Research on the application of reverse method in high-rise building construction

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Abstract: In high-rise building engineering, a variety of construction techniques can be applied, and reverse practice is one of the common ones. Based on this, in order to improve the quality of the project as the purpose, to the application of technology as the content, the construction experience is summarized. This paper first introduces the reverse method, then expounds the classification standard of this method and the characteristics of different types of techniques. Finally, the application means of the technology are summarized from the aspects of foundation engineering and concrete engineering.

1. Introduction
The increase in the number of high-rise buildings is, to some extent, influenced by the ever-expanding city size and the ever-increasing urban population. Compared with multi-storey building, high-rise building construction, the use of technology is different. Reverse method, one of the main construction methods, in the construction, has been used, and the technical level has been relatively mature. Therefore, in order to ensure the quality of the project, it is necessary to study the application method of the technology.

2. Inverse practice and its classification

2.1. Uni-axial
Sections should be numbered with a dot following the number and then separated by a single space: Reverse method is mainly a method relative to the construction sequence. Usually, the construction of high-rise buildings emphasizes the order of proceeding from bottom to top. The above construction method, with a certain reliability, has been the main construction principle followed by the project. But at present, the reverse approach has emerged, this method, subversion of the traditional construction order, the requirement from the top to the bottom of the construction. Under the above construction method, the foundation construction will be reserved to the final stage of the project, while the construction of the envelope structure needs to be advanced. This construction method, no matter from the perspective of economy, environment, or social benefits, has certain advantages. From the economic analysis, compared with the traditional construction method, the reverse method can effectively improve the reliability of the support structure, and can achieve the purpose of ensuring the stability of the building with the least support. Therefore, the cost of engineering construction is often lower and the economic benefits are good. From the perspective of society, under the above construction method, the foundation treatment method and time are relatively special, so the construction period produced less noise, relatively quiet, good social benefits.
2.2. Line thickness
Common reverse methods include four kinds: half, whole, stratified and partial reverse. The characteristics, advantages and disadvantages of the four kinds are respectively reflected in the following aspects:

(1) Semi-inverse method
Semi-reverse approach, which belongs to a common reverse approach, is also applied in high-rise building construction. In this method, the construction personnel need to choose the floor slab first, and after determining its type, it is necessary to analyze how to choose the foundation to ensure the stability of the building, and at the same time, it is necessary to analyze how to pour to enhance the mechanical properties of the building. In the above analysis is good, it is necessary to design the process of foundation pit excavation, calculate the parameters, and finally complete the construction process in a bottom-up way. Cross lattice ribbed beams are usually seen when semi-reverse construction is used. Through the summary of the construction experience, it is found that the above method used in the construction of high-rise buildings can effectively improve its stability and reliability, good construction, building settlement and other parameters can meet the needs of the project, is conducive to ensure the building effect, so the method has a high frequency of application.

(2) The whole reverse approach
In addition to the semi-reverse method, the full reverse method, in the construction of high-rise buildings, is usually more commonly used. In the process of construction based on the above technology, the construction personnel need to analyze the floor characteristics of each floor. Generally, ribbed slabs are the most common. These types of slabs can support the foundation of the building to ensure stability of the building. In the process of completing the above construction, it is necessary to apply the construction materials layer by layer in strict accordance with the order from top to bottom until the final completion of the construction of the foundation structure. The above construction methods also have good construction results.

(3) reverse stratification
This kind of method emphasizes that the construction should first be carried out for the maintenance structure of the building. After the completion of the construction process mentioned above, the whole construction process should be completed in a top-down way according to the different floors. The above reverse construction technology, the advantage is that the convenience is strong, and the cost is low, and its commonly used to cooperate with the construction technology, is based on the soil nail wall technology.

(4) Partial reverse practice
The above construction methods have obvious advantages in ensuring the stability of the building. In addition, some studies have also pointed out that this method is also helpful to reduce displacement and ensure the integrity and safety of building structures through mechanical approaches. In the process of using this method of construction, it is necessary to first carry out the construction of resistance support, after this, can start from the envelope structure, from the end of the building pile foundation, end the construction process.

3. Application of reverse method in high-rise buildings
There are many construction links in the construction project. The traditional construction method is different from the reverse construction method in the process, but the specific construction content is similar.

