Research on Construction Method of Micropiles in Transmission Lines

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Abstract. With the development of the national economy, the available land for industrial construction is becoming more and more restricted, and the paths of transmission lines and transformation projects mostly pass through regions with complex geological conditions such as mountains. The drilling micropiles foundation of transmission lines can be widely used in mountainous areas because of its strong adaptability. This paper mainly introduces the characteristics of micropiles foundation construction method and puts forward the construction process and operation points.

1 Characteristics of construction method for micropiles

The micropiles foundation has the advantages of large bearing capacity, well stability, a small settlement, and material saving in the use of functions [1-6]. Drilling micropiles has the advantages of strong adaptability, simple construction operation, and small equipment investment. However, due to the construction of drilling micropiles are mostly carried out below the ground, the construction process cannot be directly observed, which brings inconvenience to the pile quality inspection. Drilling micropiles can also pass through various geological layers and embed them into bedrock.

2 Craft principle

The principle of micropiles technology is to directly form holes on the designed pile position, use the drilling rig to break and grind the rock stratum, use the air compressor to exert pressure to bring out the drilling slag, form holes by the soil or rock mass structure, or use the mud to protect the wall. After cleaning the hole, put it into the reinforcement cage, and then install grouting pipe, pouring, to complete the construction of micropiles foundation.

3 Construction process and operation points

3.1 Construction process flow chart

The construction process of this typical construction method is shown in Fig.1.

3.2 Operational points

3.2.1 Construction preparation

Construction personnel should be familiar with the construction drawings, complete the preparation of micropiles construction work instruction and approval. Before construction, all construction personnel shall be required to carry out safety technical clearance.

Drilling rig operators must be trained and obtain relevant qualification certificates before they can be employed.

Measuring, testing instruments, and steel rulers must be qualified before use. Safety hazards should be checked in the hydraulic oil circuit and mechanical parts of the equipment to ensure that the hydraulic system is good and the construction safety is ensured. According to the geological survey report, the geological conditions of the construction pile are summarized and analyzed, and different drill bits are selected according to different geological conditions.

The construction site should be smoothed to ensure the smooth construction site of the rotary drilling rig and avoid the subsidence of the drilling rig during drilling. The construction area, tool area, test area, material processing, and stacking area should be arranged reasonably. Measurement release: according to the spacing, row spacing, and elevation provided by the design drawings, the measurement release is carried out. Pore spacing positioning: according to the design of hole diameter, spacing, row spacing using chopsticks into the underground positioning.

After the in-situ drilling rig is set up on the working platform, the moving drilling rig makes the turntable center roughly aligned to the foundation center, lifting the bit, displacement drilling rig, so that the bit center is right to the pile. Pile position deviation should be

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controlled within 20 mm, vertical deviation of the straight pile should not be greater than 1 %, and inclination of the inclined pile should be adjusted according to design requirements. Hold the rig chassis level, you can start drilling. When the inclined pile is drilled, the inclination of the drill pipe is checked with the compass by using the method of the rig footplate pad height to the requirements.

