Application Research of Engineering Foundation Pit Support Based on 3D Geological Modeling Platform - ITASCAD

Bentao Zhang¹*, Cheng Xu¹

¹,²Xi’an China Highway Geotechnical Engineering Co., Ltd., Shaanxi, China

*E-mail: zhangbt123456@126.com

Abstract. Foundation pit support is the key link in the construction of engineering construction, and it is also an important guarantee for the overall safety of engineering construction. At present, the country and society have higher and higher requirements for the quality of engineering construction, and the construction conditions of engineering projects are more and more complex, which makes the traditional engineering foundation pit support design and construction methods exposed more and more disadvantages. ITASCAD is to create an international level of large software for the geotechnical industry. Therefore, this paper expounds the problems existing in the design and construction of engineering foundation pit support, and discusses the typical application cases of Itascad technology in engineering foundation pit support. Based on the study of several practical cases, this paper analyses the breakthrough and innovation brought by the application of Itascad technology for engineering foundation pit support, and provides a new thinking direction for the development of foundation pit support technology.

Keywords: Itascad, Foundation Pit Support, Engineering Application, ITASCAD

1. Introduction

The continuous deepening of urbanization in China directly promotes the rapid development of construction industry. With the increase of construction difficulty and construction scale, the safety of construction becomes more and more important. In the construction process of engineering project, foundation pit support is an important guarantee for the overall safety of engineering construction. If there are technical defects in the design and construction of engineering foundation pit support, the quality of engineering construction cannot be guaranteed. At present, although China has made some breakthroughs in technical research of engineering foundation pit support, there are still some defects in the rationality and reliability of foundation pit support design. Therefore, construction enterprises should pay attention to the integration of Itascad technology and engineering foundation pit support
technology, only in this way can effectively improve the quality of foundation pit support and the overall safety of engineering buildings.

2. Overview of engineering foundation pit support

2.1. The importance of engineering foundation pit support

The essence of engineering foundation pit support is to ensure the safety of underground structure construction and the surrounding environment of the foundation pit. It is a kind of protective measure for building safety in the early stage of construction. Foundation pit support plays an important role in engineering construction, which lays a foundation for the subsequent construction of the project\(^1\). At present, the common foundation pit supporting technologies in construction engineering include I-steel foundation pit supporting, underground continuous wall, etc. In the actual construction process, the safety of engineering construction will be affected by many factors. If the foundation pit support is not in place, it will lead to the instability of the deep foundation pit, and even cause a large area of collapse and collapse, which will affect the bearing capacity of the building foundation and reduce the construction safety. Therefore, the construction enterprise must perfect the support work of the foundation pit and design the support scheme reasonably to avoid the collapse caused by instability.

2.2. Problems in engineering foundation pit support

(1) The design method of foundation pit support is relatively backward

At present, in most cases, the support scheme design of the complex foundation pit can only rely on the practical experience accumulated by construction technicians for many years or the customary practice expressed in a plane way, which greatly affects the quality of the construction scheme design, and cannot clearly express the relationship between space and time in the construction of the foundation pit structure\(^2\). Engineering practice proves that reasonable construction scheme design plays an important role in improving production efficiency, reducing engineering cost, ensuring engineering quality and construction safety.

(2) The overall design of engineering foundation pit support is not perfect

Because the foundation pit support belongs to underground engineering, it must be strictly investigated before design and construction. No matter the geological conditions, water quality conditions or the surrounding building foundation conditions in the use area, strict and careful inspection and investigation shall be carried out\(^3\). Only on the basis of effective field investigation and detailed data analysis can we guarantee the comprehensive design. But in the actual construction process, there are some problems in the early exploration work of many construction units. For example, the work of these units in geological exploration, the investigation of the surrounding environment, data analysis and other aspects is not sufficient, which leads to the huge uncertainty of the designed scheme.

3. Application of Itascad technology in engineering foundation pit support

3.1. Overview of Itascad technology
Itascad is a comprehensive technical platform integrating 3D modeling, engineering data analysis and aided design[4]. It is developed from the initial computer 3D modeling software and can meet the needs of geological engineering survey and design and operation safety management. Under the background that the construction environment of foundation pit supporting engineering is becoming more and more complex, Itascad has been applied reasonably in many foundation pit supporting engineering because of its unique advantages in design mode and design means.

