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Effect of Different Property Loess and Soft Soil on Foundation Pit Deformation based on flac3d

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ABSTRACT: Current foundation pit engineering is developing rapidly, and a series of projects are established on various types of soil. It is well known that the nature of the soil has a very important influence on the deformation of the foundation pit. Therefore, based on flac3d finite element software, the deformation phenomenon of two soft soil as foundation. In order to show the influence of the soil properties on the deformation of the foundation pit. It provides a reference for the corresponding engineering construction, especially the selection of foundation pit engineering support means.

KEYWORDS: Geotechnical engineering, loess; soft soil, flac3d.

I. INTRODUCTION

At present, with the rapid development of the construction industry, a series of construction projects have been erected, and one building floor stands tall. With the rapid development of the society today, the rapid development of foundation pit engineering is also facing more and more problems. Buildings are mainly built on the ground, which requires a good, firm foundation. The overall engineering nature of foundation soil still plays an important role and has a profound impact on the construction of buildings. The engineering geological nature of the soil is good, so it is not necessary to spend too much time and energy to consider the enclosure and support of the foundation pit. It also plays a role in the construction of the building. At present, the main bearing soil of buildings is soft soil and loess, so it is very important to prove the influence of foundation pit deformation under the action of loess and soft soil foundation. It even comes to the stability of the building.

II. RELATED WORK

At present, many scholars have studied the deformation of the foundation pit. Zhang Dashi [1] uses the finite element method to simulate the deformation problem of foundation pit excavation. The deformation law of foundation pit excavation in loess area is studied. It can promote the engineering construction in the loess area. Ren Jianxi et al. [2] combined with a foundation pit project in Xi'an in the loess region. They used FLAC3D software to simulate the excavation process, analyzed and studied the deformation of the foundation pit, and compared with the actual monitoring results, and obtained the relevant rules of excavation deformation of deep foundation pit in the loess area. Li Yuyang [3] Through the analysis of the loess region, xi'an is a regional engineering example as the research object, using the finite element software to study the influence law of foundation pit deformation in the loess region. Wu Yiqian [4] first summarized the current foundation pit deformation characteristics in the loess region, and then combined with the example of a deep foundation pit project in Lanzhou city, the foundation pit deformation was studied and analyzed through the finite element software simulation. Wang Yingcai [5] Combined with a project in Shanghai, we monitored the deformation of foundation pit retaining structure and surface deformation, analyzed and studied the deformation caused by foundation pit excavation in soft soil area. Zheng Gang [6], combined with specific examples, studies and analyzes the deformation of supporting structure caused by foundation pit excavation and the deformation of adjacent buildings caused by foundation pit excavation. The specific change of foundation pit deformation in loess area is obtained. Ding Xiangdong [7] uses finite element software to study a foundation pit project in Nanjing, analyzed and compared the simulation results with the measured results, so as to study the deformation of soft soil foundation pit. Wang Tianzuo et al. [8] analyzed the deformation law of the excavation caused by the foundation pit excavation, so as to summarize the deformation law of the foundation pit in the soft soil area. Most of the above literature has conducted a very rich research on the foundation pit deformation, and the influence of

the foundation pit deformation is analyzed by studying the real cases. The deformation phenomenon of foundation pit in loess area and soft soil area is analyzed. However, it rarely does special research on a specific factor to explore its influencing factors. Li Yanwei [9] Based on the deep foundation pit project of three support schemes in Suzhou, combined with the measured data of 15 related projects in Suzhou, analyzed the spatial and temporal evolution law of side movement and vertical deformation of soil wall, vertical deformation around and around the building. Zhou Xueliang [10] combined with the elliptic foundation pit project of 27.0 m deep in Shenzhen, established a three-dimensional numerical analysis model, and conducted a numerical simulation of the elliptic support scheme with different lengths and shortening proportions. The stress and strain characteristics of the supporting shell structure and the supporting ring beam are analyzed. Hu Ruigang [11] Taking the coastal earth-rock combined foundation pit project of adjacent buildings as an example, chooses the micro steel pipe pile-anchor-soil nail support method, based on the field measured data and PLAXIS finite element software, discusses the applicability of different soil constitutive models to the support structure deformation caused by foundation pit excavation. In the above literature, the comparative analysis method is used to study the influencing factors, but few people study the influence of foundation soil properties on the deformation of foundation pit. This paper is combined with the above literature, analyze and combine the two to compare and analyze the foundation pit engineering under different soil properties. At the same time, flac3d modeling software is used to study and explore the foundation pit deformation under different soil properties, in order to find out the corresponding rules and make contributions to the construction of foundation pit engineering.

