

Application of Deep Foundation Pit Construction Technology in Civil Engineering Construction

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Abstract: As one of the commonly used technologies in modern civil engineering, the construction technology is becoming more and more widely used with the continuous growth of building height. In the construction process of high-rise buildings, the deep foundation pit support provides the necessary stability for the foundation structure of the building project, and more effectively guarantees the quality of the project. Through the reasonable supporting structure, the deep foundation pit technology can effectively prevent the risk of soil collapse, foundation pit deformation and other risks, and improve the safety factor of the whole construction project. Especially in the high-rise buildings, the deep foundation pit support technology can consolidate the foundation for the long-term stability of the project, and significantly prolong the service life of the building. The continuous development of deep foundation pit construction technology is the inevitable demand of high-rise building construction, and also provides a powerful help for the development of civil engineering industry. Based on this, this paper focuses on the application of deep foundation pit construction technology in civil engineering construction.

Keywords: Civil engineering; Deep foundation pit construction technology; Application

Online publication: February 13, 2025

1. Foreword

Deep foundation pit construction technology is widely used in the construction of high-rise buildings and other projects. With the advancement of urbanization process, land resources are increasingly tight, and the demand for deep foundation pit project is increasing. In order to ensure the safety and stability in the construction process of deep foundation pit, the reasonable application of support technology is particularly important. Deep foundation pit support technology aims to prevent soil collapse, foundation pit deformation and other safety risks, and ensure the smooth construction through the effective support structure.

2. Analysis of the importance of deep foundation pit support construction

With the acceleration of the urbanization process, more and more building projects have begun to expand to the

underground space, and deep foundation pit engineering has gradually become a common demand in modern building construction. However, the soil environment of the construction site is usually complex and changeable, and the geological conditions are quite different, which makes some soil layers cannot directly meet the requirements of the construction of high-rise buildings, and there may even be a risk of instability^[1-5]. Therefore, the construction technology of deep foundation pit support arises at a historic moment. Strengthening the soil to avoid soil collapse, deformation, and other problems, provides a safe working environment for the subsequent construction. Common supporting technologies include concrete pile plates, steel sheet piles, concrete mixing piles, etc., which can effectively support the soil layer, prevent the surrounding ground subsidence, ensure the stability of the foundation pit, and prevent the penetration of groundwater and the movement of the soil. The choice of each support method needs to be formulated according to the specific geological conditions of the construction site, the surrounding environment, and the project scale.

In modern civil engineering projects, especially in the construction of deep foundation pit and large-diameter projects, the requirements of deep foundation pit support are getting higher and higher. With the continuous expansion of the project scale, the design and construction of the supporting structure often face greater challenges. The stability of deep foundation pit support is directly related to the safety of the whole project. Once the problem occurs in the foundation pit support structure, it may lead to soil collapse, affect the construction progress, and even bring serious safety accidents. Therefore, the construction team must calculate the carrying capacity of the supporting structure according to the actual situation of the site, and scientifically design the supporting system to ensure the safety and reliability of every step in the construction process. To solve the problem of soil layer stability, deep foundation pit support is more necessary to consider seepage prevention and waterproofing, to avoid the damage of groundwater infiltration to the foundation pit. Seepage prevention and reinforcement play an important role in this process. Commonly used technologies include wellpoint dewatering, dewatering well, and other methods, which can effectively reduce the risk of water accumulation in the foundation pit and reduce the influence of the hydrological environment on the supporting structure in the construction process^[6-9].

However, the deep foundation pit support is not only designed to provide a temporary safety guarantee in the construction process but also plays an important role in the whole life cycle of the project. After the completion of the project, the foundation pit supporting structure usually needs to be removed. How to carry out the demolition operation and make reasonable use of the demolition materials has become a new topic. In the process of demolition, the recycling of materials directly affects the economic benefits of the project. The construction team needs to pay attention to how to reduce the waste of resources and improve the reuse rate of demolition materials, to achieve the goal of saving cost and reducing environmental pollution. In general, the construction team should reasonably select the support methods according to the needs of the specific project, to ensure the safety and stability of the project, and to maximize the overall benefit of the project. Under the condition of limited resources, through the scientific construction of the supporting structure, we can realize the maximum benefit of the project construction, and promote the development of modern civil engineering towards a safer, more efficient, and environmental protection direction.

3. Application of deep foundation pit construction technology in civil engineering construction

3.1. Construction technology of reverse arch wall support

The construction technology of reverse arch wall supports is constructed through various structural forms such as round or oval, which have high stability and can effectively resist the soil lateral pressure in the process of foundation pit excavation^[10-15]. During the construction, the principle of layered construction from top to bottom

must be followed, and the supporting structure of each layer needs to be accurately constructed to ensure the stability of the overall structure. However, in the construction process, if the arch cannot be successfully formed, the construction team should check the site situation in time, adjust the support scheme, and use the composite support system to provide additional support, to ensure the construction safety. Designers need to pay special attention to the water level change when determining the vector span ratio of the axis of the arch wall. If the water level in the foundation pit is too high, it may cause adverse effects on the bottom structure of the foundation pit, and even endanger the safety of the whole project in a serious case. Therefore, the construction team should implement effective water level control measures according to the precipitation situation, timely flow closure, prevent the occurrence of water accumulation phenomenon, and ensure the smooth construction of the reverse arch wall support.

