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Introduction of Concrete Quality Control Points of Artificially Dug Piles for 500kV Transmission and Substation Foundation in High Altitude Area

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Abstract

In the power construction project, the tower foundation construction work is an important process essential to the foundation stage, because of its operation point of the geological foundation structure is complex and changeable, the workload is large, many dangerous factors and difficult to observe and identify, the construction is easy to cause safety accidents. The excavation of hand-dug piles is simple and convenient, and the requirements for equipment and instruments are not high, as long as the position is set, all excavation work can be completed manually, which has strong mobility. Since this project is located in the plateau area of Tibet, it is intended to study the applicability of "Quality Control Points for Concrete of Artificially Dug Pile in 500KV Transmission and Transformation Foundation Project in High Altitude Area" in the plateau area through this project.

Keywords

Power Construction Project; Tower Foundation; Hand-dug Piles; Highland Areas.

1. Review of the Level of Domestic and International Research

The concept of hand-dug piles was first introduced in the United States in 1983. Due to the rapid development of cities such as New York and Chicago at that time, land was scarce and therefore the requirement for building layers was increasing. However, most of the urban foundation soils were soft layers or clay layers with low strength, which could not meet the requirements of settlement for high-rise buildings[1]. Thus, artificial bored piles were finally successful and solved the difficulties brought by urban development at that time by borrowing the ancient well-digging technology. Because of the simple construction process of hand-dug piles and the fact that they do not require large machinery, they soon spread to urban construction all over the world.

China began to apply artificial bored piles in the early 1960s, and first in coastal areas, and later in Beijing, Shanghai, Shenzhen, Guangzhou, and other large and medium-sized cities widely used in bridge foundations, high-rise buildings and other large buildings. In recent years, due to the advantages of simple process, wide range of application, relatively small impact by climate, safety and reliability, low cost, flexibility, and can be carried out in a large area, so from the principle of local conditions, convenient construction, to ensure the pile foundation bearing capacity, in the western region of China construction, especially in the region of complex and changing mountainous areas are widely used[2].

The development of the domestic electric power and energy industry is the main condition to promote the development of the local economy. In the past 20 years, with the increase of national financial support and the in-depth development of electric power, the national electric power and energy industry has achieved unprecedented development, producing huge economic benefits reflected in all aspects of people's lives, and the basic and pioneering role played by electric power in promoting and

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driving regional economic development is irreplaceable. With the strong national investment in the construction of Qinghai and Tibet, the scale of power transmission and transformation projects in high-altitude areas is expanding. And the construction environment of foundation artificially dug hole in high altitude area is harsh and the construction is difficult; for 500KV transmission substation foundation project in high altitude area, such as concrete quality control of artificially dug hole pile, the quality of foundation concrete directly affects the development of later work and even the safe and stable operation of the whole line, combined with the fact that this project is located in Tibetan plateau area, research "500KV transmission substation foundation project in high altitude area Manual pile concrete quality control points", mastering the key technical quality control points and measures and methods of construction in high altitude and alpine areas, the duration of the foundation construction in Tibetan areas and construction quality assurance has been effectively improved, this study to ensure that the company safely and efficiently complete the construction task of high altitude areas of the plateau project, while providing mature technical guarantee for the company similar to other areas of line construction. It is of great significance to the development of the west and to improve the quality control of construction on site; to provide a strong guarantee for the development of infrastructure construction in the plateau area[3].

2. Theoretical and Practical Basis of the Study

Sichuan-Tibet Railway Changdu to temporary section construction power supply project (phase II) package 5: Lancangjiang ~ Bomi 500 kV line project (crowded village - crowded village), starting from the crowded village near the N2023 tower, ending at the crowded village N2104 tower. The whole line of new towers 81 bases, 10 bases for rock inlay foundation, 4 bases for infill pile foundation, 67 bases for artificial excavation foundation[4]. The project location is 4100m-4900m above sea level, high altitude, mechanized construction is difficult, for the complex and changing mountainous areas for artificially dug pile excavation is more practical, combined with the construction process quality control points, and summary analysis, so as to reduce safety risks, improve construction quality, for the plateau area artificially dug hole foundation construction to provide favorable protection.

