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Research Article

Characteristics and Construction Technology Analysis of Static Pressure Prestressed Pipe Piles in Construction Engineering

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Abstract: The development of urbanization has led to an increase in the number and scale of construction projects and the types of building construction engineering are getting advance and diverse due to the rapid development of technology. One of them is the static pressure prestressed pipe pile which is the most commonly used technology in modern building construction work. It is mainly used for pile foundation in construction work, and it has the advantages in less pollution, low noise, and high efficiency compared to the traditional pile foundation. Study on the characteristics of static pressure prestressed pipe pile must be carried out and strengthened the research to increase the effectiveness and quality of static pressure prestressed pipe pile on construction works. This paper is mainly to analyzed the characteristic and construction technology of static pressure prestressed pipe piles on building construction work.

Keywords: *building construction work; static pressure prestressed pipe pile; characteristic; construction work technology*

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0 Introduction

Pile foundation is an important part in construction work to ensure the safety of building construction project. The techniques of pile foundation in construction work are more advance while the technology is improving. The static pressure prestressed pipe pile technology has become the main technical method in the current pile foundation construction. Static pressure prestressed pipe pile construction is a high-strength prestressed construction method which has the advantages of strong stability and large bearing capacity and requires less construction cost. Static pressure prestressed pipe piles, currently, have been widely used in the construction of high-rise buildings or tower. However, application of static pressure prestressed pipe piles in construction works will also be interfered by many factors, which will seriously affect the construction works, so it is necessary to solve and improve against the problems.

1 Characteristics of static pressure prestressed pipe piles

Static pressure prestressed pipe pile is a new type of pile foundation with the column that made up from high strength concrete and a steel cylinder with relatively strong prestressed capacity. It has some features in the actual application process, the prestressed pipe piles have a wide range of applications, the diameter of the pipe string is generally in between 300 and 1000 mm, the thickness is controlled in the range of 80–120 mm, and the length is generally 5–15 m. The type of pipe string can be sorted according to the specific model such as prestressed concrete pipe columns and thin-walled pipe columns and the type of pipe used can be selected reasonably according to the region and geological conditions.[1] For example, a pipe column with a diameter of 300 or 400 mm can be selected in the civil engineering construction project, and 800 mm pipe column can be selected for a highway.

Among the different types of static pressure prestressed pipe pile, the bearing capacity of the single concrete pile is much more stronger, as in the extrusion, the

bearing capacity of its pile end can be increased around 50% compared to that of the original pipe pile and thus it has higher speed in digging compared to the manual digging pile. In addition, the production of the pipe piles it must be customized according to the needs of the actual situation. Under normal circumstances, the length of the pipe piles will not be affected by the length of the single pile column, but the lengthening process must be done in a standard factory. Furthermore, in the production of pipe piles, it must mix the appropriate ratio of the different materials such as mineral powder and aggregates of rocks and mineral fragments according to the actual requirements of needs. Different construction projects will use the different strength of the pipe piles.[2]

In addition, to ensure the environmental protection of the construction, the prestressed pipe piles need to be produced by the manufacturers and industrialization for standardization and then transported by the factory to the construction site. Therefore, it is necessary to carry out prefabrication in advance, the construction speed is fast, and the quality still has no problems. At last, the foundation of the pile will be inspected and checked after it is produced.

2 The Analysis of Process Flow of Static Pressure Prestressed Pipe Piles

Static pressure prestressed pipe pile construction is an important way in pile foundation of current building construction works. To ensure the quality and efficiency of construction work, it must be strictly carried out according to the process flow of static pressure prestressed pipe pile, and the process flow of the static pressure prestressed pipe pile will be analyzed.

2.1 Production process of static pressure pipe pile

The construction process of the static pressure pipe pile is as follows: The measurement of the pile position, the pile foundation is transported at the place, the lifting and inserting of the pipe pile, the adjustment of the pile body, the static pressure in the pile, lift up the pile, re-sink the pile, crimping the pile, check and accept the pile status, and finally to cut the extra tip of pile.

