Study on the Influence of Deep Foundation Pit Excavation on Existing Structures Around

Changyi Yu

ABSTRACT

For a foundation pit project, due to its large depth, complex surrounding environment and close proximity to subway tunnel, the influence of foundation pit on the surrounding existing structures needs to be considered in excavation. According to the local geological conditions and the characteristics of the foundation pit, this paper designs the foundation pit, analyzes and evaluates the impact of foundation pit excavation on the surrounding environment. This paper puts forward the timely detection of the supporting structure and the surrounding environment in the process of deep foundation pit construction and reasonable supporting and protection measures.  

INTRODUCTION

Geotechnical engineering has the characteristics of uncertainty of geological conditions, uncertainty of soil parameters and diversity of load conditions [1], so it is necessary to monitor [2-3]. Previous scholars have carried out extensive research on the construction monitoring of building foundation pit and subway deep foundation pit, but less on the monitoring of building foundation pit adjacent to subway protection area. The excavation area of this project is large, the surrounding environment is complex, and it is adjacent to subway. Taking this foundation pit project as the research object, monitoring the supporting structure and surrounding environment of foundation pit in the process of foundation pit excavation has certain

1Changyi Yu, CCCC-Tianjin Port Engineering Institute, Ltd., Tianjin 300222
Changyi Yu, CCCC First Harbor Engineering Company, Ltd., Tianjin 300461; Changyi Yu, Key Laboratory of Geotechnical Engineering, Ministry of Communications, Tianjin 300222
Changyi Yu, Key Laboratory of Geotechnical Engineering of Tianjin, Tianjin 300222, China
The impact of foundation pit excavation on the surrounding environment is analyzed and evaluated. The details are as follows: Design and construction safety evaluation of foundation pit enclosure; Analysis of the impact of foundation pit excavation on the surrounding environment; Protection measures to reduce the impact of foundation pit excavation on the surrounding environment.

ENGINEERING SURVEY AND PROTECTION PROGRAMME

North of the foundation pit: Changyang Road, under which the subway line 12 has been built, with sewage pipes, rainwater pipes, water distribution pipes, power supply lines and information pipelines distributed. There are 10 brick houses (shops) along the north street.

North section on the east side of the foundation pit: rainwater pipes, water supply pipes and gas pipes are distributed under the road adjacent to Liaoyang Road.

South section on east side of foundation pit: near Liaoheai community

South side of foundation pit: adjacent to Huoshan Road, rainwater pipes, water distribution pipes, gas pipes, power supply lines and information pipelines are distributed under the road. South of Huoshan Road is the reconstruction and expansion of Shanghai East Middle School.

On the west side of the foundation pit: adjacent to Jingzhou Road, there are gas pipes, rainwater pipes, water distribution pipes and information lines under the road. To the west of Jingzhou Road is the Museum of Modern Chinese Treasures.

The boundary between the basement exterior wall and the red line around the project is about 5.1 ~ 11.9 m, and the nearest distance between the basement exterior wall and the pipeline under the surrounding road is about 7.4 m.

The excavation depth of this project is about 16.1 m (main building 16.9 m) / 11.8 m, and the surrounding environment is complex. According to the successful experience of a large number of foundation pit projects already implemented in Shanghai, the enclosure similar to foundation pit projects generally adopts two forms of underground continuous wall, cast-in-place pile and waterproof curtain.

According to the characteristics of the main structure of the project, the excavation depth, area and surrounding environmental factors of the foundation pit, the enclosure form of underground continuous wall is recommended for the periphery of the foundation pit and the small pit partition wall of the project, and the enclosure form of cast-in-place pile combined with water stop curtain or underground continuous wall can be adopted for the large pit partition wall.

Temporary horizontal supports shall be provided for foundation pit construction plan. For the small pit area close to the subway, the first support is reinforced concrete, and the second and third supports adopt steel support axial force automatic servo system, which can not only speed up construction, but also effectively apply prestress and effectively control deformation.
SPECIAL PROTECTION MEASURES FOR SUBWAY

The foundation pit shall be divided into districts, and the space-time effect shall be used to control its impact on the subway to avoid the adverse impact caused by large-scale overall excavation.

The enclosure structure is strengthened by the subway side, and 800 - thick underground continuous wall + 1 concrete support + 2 steel supports are adopted to improve the safety of the support system.

On the subway side, the pit is reinforced with 3850 @ 1800 triaxial mixing pile soil with high cement content. The soil in the pit is reliable in resistance and can further control the deformation of the subway structure.

During the construction of the underground continuous wall and the triaxial mixing pile, the construction unit is required to take measures to reduce the disturbance of the construction to the soil layer.

Earthwork excavation shall be carried out in layers, sections and blocks, and shall be carried out along with excavation, making full use of the space-time effect and the effect of retaining soil along the pit to reduce the deformation and development of the foundation pit.

Implement the dynamic design and construction of information monitoring, inspect the development trend, and timely adjust the construction deployment and construction plan.

NUMERICAL SIMULATION

According to the surrounding environment of this project, the main protection objects for foundation pit excavation of this project are subway, road and buried pipeline under the road. Due to the different enclosure forms and protection objects, three sections (11.8 m/16.1 m/16.9 m in depth) are selected for calculation and
analysis according to the analysis needs: the first section is the common area, and the protection objects are roads and pipelines; The second analysis object of the calculation section is the north area and the protection object is the subway. The third analysis object of the calculation section is the south area, and the protection object is the natural foundation residence in Liaohai district. The results are shown in Figure 2.

Corresponding to the distance between the pipeline around the foundation pit, subway and the project, the settlement of pipeline around the foundation pit, subway and residential buildings under construction due to foundation pit excavation all meet the protection requirements.

![Figure 2. Horizontal and vertical displacement nephogram.](image)

Based on the above analysis and combined with the experience of similar projects, the impact of foundation pit construction on the surrounding environment is controlled within the standard control standards to meet the requirements for the protection of the surrounding environment.

**CONCLUSIONS**

According to the analysis of the stability of foundation pit, the displacement of retaining wall and the impact of foundation pit excavation on the surrounding environment, it is shown that the retaining scheme of underground continuous wall + one reinforced concrete support and two steel support axial force automatic servo system is adopted near the subway side, while the retaining scheme of underground continuous wall (the inner partition wall adopts cast-in-place pile combined with waterproof curtain + three reinforced concrete horizontal supports) is adopted on the other side, and the cushion layer within 12m of the side pit edge of the residential building near the natural foundation in Liaohai district is thickened to 200
mm, which can meet the stability of the foundation pit itself and the protection requirements for the surrounding environment.

Due to the deep excavation depth of the foundation pit, the time-space effect theory is strictly followed in the earthwork excavation and support process, and the support construction is completed within the time limit by adopting the method of layered and block excavation; After the foundation pit is excavated to the design elevation at the bottom of the pit, the cushion layer shall be poured in time (within 8 hours) to control the deformation of the foundation pit and protect the environment.

The deep well points are evenly arranged in the foundation pit to carry out construction leading dewatering and dewatering to reinforce the soil, so as to improve the shear strength of the soil and the construction conditions. Precipitation elevation should reach 0.5 ~ 1.0m below the final pit excavation surface.

It is suggested that the enclosure structure and surrounding environment should be monitored throughout the construction process, and necessary engineering measures and management measures should be taken to minimize the impact on the environment during foundation pit construction.

Strengthen the monitoring of subway, and the alarm value is that the daily variation of subway settlement is greater than 0.5 mm and the cumulative variation is greater than 5 mm for three consecutive days. The accumulative convergence deformation of subway structure is more than 10 mm.

REFERENCES