3. Suitability of Hand-dug Piles in Highland Areas

Hand-dug piles have many advantages, but they are also limited by the conditions in actual construction. Manual bored piles are not suitable for use in all areas. For the excavation of pile foundation in high altitude areas, we should study the design drawings carefully before the project starts and understand the geological conditions of pile foundation clearly. For most of geological conditions in Tibetan Changdu area are suitable for hand-dug pile foundation. Combined with the actual conditions of the construction site, among them, the construction method of hand-dug pile is suitable for the foundation excavation in high altitude areas[5].

For the suitable use of artificial bored pile conditions are generally: good construction geology, no sudden water and mud, no groundwater, and the longest artificial bored pile does not exceed 15 m, the pile diameter is not less than 1.2 m. For high altitude areas the practicality of artificial bored pile is mainly reflected in.

1) The use of hand-dug pile construction process is simple and convenient, for construction machinery requirements are not high, high altitude mountainous construction environment does not meet the large apparatus into the field conditions, in the construction process only need accurate positioning, excavation work rely on manual, with strong mobility and hand-dug pile required equipment is simple, the pollution of high altitude areas is small, the construction quality is easy to receive control.

2) In high altitude areas using artificially dug pile construction process, artificially dug hole process will not produce mud, the noise generated during the construction process is also relatively small, artificially dug hole pile in the construction process can be found in time, not affected by environmental terrain conditions, can be applied to most of the tower foundation excavation.

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3) The reinforcement rate of hand-dug piles is low, and the construction materials and construction costs are lower than those of mechanically infilled piles. In addition, the forming of hand-dug piles is easy to observe, and thus the construction quality of reinforcement cage and concrete can be effectively guaranteed.

4. Construction of Hand-dug Piles in Highland Areas

This thesis takes the new tower in Changdu area of Tibet as an example.

1) Preparation of materials and tools, foundation excavation. Before the foundation excavation carefully study the design data while calculating and analyzing, according to the design data and positioning cross pile point to determine the excavation position, and then use white lime to draw the hole pile center position, and then ensure that the artificial excavation pile positioning accurate, no position deviation.

2) The pile hole should be excavated from top to bottom, and the center of the hole should be excavated in order to ensure the size of the hole. For the excavation of the soil and rocks produced in time to transport to the ground, can not be randomly piled in the pile hole, pile hole of the inner wall to be smooth and flat, the ground should be flat.

3) In order to prevent the collapse of the pile hole wall, to ensure the safety of construction into the hole should be set retaining wall. The tower foundation is set up with steel retainer, retainer hole diameter is 1.6 m, retainer buried at the bottom of the replacement clay and ramming, the thickness is 0.5 m. The retainer surrounding ramming filled with dense clay. The height of the barrel is at least 300mm above the ground and not less than 500mm above the top elevation of the pile, the deviation of the plane is not more than 50mm, the deviation of verticality is not more than 1%, the barrel is required to withstand compressive and tensile stresses and no water leakage.

4) In the production of reinforcement cage can be separated from its skeleton to a section of the production, the specific data according to the design needs to determine, in the storage and delivery of reinforcement cage to ensure that the shape of the cage remains unchanged, can not be deformed, after arriving at the construction site with a crane will be lifted and placed in the pit, in the right position will be welded well to meet the specification requirements.

5) Concrete filling of pile body. When the reinforcement cage is in place in the shaft, it can be filled with concrete, and the concrete should meet the design requirements. Concrete filling is not to pour concrete directly into the well at the wellhead, which is easy to make concrete segregation, so that the strength of the column is weakened. Concrete should be injected into the well with a string of buckets, the optimal distance from the ground to the mouth of the string of buckets is 2m, and to reduce the number of string of buckets as the amount of concrete in the well increases.

