

Key Points for Construction Quality Control of Steel Bar Concrete Structure

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Abstract: In view of the good effect of steel bars in improving the elastic-plastic and flexural properties of concrete structures, combined with the good compressive strength of concrete, steel bars in the traditional reinforced concrete column and shear wall structures can greatly improve the performance of the main stress-bearing structures of super high-rise buildings. In order to clarify the key points of construction quality control of steel bar concrete structure, the control points are analyzed by theoretical analysis method combined with an engineering example. The results show that it is feasible to replace the traditional solid web section steel with the scattered steel bars to solve the difficult problem of the layout of the stirrups and longitudinal bars of the solid web section steel reinforced concrete column, and the ear plate connection of the steel bars is feasible; BIM Technology can realize the accurate positioning of steel bars and greatly improve the construction quality of steel bar concrete structures; During the construction process, it is very important to strictly control the verticality of steel bars, the spacing between steel bars, the distance from the outside of steel bars to the reinforcement at the column edge, and strictly control the quality of formwork installation and concrete pouring to ensure the quality of steel bar concrete structure..

Keywords: Steel bar concrete structure, Construction quality, BIM Technology, Ear plate connection, Theoretical analysis.

1. Introduction

In the field of architecture, reinforced concrete structure is one of the most important building structures, which is widely used in various types of buildings [1,2]. With the emergence of super high-rise buildings, the application of high-strength structural members is more and more extensive. As a good member to improve the elastic-plastic and flexural properties of structures, the combination of steel bars and reinforced concrete, and steel bars and other steel structures is more and more widely used.

Adding steel bars to the main structure of the project can effectively improve the stability of the structure, which provides a new idea for structural construction [3]. The steel bar can be connected in advance and then hoisted, which shortens the construction period to a certain extent and reduces the difficulty of structural construction; The application of component steel bars is reduced, the purpose of energy saving and efficiency increasing can be achieved, and the quality of concrete structure can be effectively improved.

In view of the good effect of steel bars in improving the elastic-plastic and flexural properties of concrete structures, combined with the good compressive strength of concrete [4], steel bars in the traditional reinforced concrete column and shear wall structures can greatly improve the performance of the main stress-bearing structures of super high-rise buildings. Obviously, the construction quality of steel bar concrete structure will greatly affect its bearing performance. In order to provide reference for similar projects, this paper defines the key points of construction quality control of steel bar concrete structure combined with a certain project.

2. Project Overview

The project is located in Guiyang city. It is a project of 5 super high-rise buildings with a maximum height of more than 350m. The building structure is a core tube structure in

the outer frame. The lower part of the outer frame column is about 2/3 high, and the rest is reinforced concrete columns.

In order to solve the problem that it is difficult to arrange the stirrups and longitudinal bars of the solid web steel reinforced concrete column, the steel bars distributed in the concrete core area are used to replace the traditional solid web steel, and the replacement principle is that the steel content of the steel bone is the same. The checking calculation shows that the distributed steel rod concrete column can reduce the axial compression ratio, improve the working conditions of compression members, reduce the section size of the column and increase the building area. There is basically no construction experience for reference in the construction of decentralized steel rod concrete columns in this project. The project has formed a complete set of construction technology after a lot of exploration, which has the advantages of fast construction speed, good construction quality and low construction cost.

3. Quality Control

Through the on-site construction, the steel bar quality is systematically analyzed from the steel bar quantity, assembly, hoisting and construction technology.

3.1. Introduction to Steel Bar Connection

The mechanical connection modes of large steel members in the project mainly include ear plate connection, threading connection, flange connection and integral clamp connection. Considering that the main purpose of the project is to solve the difficult problem of the layout of the stirrups and longitudinal bars of the solid web steel reinforced concrete column. Considering that other connection methods except ear plate connection have the problems of large space occupation or difficult construction operation. Therefore, the ear plate connection method shown in Figure 1 is mainly adopted for the steel bars of the project.



