Impact Analysis of Foundation Pit Design and Construction on Existing Metro Structures in Nansha Soft Soil Area: Postprint

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Abstract

The muck and mucky soil in Nansha District exhibit characteristics such as higher water content, large void ratio, low natural density, high compressibility, and low strength. Compared with marine soft soils in other domestic regions, they exert a more pronounced influence on engineering construction and operation, posing substantial risks and challenges to the construction and operation of rail transit networks. In response to soft soil strata, some domestic regions and cities, such as Shanghai and Shenzhen, have implemented targeted management requirements in rail transit protection specifications and relevant regulations, including expanding the scope of protection zones and strictly prohibiting the use of displacement piles, to mitigate the impact of engineering design and implementation in soft soil areas on existing rail transit structures. Based on the particular characteristics of soft soil in the Nansha area, this paper analyzes various targeted measures in foundation pit engineering design concerning their influence on operating subway tunnels. Furthermore, using a cross-river channel project in Nansha District as a case study, which crosses over Metro Line 4 twice with a minimum vertical clearance of 4.6 m from the metro tunnel, this paper investigates the influence of external foundation pit engineering on rail transit structures from the perspectives of design and control measures, and proposes concluding recommendations such as a support pile length-to-depth ratio L/H>3, that support walls adjacent to the metro should be rock-socketed, and that isolation walls should serve as permanent structures, which hold significant importance for the operation and structural safety protection of rail transit under such special geological conditions in the Guangzhou area.

Full Text

Preamble

Analysis of the Impact of Foundation Pit Design and Implementation on Existing Subway Structures in Soft Soil Areas of Nansha

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Abstract

The muck and muddy soils in Nansha District exhibit characteristics of higher water content, large void ratio, low natural density, high compressibility, and low strength. Compared with marine soft soils in other regions of China, these properties have a more pronounced impact on engineering construction and operation, posing significant risks and challenges to rail transit network development and operations. In response to soft soil strata, some Chinese cities such as Shanghai and Shenzhen have implemented targeted management requirements in their rail transit protection specifications and relevant regulations, including expanded protection zone ranges and prohibitions on the use of displacement piles, to mitigate the influence of engineering design and construction on existing rail transit structures in soft soil areas. Based on the particularities of soft soil in the Nansha region, this paper analyzes various targeted measures in foundation pit engineering design concerning their impact on operating subway tunnels. Using a cross-river channel project in Nansha District as a case study —where the project crosses Metro Line 4 twice with a minimum vertical clearance of only 4.6 meters—this research explores the effects of external foundation pit engineering on rail transit structures from the perspectives of design and control measures. The study proposes several key recommendations: a support pile length-to-depth ratio $L/H > 3$, the retaining wall on the metro-adjacent side should be rock-socketed, and the isolation wall should function as a permanent structure. These conclusions hold important significance for protecting rail transit operations and structural safety under such special geological conditions within the Guangzhou area.

Keywords: deep soft soil; foundation pit engineering support design; rail transit protection measures analysis

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