Parameter Optimization of Retaining Structures for Deep Foundation Pit Excavation in Cable Tunnels (Postprint)

Authors: Zhixiang Zhu

Date: 2025-07-29T19:11:14+00:00

Abstract

Based on a deep foundation pit project for a cable tunnel, a numerical calculation model of the deep foundation pit and its supporting structure was established using MIDAS GTS NX software and verified through comparative analysis with field measurement data. The influence of parameters such as diaphragm wall thickness, cement mixing pile depth, diaphragm wall depth, and support stiffness on the deformation characteristics during foundation pit excavation was investigated, and optimization design recommendations were provided. The results demonstrate that increasing diaphragm wall thickness reduces displacement variations in the retaining structure and adjacent structures; however, when the diaphragm wall thickness reaches 1.0 m, its effectiveness in restraining soil deformation becomes insignificant. The settlement of power tower foundations, displacement of underground pipelines, and ground surface settlement all decrease with increasing depth of diaphragm walls and mixing piles, yet when their depth reaches 35 m, the enhancement of foundation pit support effectiveness becomes negligible. It is recommended that the depth of diaphragm walls and concrete mixing piles be designed as 35 m. Although increasing support stiffness can reduce displacement variation of surrounding soil, its effect is less pronounced compared with increasing the depth of diaphragm walls and mixing piles.

Full Text

Preamble

Study on Parameter Optimization of Support Structure for Deep Foundation Pit Excavation of a Cable Tunnel
Zhuzhixiang

China Railway 16th Bureau Group Road and Bridge Engineering Co., Ltd., Beijing 101500, China

Abstract

Based on a deep foundation pit project for a cable tunnel, this study establishes a numerical model of the excavation and its support structure using MIDAS GTS NX software. The model is validated against field monitoring data to investigate the influence of key parameters—including diaphragm wall thickness, cement-mixing pile depth, diaphragm wall depth, and support stiffness—on deformation characteristics during excavation. The results indicate that increasing diaphragm wall thickness effectively reduces displacements in the retaining structure and adjacent facilities, but its effect on restraining soil deformation becomes negligible beyond a thickness of 1.0 m. The settlement of power tower foundations, underground pipeline displacements, and ground surface settlements all decrease with greater depths of the diaphragm wall and mixing piles; however, when their depth reaches 35 m, further improvements in support performance are marginal. Therefore, a depth of 35 m is recommended for both the diaphragm wall and cement-mixing piles. While increasing support stiffness can also reduce soil displacements, this measure proves less effective than increasing the depth of the wall and piles.

Keywords: Cable tunnel; Deep foundation pit; Support structure; Parameter effect; Optimization

Note: Figure translations are in progress. See original paper for figures.