3.2. The typical application case of Itascad in engineering foundation pit support

(1) Itascad technology has been successfully applied in the foundation pit support of a mine in Nanjing. In this case, on the basis of comprehensive analysis of geological data, the construction enterprise uses the powerful 3D modeling function of Itascad to generate a high-precision model of foundation pit support, which solves the problem of low accuracy of traditional measurement methods. At the same time, the three-dimensional geological model directly shows the complex geological conditions of the mine pit, which provides a solid technical support for the design and construction of foundation pit support. At the same time, the introduction of three-dimensional model technology not only makes the two-dimensional drawings in the design scheme of foundation pit support more visualized, but also makes the calculation of quantities and drawings more accurate, which provides great help for the later implementation of the mine pit reconstruction project.

(2) In the construction process of Shanghai Metro, the construction enterprise uses the foundation pit data obtained from the actual engineering exploration to generate "three-dimensional grid section" in Itascad software, and in the three-dimensional map, different colours are used to represent different strata. At the same time, the construction enterprise combines the three-dimensional stratum model with pile foundation engineering to realize the effective judgment of each pile bearing stratum. On this basis, the designer added the mechanical and material information into the original model, and realized the reasonable arrangement of the construction schedule of the foundation pit support project. In addition, the simulation technology of Itascad software directly shows each process of foundation pit support, and precisely analyses the factors involved in these processes, which effectively improves the construction quality and efficiency of the project.

(3) In the foundation pit supporting engineering of a certain building in Shenzhen, the designer established a clear three-dimensional model of engineering geology in Itascad software according to the geological survey report and the design drawing of foundation pit supporting. The geological model of the foundation pit can clearly and intuitively reflect the geological condition of the project. Compared with the conventional investigation report, the geological information obtained through this way is more accurate. The application of Itascad technology provides reasonable early guidance for the design and construction of the foundation pit support, and effectively avoids the safety problems caused by improper consideration of the designers.

4. The changes of foundation pit support brought by the application of Itascad technology

4.1. Itascad technology makes the engineering foundation pit supporting more visual

At present, most construction enterprises rely on two-dimensional CAD drawings for design and construction. However, the information transmitted by two-dimensional drawings is not intuitive, and
only professional technicians can really understand the content of drawings, which leads to low efficiency of drawing information transmission[5]. By using Itascad technology, designers can transform 2D CAD drawings into 3D visual models, which can help managers to understand the object of the building, the progress of the project, the construction sequence, etc. After transforming the format of the model, it can be imported into the rendering module of Itascad software to generate a three-dimensional rendering drawing of foundation pit support. Through this visual representation, the designers and constructors can intuitively find the defects in the design scheme of foundation pit support, thus effectively avoiding the potential safety hazards due to imperfect design. Figure 1 shows the visualization model of foundation pit support created by Itascad technology, which clearly reflects the real situation of foundation pit support.

![Figure 1. The visualization model of foundation pit support](image)

4.2. *Itascad makes the simulation of the construction process more efficient in foundation pit support*

The simulation function of Itascad software provides an intuitive basis for project managers to make schedule plans and site layout plans. The efficient simulation of the construction process of foundation pit support can make the managers have an intuitive understanding of the key and difficult points of the foundation pit project. In this way, not only can the construction personnel directly understand the content of the design drawings, but also can make the project management personnel discover the possible problems in the construction process in advance, so as to avoid the problems by adjusting the design and other means in time. Improve the construction quality of the foundation pit. Figure 2 shows the simulation diagram of the foundation pit support construction process generated by Itascad software. Its clear and intuitive presentation provides a solid technical support for design and construction personnel.

![Figure 2. The simulation diagram of the foundation pit support](image)
Figure 2. The simulation diagram of the construction process generated by Itascad software

4.3. Itascad technology makes the construction process of foundation pit support more coordinated

Coordination means that the construction units will not affect each other\textsuperscript{[6]}. Through the collision detection function of Itascad, the construction personnel can clearly evaluate the coordination of the construction process of foundation pit support. Itascad technology regards coordination inspection as a method of prediction, which can provide some reference for the design and construction personnel of foundation pit support. In this way, designers and constructors can optimize the design scheme and improve the construction method, so as to improve the overall quality of the project.

5. Conclusion

The increasing construction difficulty of engineering projects puts forward higher requirements for the safety and reliability of foundation pit support. In this context, the application of Itascad technology is particularly important for the design and construction of engineering foundation pit support. Through the research in this paper, it can be found that Itascad technology plays a special role in the visualization of the design scheme and construction process simulation of engineering foundation pit support. In general, Itascad technology forms a complete integration of all kinds of information in construction engineering, which not only effectively improves the efficiency of the design and construction of foundation pit support, but also ensures the overall safety of the engineering construction to a certain extent.

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