THE EXPERIMENT ABOUT RECOVERABLE ANCHOR CABLE IN THE FOUNDATION PIT SUPPORT

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KEYWORD: recoverable anchor cable ;foundation pit support; resistance to plucking of anchor cable

ABSTRACT: Using recoverable anchor cable is a good way to resolve problems about underground space occupation and waste of money . So the recoverable anchor cable applied in engineering has long and meaningful significance .this treatise uses the resistance to plucking of anchor cable in the certain unit dismantling and settling building for example ,and it proves that recoverable anchor cable is applicable.

Introduction

With the incessant development of construction trade, for guaranteeing someone's safety, foundation ditch becomes more important in engineering. However, foundation ditch as a temporary structure changes from necessary to rubbish. And some supporting structure has to stay at underground, and it not only occupies a lot of the space underground, but also causes the waste of money. This passage refers to the recoverable anchor cable which can solve the problem mentioned before. At the same time , this passage uses the resistance to plucking of anchor cable to prove the feasibility and importance of the recoverable anchor cable.

Project Overview

The project is the second bid section of dismantling and settling house of the residents whose status are changed from rural to urban in one plot and the project is located in Jiubao Town, Jianggan District, Hangzhou City. The second basement area in the south of the foundation pit adopts cast-in-situ bored pile plus two recoverable anchor cables and cast-in-situ bored pile plus one reinforced concrete horizontal inner support bracket, beyond the pit, three-axis cement mixing pile is provided to stop water and the foundation pit security is level 1, and the recoverable anchor cable connecting method is shown in Figure 1, 2 and 3.

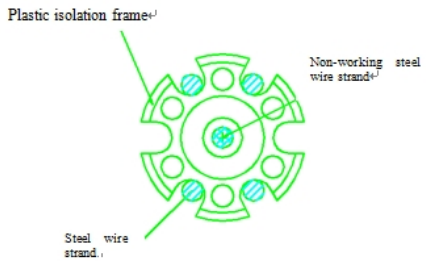

Figure 1. The structural drawing of recoverable anchor cable end

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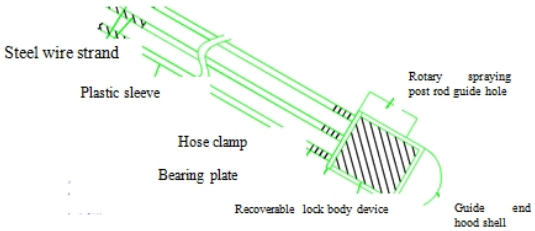

Figure 2. Anchor cable to bracket enlarged detail

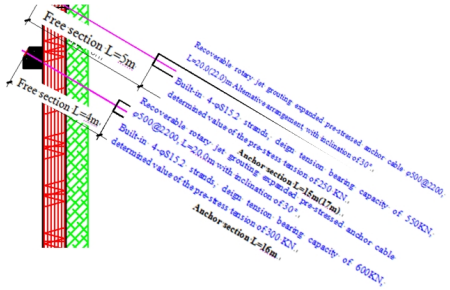

Figure 3. Anchor cable connection detailed diagram

The first basement area in the north of the foundation pit and the boundary area of the first floor underground and the second floor adopt soil nailing wall (shot anchoring net) bracket, the foundation pit security is level 2. The anchor cable construction is carried out following the principle of "by sections and floors, from top to bottom, anchoring first and excavation second" ,and the recoverable anchor cable construction process is shown in Figure 4.

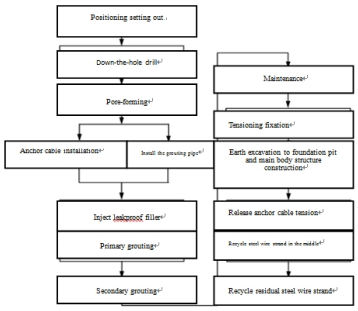

Figure 4. Recoverable anchor cable construction process flow chart

The three anchor cables in the test are test anchor cables with a total length of 20m and the whole length as free section, 4 bundles of Φ15.2 pre-stressed steel wire strand are built in the anchor cable and the design bearing pull-out capacity standard value is 700kN.

