Research on transfer floor technology in high-rise building construction

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Abstract: With the continuous improvement of the level of urbanization, people put forward higher requirements for the quality and safety of high-rise building projects. As an important part of high-rise building construction, the quality of transfer floor construction will directly affect the overall level of the construction industry. This paper mainly analyzes and explores the general situation and technology application of the transfer floor of high-rise building structure. These applications improve the construction strength of concrete, steel bar and formwork; grasp the promotion of key links. Thus the overall construction reaches a higher standard, and the stability performance of high-rise buildings is improved.

1. Introduction
In recent years, with the development of modern society and the progress of technology, high-rise buildings have been paid more and more attention in people's daily life and commercialization. So they have developed rapidly[1]. With the gradual increase of people's demand for land, the types of buildings have also undergone tremendous changes. Diversification, complexity and integration have become the general trend of current development. Therefore, in modern high-rise buildings, the lower multi-storey buildings are generally used to construct comprehensive commercial network, while the upper high-rise buildings are residential or office buildings. Structurally, they have been greatly changed from simple residential buildings, and the transition structure storey from large-span structure to small-span structure has been increased. Thus, in the design and construction of building structure, the transfer of structural storey has become the focus and difficulty of high-rise buildings[2].

Structural transfer floor is a joint of different structural forms in a building. It is not only the top of the lower structure, but also the aerial foundation of the upper structure. It plays an important role in connecting the whole structure system of the building[3]. The transfer floor has the advantages of direct transmission of force, clear force and low cost. It has been widely used in practice and is now a high-rise building. Vertical transformation is the most commonly used structural form in architecture. This paper analyses the stable construction of the transfer floor of high-rise buildings, and really abandons the unhealthy matters in the present situation, so that the whole structural construction can be concerned. In the long-term construction process, truly enhance the construction strength of concrete, steel bar and formwork, grasp the promotion of the research strength of key links, and make the whole construction possible. Standards can be well constructed to really improve the stability of high-rise buildings, and innovative construction technology can be implemented and applied at any time, so that its stability can be stabilized[4].
2. General situation of transfer floor of high-rise buildings

The prominent characteristics of the transfer floor in high-rise buildings are mainly two aspects. First, the transfer floor is usually located at the lower part of the building, which bears dozens of layers of loads on it, and the stress is complex, and its damage will lead to catastrophic consequences. On the one hand, the limitation of analysis method in design, it is difficult to accurately analyze all kinds of transfer stories. On the other hand, the seismic response of transfer stories is strong\cite{5}. Because of the huge load on the transfer floor, the section of the transfer floor is beyond the normal level, the steel consumption and stiffness are large\cite{6}. The weight of the transfer floor is significantly larger than that of the general floor.

Horizontal force of high-rise buildings plays a controlling role. In earthquake area, the quality and stiffness of floors are generally required to change evenly, and sudden changes should not occur. Otherwise, weak floors are easy to occur under earthquake. The change of mass and stiffness of high-rise building in the transfer floor leads to the increase of seismic response in this part. In addition, the huge section of the transfer floor will bring a lot of inconvenience to the construction. For example, in Wuhan New World Centre, 1.6m thick slab is used in the transfer floor. This kind of slab is not only difficult to reinforce and concrete pouring, but also difficult to control the quality of construction and strict requirements for its lower formwork support system are required during construction. For the pouring weight of 0.5kN/m$^2$ or more, the conventional formwork support is not suitable. It needs to be designed and manufactured separately, which increases the cost of the project. Generally speaking, the shear wall structure with small bays is above the transfer floor, while the large space structure with columns as the main bearing capacity is below the transfer floor. Obviously, the shear stiffness of the structure above the transfer floor is greater than that of the structure below the transfer floor, which must be adjusted.