6) The verticality and center of the pile hole should be strictly controlled, and the verticality and center of the pile hole should be determined in time after the pile hole retaining wall is ready with tools such as lifting hammers and radius rods to ensure the verticality and center of the pile hole are accurate.

7) The final hole of the pile should ensure the design pile length. In the final stage of excavation, the ground soil quality should be checked to ensure that it is on the specified bearing layer.

8) In the filling of concrete requires a one-time completion, there can be no pause, to ensure that there is no gap between the column body.

5. Quality Control Points of Hand-dug Piles in Highland Areas

5.1 Note the Phenomenon of Water Gushing

1) After the emergence of water to pay attention to the reasons for its emergence to investigate. In general, in the excavation process occurs in the fracture of the rock layer and in the fracture joints just when there is water in the excavation of the hole pile will appear water.

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2) The emergence of water will have a great impact on the quality of the pile column, which will cause a decline in the quality of concrete, making the pile column fracture or even cause the collapse of the hole.

3) The emergence of water gushing phenomenon to immediately stop construction, stop all underground operations, by technical personnel to analyze the causes of water gushing, and take relevant measures to solve the problem. If the initial can not accurately determine the cause of water gushing should be to the bottom of the well to collect information, as soon as possible to find out the cause.

5.2 Note the Phenomenon of Sand Gushing

(1) In some areas with rich groundwater sources, when excavating to the sand layer, it is easy to occur the phenomenon of sand surge, which will bring great trouble to excavation, making the pile hole can not be shaped, and if not handled in time, it may even lead to collapse.

(2) When encountering the situation of sand surge, you can reduce the depth of one-time excavation, reduce the direct appearance of sand, use anti-filtration geotextile to support the sand, and then remove the template of the retaining wall after it is built.

5.3 Some Other Points to Note

(1) For some areas, there are more silt in their strata, humus and other mud containing a lot of organic matter, which can easily produce toxic gases such as hydrogen sulfide and methane in the humid underground environment, and such gases are accumulated in the bottom layer due to their generally higher density. Measures for the phenomenon of toxic gas. Generally, for holes with little depth, live experiments can be used.

(2) In the construction process, there are often accidents such as falling into the well, electric shock, falling object strikes, etc. Such accidents are caused by irregularities in construction operations, and are also related to the weak safety awareness of construction personnel. Therefore, it is necessary to standardize the construction and emphasize construction safety to avoid such accidents during the actual construction.

6. Summary

The construction of artificial borehole piles on highland slopes generally takes construction access roads or mountain paths to transport materials, abandoned earth and personnel, which is inefficient and has high transportation cost. The construction of artificial borehole piles with zero brush slope construction method can effectively reduce construction cost, improve construction efficiency and construction quality, and guarantee the safety of construction personnel. At the same time, it maintains the original landform of the slope, protects the ecology and reduces the damage to the ecological environment of the area.

References

[1] Du Yanping. Design and research of tower infrastructure in highland areas [J]. Yunnan Electric Power Technology,2017,45(02):139-141.

[2] Buybaiti Aili Tursun. Introduction to the construction process of hand-dug piles in plateau areas [J]. Heilongjiang Transportation Science and Technology,2013,36(02):155.DOI:10.16402/j.cnki.issn1008-3383.2013.02.130.

[3] Wang G, Huang JX, Wang ZF. Overview of zero-brush slope construction method for artificially dug piles on highland dangerous slopes[J]. Bulk Cement,2022(05):174-176.

[4] Xie Guifang. Research on quality control of construction process of hand-dug pile foundation [J]. Quality and Market,2021(07):60-62.

[5] Zhang Xuehua. Quality control of artificially dug pile foundation construction in electric power engineering[J]. Science and Technology Information,2006(12):19-20.DOI:10.16661/j.cnki.1672-3791.2006.12.017.