

## Common Engineering Geological Problems and Countermeasures in Foundation Pit Support Engineering

Jiajun Wu<sup>1,a</sup>, Shaolin Xiang<sup>1,b</sup> and Zudong Hu<sup>1,c</sup>

<sup>1</sup>College of Resources and Environment, Henan Polytechnic University, Jiaozuo 454003, China.

<sup>a</sup>1620588217@qq.com, <sup>b</sup>2190863008@qq.com, <sup>c</sup>2030906217@qq.com

### Abstract

With the rapid improvement of my country's economic level and the acceleration of urbanization, the demand for geotechnical engineering is increasing. The effective application of foundation pit support technology in engineering geology and geotechnical engineering can not only improve the construction quality of the project, but also accelerate the construction speed, shorten the construction period, effectively control the construction cost, and ensure the construction project on the basis of ensuring the construction quality. Safety brings certain economic and social benefits to construction enterprises. In the actual application process of the construction technology of deep foundation pit support in geotechnical engineering, construction personnel need to combine the actual conditions of the construction site to carry out scientific construction design, strengthen construction management and supervision, promote efficient quality management, and ensure reasonable support technology Effective application, thereby reducing construction risks, and ensuring the orderly development of geotechnical engineering. The article mainly describes some problems in the construction of deep foundation pit support in geotechnical engineering, and puts forward some control strategies for construction quality, aiming to further improve the construction safety of deep foundation pit support and improve the construction quality of geotechnical engineering Provide solid protection.

### Keywords

Geotechnical Engineering; Foundation Pit Support; Countermeasures.

## 1. Introduction

With the rapid development of cities, land resources for construction are becoming scarcer and scarce. Buildings are built higher and larger and larger in scale. In order to meet the use function and people's requirements, the large-scale projects currently developed generally have a deeper basement, so the deeper the foundation is embedded, the deeper the excavation depth of the foundation pit, the more and more problems More, the higher the requirements for the construction of deep foundation pit engineering, which brings great difficulties to construction. In deep foundation pit support engineering, due to improper construction and unreasonable design, engineering accidents such as foundation pit collapse, building and road collapse, etc., directly affect the construction progress and project cost, and even endanger the safety of life and property. In order to ensure the stability of the building, solutions to corresponding problems are proposed to ensure the safety of the foundation pit. Reasonable deep foundation pit support is the key to ensuring the safe construction of the building.

## 2. The main problems existing in the foundation pit supporting engineering

### 2.1 Overcut and undercut

Overcut and undercut are common problems in the process of foundation pit support engineering. These problems affect the quality of engineering and the efficiency of construction. Investigate its reason, can appear the problem such as overbreak and underbreak, have inseparable relation with the actual construction skill of construction personnel. In particular, if the operation technology of equipment related operators cannot meet the actual operation requirements, it will inevitably affect

the construction results. Due to the limitation of actual construction, including the influence of construction environment and human factors, it is very difficult to excavate in the early stage. And with the continuous development of excavation foundation, if the operation technology and professional awareness of relevant operators cannot meet the actual construction requirements, it is likely to appear in the excavation slope surface roughness and other problems affecting project safety. Once such problems occur, they must be reworked and other ways to make up for them, which may have a great impact on the construction quality and schedule of the project.



Fig.1 The collapse map of the foundation pit at the construction site

### 2.2 Technology application is easily affected by external environmental factors

For foundation pit supporting, in the construction of the supporting technology application has strict requirements on the depth of the excavation work, it is in a certain extent, increased the city underground pipeline and geological hydrology etc. The influence of environmental factors on the construction of the foundation pit supporting, this need to be in front of the construction of urban ground pipeline distribution and geological hydrology detailed investigation and analysis on the record, reduce the influence of the external environment factors on the technology application effect. However, there are still some construction departments that fail to carry out various investigations and on-site surveys before construction, and the relevant data and information are not fully grasped. In this case, excavation and support of foundation pit will often encounter various problems, which will increase unnecessary troubles and fail to ensure the construction quality.