According to different structural transformation functions, transfer stories can be divided into two types. First, the structural forms of the upper and lower floors of high-rise buildings are different. The structural changes from the upper to the lower floors are completed through the transfer stories, as shown in Figure 1. Secondly, the structural form of the upper and lower floors of high-rise buildings and the arrangement of column network axes are changed simultaneously through the transfer floor. In order to change the structure form of upper and lower storey and column network in high-rise buildings, the following structural transformation forms are often used: beam-type conversion and plate-type conversion storey. The thickness of the plate is usually very large to form a thick plate type cap transfer layer. Its lower column network can be arranged flexibly without strict alignment with the upper structure. But the board is very thick and the weight is very large, so the material consumption is very large.

![Figure 1. Diagram of transfer floor of high-rise building](attachment:transfer_floor_diagram.png)
3. Construction characteristics of transfer floor of high-rise buildings

The construction of the integral transfer floor of high-rise buildings is complex, which leads to many difficulties in the construction[7]. In the whole construction process, the comprehensive structure construction can be clearly understood, so that the effective construction technology can be applied.

3.1 Characteristic analysis of whole project construction

The transfer floor of construction technology is inseparable from the construction of the overall bearing capacity. The structure and formwork, technology and state are to be compared. In the long-term construction process, the stress surface and support point are effectively constructed. The scientific breakthrough point of construction analysis is found, so that the empirical things can be reflected, and the key construction technology of construction is put forward. Timely use, perfect construction control in the supervision process can be perfectly reflected. However, such construction implementation has only played a role in the overall stability of the building itself, and has not fundamentally been comprehensively solved. The span of the transfer floor and load-bearing data presented, so that in the construction process, only recognizing the reinforcement and reinforcement bones. The height and depth of the frame can effectively improve the construction effect.

3.2 Analysis of construction characteristics of frame structures

For the overall framework, it is the solid foundation of the whole construction. In the research and key investigation of bearing capacity, effective information is captured. The building area and height are clearly understood, the thickness of the transfer floor is kept to the best level. The strength of concrete is kept stable, and the building stability of itself is effectively improved. In order to make the supporting points of the overall framework perfect and upgrade, in the process of comprehensive construction, the construction of points, lines and surfaces can be steadily upgraded. And the stability of the internal system data can be analyzed and maintained, so that the construction can be successful.

4. Key points of transfer floor construction of high-rise buildings

As an important part of high-rise building construction, the level of construction technology of transfer floor plays a key role in the development of construction industry. In order to improve the overall technical level of high-rise building construction, this section analyses the construction key points of the transfer floor of high-rise building. It is necessary to have a clear understanding of the construction process, the construction matters of formwork engineering, steel bar engineering and concrete engineering.

4.1 Construction of formwork project

In order to make the structural quality of concrete of transfer floor effectively and stably constructed, it is necessary to use formwork to support. In the construction process, because of the faster construction speed, more formwork needs to be laid, and more problems need to be noticed in the construction process. For the application of construction technology of bottom formwork, supporting effect must be brought into full play. The steel tube scaffold of 48mm*3.5mm is established to support the system. In the process of measuring and analyzing the spacing and step height of the opposite pole, it can effectively establish the sufficient and stable construction items. In the process of strengthening the implementation of construction technology, through the main corrugates and secondary corrugates. Effective construction of bone enables it to effectively support the formwork, grasp the improvement of the construction strength of key support points. Effective using the plastic film of plywood in the process of quality protection of corrugated bone, so as to keep the temperature and humidity of concrete bottom to a certain state. It is truly combining the protection, prevention and construction of sound promotion.
As shown in Figure 2, in the process of the research on the supporting items of the lateral formwork, the quasi-surface height of the transfer floor is firmly established. In the construction process, the fixed items of anchoring bolts are studied to enhance the use standard of bolts. The whole structure of bolt and support system and horizontal concrete should be connected and fixed. In the process of column welding, attention should be paid to enhancing the auditing strength of embedded reinforcement. Because of the rapid heat dissipation of the formwork, it is necessary to timely dismantle, moistenize and heat preservation methods. In order to keep the temperature normal and have no effect on other parts, and upgrade the existing construction standards of the formwork, the strength of heat preservation and moisture preservation can be effectively enhanced.

