

Study on Quality Detection and Reinforcement Effect of CFG Pile

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Abstract. There won't be too much of an issue in the terms of bearing capacity, but may be a problem in the CFG pile construction for the CFG piles composite foundation design. basis on the CFG pile quality inspection standards, test the construction technology of CFG pile and reinforcement effect of composite foundation respectively adopting borehole core testing, pile reflection wave method to detect, single pile static load test. The results show that, the CFG pile as same as the grave pile have the effect of compaction reinforcement and substitution on the foundation. Due to the higher strength of pile body, the pile can effectively transfer the load to the deep soil layer to ensure the displacement of pile for foundation reinforcement when the compacting effect not good in the cohesive soil.

1. Introduction

Basic engineering is the foundation of construction engineering. Its quality directly affects the safety and stability of the whole building structure, and relates to the safety of life and property of the people. From wood piles to reinforced concrete piles and steel piles, the construction technology has made continuous improvement and development. Because of the pile foundation construction with high concealment, there will be a series of quality problems, such as punching pile prone to neck, clamps mud, and hollow. It is an important task to find out these quality problems and take effective reinforcement measures to prevent them from happening.

This paper studies a project in Foshan. Putting forward a feasible strengthening scheme combining with the structure type, geological conditions and environmental conditions of the project to ensure the structural safety by verification test.

2. CFG pile testing technology

2.1. Testing standard

Because CFG pile belong to underground concealed works, the quality control should be through in the whole process of construction. The construction inspection should be in accordance with the provisions of the table.



Table 1. CFG pile quality inspection standards

Items	Check project	unit	Rules or allowable deviation	Check method
1	pile spacing	mm	± 150	Random inspect 2%
2	pile diameter	cm	Not less than the design	Random inspect 2%
3	Pile length	M	Not less than the design	Check construction records
4	concrete Strength	MPa	Within the eligibility criteria	Check according to appendix D of JTJ071-98
5	vertical degree	%	1.5	Check construction records

2.2. Drill and extraction test

The detection shows that the core is intact, the surface is smooth, the cementation is tight, the coarse aggregate is evenly distributed, the concrete core is gray and the fracture is well connected. The maximum compressive strength of concrete pile was 39.6MPa, and the minimum compressive strength of concrete pile was 32.5MPa. The mean value of the concrete core sample of the pile should be taken as the average value, because of the value of the compressive strength of the concrete core sample in two or more groups at the same depth of the same test pile. The test meets the design specification requirement. The sample data of pile concrete strength test is shown in table 2. Other component detection data is basically the same, no longer listed here. The detection of the extraction hole of the pile is summarized in table 3.

Table 2. Test pile strength data of drilling method

Name Location	Size(mm) (dia.*height)	Strength(MPa)	Conversion Strength (MPa)	Representative Value (MPa)	Age(d)	Design Strength Grade
44-10	83*83	31.4	35.7	36.3	61	C15
1.0-	83*83	32.5	36.9			
1.5m	83*83	32	36.4			

Table 3. Drilling core hole testing summary

Pile no.	pile diameter	Design pile length	Detection pile length	Drill hole depth	quality situation of pile body concrete	Concrete strength of check pile body	bearing layer situation of Pile end
	m	m	m	m		MPa	
44-10	0.4	16.00	16.14	16.67	Strong bonding	32.5	Mucky clay
30-19	0.4	16.00	16.18	16.72	Strong bonding	33.1	Sludge cohesive soil
9-6	0.4	16.00	16.05	16.70	Strong bonding	34.3	Sludge cohesive soil

2.3. Pile reflection wave detection

The basic principle of foundation pile reflection wave method which is used to measure the structural integrity of pile is that the stress wave is generated by applying the excitation signal at the top of the pile. When the stress wave is propagated along the pile body, the reflection wave will be generated when the discontinuous interface such as honeycomb, clay, fracture, hole and other defects and pile bottom surface are encountered. The time of propagation, amplitude and waveform characteristics of reflected waves can be analyzed to determine the integrity of the pile.

According to the figure of the waveform as shown in figure 1, the silicon design strength grade of the pile is required, the integrity of the pile structure is divided into four categories. The first kind, the pile structure is complete. The second kind, there are slight defects in pile body structure, but the structural integrity of pile is not affected. The third kind, there are obvious defects in the pile body, and other methods should be adopted to further check whether it is available. The Fourth Kind, there are serious defects or broken piles in the pile. The total test was 89 piles. The first kind, is 71 and the second kind is 18. The main performance is the quality defect of pile top, and the reason is that the pile head is not protected in time.