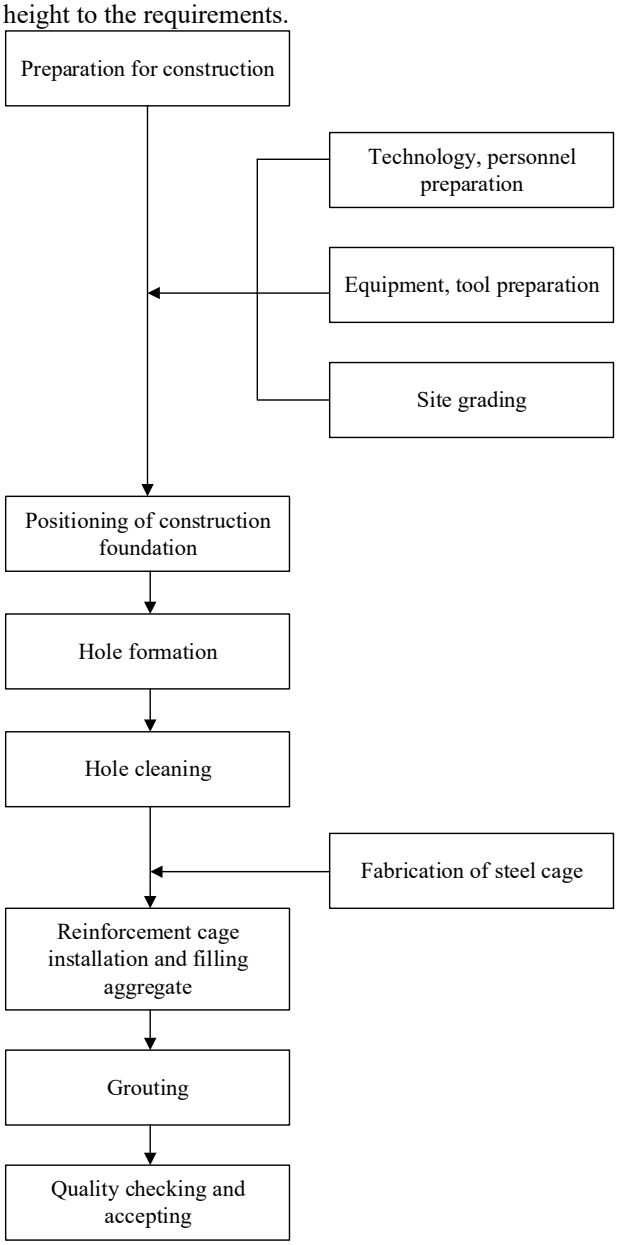

Fig. 1. Micropiles construction technology flow chart

3.2.2 Hole formation

According to different design requirements, different machines are selected for micropiles drilling. According to the engineering geological conditions, dry hole drilling or slurry wall drilling can be used. In the construction of micropiles, the phenomenon of perforation and large loss of grout along the sand layer should be prevented, and measures such as hole-jump construction, intermittent construction, and increasing accelerator can be used for treatment.

3.2.3 Hole cleaning

Clearing holes for dry holes. When the dry hole is cleared, the hole is cleared directly through the rig itself. The soil is blown out by the bit pressure, and then the bit is lifted out of the hole for repeated flushing to complete the whole cleaning operation.

Cleaning hole for slurry wall protection. The mud was used to protect the wall and form the hole. After forming the hole, the water was washed to clear the hole, so that all the mud in the hole was discharged.

3.2.4 Fabrication of steel cage

When making a steel cage or steel frame, longitudinal reinforcement should be uniformly arranged along the circumferential direction. The diameter and spacing of stirrups, the protective layer of longitudinal reinforcement, and the spacing of stiffeners should meet the design requirements. When binding between stirrups and longitudinal reinforcement (main reinforcement), welding should be adopted at both ends and central part of stirrups, to increase the strength of the reinforcement skeleton and facilitate hoisting into holes.

In addition to meeting the design requirements, the diameter of the reinforcement cage should also meet the following requirements: the diameter of the reinforcement cage should be more than 100 mm larger than the outer diameter of the pipe connection when the micro piles are poured into the underwater concrete by the pipe method. During the manufacture, transportation, and installation of steel cages, measures should be taken to prevent excessive deformation and to set up protective cushion blocks.

3.2.5 Reinforcement cage installation and filling aggregate

When the reinforcement cage is suspended into the hole, it should be aligned to the center of the hole, and the hole wall should not have collided. The reinforcement cage should be suspended and stabilized, and it will sink slowly. After the reinforcement cage is down to the design position, a lifting hook is welded on the top to lift the reinforcement cage to be fixed on the frame or the steel pipe on the ground, and the position of the reinforcement cage is fixed to prevent the success or failure and displacement during pouring. After the reinforcement cage is suspended, the initial grouting pipe is lowered into the hole.