III. METHODOLOGY

Simulation overview

The simulated building site is a homogeneous soil body, and the excavation size of the foundation pit is 20m long, 20m wide and 10m deep. The model size is set to be 50m and 50m 30m. By selecting the same test factor and changing the different properties of the soil, the deformation of the excavation of the soil is analyzed. The Moore coulmb model was used for the constitutive model. Boundary conditions, limit the horizontal vertical displacement of the base and surrounding areas, after the initial stress balance, conduct soil excavation and observe and analyze the deformation characteristics of the soil. The specific test parameters are shown in Table 1.

Main research ideas

Four kinds of soil were selected for flac3d numerical simulation to analyze the characteristics of base uplift, the horizontal displacement change of foundation pit and the settlement change of around foundation pit during excavation. The monitoring points are arranged to monitor and analyze the foundation pit uplift, the deformation of the side wall and the settlement around the foundation pit. Observe the change trend of foundation pit deformation with excavation time and distance, and study the deformation characteristics of different soils. The monitoring points are arranged as shown in Table Table 2.

Analysis and comparison of the test results .

Basal uplift

According to Figure 3, the final settlement deformation of all types of soil during excavation shows an upper convex shape of "small at both ends and large in the middle". Present with an elastic deformation stage. Its deformation shows a symmetry along the position of the central point of the base. Among them, the deformation of test four soft soil is 1.1-1.9m, the deformation of test three soft soil is 0.5-0.8m, and the deformation of test two loess and test one loess is 0.1-0.2m. From the above analysis, we can see that the uplift deformation of soft soil foundation pit is greater than that of loess. The base center is most deformed and subsequently decreases along the sides to the foundation pit side wall. This is mainly because the center of the foundation pit is mainly squeezed by the action of the soil on both sides, coupled with the unloading effect, resulting in the increase of shear stress, the soil on both sides to the center at the same time, resulting in upward uplift. On both sides of the foundation pit, in addition to the lateral extrusion force, there is also vertical stress, resulting in the resulting stress transmission along the soil to the center. Finally, the uplift and deformation are released in the center of the foundation pit.

Horizontal displacement of the foundation pit

From Figure 4, the horizontal displacement of the side wall of the pit with the increase of the height from the pit bottom shows a deformation trend of first increasing to the extreme point and then slowly decreasing the deformation, and finally reaching the equilibrium. Among them, the deformation amount of test 1 and test 2 loess is -5-0m, and the deformation trend is relatively flat, which mainly increases slowly and finally tends to the fixed value. The deformation amount of the test three soft soil is -35-0m, and the deformation trend increases rapidly first and then



decreases slowly and then tends to the fixed value. The deformation of test four soft soil is between-80-0m, and the deformation trend increases first, then decreases and finally tends to the fixed value. The difference of loess deformation in experiment 1 and experiment 2, while the variation of soft soil between test 3 and experiment 4 shows an obvious gap. This shows that the nature of the soil has a great impact on the horizontal deformation of the foundation pit side wall. The soft soil has great sensitivity to lateral deformation and the loess has little sensitivity to lateral deformation. With the different properties of the soil, the deformation is also very different.

Settlement around the foundation pit

As shown in Figure 5, the settlement around the foundation pit shows an inverted triangle with the distance, and the closer to the foundation pit, the greater the settlement deformation. The subsidence around the foundation pit of loess in tests 1 and 2 showed slow deformation. The change amount is basically the same, and the change interval is-5-0m. The settlement around the foundation pit of the test three soft soil showed an inverted triangle, with the change interval of-33-0m. The settlement around the foundation pit of the test four soft soil showed an inverted triangle, with the change interval of-83-0m. The variation of soft soil is greater than that of loess. The above deformation is mainly due to the excavation of the foundation pit, the dumping effect appears around the foundation pit, and the stress is released and dumped towards the periphery of the foundation pit.

Number of excavation steps

As shown in Figure 6, as the number of excavation steps increases, the maximum deformation of the foundation pit shows a general trend of increasing first and then flattening out. Among them, the change trend and change amount of test 1 and test 2 loess are roughly equal, and the deformation interval is 0-0.2m. The change trend of test three soft soil increases first and then balances, and the change interval is 0-0.7m. The change trend of test four soft soil first increases and then tends to balance, with the change interval of 0-1.9m. The change trend of soft soil is obviously greater than that of loess, and the change of soft soil with the number of excavation steps is obviously greater than that of loess. The sensitivity of soft soil is also much greater than that of loess.