2.2 Preparation of static pressure prestressed pipe piles before construction work

Before the beginning of construction works, the construction site must be cleaned, and the obstacles and wastes on the construction site are completely removed. The underground pipelines must be nicely paved and protected to ensure the completion of three supplies and one leveling (which are the access to water supply, access to electricity supply and road assessment, as well as land leveling). Second, according to the specific construction organization design requirements, reasonably select the construction equipment, tools, and arrange construction work schedules, and draw up the specific amount or demand for the materials and equipment.[3] Again, check the quality of the pipe piles, ensure that the pipe piles must have the factory certificate and inspection report, and make sure the strength of the pipe piles must meet the corresponding design requirements, and the pipe piles should not be stored until four floors height. Finally, must nicely done the pilot work for axis which is a distance of 6–8 m must be drawn outward at the control point of the pile axis, and the measurement error must be controlled within 10 mm during the measuring process.

2.3 Analysis of the main points of hanging and instrumentation

In the lifting process of the pile, certain technical points need to be followed to ensure the safety and efficiency of the pile lifting. It is necessary to maintain a vertical state between the preset point of the pile and the pile body, and the error is controlled at 0.5%. After the pile is steadily stabilized, the piledriver is re-started. In the process of pile pressing, first pressing is from the lateral direction, and then the pile is pulled and pushes to become straight. After the pile is guaranteed to be in position, the place of pile foundation is adjusted to ensure that the pile tip and the center of the pile are in the same straight line and parallel, and the pile is pressed again. In the process of pile pressing, the speed of process must be strictly controlled. The pressing process is stopped when the pile is pressed into the soil about 1 m in, adjusts and proofreads the horizontal and vertical direction against the insert point of pile and to ensure that the pile tip and the pile center are always maintained in the same straight line, then pressing of the pile is carried on.[4]

2.4 Analysis of technical points of piles

In the process of pressing piles, the angle of pile body must be ensured, and the first section of pipe pile must be controlled in a vertical condition which its deviation is within 0.5% vertically, to ensure the accuracy of pile position which can be observed from the directions of

vertical and horizontal. The forward and side direction of the pile can be adjusted using the theodolite and tow rope. Then place the level at a position of about 5 m from the pile foundation, accurately measure the length of the pile, and mark it to ensure that the position of the mark is consistent with the actual position of the pile to meet the design requirements of the pile foundation. Errors in the process of the pile pressing must be adjusted in time.

Before the pile is pressed, testing of pile pressing must be carried out to understand and records the pressure of pile, the depth of soil and the final pressure value of the pile to assure that the design requirements are met, and the construction quality of the pile is improved. In the process of pile pressing, the records (depth of the soil and the value of the pressure) which provide important foundation and parameters for the construction work of the pile must be recorded, and it is necessary to make corresponding records accurately. Furthermore, the bearing capacity of the pile can be effectively judged by observing the pile sinking depth and pressure changes. If the pressure suddenly rises or falls during the process of pile pressing, it is necessary to stop the pile work immediately and then to find out whether there is a hard object under the pile or a broken pile, etc., and continue to press the pile after confirming that there is no problem.

2.5 Analysis of continuous pile driving technology

In the process of pile pressing, to prevent the impact of the broken pile on the quality and progress of the pile, it is necessary to strictly control the speed of the pile and it usually controlled within 2 m/min. At the same time, the construction time interval of the same pile needs to be controlled within 30 min. If the pile pressing is in the hard soil, time interval of construction work must be strictly controlled to prevent the construction progress from being affected and the difficulty of lifting the piles due to the increase of resistance of frictions during the interval process.

2.6 Analysis of pile connection/join technology

In the process of joining the piles, it is necessary to carry out the specific pile joining method according to the specific conditions of the site. In the construction of the pile's connection, carbon dioxide gas is used to protect the welding, and the purity of carbon dioxide needs to be controlled above 99.5% to prevent the occurrence of pores during the welding process. In the process of joining piles, it is required that the pressed pile on the ground must be 0.8–1.0 m above the pile head, and then the joining process is carried on. During the pile joining process, the upper and lower pile sections must be kept straight, and the upper and lower short plates are cleaned to ensure the quality of the welding. It is needed to hold the leaking metal luster in the welded groove and the general pile joining port is U-shaped. The welding level must more than 3 layers, and to ensure the continuity of welding. The roof of the upper pile has a supporting effect on the whole pile, so it is necessary to weld the roof of upper piles. Defect on the weld part undercuts or extra welds are not allowed at the welding position.