After the reinforcement cage is filled with gravel aggregate and the grouting pipe is suspended, the gravel aggregate is filled to the top of the borehole. When the gravel aggregate is filled, the high-pressure water is continued to be injected into the borehole through the initial grouting pipe to clear them to prevent the soil from mixing into the borehole with the rock filling.

3.2.6 Grouting

The cement of the cement slurry is ordinary Portland cement. The cement slurry is prepared 30 min before the water injection slurry, and the cement slurry enters the slurry pump, which is then pumped into the grouting pipe.

The initial water injection mud hole to hole out of the mud sand to meet the requirements of the mud proportion, the initial water injection mud when the normal pressure of the water injection mud pump is controlled at about 0.3Mpa; When injecting water into the slurry, the cement slurry should rise uniformly until the filling is full, and the thick slurry is produced at the orifice, and the first injection slurry is ended.

Secondary water injection mud to the first injection of the cement slurry to achieve the initial setting, in 5 ~ 7 hours after the start of secondary water injection mud, secondary water injection mud grouting pressure is 2 ~ 4Mpa, from the bottom to the upper grouting, grouting while pulling up the grouting pipe, should maintain a certain upward speed, after pulling out the grouting pipe should be immediately filled with gravel at the top of the pile, and in the range of 1 ~ 2 m supplementary grouting.

3.2.7 Drilling rig withdrawal (transfer) field

The degree of drilling machine disassembly after foundation pouring depends on the situation of the withdrawal (rotation) field. Crawler rigs or automatic walking rigs do not need to be dismantled, and the drill pipe is tilted backward by 45° when the field is transferred to the next designated construction site. Other non-automatic drilling rigs should use flat cars and trailers to transport the rotation field, and the drill pipes and bits should be removed before the rotation field is removed.

3.2.8 Foundation maintenance, pile cap foundation stripping

To make the cast-in-place concrete have suitable hardening conditions and prevent its abnormal shrinkage, to prevent the exposure of concrete surface cracks, the concrete is covered and watered. The maintenance of concrete shall begin within 12 hours after the completion of concrete pouring (hot and dry windy weather for 3 hours). Coverage should be added to the base template, watering times to protect the concrete surface humidity. No water shall be poured when the daily average temperature is lower than 5 °C, and the water for maintenance shall be the same as that for mixing concrete.

The mold removal time varies with the ambient temperature during curing and the type of cement used. The foundation demolding gate should be strictly controlled, and the top-down demolding should be carried out to ensure that the concrete surface and corner are not damaged, and the strength should not be less than 2.5 MPa.

4 Quality control

4.1 Hole formation

Before drilling, to ensure the verticality of the pile, it is necessary to adjust the flatness of the drilling rig before and after the horizontal ruler. To control the deviation of the pile position, the pile position is accurately determined by the instrument before drilling, and the chopsticks are fixed on each pile position. When drilling, the center of the bit is aligned with the head of the chopsticks before drilling. To ensure that the size of the drill bit is measured with a ruler before the pile diameter is drilled, it is found that the diameter is not enough to immediately replace or repair the drill bit. The drill bit is measured once after each footage reaches 200 meters. If the hole is a dry hole, after the hole is formed to the design elevation, the drilling rig air compressor is used to directly wash the hole, and the final measured depth is the design depth. The hole is formed by a drilling rig with water. After the hole is formed at the design elevation, the drilling rig should be used to wash the hole directly. The mud in the visual hole is no longer turbid to place the steel pipe to put stones. And make construction records.

4.2 Production of grouting pipe

The initial grouting pipe adopts Φ48 × 3.6 mm steel pipe. For the pile length is too long, the steel pipe needs to be welded by butt welding. Three steel bars with 160 mm length are used to strengthen the outer side, and the rubber sleeve is used to seal the interface if necessary. secondary grouting pipe selected Φ48 × 3.6mm steel pipe, grouting pipe 1 / 3 length in the lower range of each 30cm plum blossom type layout grouting hole, the diameter of the grouting hole is 8mm, the hole is directly spotted by electric welding machine, the grouting hole is closed with a rubber sleeve, the lower mouth of the secondary grouting pipe is smashed and flat sealed. secondary grouting pipe tied in the reinforcement cage, with the reinforcement cage into the borehole.