4.2 Construction of reinforcement engineering

As shown in Figure 3, in the process of reinforcing bar construction, attention should be paid to the planning of the standard in the course of laying the position of transverse and vertical reinforcing bars. In the process of implementation, the measured data should be effectively studied so as to improve the connecting quality of reinforcing bars and layers effectively. In the process of construction, the reinforcing bars of concealed beams are relatively concealed, and caution should be taken in the operation, and the data should be studied carefully. Results effective analysis is needed to make the steel bars crossed vertically and horizontally effectively erected, and to continuously construct the internal control process in a coherent way. In order to enhance the strength and erection effect of the combined steel bars, it is necessary to effectively differentiate the overall construction items, to enhance the protection strength of the internal steel bar protective layer, and to truly advance the comprehensive construction standards. Line presentation, so that the comprehensive data research process, can be effectively penetrated, and truly enhance the support capacity of steel reinforcement.
4.3 Construction of concrete engineering

When concrete is poured, the temperature of injection mould should be controlled within 25 degree to prevent excessive temperature from increasing the hydration heat of concrete. The frame pillar is C50 and the other beams and slabs are C40. After pouring the columns, the beams and slabs are poured. A ground pump is set up at the same time by grouting at one end. Steel wire mesh and small round bamboo are used to separate the concrete of different strength grades of beam and column joints, and the small round bamboo is demolished at the joint of beam and slab concrete. When pouring beam concrete, layered pouring, layered vibration and layered thickness should be controlled at 400mm. One-time pouring of concrete should not be too high or too thick to ensure the uniform rise of concrete temperature.

Because of the dense reinforcing bars and the small net distance of reinforcing bars in the girder of the transfer floor, the existing diameter 50 bars are difficult to insert into the girder. Diameter 30 vibrating bars are used in the concrete pouring of the girder, and diameter 50 bar are used in the other parts of the concrete pouring. The moving distance of the vibrating rod is about 400mm, and the vibration time is 15s to 30s. The cast-in-situ slabs are levelled vertically and horizontally by levelling the aluminium alloy square. The secondary vibration of the plate vibrator is strengthened to prevent shrinkage cracks. In order to avoid cracks in concrete, the second vibration must be carried out before the initial setting and final setting of concrete. The compactness of vibration must be guaranteed during vibration, but not over vibration, in order to prevent the expansion of formwork.

The concrete surface after pouring is polished and compacted before initial setting and final setting to enhance the crack resistance of concrete surface and reduce surface cracks, as shown in Figure 4. Horizontal control of concrete slab should not only be controlled according to the elevation point on the insertion bar of shear wall, but also be monitored and levelled by setting up a level meter on the pouring level.

![Figure 4. Concrete construction drawings in high-rise buildings](image)

During concrete pouring, the safety officer and the woodworker specially observe whether the load-bearing frame is abnormal during concrete pouring. Whether the support frame, formwork, reinforcing bar, embedded parts and inserting bars are moved, deformed or blocked, so as to find out the problems and deal with them in time. As far as possible, the horizontal impact of pumping on load-bearing frame and formwork can be minimized, and the excessive accumulation of commercial concrete on formwork can be controlled. After concreting the transfer floor, the concrete should be watered and maintained for no less than 14 days.

5. Conclusion

The construction of transfer floor occupies an important position in the construction of high-rise buildings. In the construction of projects, construction enterprises must strictly carry out construction and operation in accordance with the construction norms. This paper makes an effective analysis of the key points of construction in the transfer floor. Only by effectively upgrading the construction items, applying innovative technologies in the construction process and establishing comprehensive construction standards, can the quality of high-rise buildings be effectively improved.
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