Figure 1. Steel bar ear plate connection

3.2. Research on Steel Bar Quality Control in Construction Preparation Stage

The first step of steel bar concrete structure construction is material selection. The quality of raw materials directly determines whether the subsequent project construction is smooth, and also determines the final project quality, which is the basic guarantee for the construction quality of the whole steel bar concrete structure.

In the factory, the steel bar quality shall be tested first, and then processed and manufactured. The length of a single steel bar is 9m. To ensure the butt joint quality of steel bars, the upper and lower parts shall be polished. During the processing of steel bars, hoops are welded on steel bars to enhance the combined connection between steel bars and concrete. Steel bar mobilization and stacking: place the bottom steel bar on the channel steel. Steel bars shall be stacked with batten for isolation, and the height of batten shall be greater than the height of ear plate at connection node. The spacing between channel steel and timber is 2m. To ensure safety, the maximum stacking layer is 9. The components stacked on the ground shall be comprehensively inspected and can be partially fixed to prevent overturning. Flatness inspection: after mobilization, use a right angle steel ruler to inspect the flatness of two surfaces of the steel bar.

3.3. BIM Assisted Accurate Positioning Analysis

BIM models in structural field can be divided into user model, design model, analysis model, construction drawing model, detailed design model and refined analysis model according to the evolution process of structural model. Among them, the deepening design model refers to the reinforced concrete structure model after the deepening design, which is the virtual simulation model of the real world building structure. The refined analysis model refers to the reinforced concrete structure model based on the real geometric information of components and reinforcement. Based on the detailed design node model, strict construction control measures can be formulated to effectively solve the technical problems in the construction of steel bar concrete structures, such as the conflict between the position of steel bars and steel bars, the denseness of steel bars, the difficulty in ensuring the construction quality, and the inability of concrete pouring. In order to preview the construction process, achieve accurate positioning, optimize the construction process, facilitate the visual disclosure on site, ensure the reasonable position of steel bars and reinforcement, and ensure the smooth pouring of concrete, the project uses Revit software to accurately model the joints of steel bar concrete

columns before the hoisting of reinforcement, as shown in Figure 2, Use the surveying and mapping instrument to locate the accurate position of the formwork and steel bar in the steel bar concrete column according to the positioning coordinate diagram.

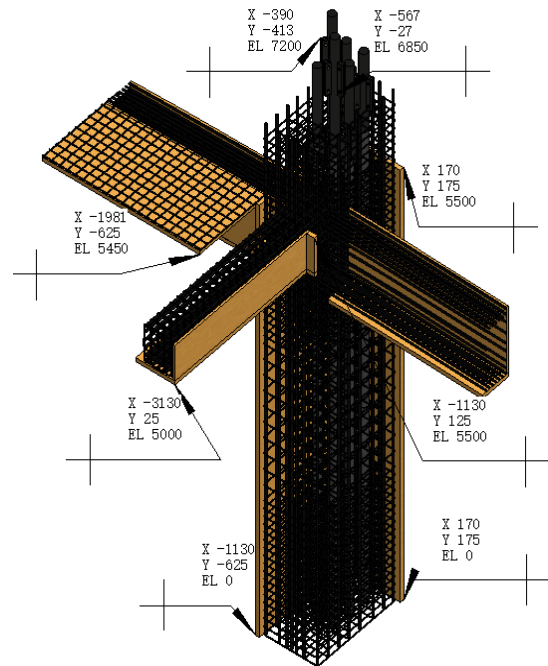


Figure 2. BIM deepening design model

3.4. Steel Bar Hoisting and Installation

Two tower cranes are arranged on site for steel bar hoisting.

Installation of steel bars on the first floor: set out the coordinate points of each steel bar column foundation slab according to the coordinate control points. The coordinate point is projected onto the supporting stirrup of the bottom plate to position and install the first section of steel column. The elevation and verticality shall be calibrated after the positioning of the first steel column. After calibration, recheck the positioning of steel column axis through the three-level control network.

