using non-industrialized methods for construction. When upstream costs cannot be reduced and component standardization requires time, new industry drivers must be sought.

3) Low Degree of Industrialization and Informatization in the Construction Industry

The relationship between residential industrialization and economics: To fully leverage the advantages of "industrialized rapid manufacturing" in residential product production (improving product delivery time, accelerating capital recovery, mitigating financial risks, and promoting enterprise development), residential enterprises must first accurately grasp and assess customer needs to enable timely production and improvement. This requires sufficient technical support for timely market information collection and analysis through information technology and network technology. Therefore, to utilize "industrialized rapid manufacturing" to shorten production cycles and achieve rapid capital turnover during industrialization implementation, residential enterprises must increase investment in R&D for market information collection technology, creating necessary hardware conditions for implementing "industrialized rapid manufacturing."

4) Insufficient Information Exchange Among Construction Stakeholders

Real estate enterprises integrate resources from planning and design, building material suppliers, construction, supervision, sales, property management, and other parties, forming an industrial chain spanning multiple industries, professions, and disciplines (referring to the path where various resources in upstream industries continuously transfer to downstream industries through multiple levels, ultimately reaching consumers). The core competitiveness of residential industrialization essentially lies in the integration and coordination of various resources across the industrial chain. To achieve above-average profits, resources must be integrated from a whole-industry-chain perspective, requiring an interactive platform for project information transmission among all parties. This would enable everyone to access necessary information throughout the residential building' s life cycle, facilitating smooth information exchange, mutual cooperation, high trust, and information sharing that adds value. However, the current situation is characterized by insufficient information exchange and sharing among stakeholders in the industrial chain, resulting in independent work among parties and preventing the industry from becoming a people-serving integrated chain.

5) Lack of Industry Standards for Residential Industrialization

Residential industrialization is centrally manifested through socialized collaboration and economies of scale; without industry standards and norms, large-scale operations become impossible. Currently, there is no enforceable industry standard for industrialized residential design in China, with everything from generic housing unit designs to local building component manufacturing being diverse and chaotic, causing market confusion and leading to resource-wasting phenomena such as redundant design, production, and assembly. There is a lack of standards and norms for prefabricated building design and construction; an absence of industrialized and standardized production systems for residential building materials and components; and related construction techniques, methods, and safety regulations remain unestablished. In some aspects, these even conflict with existing domestic building technical standards and norms, leaving design, approval, and acceptance without reliable criteria.

6) Application Advantages of BIM Technology

BIM is the key technology for implementing residential industrialization, providing consistent information throughout the entire life cycle as a virtual digital representation of the actual building. Through its capabilities in visualization, sustainability, structural analysis, and other aspects, BIM can provide strong support for residential generic design, standardized design, core technologies of industrialized housing, sustainable residential design, and residential design standards, thereby promoting residential industry informatization and strengthening information exchange among stakeholders.

Note: Figure translations are in progress. See original paper for figures.