2.7 Analysis of main points of piles joining technology

After the final pile is completed, the position above the ground needs to be cutoff. To prevent damage to the pile during the process of cutting the pile, it must be strictly carried out according to the requirements. The deviation of elevated length of the pile top needs to be controlled within 10 cm to ensure the construction quality of the static pressure prestressed pipe pile. Finally, the verticality and integrity of the pile body are ensured, and the quality and efficiency of the static pressure prestressed pile are improved.

3 The Control Points of Static Pressure Prestressed Pipe Pile Construction

3.1 Strictly control the quality of the welding pile tip

In the welding construction of the static pressure prestressed pipe pile, not only to perform spot welding on it but also to weld the joining point in 1 week of the welding point. In the process of designing static pressure prestressed pipe piles construction work, the pile tip must be penetrates into the stratum; thus, the requirement on its strength is relatively high. If the welding does not reach the corresponding strength, it will lead to cracks or shedding, and thus the pipe pile does not penetrate the soil layer, and this will affects the quality of the pipe pile.

3.2 Measurement of static pressure prestressed pipe piles must be done nicely

Before the static pressure prestressed pipe pile construction, it is necessary to do the measurement work and ensure the accuracy of the measurement. The level is mainly used in the measurement process,

maintains a reasonable distance between the level and the piledriver, and the length of the pile is measured using the level, and the marking and data recording is performed. In the process of inserting the pile, it is necessary to observe by the professional to ensure that the level line and the equipment mark are at the same level.

3.3 Strictly control the vertical degree of piles during construction

In the construction process, the verticality of the pile body must be ensured. To ensure the verticality of the pile body, it is generally detected by means of a cross and the testing is carried out. If the pile body is found to have a deviation in the verticality, it must be pulled out in time and re-inserted again. It is strictly forbidden to move the pipe pile during the construction process to avoid cracks or breakage of the pipe pile. During the construction of static pressure prestressed pipe piles, if the pile body does not enter vertically, the pile body will be fractured or crushed due to the problem of eccentric force during the process of pressing the pile, thereby reducing the bearing capacity of the pipe pile.

3.4 Pipe piles cutting processing work

After the pipe pile is pressed in, if the distance between the position of the pile inserted and the designed position is exceed the allowable error distance, worker will generally solve the problem by cutting the pile, and pile cutting process will greatly increase the construction cost, and also lead to the waste of materials, which will also have a serious impact on the bearing capacity of the pile. Therefore, it is necessary to carry out scientific and accurate calculations on the piles before the construction work to ensure that they can reach the pre-designed position and prevent the occurrence of post-rework.

4 Cases of static pressure prestressed pile construction work

During the construction of static pressure prestressed piles of project X, the specific construction conditions are as follows. The building has 20 floors and one underground floor with a total height of 80.43 m. The whole building consists of two parts which are the main building and the wing/annex building. The total floor area of the two sections is approximately 24,600 m^2. To ensure the construction quality of static prestressed piles, site surveys at the construction area are required before construction work start. The survey results showed that the range of artificial backfilling needed is 2–4 m, the thickness of seabed is 0.2–2.8 m, and the building pressure is 2.7×10^6 N. The specifications of the pipe piles and construction work process are reasonably selected according to the conditions above. In this project, the diameter of the pipe string is 400 mm, and the specific construction process is as described above.

5 Conclusion

In summary, static pressure prestressing construction has been widely used in building construction. Due to the advantages of static pressure prestressed pipe pile construction, its value and role in construction are relatively large, so it has been widely used in the construction industry. However, there are some problems exist in the application process in the actual construction work; thus, it must hold every detail reasonably and ensure the quality of the construction work to fulfill the corresponding requests.

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