# Key Issues and Solutions in the Implementation of Prefabricated Building Engineering Supervision

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**Abstract:** With the acceleration of construction industrialization, prefabricated buildings are widely used due to advantages such as green efficiency and controllable quality. However, engineering supervision, as the core link of quality and safety control, has not yet fully adapted to the characteristics of "factory production + on-site assembly" in prefabricated construction. In practice, issues such as disconnection in component quality control, accumulation of on-site installation risks, inefficient collaboration among participants, and insufficient professional capabilities of supervision personnel are prominent. These problems not only affect construction efficiency but also pose potential threats to structural safety and functionality. Therefore, this article systematically analyzes the key issues in the supervision of prefabricated building engineering and explores targeted solutions, hoping to provide references for improving the supervision work system and ensuring the quality of prefabricated construction projects.

## 1. Introduction

Against the backdrop of China promoting the transformation and upgrading of the construction industry and vigorously developing green construction, prefabricated buildings have become an important carrier for achieving construction industrialization due to the advantages of factory prefabrication and on-site assembly. However, compared to traditional cast-in-place concrete structures, engineering supervision for prefabricated buildings faces more complex scenarios. Problems arising during construction not only constrain the efficiency of prefabricated building construction but also directly impact structural safety and performance. Based on this, in-depth analysis of the key issues in the implementation of prefabricated building engineering supervision, combined with exploring practical optimization paths through engineering practice, holds significant practical value and theoretical importance for improving the prefabricated building supervision system and promoting high-quality development of construction industrialization.

## 2. Core Requirements for Prefabricated Building Engineering Supervision

Based on the particularities of prefabricated building construction, its engineering supervision needs to break through the traditional supervision framework to ensure project quality and safety[1].

The whole-life-cycle management requirement is the primary principle of prefabricated building supervision. Unlike traditional building supervision focusing on the construction phase, the quality formation of prefabricated buildings runs through the entire process of "design – production – construction – acceptance." Omissions in any link can lead to overall quality defects. In the design phase, supervision needs to intervene early to review component splitting schemes, focusing on checking whether split components are convenient for factory production, transportation, hoisting, and on-site installation, avoiding increased production difficulty or installation risks due to unreasonable design. For example, if prefabricated wall panels are split too large, they might exceed transport vehicle width limits or hoisting machinery capacity, requiring supervision to collaborate with the design unit to optimize the split dimensions. In the production phase, supervision needs to station personnel at the component plant to monitor key processes such as rebar processing, formwork installation, concrete pouring, and embedded part fixing, ensuring production complies

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with design drawings and specifications. Simultaneously, it is necessary to review the factory's raw material intake records, concrete mix ratio reports, component curing records, and other documentation to control component quality from the source. In the construction phase, supervision needs to focus on monitoring component hoisting, connection joint construction, waterproof sealing, and other processes, especially for concealed works like grouting sleeves and mortar anchor laps, requiring verification of construction quality through witness sampling, non-destructive testing, etc. In the acceptance phase, supervision needs to comprehensively evaluate the overall project quality based on component factory certificates, production process records, on-site installation test reports, and other data, ensuring it meets final acceptance standards.

## 3. Key Issues in the Implementation of Prefabricated Building Engineering Supervision

### 3.1 Disconnection Between Component Production and Supervision Control

The characteristic of prefabricated building components being factory-produced leads to a significant control gap in the traditional supervision model that "emphasizes the site, neglects the factory." This disconnection directly causes component quality risks to be exposed concentrate upon arrival on site. In practice, supervision's involvement in the production link is generally insufficient. Most projects rely solely on factory certificates and visual inspections upon arrival, without going deep into the production process for substantive supervision. For example, in rebar processing, some factories simplify the tying process to pursue efficiency, leading to excessive rebar spacing or insufficient cover thickness. However, because supervision is not stationed at the factory, such issues are only discovered during component installation, when rework is impossible, and only design changes for reinforcement can be made, increasing costs and delaying schedules.

A deeper contradiction lies in the fact that component production involves multiple processes such as mold debugging, concrete pouring, and steam curing, each of which can affect the final quality. For instance, uncorrected mold size deviations can lead to batches of components exceeding geometric tolerances; inadequate concrete vibration can leave internal voids, reducing component load-bearing capacity. In current supervision work, there is a lack of standardized supervision procedures for factory production. Neither the responsibilities of stationed supervision personnel are clearly defined, nor are sampling inspection mechanisms for production processes established, leaving component quality control in a "passive acceptance" state.