Installation of steel operation platform: assist site personnel to carry out construction, improve the accurate installation and positioning of steel bars and construction efficiency, and determine the size of the platform according to the size of steel bar concrete column and the installation height of steel bars. Fabrication: the overall design of the structure is carried out considering the construction load and the weight of two steel bars. 50*5 angle steel is used for the inclined web member of the platform, and 10# channel steel is used for the upright and straight web members. The platform is easy to make and has good security. It can be moved and reused. Hoist the operation frame to the position of the outer frame column on the floor, and then weld it to the steel bar with the positioning rod (6# steel). After the steel bar is installed, cut the positioning rod at the welding position, and then use the tower crane to remove the operation frame for the next use.

Hoisting analysis: before hoisting, use a plumb bob to measure the verticality of the last steel bar.

Hoisting in place: a comprehensive analysis is made based on the hoisting times, number of hoists, construction cost, construction time and safety quality. When the number of steel bars hoisted in a single time is two, the construction efficiency is the highest and the construction quality and

safety can be guaranteed. The tower crane is used for hoisting, and the number of steel bars hoisted in a single time is two. The two operators respectively align the lower part of the two steel bars with the upper smooth surface of the corresponding steel bar on the upper layer, and connect the bolts of the three ear plates with the two end faces facing each other horizontally. Adjust the perpendicularity by fine adjusting the bolts of the ear plates. Tighten the bolts after the perpendicularity calibration is completed.

Re measurement and fixation of hoisting: the verticality of steel bars and the spacing between steel bars shall be rechecked with a plumb hammer and a steel ruler. On the operating platform, the operator shall weld all steel bars to the whole with a 20mm diameter steel bar, and the welding position shall be 500mm below the top of the steel bar. Ensure its perpendicularity. After the top steel bar is installed, the steel bar mesh is added at the top of the steel bar embedded in the frame column at the top of the steel bar; Reinforcement mesh: C12 transverse spacing of reinforcement mesh: 100mm × Vertical spacing of 100mm reinforcement mesh: 80mm vertical reinforcement mesh: 7 layers in total.

Staggered hoisting: according to the design section requirements, raw material production length and tower crane hoisting conditions, in order to ensure that the hoisting time of steel bars does not affect other subdivisional works, the staggered and segmented hoisting method is adopted. The length of steel bars is two standard layers (9m). The method of two layers and one hoisting can save construction time and cost.

Rebar binding: strictly control the perpendicularity of steel bars, the spacing between steel bars, the spacing between steel bars, and the distance from the outside of steel bars to the reinforcement at the column edge.

3.5. Templates Installing

During the construction of formwork works, the size, shape and position of relevant concrete components shall be strictly controlled, so that the formwork works can improve the corresponding function and safety of the construction works as a whole. Due to the complex construction environment and many construction links, the quality of formwork engineering should be strictly controlled. If you want to give full play to the function and effectiveness of formwork engineering, you must start from the materials, preparations, construction links and other parts to strictly ensure its quality.

The construction formwork shall be installed step by step according to the design standard of the construction scheme. During the assembly of column formwork, the first formwork shall be installed first. After the installation is completed, the adjacent second formwork shall be installed and fixed, and then other formwork shall be installed correspondingly. During the installation, the diagonal line and installation position of the formwork shall be checked to ensure that the installation meets the design standard. In addition, the column formwork shall be checked from top to bottom, and column hoops and diagonal braces shall be installed at the corresponding positions to avoid the inclination of the column formwork. After the overall installation is completed, each link needs to be checked again to ensure that the installation standard is met. The installation steps of each link are as follows:

(1) After the first piece of formwork is installed, the formwork shall be preliminarily fixed with diagonal braces to

prevent the formwork from tilting and toppling.

(2) After installing the second formwork, it is necessary to assemble the first and second formwork, and paste an anti-seepage sponge between the two formworks. The size of the sponge should be controlled above 2mm and the shape should be strip, so as to avoid slurry leakage during later construction. Finally, use wood bolts to fix the two columns, so as to maintain good stability of the two column formworks.