Geological Conditions

Foundation soil physical mechanics parameter list

Table 1 Foundation soil physical mechanics parameter list

Soil layer number	Soil layer name	Natural foundation		Pre-stressed pipe pile		Cast-in-situ bored pile		Pile periphery soil pull-out bearing capacity factor
		Foundation soil bearing capacity characteristi-c value	Compressi-on modulus	Side resistance characteris-tic value	End resistance characterist-ic value	Side resistance characteris-tic value	End resistance characteris-tic value	
		fak	Es1-2	qsia	qpa	qsia	qpa	λ
		kPa	MPa	kPa	kPa	kPa	kPa	-
①	Clayey silt	85	5.5	10		8		0.60
②	Muddy silt clay	75	3.2	11		10		0.75
③	Silt	180	9.0	32	1400	28		0.60
④	Clay silt	150	6.0	32	700	29		0.75
⑤	Silt	220	12.0	30		28		0.60
⑥	Completely weathered argillaceous siltstone	180	10.0			38		0.70

Inspection

Inspection equipment

100t centre hole jack, straight steel ruler, dial indicator, etc.

Inspection method

The test obtains the conclusion with multi-cycle loading method in basic test method through load-displacement figure analysis and diagram analysis. The loading grade and anchor head displacement observation time can be seen in Table 2.

Table 2 Multi-cycle loading test loading grading and anchor head displacement observation time

Cycle times	Ratio of grading load and maximum test load (%)						
	Initial load	Loading process			Unloading process		
First cycle	10	20	40	50	40	20	10
Second cycle	10	30	50	60	50	30	10
Third cycle	10	40	60	70	60	40	10
Fourth cycle	10	50	70	80	70	50	10
Fifth cycle	10	60	80	90	80	60	10
Sixth cycle	10	70	90	100	90	70	10
Observation time(min)		5	5	10	5	5	5

Reading time and discriminating stability standard:

(1)Under initial loads, the anchor head displacement reference value is measured for 3 times, when the degrees every 5 min are same, it can be the anchor head displacement reference value.

(2)After each grade loading and unloading is stable, anchor head displacement is measured for no less than 3 times within the observation time.

(3)When the anchor head displacement increment is not more than 0.1mm, the next grade load can be applied within each grade load observation time.

(4)After loading to the maximum test load, when the terminating loading conditions are not reached, the next grade loading can be carried out continuously.

Conditions of terminating loading:

(1)The anchor head displacement increment generated from the later grade load is larger than 5 times of the anchor cable displacement increment generated from the last grade load under unit load;

(2)Anchor head displacement is not constricted;

(3)Anchor rod body is broken.

Result determination:

(1)The ultimate pull-out bearing capacity of single anchor cable shall take the last load value of terminating load when the terminating loading conditions are occurred under one grade test load; when they are not occurred, it shall be take the maximum test load value.

(2)For the test anchor cable participating in the statistics, when the ultimate pull-out bearing capacity range is not more than 30% of its average value, the anchor cable ultimate pull-out bearing capacity standard value can take the average value; when the range is more than 30% of the average value, the test anchor cable number should be added appropriately and the anchor cable ultimate pull-out bearing capacity standard value should be determined after re-statistics based on the actual situations according to the cause of too large range.

Test Result Analysis

The ultimate bearing capacity conclusion results of three anchor cables obtained from the anchor cable pull-out test can be seen in Table 3 and its corresponding load- displacement curve, load- elastic displacement-plastic displacement curve can be seen in Figure 5-10.

Table 3 Anchor cable pull-out test results summary table

No.	Anchor cable number	Test date	Cyclic loading		Final loading		Ultimate bearing capacity
			Maximum test load (kN)	Cumulative displacement volume (mm)	Maximum test load (kN)	Cumulative displacement volume (mm)	
1	S1#	2015.3.16	700	99	840	123.4	≥840kN
2	S2#	2015.3.17	600	10.99	/	/	≥600kN
3	S3#	2015.3.18	500	82.8	660	115.4	≥660kN