### 3.2 Supervision Risks in On-site Hoisting and Connection Joints

On-site hoisting and connection joint construction are core links for the quality and safety of prefabricated buildings and are high-risk points for supervision work. Current supervision omissions in this link mainly manifest in lax process control and insufficient technical inspection. During hoisting operations, supervision's review of preliminary plans is often perfunctory, failing to verify the rationality of equipment selection and lifting point design based on the actual project. For example, during the hoisting of a large precast composite slab in one project, the crane's lifting capacity met requirements, but the boom length was insufficient, causing an excessive hoisting angle. Supervision failed to identify this issue, ultimately leading to a safety incident where the component tilted and collided with scaffolding.

Supervision defects in connection joint construction are more concealed, especially for concealed works like grouting sleeves and mortar anchor laps, where supervision finds it difficult to judge quality visually. In some projects, supervision only witnesses the preparation of grouting material but does not monitor the entire grouting process. Contractors might have issues like incomplete grouting or missed grouting, which cannot be detected later through visual inspection alone. Furthermore, for bolted connections, supervision may not use torque wrenches as required by codes to check tightening torque, leading to bolt loosening and affecting connection stability. Sealant application is also a weak point in supervision control. If supervision does not check the continuity and thickness of the sealant, leakage problems can easily occur later. The root cause of these risks lies in the quality of critical joints being in an "out-of-control" state.

### 3.3 Low Supervision Efficiency under Multi-Party Collaboration

Prefabricated buildings involve multiple participants such as design, production, construction, and transportation. Information barriers and lack of collaboration among these entities lead supervision work into a dilemma of "difficult coordination, slow progress," severely affecting overall project efficiency. At the information transmission level, traditional communication modes have significant lag. If change notifications from the design unit are not promptly synchronized with the component plant and the supervision unit, it can easily lead to mismatches between produced components and on-site requirements. For example, in one project, the design unit adjusted the position of reserved openings in prefabricated wall panels but did not inform the plant immediately. Supervision also did not intervene early to review the impact of the change, resulting in 20 already produced wall panels being scrapped, causing significant economic loss. Simultaneously, the lack of unified information recording standards among participants, and the failure to share data such as component production progress and on-site construction plans, make it difficult for supervision to accurately grasp the overall progress and anticipate supply-demand conflicts in advance.

At the collaboration mechanism level, supervision lacks effective coordination and integration capabilities. The vague boundaries of rights and responsibilities among participants easy lead to buck-passing. For example, when component transportation delays cause on-site hoisting downtime, the transporter might shirk responsibility citing "road restrictions," the component plant claims "production was completed on time," the contractor complains that "supervision did not coordinate in advance," and supervision, due to the lack of a clear collaborative responsibility list, cannot quickly identify the responsible party,can but passively coordinate, delaying problem resolution. Furthermore, supervision often fails to establish a regular collaborative communication platform. Parties only hold temporary meetings after problems arise, making it difficult to avoid conflicts in advance. For instance, when the component production plan does not match the on-site hoisting schedule, if supervision does not organize coordination meetings involving design, production, and construction units in advance, it can lead to either component backlog on site or work stoppages waiting for materials, severely affecting construction efficiency. This collaborative dilemma of "poor information flow, unclear responsibilities, inefficient coordination" traps supervision work in a passive state of "being overwhelmed," making it difficult to play its core role in quality control.

## 4. Solutions to Key Issues in Prefabricated Building Engineering Supervision

### 4.1 Building a Whole-Process Supervision and Control System for Component Production

To address the disconnection between component production and supervision control, it is necessary to break the traditional "post-event acceptance" model and establish a supervision mechanism covering the entire production process.

First, implement a combined model of "stationed factory supervision + specialized inspections." The supervision unit must station supervision personnel with expertise in prefabricated components at the factory according to the production plan, clarifying their responsibilities: starting from mold acceptance, checking the consistency of mold dimensions with design drawings, focusing on the sealing of mold joints to avoid slurry leakage during pouring; during rebar processing, whole journey supervising rebar cutting and tying accuracy, checking rebar type, spacing, and cover thickness against drawings, and immediately requiring rectification for non-compliant processes.

Second, improve the sampling inspection mechanism for production processes. Supervision personnel need to conduct sample inspections of key links like concrete pouring and steam curing by batch. For example, witness slump tests during concrete pouring to ensure workability meets requirements; regularly check curing temperature, humidity, and duration during steam curing to avoid insufficient component strength due to improper curing. Simultaneously, establish a traceability file for component production, where stationed supervision records information such as production time, raw material batches, and key process inspection results for each batch of components, forming a "one-component-one-file" system for future quality tracing.