4.3 Negative temperature welding of steel bar

When the ambient temperature is lower than −20°C and the wind speed exceeds grade 3, a heating shed should be set up. The welding operators and welding parts are carried out in the heating shed to avoid the ice and snow and rapid cold brittleness of the welding sample.

In the actual welding process, appropriate current can be selected according to the grade, the diameter, and welding position of the steel bar to prevent overheating, burning, bite, and cracks, and stratified temperature control welding can be used.

5 Analysis on superiority of micropiles application in transmission lines

5.1 Pressure grouting can improve the mechanical properties of soil around the pile and increase the bearing capacity of the foundation

There are two ways to improve the anti-overturning capacity of the tower foundation: strengthening the stiffness and strength of the foundation and improving the resistance of soil around the pile. Under the condition of certain strength and stiffness of the pile, the stress characteristics of the soil around the pile can be improved by pressure grouting, and the anti-overturning bearing capacity of the transmission lines foundation can be improved. The theoretical basis is the splitting grouting theory and the compaction grouting theory.

Splitting grouting is based on high grouting pressure to overcome the initial stress and soil shear strength in the foundation, so that the soil splits along the plane perpendicular to the small principal stress or the plane with the weakest soil strength, and extends the splitting surface. After the slurry enters the soil along the splitting surface, on the one hand, the soil is improved, on the other hand, the pressure slurry is applied to the surrounding soil. With the extension of time, the compressed soil is consolidated, and the soil strength is also significantly improved.

Compaction grouting is to inject a high concentration of slurry into the foundation soil, which forces the soil near the grouting point to compact and form slurry bubbles. At the beginning of grouting, the grouting pressure spreads along the radial direction. With the expansion of the grouting bubble, the grouting pressure increases, the soil around the slurry is compressed and deformed, and the soil in a large range is compressed, resulting in compaction and consolidation. When the grouting pressure is large, it will also produce upward lifting force.

5.2 The pile group effect coefficient of the micropiles group pile foundation has little influence

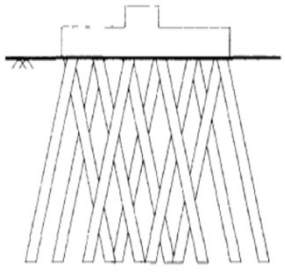

Fig. 2. Diagram of composite micropiles foundation

In engineering practice, micropiles are often made into mesh structures (composite micropiles), as shown in Fig.2.

Composite micropiles often adopt the form of spatial distribution pile groups, which are connected by a group of vertical and inclined micropiles in three-dimensional space according to the network. There are both straight piles and inclined piles, forming a laterally constrained pile-soil composite structure. It can not only meet the requirements of compressive strength but also bear large uplift force and horizontal force. It can effectively improve the mechanical properties of straight pile group piles and reduce the deformation of the foundation under various loads.

The composite micropiles foundation strives to make the inclination of the inclined pile consistent with the direction of the resultant force of the uplift force and horizontal force on the foundation or the direction of the resultant force of the lower pressure and horizontal force, to give full play to the characteristics of the large axial bearing capacity of the pile foundation and improve the bearing capacity of the foundation.

6 Summary

The results show that when the load is the same, the geological conditions are not good, and other foundation forms cannot meet the stress requirements or construction difficulties, the micropiles foundation can reduce costs and save costs because of its prominent structural characteristics. Correct selection of construction methods, reasonable equipment and personnel, scientific calculation of material ratio, control of concrete filling coefficient and over-irrigation, and improvement of labor productivity are effective ways to control and reduce the construction cost of micropiles.

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