

Summary of present situation of deep foundation pit support technology

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Abstract

A summary of the relevant literature and summarized, to tease out a literature review of this paper. It mainly summarizes the research background and characteristic of deep foundation pit support. Engineering application and numerical simulation are summarized in this paper. The problems and development prospects of deep foundation pit support technology at the present stage are summarized. Put forward my own view, also. By reading this article can grasp the present situation about the design and construction of deep foundation pit supporting technology.

Keywords

Deep foundation pit, supporting structure, supporting technology, research present situation, engineering application and numerical simulation.

1. Introduction

Early in the 20th century, 30 years, Terzaghi and others have begun to study geotechnical engineering problems in Foundation Pit Engineering, and proposed the prediction stability of excavation and support load - size total stress method. From then on, many scholars from all over the world have devoted themselves to the research and have made great achievements in this field. Foundation pit project starts relatively late in our country[1]. Before 1970s, the foundation pit was relatively shallow, and the basement of the high-rise and multi-storey buildings in Beijing, Shanghai and other places were about 4m[2] single basement, and the foundation pit of other cities developed more slowly.

With the rapid development of China's economy in recent years, the scale of urban infrastructure has gradually increased. The ground space is increasingly unable to meet the needs of development, the utilization of underground space is taken seriously, and then the requirements for foundation pit engineering are also increasing. The existing deep foundation pits engineering is generally concentrated in the vicinity of urban buildings, which has great influence on the surrounding buildings and affects the normal life of the residents nearby. In addition, deep foundation pit supporting engineering in earthwork construction, the construction of retaining structures, the precipitation construction projects and other engineering will affect the surrounding geological structure, and take the bad influence of the surrounding environment. So the problem of deep foundation pit supporting stability has become more and more complicated, so as to further promote the technology of deep foundation pit excavation and supporting technology research and development, which has produced many advanced design and calculation method, and many of the new construction technology has been put into practice[3-6].

2. Deep excavation and supporting

2.1 The main characteristics of deep foundation pit engineering

The deep foundation pit refers to the excavation depth of more than 5m or the basement of three floors and above, or the depth is not more than 5m, but the geological conditions and surrounding environment and underground pipelines are particularly complicated projects[8].

The main characteristics of deep foundation pit engineering include:

The building is getting higher and higher, and the depth of the foundation pit is getting deeper and deeper.

The excavation area of foundation pit is large, the length and width can reach hundreds of meters, which makes it more difficult to maintain the stability of the foundation pit by supporting the structural system.

In the weak soil layer, the excavation of the foundation pit will produce larger displacement and settlement, which will affect underground pipelines and the foundation of surrounding buildings.

The construction time of the deep foundation pit is long, the construction site is narrow, the rainfall and the piling up of the heavy load are unfavorable to the stability of the foundation pit.

In the construction of adjacent site, piling, precipitation, digging and foundation pouring concrete and other processes will restrict and influence each other, and increase the difficulty of coordinating work.

2.2 The characteristics of deep foundation pit supporting

In order to ensure the safety of the underground main structure and the surrounding environment of the foundation pit, the temporary support, protection, reinforcement and groundwater control measures adopted in the foundation pit are called foundation pit supporting[12,17].

Deep foundation pit support engineering has the following characteristics:

It belongs to temporary engineering and has relatively little safety reserve.

The depth of foundation pit is getting deeper and deeper, and the area is more and more big, so it is more difficult to support the foundation pit.

The complex heterogeneity of soil properties and hydrogeological conditions at the excavation site results in the fact that the geological survey data can not fully reflect the situation of the construction site. It increases the design and construction difficulty of support engineering.

It is easy to excavate foundation pit in soft soil, high ground water level and other complex site conditions, which can easily cause soil slip, instability of foundation pit, serious leakage of support structure, and flow soil. They can cause serious damage to the surrounding underground pipelines and building foundation.

The foundation pit construction of adjacent site, its piling, precipitation, excavation and other processes will have mutual influence and restriction, and increase the accident inducing factor.

The construction period of deep foundation pit is long and the site is narrow, and the adverse conditions such as rainfall, surrounding heap load and vibration increase the randomness of the stability of foundation pit supporting.

3. The current situation of the development of deep foundation pit supporting technology

The main types of deep foundation pit supporting technology in China include soil nail wall supporting, cement mixing pile supporting, steel sheet pile supporting, underground continuous wall supporting, soil rock bolt supporting, anti-slide pile supporting and reverse course[13,19]. The engineering conditions of different construction methods are also different. For the actual situation of the project, it is necessary to take the specific analysis method to the argument, and then select the appropriate deep foundation pit supporting scheme.

The underground continuous wall supporting is a kind of common deep foundation pit enclosure structure, which can be used for more complicated construction situations such as abundant groundwater, soft soil, clay and sand. The soil nailing wall support structure is a kind of in-situ reinforced support technology, which is suitable for the slope support of clay, silty, and mixed soil foundation pit after underground water level or artificial precipitation, which is not suitable for the support of silt soil. And the soil nail needs to be deep inside the soil layer. Therefore, it is not applicable in the surrounding area of the foundation pit to prevent the damage of the pipeline when

the soil nail drilling is set up[22]. The soil anchor bolting is the bolt drill to the predetermined depth, then the cement paste mud wall is started, then the steel strand is put through, and then the slurry is finished. Steel sheet pile is a kind of steel with notches. Steel sheet pile is first pile, then dig. As the excavation advances, support protection is carried out. It can be used in the foundation pit depth of no more than 7 m deep foundation pit supporting, not suitable for deep foundation pit[16], the steel sheet pile in soft soil layer unable to form a larger volume, so it doesn't fit.