### 2.3 Leakage problem of the parapet

The retaining wall is an important part of the retaining system. In the actual construction process, if there are problems in the retaining wall construction, water leakage will easily occur. Such problems will affect the life and appearance of the support structure. In the case of small amount of water, mortar or concrete can be used to seal off the seepage part in the pit. If the leakage is serious, the branch shall be wall back excavation to the leaking position range of 0.5 ~ 1 m, and the use of concrete material for block in order to avoid water seepage, real in supporting the construction process, to pay attention to each link of cohesion, grouting to avoid such problems as breaking pulp as far as possible, in size, can add sodium silicate, adequate to ensure that the condensed as soon as possible. In addition, it should be noted that segregation of slurry should not occur. During the process of slurry modulation, the time of modulation should be controlled reasonably and there should not be too long stop. The grouting sequence requirements should be strictly followed to complete the grouting. This is the prerequisite for further enhancing the structural bearing capacity. Given that the support wall will inevitably be affected by pressure to a certain extent during the construction process, under the condition of large load, the support wall will move to the position of the pit edge as a whole. For this reason, drainage measures should be further optimized, such as adding a valve at the top of the grouting pipe to avoid problems such as slurry burst.

## 2.4 Seriously affected by groundwater

From a conventional point of view, most construction sites will be affected by groundwater to some extent during the excavation of building foundation pits, especially when the current construction scale is gradually expanding and the foundation pits are deepening, the influence of groundwater factors becomes more and more obvious. Some construction department did not ahead of time before the construction of foundation pit support construction of seepage and leakage risk prediction and analysis, more not formulate emergency processing plan, cause serious security hidden danger for the foundation pit supporting construction, the construction safety, construction quality and construction progress caused great influence, especially in the work of the underground water level is higher and the silty sand foundation, to severe groundwater seepage in the foundation pit excavation work problems.



Fig. 2 Site diagram of foundation pit support engineering

## 3. The corresponding countermeasures against the problem

### 3.1 Formulate a scientific and reasonable technical plan for foundation pit support

Formulate scientific, perfect, high feasibility of foundation pit supporting technical scheme is an important premise, the construction technology of effective application of technical personnel to deal with the work and the surrounding hydrogeological conditions and the characteristics of weather factors such as a comprehensive survey, the results generated detailed records, then combination with the engineering requirement for foundation construction scheme, perfect the technology selection and application of precise technology application in all kinds of parameters, clear parts construction required for preparation of construction materials, mechanical equipment, etc. In combination with the technical application scheme, the laying of underground pipelines should be mastered, and this part of the line should be avoided in the excavation work, so as to reduce the impact on the life of surrounding residents. The scheme designer shall participate with the construction department in the process of formulating the technical scheme of foundation pit support and complete it through unified negotiation, so as to ensure the feasibility of the scheme and take into account the technical application level, construction safety and construction schedule of foundation pit support.

### 3.2 Perfect the engineering design method of deformation control

At present, the limit balance principle used by designers is a relatively common method, which has reference value. But it also has its drawbacks. The application of this design method to the foundation pit support structure can not ensure the stiffness of the support structure, but only meet the strength requirements of the foundation, so as to produce more engineering accidents due to the deformation of the support structure. Whether a support structure meets the requirements of strength and the pros and cons of the design scheme is an important factor to determine whether a support structure is reasonable. Secondly, the size of deformation is also a key point. In view of the above practical situation, the space effect, standard and influence of deformation control of support structure should be studied before the new deformation control design scheme is formulated, so as to ensure the integrity of the engineering design.