IV. EXPERIMENTAL RESULTS

Table 1. Test soil parameters

Test parameters	Soil type	unit weight γ Kg/m ³	cohesive strength cKPa	angle of internal friction ϕ	modulus of elasticity EMPa	Poisson ratio ν	bulk modulus K	modulus of shear ing	tensile strength	data source
Test 1	New loess	21.6	24	22.5	15	0.28	11.36	5.86	0	[4]
Test 2	Loess soil	17.7	17	27	10	0.32	9.26	3.79	0	[4]
Test 3	Peat-containing silty clay	17	13	14	3	0.31	2.63	1.14	0	[12]
Test 4	Gray,	17.5	12	17	1.3	0.31	1.1	0.496	0	[13]



silty,	4	7
silty		5
clay		0

Table 2 Arrangement of monitoring points

Monitoring point number	Monitoring point coordinates	Detection content
1		unbalanced force
2	15 25 20	
3	17 25 20	
4	19 25 20	
5	21 25 20	
6	23 25 20	
7	25 25 20	Basal settlement
8	27 25 20	
9	29 25 20	
10	31 25 20	
11	33 25 20	
12	35 25 20	
30	35 25 20	
31	35 25 21	
32	35 25 22	
33	35 25 23	
34	35 25 24	
35	35 25 25	Horizontal displacement of the foundation pit lateral wall
36	35 25 26	
37	35 25 27	
38	35 25 28	
39	35 25 29	
40	35 25 30	
52	35 25 30	
53	36 25 30	
54	37 25 30	
55	38 25 30	
56	39 25 30	
57	40 25 30	Settlement of the soil around the foundation pit
58	41 25 30	
59	42 25 30	
60	43 25 30	
61	44 25 30	
62	45 25 30	

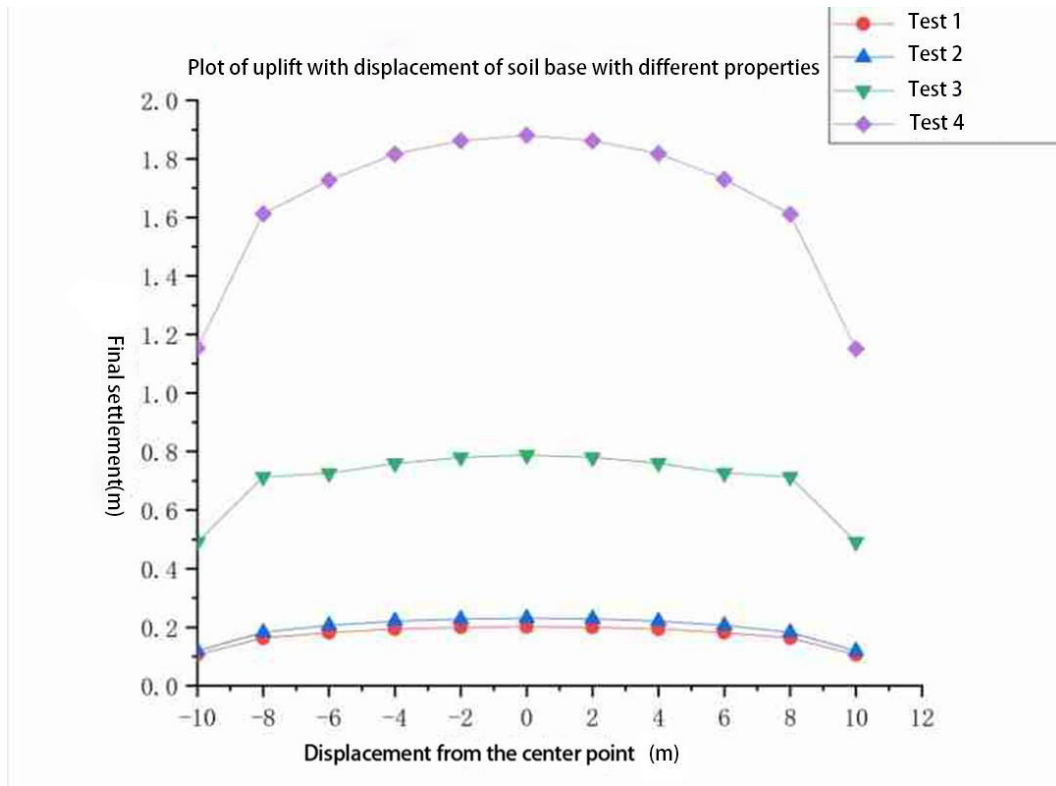


Figure 1 Plot of foundation pit uplift of different soil properties varying with distance