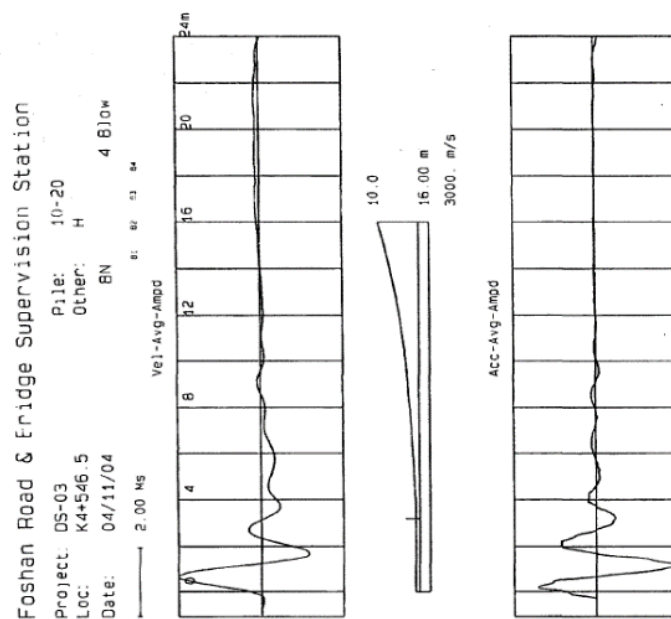


Figure 1. waveform figure of pile reflection wave method to detect pile body structure

2.4. Single pile static load test

In order to test the construction technology and the reinforcement effect of composite foundation, we carried out single pile static load test. The design value of the single pile bearing capacity of this project requires 240KN which is carried out by a pressure-weight platform reaction device.

As the load reaction force, the load weight of the pressure platform is more than the load of the maximum test load. The load is added to the platform at a time before the test, and the hydraulic jack is used for the test. The pressure plate is circular with a diameter of 400mm. The maintenance load method is used to load 1/10 of the maximum test load.

Two percentage tables are installed on both sides of the pile top, and the settlement amount is measured in accordance with the specified time. The accuracy of the percentage is 0.01mm. When the test load to 240.0 KN, the total settlement is 4.44 mm, the residual subsidence in 1.04 mm, bearing capacity design value 0.68 mm corresponding settlement measures. The ultimate bearing capacity of pile is $Q_u > 240.0$ KN based on analysis. Foundation reinforcement completely conform to the requirements of the design specification and the Strengthening effect is good.

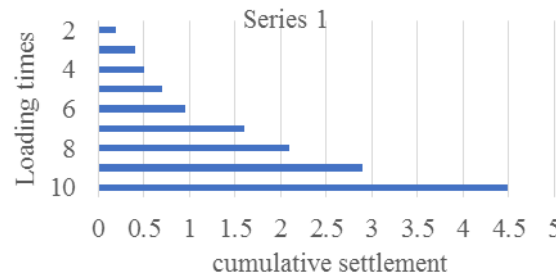


Figure 2. Corresponding relations between load and settlement

This paragraph project set up flexible and bidirectional geogrid mattress layer material between the pile and foundation which have a direct impact on the pile and pile composite subgrade soil strength between the play. That also improve the pile and the soil shear strength, which have a facto compensation effect on the uneven settlement of the foundation. The reasonable thickness of cushion layer is very beneficial to improve the bearing capacity of composite subgrade and reduce subsidence deformation, which will fundamentally solved problems of the relative deformation of piles and soil. The thickness of the paper puts forward is that the best the mattress layer is 30 cm. This test did not test of mattress layer thickness and literature data can be used as a reference.

Through the construction test, Small tube drawing too fast will cause the pile diameter small or necking pile even breaking, too slow may cause bleeding to make stone and cement pile end segregation which leads to the low strength of pile body. By the field test, tube drawing should follow the principle of "more slow pull" of vibration. It is appropriate tube drawing speed control in decannulation rate of 1.2 ~ 1.5 m/min. Mixture should be constantly in batches to join at the same time. Block of material test mixture ratio should be based on the actual construction site of the soil and water content ratio. Slump control in 4~6 cm, Proper adjustment according to actual condition. Do not allow the insert tube in the process of drawing and the mixture of perfusion must be continuous.

3. Conclusion

Based on the experience of the construction, the CFG pile body material can be mixed with industrial waste fly ash, not worthy to be reinforced, give full play to the bearing capacity of soil between piles in composite subgrade with. The force and deformation of CFG pile is similar to that of concrete pile, which with high subgrade bearing capacity, small deformation, stability, fast, simple construction, engineering, quality assurance and so on. So, economic benefit is very significant. The CFG pile improved the rigidity of the gravel pile, which make it not only can play a very good role on the side resistance of whole pile and at the same time also can play a role of its resistance. Therefore, it is widely adopted and achieved good economic and social benefits.

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