3.2. Construction technology of concrete pouring pile

Concrete cast-in-place pile construction plays an important role in civil engineering, especially in deep foundation pit construction. The construction technology of concrete cast-in-place piles can effectively improve the underground seepage problem, effectively protect the pit wall of the foundation pit, reduce soil erosion, and ensure the safety of the construction process. Through the high-strength cement wall of the cast-in-place pile, the safety risks such as settlement and collapse can be significantly reduced, making the whole foundation pit structure more stable^[16-19]. Compared with other supporting technologies, a significant advantage of concrete pile construction is rarely hole collapses in the construction process. To ensure smooth construction, the construction team needs to accurately calculate the pile spacing to avoid the problem of too dense or too thin piles. In the specific operation process, the construction personnel should focus on the analysis of the difficulties in the project, especially the slope protection problems, and take corresponding measures to solve them to ensure the stability of the civil engineering project structure. In the technical implementation, the team must carry out each step in strict accordance with the professional process, ensure the construction quality of the concrete cast-in-place pile, and control the quality of the project to prevent any accidents. Through reasonable construction technology, the concrete cast-in-place pile technology can effectively improve the overall stability of the deep foundation pit engineering, and ensure the smooth progress of the civil engineering project.

4. Construction of slope protection pile

To ensure the construction quality, the construction personnel should first carry out detailed site verification on the construction site, and make a feasible construction plan based on the site geological conditions and construction needs. In this process, the engineer in charge must fully master the construction technology and characteristics of the slope protection piles, and deeply understand the adaptability and performance of the piles under different construction environments, to ensure the safety and effectiveness of the supporting structure. Through the reasonable layout of the slope protection pile, the sliding and collapse of the pit wall can be effectively prevented, especially in unstable soil environments such as high water levels or soft soil layers. The slope protection pile plays a vital role in supporting it. The construction team should operate in strict accordance with the established supporting structure scheme to ensure that every link in the construction process is consistent with the design requirements, to ensure the smooth progress of the construction.

5. Construction technology of anchor bolt support

The anchor bolt support construction technology is widely used in deep foundation pit engineering and has

good stability. This technique inserts the anchor rod deeply into the soil layer, which prevents the collapse and deformation of the foundation pit wall. In the actual construction process, it is necessary to accurately measure the site, and determine the layout position and quantity of the bolt, to ensure the rationality and safety of the supporting structure. The installation of the anchor rod not only needs to ensure that it is fixed firmly but also needs to strictly control its tilt angle and elevation to ensure the balanced distribution of its support force. The construction team should pay special attention to the accuracy of the drilling operation. If abnormal conditions are found, such as drilling deviation or soil instability, stop the operation immediately, conduct an on-site inspection, and adjust the technical scheme according to the specific problems^[20].

6. Construction technology of soil nail wall

Soil nail wall construction technology is an important application method in deep foundation pit support, which is widely used in various soil environments. In the construction process, the design drawings of the project need to be carefully verified to ensure the reasonable layout of the drainage system to avoid water accumulation affecting the stability of the foundation pit soil. The design of a drainage system usually adopts a network format structure, which can effectively reduce soil erosion and enhance the bearing capacity of soil. During the installation of the large-diameter soil nail hole, the depth and position of the drilling hole must be strictly controlled to ensure that the soil nail hole is not affected by the surrounding environment and avoid the drilling deviation. Simultaneously, the construction team should ensure the quality of the soil nail material, especially the strength of the steel bar, to avoid rust or inferior materials, and affect the long-term stability of the soil nail wall. When welding the soil nail wall support, the construction personnel need to pay attention to the moderate mix ratio of the mortar, to ensure that it has enough bonding strength, and at the same time to pay attention to the combination strength of reinforcement and concrete. During the grouting operation, the grouting pressure and slurry fluidity must be accurately controlled to ensure that the cement slurry can fully penetrate the inside of the soil nail hole and form a solid support body. After grouting, the team shall check the grouting pipeline in time to remove impurities to ensure the smooth progress of subsequent operations. During the net operation, the construction team shall ensure that the wire mesh is welded firmly, select the appropriate drainage pipe material for installation, and conduct a quality inspection to ensure that the drainage function of the pipe meets the standard.

7. Pile row support technology

Pile row support technology provides the necessary support for the foundation pit through pile row to ensure safety in the construction process. Pile row can be divided into precast pile, slab pile, and cast-in-place pile, among which concrete cast-in-place pile becomes the most commonly used choice because of its good bearing capacity and adaptability. Generally, pile discharge technology is suitable for foundation pits ranging from 7 to 13 meters deep, and a detailed investigation of groundwater level, soil conditions, and other factors is required before construction. In some special circumstances, such as the requirements of the site conditions, the design scheme of a double-layer concrete cast-in-place pile may be adopted, and the construction sequence needs to be strictly controlled to ensure the coordination and stability between the pile foundations. The key point of pile row support lies in the layout density of the pile foundation. The drilling and piling operation must be rigorous to ensure that each pile can effectively withstand the pressure of the surrounding soil and prevent the collapse of the foundation pit. In the construction process, special attention should be paid to noise control, and reasonable selection of construction time, to avoid bringing unnecessary trouble to the surrounding residents. By taking noise prevention and control measures, the environmental protection of pile discharge technology can be effectively improved.

8. Epilogue

Deep foundation pit construction involves complex soil quality and hydrological conditions. Against this background, the application of various support technologies, such as reverse arch walls, concrete cast-in-place piles, and anchor bolt support, has gradually become an important means to ensure construction quality and safety. With the continuous development of technology, new construction methods are constantly introduced. However, the progress of technology does not mean that the accumulation of traditional experience can be ignored, especially the supporting technology in extreme environments, which needs to be flexibly adjusted according to the actual situation. The development of deep foundation pit construction technology should pay attention to the innovation of technology, but also strengthen the comprehensive consideration of environment and safety, and promote the integration of green construction concepts, to provide more efficient solutions for urban construction.

Disclosure statement

The author declares no conflict of interest.

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