For example, a construction manager could create a design team to brainpower the design of a support project. (1) All kinds of theories should be analyzed, and all kinds of relevant data should be searched and mastered. Based on this, more reasonable design ideas and schemes should be put forward to ensure the feasibility of construction. (2) The construction site shall be inspected on the spot, and geological experts shall be invited to carry out geological survey on the site and understand the condition of underground pipelines, and then the design scheme shall be refined according to the soil quality and the foundation depth. (3) The environment around the construction site should be comprehensively monitored, such as the density of surrounding buildings and important roads, so as to further improve the construction design scheme. (4) The upper and lower passages of the construction site should be included in the design scheme to ensure the normal travel of construction personnel and construction vehicles. (5) After designing the construction plan, the design team should also follow the construction throughout the whole process, observe the construction situation all the time, and make the adjustment of the plan in time to ensure that the whole construction is in the plan and progress and ensure the construction quality.

### **3.3 Carry out reasonable foundation pit excavation work**

In the foundation pit supporting engineering of building engineering, a considerable part of foundation engineering is carried out on soft soil foundation and soil rock foundation, and in the process of foundation pit supporting construction, it needs to carry out large-scale excavation work. Therefore, the construction department should summarize and analyze the contents of foundation pit excavation according to the construction technical scheme, and select the most effective technical method on this basis. At present, the foundation of most construction projects in China will be excavated separately, so as to ensure that the excavated soil can be exported timely and prevent the accumulation of soil in the site and reduce the construction work space. In addition, during the excavation of foundation pit, it is necessary for the staff to carry out comprehensive and real-time monitoring of the entire excavation process, so as to reasonably control the quality and rate of excavation construction.

### **3.4 Carry out experimental research on support structure**

The correct theory is based on a great deal of experimental research. However, there has been no systematic and normative experimental study on pit support structure in China. It is a problem that there is no scientific and systematic summary of the success and failure of support structure. Although a lot of rich technical data have been accumulated in the support construction process, due to the unscientific test data, scientific data analysis cannot be carried out, thus failing to reach the height of the theoretical level, leading to problems. This is a big flaw in the design. Simulation test and engineering field test are two important aspects of supporting structure research. Some money is needed to carry out these two kinds of experiments. Therefore, engineering design must be carried out after scientific experiments, so as to save money. Through the practice of engineering field test, a large number of effective test data can be accumulated to provide direction and reference for the subsequent engineering design and scientific data for theoretical research.

### **3.5 Define the best technical method of foundation pit support**

At present, the bracing structure of foundation pit in domestic construction is mainly divided into hybrid retaining structure, gravity retaining wall structure and cantilever retaining structure. The main feature of the hybrid support structure is that it can make use of the action between the shotcrete layer and the bolt to form a unity between the support structure and the foundation pit, and further improve the safety factor of the foundation pit support by virtue of the interaction between the support structure and the bolt. More than half of the cantilever retaining structure is set in the soil or rock at the bottom of the foundation pit. The stability level of the foundation pit retaining mechanism is improved by the support force of the soil layer itself. This structure is mostly used in foundation engineering with good soil quality and large excavation depth of the foundation pit. Among them, gravity retaining wall realizes the balance of household structure under various pressure environments by exerting its own structural gravity function. The soil nail wall method is widely used in this structure. Foundation

pit supporting technology application is vulnerable to the interference of external factors, severe cases can cause serious problems of quality and safety, and construction departments should strengthen the technology risk prediction and analysis, make the risk of sudden emergency processing plan, if uplifts and land change problem in the construction, should be combined with the specific circumstances adjust excavation sequence, the reinforcement pad in the form of discontinuous excavation laid into the pit, the use of sand bags for back pressure. If the construction can only cause obvious soil displacement problems, the work should be stopped and the strength of foundation pit soil should be tested. Backfilling construction should be carried out if necessary. If obvious cracks appear after the application of support technology, grouting can be carried out to repair the cracks. In order to reduce the influence of groundwater factors on the application effect of foundation pit support technology, it is necessary to observe the foundation pit seepage, prevent the risk of leakage, and comprehensively monitor the changes of groundwater, so as to prevent the groundwater from causing serious construction quality and safety risks. Prepare a full set of emergency equipment in advance, such as shotcrete machine, water pump, sandbag and generator.