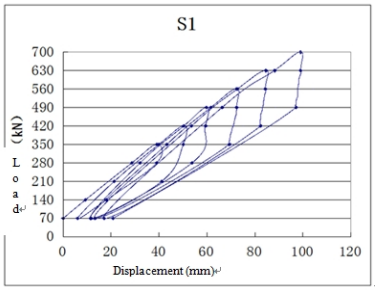

Figure 5. S1#Load - displacement curve

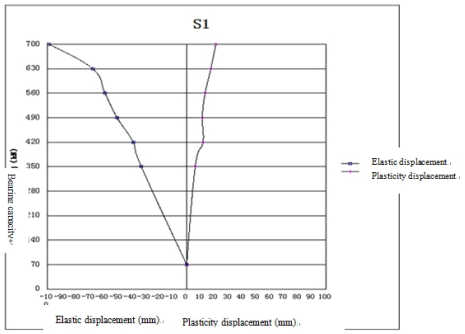

Figure 6. S1# Load - elastic displacement - plasticity displacement curve

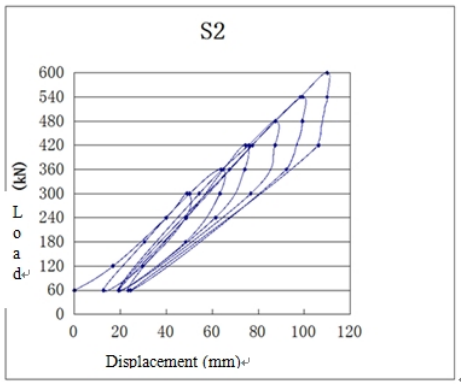

Figure 7. S2# Load - displacement curve

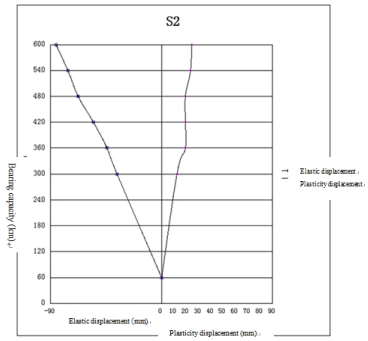

Figure 8. S2# Load - elastic displacement - plasticity displacement curve

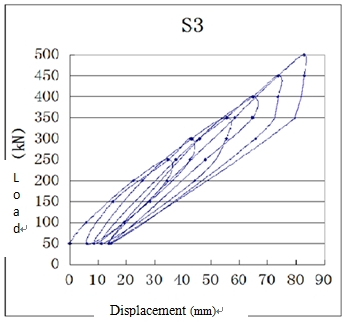

Figure 9. S3# Load - displacement curve

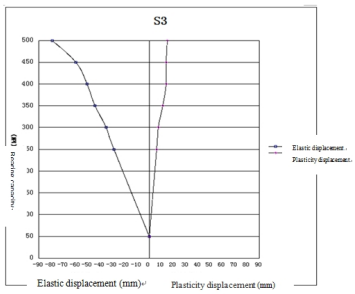

Fig. 10 S3# Load - elastic displacement - plasticity displacement curve

It can be seen from the figure：

S1 # test anchor cable is graded according to 700kN pull-out bearing capacity standard values and not broken within six-cycle loading scope, in order to test the anchor cable ultimate bearing capacity, the load is continuously loaded to 840kN, but the anchor cable is still not broken.

According to the anchor cable test site coordination meeting, considering the anchor cable may not be recycled for deformation on the anchor cable end because of too large loading value, S2# and S3 # test anchor cable is loaded circularly by grades according to 600kN and 500kN loads required by the design unit.

S2 # anchor cable is not broken under 600kN grading cyclic loading condition.

S3# anchor cable is not broken under 500kN grading cyclic loading condition and is still not broken after finally loading to 660kN.

Conclusion

(1) The recoverable anchor cable, which can not only reduce underground space resource occupancy, but also facilitate the cost recycling and saving, is one of the important methods for foundation pit bracket.

(2)The recoverable anchor cable displacement linearly varies with the multi-cycle loading of the tensile stress approximately and it is of very obvious laws.

(3)Through on-site project inspection, the recoverable anchor cable has a certain pull-out effect, which can be sufficient to provide the project with the required resistance to ensure its safety.

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