Finally, strengthen control at the intake acceptance stage. Beyond routine visual inspection, supervision needs to use tools like laser distance meters and rebar scanners to accurately detect component geometric dimensions, embedded part positions, and rebar distribution. Components failing inspection must be firmly rejected, preventing "defective components" from entering the construction site and blocking quality risks at the source[2].

### 4.2 Standardizing Supervision Procedures for On-site Hoisting and Connection Joints

To address the supervision risks associated with on-site hoisting and connection joints, it is necessary to build a full-chain supervision process of "pre-approval – process control – post-inspection." Before hoisting operations, supervision must strictly review the hoisting plan submitted by the contractor, focusing on whether equipment selection matches component weight and site conditions, whether lifting point design meets structural requirements, and whether emergency plans cover contingencies like component overturning or mechanical failure. Hoisting can only proceed after approval.At the same time, check the special operation qualifications of hoisting personnel, and verify the inspection reports and condition of lifting appliances and slings, ensuring both equipment and personnel meet safety operation requirements[3].

During hoisting, supervision must implement full-time observer supervision, controlling hoisting operations in real-time: observe whether lifting points bear load evenly during lifting to avoid cracking from single-point stress; supervise operators to control hoisting speed and attitude during movement to prevent collisions with scaffolding or other structures; after positioning, check if temporary stabilization measures are adequate, such as the installation angle of braces and the tension of guy ropes, ensuring component stability during subsequent connection work, avoiding instability before formal connection is completed.

Connection joint construction is the top priority of supervision control. For grouted sleeve connections, supervision must witness the preparation of grout, check its type and mix ratio, supervise the grouting process according to specifications, and after completion, use endoscopes or ultrasonic testing to verify internal grout fullness. For bolted connections, supervision must use torque wrenches to check the tightening torque of each bolt point by point, ensuring it meets design requirements. For sealant application, check the continuity and thickness of the sealant to avoid later stage leakage due to poor sealing.

### 4.3 Establishing a Multi-Party Collaborative Supervision Work Mechanism

To solve the problem of low supervision efficiency under multi-party collaboration, it is necessary to establish collaboration mechanisms from both information sharing and responsibility coordination aspects. First, build a multi-party collaborative supervision platform based on BIM technology, integrating information such as design drawings, component production plans, on-site construction schedules, and design change notifications onto the platform, enabling real-time access and synchronous updates for all participants. For example, after the design unit initiates a change, the platform automatically notifies the component plant, contractor, and supervision unit. Supervision can immediately review the impact of the change on production and construction, coordinating with the plant to adjust production plans and avoid of no avail production.

Second, establish a regular collaborative meeting system. Led by the supervision unit, weekly coordination meetings should be organized with participants from design, production, construction, transportation, etc. Participants report work progress and issues needing coordination: the component plant feedbacks production progress and components ready for transport; the contractor explains the on-site hoisting plan and site preparation; the transporter reports transportation routes and schedules. Supervision coordinates based on this information, adjusting the sequence of component arrival to match on-site hoisting needs and resolve conflicts between component supply and construction sequencing.

At the same time, clarify a collaborative responsibility list for all participants. The supervision unit should carding the responsible entities for each link, such as component production, transportation, hoisting, and connection. For example, protection responsibility during transport lies with the transporter, safety responsibility for on-site hoisting lies with the contractor, and technical disclosure responsibility for design changes lies with the design unit. Defining responsibilities through this list helps avoid buck-passing when issues arise. During collaboration, supervision needs to monitor responsibilities and track issues, promptly requesting rectification from units failing to fulfill their duties, ensuring orderly progress of collaborative work and improving overall supervision efficiency.

## 5. Conclusion

In summary, optimizing the engineering supervision of prefabricated buildings is an inevitable requirement for adapting to the development of construction industrialization. The core lies in breaking the limitations of the traditional supervision model and forming systematic solutions for key issues in component production, on-site operations, and multi-party collaboration. The proposed solutions—building a whole-process supervision system for component production, standardizing supervision procedures for on-site hoisting and connection joints, and establishing a multi-party collaborative supervision work mechanism—are not isolated. In practical engineering applications, they need to be flexibly adjusted based on project scale, component types, and technical conditions, thereby contributing to the sustainable development goals of the construction industry.

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