Vol. 13, No. 34, Spring 2023, pages 27-39

Journal of Analytical and Numerical Methods in Mining Engineering

Journal home page: http://anm.yazd.ac.ir/

Research article

Estimation of the stability number and face pressure of the tunnel at the serviceability limit state based on the results of numerical modeling

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*(*Received*: May 2022*, Accepted*: September 2022)*

Keywords

Tunneling
Numerical modeling
Face pressure
Serviceability limit state
Stability number

English Extended Abstract

Summary

In the evaluation of the face pressure in the serviceability limit state (SLS), volume loss and surface settlement are limited to acceptable values. In this paper, PLAXIS 3D software is used to estimate the face pressure in the serviceability limit state. In this regard, geometrical conditions (excavation diameter of 9 m) and geotechnical information in Tehran metro lines are considered in the numerical modeling. To validate the results of the modeling, the results of the settlement monitoring of the Southern Extension Tehran Metro Line 6 have been used. Using the characteristics of Young's modulus, groundwater level, and volume loss, three new equations and formulas for estimating the corresponding tunnel face stability number are proposed.

Introduction

Due to the lack of a suitable model for estimating tunnel face pressure in the serviceability limit state, a comprehensive research study is conducted for Tehran metro tunnels. In this context, by using numerical modeling with Plaxis 3D V20 software, as well as by performing validation and sensitivity analysis, and by considering the parameters affecting the surface settlement in the area of Tehran soils, a new method for estimating tunnel face pressure is provided in the serviceability limit state. This method is based on the statistical analysis of the results of 80 numerical models whose range of parameter values is adjusted according to the range of Tehran soil parameters.

Methodology and Approaches

In this research study, Plaxis 3D V20 software is used for numerical modeling. In the modeling stages, in order to make the modeling results closer to reality, the step-by-step construction process of tunnel excavation has been followed. In order to validate and check the correctness of the 3D numerical modeling, the data of the Southern Extension Tehran Metro Line 6, as well as the results of instrumentation and monitoring, have been used. In the end, multiple regression analysis has been used to investigate the combined effect of effective parameters on the tunnel face stability number using the results of numerical modeling.

Results and Conclusions

In the validation of numerical modeling, in geological sections whose settlement is less than 8 mm, modeling in an undrained state provides more consistent results with the actual settlement information. In the geological sections whose settlement is more than 8 mm, modeling in a drained state provides more consistent results with the actual settlement information. A new empirical formula for the estimation of the tunnel face stability number has been obtained using multiple regression methods in the drained state. The determination coefficient of this formula is 68%. Also, three formulas for estimating the stability number were obtained using simple regression formulas.

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DOI: 10.22034/ANM.2022.2781