3.1 Overview of engineering applications

In the present study, other studies are also put forward their own theories and views.

Li Zhengchun[4] pointed out that at present the actual situation of deep foundation pit excavation and supporting of view, the original design of deep foundation pit supporting structure theory, principles and computing formula and construction technology already cannot satisfy the requirement.

Li Guojie[10] proposed to implement the operation of deep foundation pit supporting, the geotechnical engineering condition is one of the core of deep foundation pit supporting, especially for deep foundation pit supporting effect, influence of geotechnical engineering conditions is the key.

Wang Yijun[11] points out that the scientific and reasonable design and selection of support scheme in deep foundation pit engineering is the key factor affecting the overall quality of the project.

Xu Jian[7] introduced the technological process of soil nail bolt, supporting pile, canopy beam and inner supporting technology. He made a clear statement about some of the difficulties of construction nowadays.

Liang Keling[9] points out that the foundation pit support work is an important part of foundation construction, but in the context of the current situation in our country, deep foundation pit support construction technology is mature enough, still need to constantly in the process of construction of the reference to the technology of others, to promote the professional of the deep foundation pit supporting technology.

Zhao Jiliang[14] is pointed out that the construction of deep foundation pit supporting engineering quality accident caused by improper 43% of engineering design, the deep foundation pit supporting technology development of China starts relatively late, the current design is still very immature.

3.2 The numerical simulation theory research

In addition to the research in the construction application, there are many researchers who also explore the theoretical model and study the numerical simulation theory. Xu Ling[15] surface is obtained by FLAC3D numerical simulation and the maximum displacement of retaining structures is 22, 25 mm respectively, and the principle is the software to get the maximum displacement value of 22, 20 mm respectively, and the actual monitoring surface and maximum displacement of retaining structures of 26 and 30 mm.

In the process of excavation and supporting of deep foundation pit engineering, the FLAC3D can not only be well simulated under different construction conditions of the surface settlement and horizontal displacement of retaining structure, the horizontal displacement of retaining structures and simulation effect is better. But the difficulty is also modeling, the more perfect the modeling technique, the simulation results of FLAC3D are more comprehensive and real.

Jiang Bo[6] using numerical simulation method to the engineering deformation characteristics are analyzed in the simulation, using the field monitoring data verified the accuracy of the numerical model calculation, in-depth analysis of the factors affecting the deformation of deep foundation pit supporting structure.

JIN, Yingyu, BAI, Yu[20] used the numerical analysis method to simulate the excavation process of deep foundation pit, the constitutive relation of soil are simulated using plastic hardening model, the excavation and supporting of the mechanical analysis, the theoretical basis is provided for the calculation of soil displacement.

Zhu Dapeng[21] pointed out that the retaining structures are generally considered as temporary structures, while the influence of vibration loads is often neglected. The study of cyclic and relatively long time vibration loading plays an important role in the design of retaining structure of foundation pit.

Guo Yong[18] proposed that the combination of support vector basis and particle swarm optimization as the basis point to optimize the support design of deep foundation pit can reduce the design optimization process and improve the calculation efficiency. The particle swarm optimization (PSO) algorithm is applied to find the optimal solution in the whole area.

4. Existing problems and development prospects of deep foundation pit supporting

Problems existing in deep foundation pit supporting engineering at present: (1) The design and calculation method of the retaining structure is not mature; (2) Improper calculation of soil parameters in design and calculation; (3) The space effect in deep excavation is not considered; (4) Deformation control of foundation pit.

To solve these problems, the research and practice of the past few decades have proved that, according to the traditional ideas, old thinking is not what achievements. The idea of rigid research should be broken. We can solve the problem by the following methods: (1) Change the traditional design philosophy; (2) To promote the engineering design method considering deformation control; (3) To study the calculation method of new support structure; (4) Design of retaining structure for deep foundation pit; (5) Developing information monitoring and information construction technology; (6) Try to carry out the experimental study of supporting structure. In engineering, attention should be paid to the observation of deformation and the difference between design and modification in time. Only when various measures are taken to ensure the effectiveness of the support engineering can the safety of the construction be fully guaranteed and the probability of the occurrence of the safety accident can be reduced.

5. Conclusion

After decades of development, it provides more platforms for the construction of deep foundation pit. But because China is a large country, and the geological conditions are various, deep foundation pit supporting research is forever, there is no end. The research core of deep foundation pit support technology is stable, and all research progress is inseparable from structural stability. Whether it is the selection of support design, the analysis of geological conditions, the improvement of construction process, are to ensure the stability of the foundation pit and surrounding soil and the strength, stiffness and stability of the overall structure. For this we must seek truth from facts and rigorous innovation.

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