Universe Scientific Publishing

Research on Geotechnical Engineering Foundation Pit Support Design Based on Geotechnical Investigation

Zhengxuan Han

Xihua University, Chengdu 610039, China

Abstract: With the deepening of the development of urban underground space, the scale and complexity of foundation pit engineering are increasing. Based on geotechnical survey, the key elements of geological engineering are analyzed. By discussing the selection of survey requirements, structure parameters, excavation strategy optimization and environmental assessment, a set of systematic support design methods based on geological conditions is proposed. This method emphasizes adjusting measures according to local conditions and integrating advanced exploration technology and engineering experience, aiming to improve the safety, economy and environmental friendliness of foundation pit support, and provide reliable technical support for foundation pit engineering under complex geological conditions.

Keywords: Geotechnical Survey; Geological Engineering; Design of Foundation Pit Support

Introduction

In modern urban construction, the effective use of underground space has become an important way to relieve land tension and improve the function of ban. However, the underground engineering construction is faced with many challenges, such as complex geological conditions and sensitive surrounding environment. As the key link of underground engineering, the design quality of foundation pit support directly affects the engineering safety and the stability of the surrounding environment. Traditional empirical design methods have shown their limitations in the face of increasingly complex engineering requirements. Therefore, it is of great significance to explore the scientific support design method based on detailed geotechnical survey to improve the safety, economy and sustainability of underground engineering.

1. Overview of geological engineering foundation pit support design based on geotechnical survey

With the deepening of the urban underground space development, the scale and depth of the foundation pit engineering are gradually increasing, and the construction environment is becoming increasingly complex, which puts forward higher requirements for the foundation pit support design. The core of the foundation pit support technology is to ensure the safety of the foundation pit excavation and the underground structure construction, but also need to take into account the protection of the surrounding environment. In order to achieve this goal, the foundation pit support design must be based on a comprehensive understanding of the geological conditions, which highlights the key role of geotechnical investigation in the whole design process.

Geotechnical survey provides the most basic and the most important data support for the foundation pit support design. Through the systematic investigation work, we can obtain the key information of the stratigraphic distribution, geotechnical properties and groundwater condition of the site. These information directly affects the selection of supporting structure, parameter determination and the formulation of construction plan. For example, in soft soil areas, stronger support structures or deeper retention depth may be required; while in rock areas, light support forms such as anchors may be used. Therefore, the accurate geotechnical survey data is the prerequisite to ensure the rationality and economy of the support design.

The foundation pit construction has the characteristics of tight construction period, high risk and large influence range. In the construction process, the excavation of the foundation pit will cause the stress redistribution of the surrounding soil, which may lead to ground subsidence, surrounding buildings tilt and other problems. At the same time, the treatment of groundwater is also a big challenge, and improper precipitation may cause land subsidence or the foundation stability of adjacent buildings. These characteristics require us to fully consider all possible risk factors in the design stage and formulate corresponding measures to the situation.

2. Key points of geological engineering foundation pit support design based on geotechnical survey

2.1 Deeply grasp the key points of address exploration

In the foundation pit survey, we need to comprehensively consider the characteristics of the project and the complexity of the geological environment, and develop the survey scheme in line with the actual needs. The depth and scope of the survey should be determined according to the size of the foundation pit, the surrounding environment, and the complexity of the geological conditions. Usually, the survey scope should cover the affected area of the foundation pit excavation, and the depth should reach 1.5-2 times the foundation pit depth below the bottom of the foundation pit. Such a survey scope can provide sufficient geological information for the design, and help to accurately assess the impact of foundation pit excavation on the surrounding environment. In the process of investigation, we need to focus on several key aspects: stratigraphic distribution, rock and soil physical and mechanical properties, groundwater conditions, and special geological conditions[1]. For the stratigraphic distribution, not only to clarify the thickness and distribution range of each stratum, but also to pay attention to identify the possible weak interlayer or discontinuity surface. The determination of geotechnical physical and mechanical properties should be conducted by in situ test methods as far as possible, such as standard penetration test, static touch exploration, etc., to obtain parameters closer to the actual engineering conditions. The investigation of groundwater conditions should include water level, water quality and permeability, which is crucial to determining the scheme of foundation pit precipitation. For special geological conditions, such as swelling soil, soft soil, karst, etc., special investigation and evaluation are needed.