3.1. Pile construction
Pile is the main component of high-rise building, its function is to play a supporting role in the building structure, avoid the building collapse or displacement and other phenomena, improve its stability. The key to the construction of column and pile is to position and adjust the relevant parameters, so as to ensure the mechanical performance of the building to the maximum extent. The specific methods are as follows:
(1) Positioning
In the process of positioning, the construction personnel should first choose the type of the column, in order to ensure the quality of the project, it is suggested that high-rise building engineering, choose steel pillar, as the main material of the column. In the selection of column, it is necessary to start from the axis, and perpendicularity and other aspects, arc-line work, to prepare for the process of positioning, and provide evidence. In order to reduce the error, the construction personnel need to strictly control the axis and other parameters. Studies have pointed out that verticality is the main index affecting the positioning effect. If $< 1/300$, it is very easy to lead to cheap column positioning, which will eventually affect the construction quality of the project, and even lead to the collision of the structure, so that the construction cannot be carried out. Thus, in the construction period, it is necessary to pay attention to the positioning problem.

(2) Parameter adjustment
In addition to positioning, it is also important to optimize and adjust the parameters. During the reverse construction, there are many kinds of parameters involved. Only through calculation, although can ensure the accuracy of the parameters, but if not in the construction, the strict control of it, will also lead to error increase. In order to ensure that the parameters of the construction process are consistent with the design parameters and reduce errors, the construction personnel need to use the theodolite and other equipment to adjust the parameters and control the errors of all parameters within the allowable range to ensure the quality of the project to the greatest extent.

3.2. Foundation Engineering
The foundation engineering construction needs to be carried out in the last link of the project. The main content of the construction is the excavation of earth and stone. During the construction period, it is necessary to strictly control the excavation depth according to the design requirements. In order to control the accuracy, the excavation can first be done mechanically to ensure the efficiency. When the depth basically meets the requirements, manual excavation can be done to strictly control the accuracy. After the completion of the excavation, the construction personnel shall clean up the excavated earth and stone and shall not leave it in the site, so as to avoid blocking the traffic of vehicles, leading to the decline of the construction efficiency, affecting the construction period and the construction effect.

3.3. Node Project
The node is the intersection point of the underground horizontal support system and the vertical support system, so it also becomes the place where the structure construction is most likely to have problems. There are two ways to deal with the node: one is to be connected to the component concrete protective layer chisel off, exposed the steel bar, and then the main reinforcement of the subsequent component and exposed the main reinforcement welding, formwork, concrete pouring; Second, according to the design drawings, embedded reinforcement or section steel at the node, and the subsequent component reinforcement welding, forming, pouring concrete. Due to the reverse construction, the joint form of the basement structure is quite different from the conventional construction method. Wall beam and column beam node construction is in the first column under the pile reserved on the rims and underground continuous wall embedded parts respectively welding on the steel plate, and again on the steel plate welding steel, and then tie beam reinforcement, pouring concrete, upon the foundation slab, the pouring outsourcing concrete composite column and composite wall again, composite column, wall and beam node is when the template is completed by bedding shop drawing set column, wall vertical main reinforcement position.

3.4. Concrete Engineering
Uni-axial technology in high-rise building engineering application, first of all, should consider the efficient way that the upper bearing load, to support the completed engineering structure deadweight and additional load, generally there are mainly large diameter pile engineering, permanent column load combination of holing engineering pile or precast pile, pile caps, and permanent column load
combination of holing engineering pile or precast piles, pile caps is combined with a temporary pillar carries three methods. Secondly, the bottom of the reinforced concrete column is welded by distributing bars and circumferential bars in connection with the column pile.

4. Conclusion
This paper studies the application of reverse practice in high-rise building construction, which provides a reference for the construction field, helps to promote reverse practice, gives play to its advantages, and provides a foundation for the improvement of construction quality and the guarantee of safety. In the future, high-rise building engineering, according to its own construction specific situation, considering the priority of the reverse construction, on the basis of ensuring that the application process of this method is fully mastered, the relevant parameters are calculated and adjusted, and do a good job in reinforcement and concrete engineering construction work, improve the construction effect.

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