### **3.6 Strengthen deformation observation and timely repair**

In the process of construction, the stress and deformation of deep foundation pit supporting structure should be understood through monitoring, which is the safety eye of deep foundation pit supporting structure. Through timely analysis of monitoring data, timely understanding of the practical application of earthwork excavation and support design, and analysis of existing deviations, the foundation pit soil deformation, settlement under the influence of earthwork excavation, and the deformation of underground pipelines can be timely understood. Through on-site monitoring, the influence of foundation pit excavation on the surrounding environment can be grasped in time, the construction can be effectively guided, the construction scheme can be adjusted in time, and more effective measures can be taken. Based on the timely analysis of monitoring data, the design parameters should be corrected in time for the deviation in the basement construction, and appropriate remedial measures and control measures should be taken for the parts under construction. Therefore, it is required that the on-site deformation observation data should be timely, accurate and reliable, and that the deformation observation personnel should carefully measure and be responsible in strict accordance with the predetermined design scheme to ensure the accuracy of the observation data. If abnormalities are found in actual measurements, immediate research and action are needed to prevent them from worsening. If there is a large deformation or slide, immediately analyze the main reasons, make a reliable reinforcement design and construction plan, so that the reinforcement work quickly and effectively, prevent deformation or slide to continue to develop. It is very important to arrange the monitoring points reasonably and strengthen the classification, collection, arrangement and analysis of process monitoring data for the construction of deep foundation pit support project.

## **4. Conclusion**

Foundation pit support design is an important part of geotechnical engineering construction and is closely related to the quality of geotechnical engineering. Therefore, it is very important to strengthen the design of foundation pit support. The design of deep foundation pit support is complicated, which is easy to be restricted and affected by many factors, and has high technical requirements. With the development of the city, the building quality requirements are higher and higher, so it poses great challenges to the comprehensive professional ability of the construction personnel, construction management level and other aspects. Before the construction of scientific and reasonable construction design, optimization of construction procedures, to ensure the standardization of the operation, construction technical innovation and optimization of construction management, real-time supervision and control of the construction process, combined with the actual situation of construction scheme optimization adjustment, ensure the feasibility and rationality of construction schemes, in order to promote the application effect of deep foundation pit supporting construction techniques provide a solid protection.

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## References

- [1] Lun hengyi. Problems and countermeasures of deep foundation pit support construction in geotechnical engineering [J]. Smart city,2020,6(20):58-59.
- [2] Liu Aixia, Iflin, Ning Yingfu. Problems existing in deep foundation pit support engineering and implementation of countermeasures [J]. Development of building 2020,47(19):151-152.
- [3] Zhang xiucang. Research on existing problems and countermeasures of deep foundation pit support in geotechnical engineering [J]. Building technology development,2020,47(15):157-158.
- [4] Zhang Enzhong. Problems and countermeasures in the design and construction of deep foundation pit support in geotechnical engineering [J]. Engineering technology research, 2020, 5(12)
- [5] MAO Jianxun. Analysis of design problems and Countermeasures of Deep Foundation Pit Support in geotechnical Engineering [J]. Construction technology development,2020,47(05):137.
- [6] Wang Hongjie. Main Problems and countermeasures of deep foundation pit Support construction in geotechnical Engineering [J]. World Nonferrous Metals, 2019(20):258+260.
- [7] Fu Dekun. Discussion on design problems and Countermeasures of deep foundation pit support in geotechnical engineering [J]. Sichuan Cement, 2019(10):97.
- [8] Hu Zhonghui. Analysis of common Problems in foundation Pit Support design of Geotechnical Engineering [J]. Shandong Industrial Technology, 2017(08):89.
- [9] Gao Jianying. Analysis of Common Problems in foundation Pit Support Design of Geotechnical Engineering [J]. Science and Technology Economy Guide,2017(04).