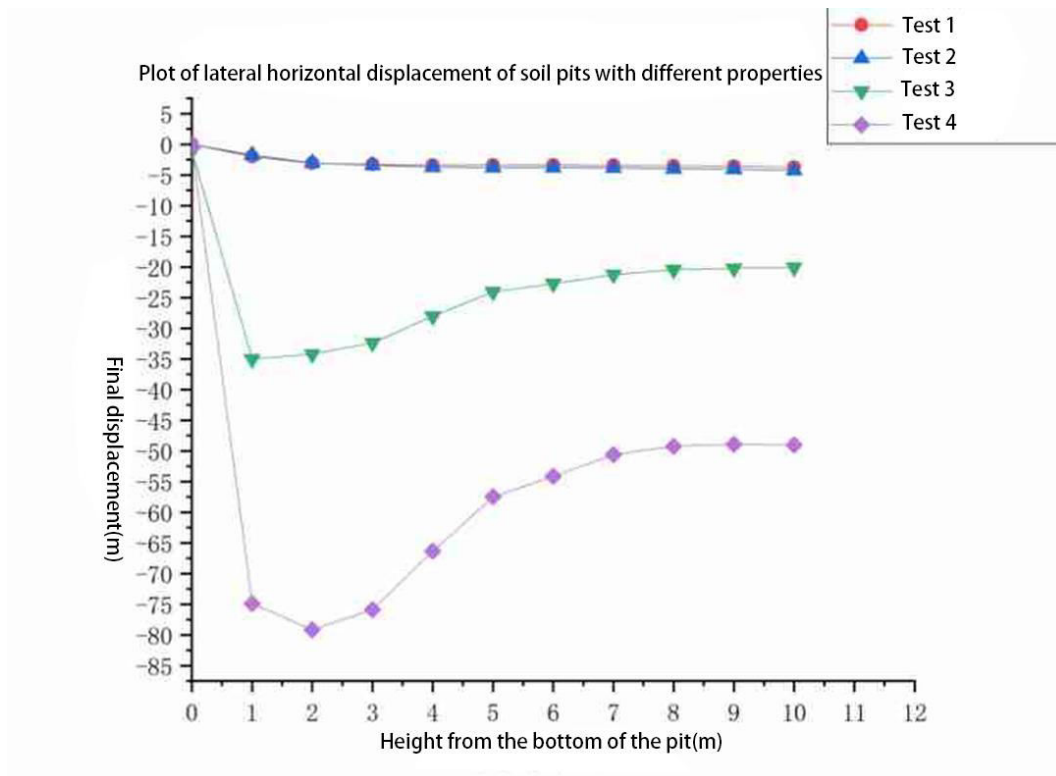


Figure 2 lateral horizontal displacement of soil foundation pit with height

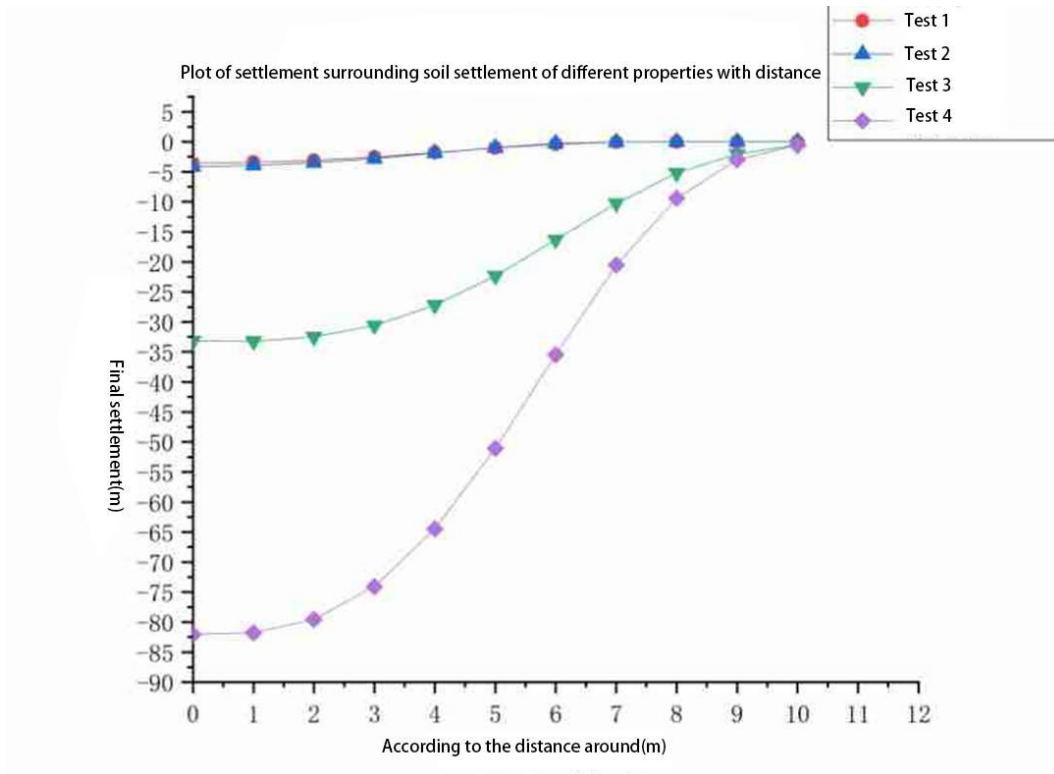


Figure 3 Settlement of surrounding foundation pit of different soil with distance

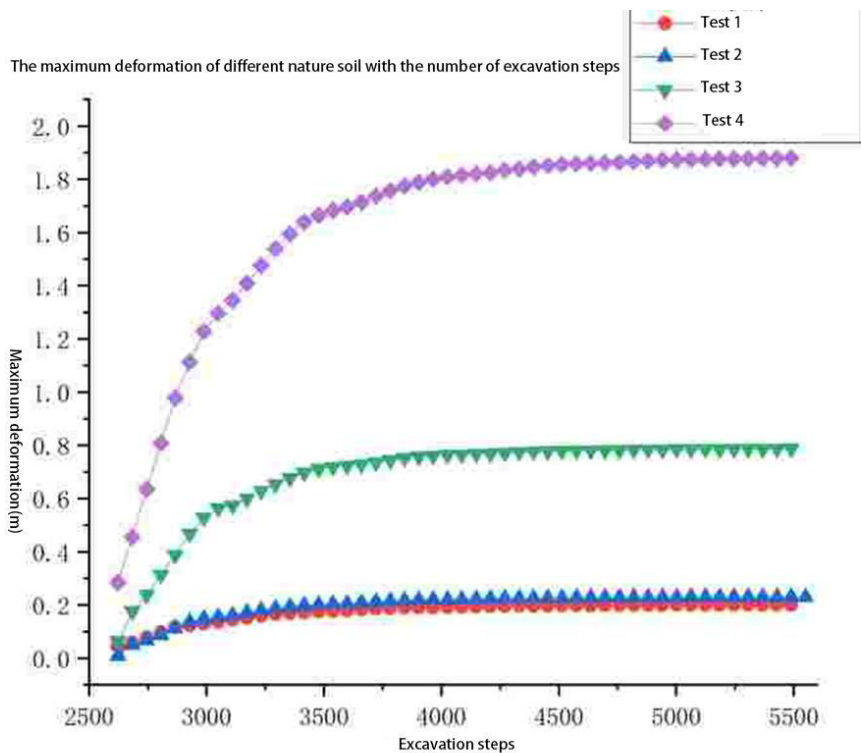


Figure 4 Maximum uplift deformation of excavation steps



V. CONCLUSION

On the basis of the analysis and study of the previous literature, this paper adopts the analysis and comparison method. The constitutive model is established based on flac3d simulation, and the loess and soft soil with different properties are used as the simulation foundation to study the base uplift, lateral horizontal displacement and surrounding settlement of the foundation pit. So that the influence of soil of different properties on foundation pit deformation is analyzed. After the analysis, it is concluded that: The deformation amount of soft soil foundation is greater than that of loess foundation. Whether the deformation of the soft soil foundation is larger than the loess foundation, the deformation of the foundation of the foundation pit is greater than the loess foundation. That is to say, the stability of loess foundation is better than that of soft soil foundation. The sensitivity of soft soil foundation is greater than that of loess foundation. From the analysis of base uplift, lateral displacement of foundation pit and settlement around foundation pit, the deformation of soft soil foundation pit changes greatly with different soil parameters, while the deformation of loess foundation pit changes very little with soil parameters. It can be seen from the above conclusions that different soil foundations have a great influence on the deformation of the foundation pit, so it needs to be specially studied and supported in the foundation pit excavation. The variation of the foundation pit shows different results with the change of the geotechnical parameters. Some do not change greatly with soil parameters, such as loess; some change greatly with soil parameters, such as soft soil. Thus, the experience needs to be more accurate and detailed in the determination of soil parameters. At the same time, it is necessary to study and evaluate different types of soil and different soil parameters to determine the supporting means and protect the stability of foundation pit and engineering safety.

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