2.2 Formulate the optimal support system parameters

When determining the structural parameters, we need to comprehensively consider multiple factors including geological conditions, foundation pit depth, surrounding environment and so on. The type selection of retaining structure is the primary problem. The common types include pile row, underground continuous wall, soil nail wall, etc. In soft soil area, underground continuous wall is widely used because of its large stiffness and good water stop effect; but in rock area, anchor rod support may be more economical and practical. The selection of structure type should be carried out on the basis of full analysis of the advantages and disadvantages of each scheme, not simply applying experience. The depth of the supporting structure is another key parameter. The determination of the insetting depth should consider the stability of the foundation pit, deformation control requirements and groundwater control factors. In soft soil areas, deep fixation depths may be required to provide sufficient passive soil pressure; while in rocky areas, the penetration depths may be relatively shallow. The thickness and strength of the supporting structure need to be determined by mechanical calculation, which should not only meet the requirements of strength and stiffness, but also take into account the feasibility of the construction. For the deep foundation pit, the setting of the internal support or the anchor rod is also an important part of the structural parameter selection. The spacing and stiffness of the internal support directly affect the deformation control effect of the support structure, while the length, inclination and prestress of the bolt are related to the stability of the whole support system. The determination of these parameters should not only meet the requirements of the design specification, but also consider the convenience and economy of construction. For example, in spatially limited urban environments, prestressed anchors may be required to reduce the deformation of the support structure, but also pay attention to the impact of the anchor solid on the foundations of adjacent buildings.

2.3 Optimize the foundation pit excavation and construction strategy

The scientific excavation scheme should be based on the detailed geological condition analysis and mechanical calculation, and usually adopts the way of layered excavation. The determination of the excavation depth of each layer needs to consider the self-stability of the soil and the bearing capacity of the supporting structure [2]. In soft soil areas, small excavation depth may be required to control deformation; in rock areas, single excavation depth can be appropriately increased to improve construction efficiency. The arrangement of the excavation sequence also requires special attention. Generally speaking, the principle of “first support before digging” should be followed, that is, be-

fore the excavation of the next layer, the construction of the last support or anchor rod should be completed first. This can effectively control the deformation of the supporting structure and reduce the impact on the surrounding environment. For large foundation pits, the partition excavation can also be considered to reasonably arrange the excavation sequence to balance the soil pressure and reduce the internal force of the supporting structure. Control of groundwater is another important concern during excavation. Improper precipitation may lead to uplift at the bottom of the foundation pit or subsidence of the surrounding ground. Therefore, the development of the precipitation schemes should be based on a detailed hydrogeological condition analysis. While total precipitation may be required in highly permeable strata, only local aquifers may be considered. At the same time, it is also necessary to pay attention to control the speed and range of precipitation to avoid excessive impact on the surrounding environment.

2.4 Comprehensive assessment of the surrounding situation of the site

In urban environments, there are often various buildings, underground pipelines and transportation facilities around the foundation pit, which are potentially sensitive receptors. Therefore, in the support design, we must fully consider these environmental factors, and develop the corresponding protection measures. For adjacent buildings, a detailed status investigation needs to be conducted, including the structure type, foundation form, use status of the buildings, etc., and determine the allowable deformation limits accordingly. For underground pipelines, it is necessary to clarify their location, burial depth and protection requirements, and reinforcement or relocation measures may be taken if necessary. The topographic conditions of the site are also a factor to be focused on. Under special terrain conditions such as slope land or river banks, foundation pit excavation may cause larger stability problems. At this time, special slope stability analysis and corresponding reinforcement measures may be taken. In addition, the hydrological conditions of the site, such as surface water and rainstorm, will also affect the construction of the foundation pit. The layout of the drainage system needs to be considered in the design to ensure that the foundation pit remains dry and stable under all weather conditions. Environmental protection requirements are another aspect that cannot be ignored. The noise, vibration and dust generated in the construction process may affect the surrounding environment. In the design, it is necessary to consider the corresponding environmental protection measures, such as choosing low noise equipment, setting sound barrier, spraying dust. For some special environmentally sensitive areas, such as near the cultural relics protection units, stricter protection measures may need to be taken, or even change the construction plan.

3. Conclusion

Foundation pit support design based on geotechnical survey is a complex system engineering, which requires engineers to comprehensively consider many factors such as structural safety, construction feasibility and environmental impact on the basis of fully understanding the geological conditions. This study reveals the internal connection between geotechnical conditions and support design by deeply analyzing key links such as survey requirements, structure parameters selection, excavation strategy and environmental assessment. In the future, with the development of information technology and intelligent monitoring system, the foundation pit support design will develop in a more refined and dynamic direction.

References:

[1] Zhang Han. Study on the supporting design of geological engineering foundation pit based on geotechnical survey [J]. Residential Facilities in China, 2023, (02): 55-57.

[2] Liu Pengcheng. Design of geological engineering foundation pit support based on geotechnical survey [J]. Paper equipment and materials, 2021,50 (02): 125-127.

[3] Zhang Xingwei. Analysis of the support design scheme of deep foundation pit for geotechnical engineering investigation [J]. Building materials development-oriented, 2021,19(24):130-132.DOI:10.16673/j.cnki.jcfzdx. 2021.0411.