(3) Next, the installation of each piece of formwork is the same as that of the first and second pieces. After the installation of the third and fourth pieces of formwork, connect the four pieces of formwork to form a square barrel shaped column formwork structure.

(4) Then, starting from the top of the square barrel column formwork structure, install the column hoop to ensure the integrity and integrity of the column. Install the column hoop respectively in the height direction of the whole column formwork. The spacing of the column hoop shall meet the requirements of the design scheme, and the maximum spacing shall be controlled below 500mm. After the column formwork is fixed, the diagonal and verticality of the column shall be tested to ensure that the column formwork is square and vertical, and the section size and position meet the design requirements.

(5) Correct the deviation and diagonal of the column formwork in two directions, and then fix it.

3.6. Concrete Pouring

As an important material for the pouring construction of housing construction projects, commercial concrete provides a basic guarantee for the forming and quality strengthening of concrete. The principle of continuous pouring shall be followed in the pouring process, so as to ensure the integrity of the concrete structure, make it have strong safety characteristics, and improve the overall structure of the housing construction project.

In the process of practical operation, the construction management personnel mainly complete each work task according to the specific requirements of the concrete pouring construction procedure, reflect the scientific and rigorous work attitude, fundamentally improve the concrete pouring construction quality, and lay a good foundation for the stability and safety of the building structure. In this process, the management personnel shall fully reflect their own work functions, supervise and manage the various operations of the construction personnel, so that they can ensure the pouring continuity when pouring concrete, and improve the concrete mixing construction quality at the same time. The operation of different links has corresponding relations. The construction management personnel should pay attention to the effective implementation of each link operation, especially when controlling the construction procedure, check the temperature parameters, water content ratio, etc., analyze the possible segregation or collapse problems, and prevent the concrete formwork from being impacted. The construction personnel shall also mix the concrete at different levels to improve the effectiveness of mixing construction on the basis of maintaining the strength between layers. When vibrating the concrete, it is necessary to control the distance between the vibrator and the formwork to prevent damage to the formwork, improve the stability of the formwork, and provide a reliable program guarantee for the optimization of the construction quality and structural strength of the comprehensive construction of the project.

Before implementing the concrete pouring construction technology of housing construction engineering, the construction personnel shall do a good job in vibration construction, fully improve the strength of concrete structure and promote the compactness of internal structure. It needs to master the actual situation of the construction site of the housing construction project in detail, clarify the specific requirements for concrete vibration and pouring construction, and reasonably select the vibrator according to the corresponding requirements to reflect the professional ability and level of the staff. It is difficult for some construction personnel to fully control the quality of concrete vibration and pouring construction during operation, resulting in uneven vibration and missing vibration. When dealing with this problem, the construction personnel need to insert the vibrator evenly, control the depth and moving length of the cement concrete, increase the strength of the vibrating mixture, and improve the tightness of the structure. This operation can effectively improve the quality and durability of concrete and prevent cracks in concrete structure. When optimizing the comprehensive effect of vibration construction, appropriate measures should be taken to protect the cement concrete to be poured.

4. Conclusion

Combined with an engineering example, the key points of construction quality control of steel bar concrete structure are analyzed by theoretical analysis method for reference to similar projects. The main conclusions are as follows:

- (1) In the traditional reinforced concrete column and shear wall structure, steel bars can greatly improve the performance of the super high-rise structure.
- (2) The difficult problem of arranging stirrups and

longitudinal bars of solid web steel reinforced concrete columns can be solved by using scattered steel bars instead of traditional solid web steel bars. It is feasible to use ear plate connection for steel bars.

(3) BIM Technology can realize the accurate positioning of steel bars and greatly improve the construction quality of steel bar concrete structures.

(4) During the construction process, it is very important to strictly control the verticality of steel bars, the spacing between steel bars, the spacing between steel bars, the distance from the outside of steel bars to the reinforcement at the column edge, and strictly control the quality of formwork installation and concrete pouring to ensure the quality of steel bar concrete structure.

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