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Assessment of the Twin-Tunnel Interaction Mechanism in Kenny Hill Formation Using Contraction Ratio Method

Abstract

Volume loss during tunneling excavation leads to ground deformation, which can damage adjacent surfaces or subsurface structures. Thus, tunnel design with proper estimation of ground deformation and realistic geotechnical simulation is essential for large-scale urban underground construction. In this study, subsurface characterization of the tunnel excavation section in Kenny Hill Formation (KHF) was conducted to develop 3D ground model and tunnel-filtered models and obtain ground sections through the spatial interpolation of borehole data using the Inverse Distance Weighting (IDW) method. Six greenfield ground sections were selected by using the tunnel-filtered model's configuration of tunnels and available tunneling-induced ground movement data. Conceptual models for finite element modeling were developed based on soil profiles, and the corresponding soil parameters were determined from ground sections. The strength and stiffness parameters of the Hardening Soil (HS) model were established using data from site investigation, in situ and laboratory tests, and empirical correlations with standard penetration test. The effectiveness of empirical correlations was determined through back analysis of twin-tunnel excavation in 2D finite element analysis using the contraction method and verified with monitored ground movement data. The numerical back-analyzed results of twin-tunnel excavation simulation using HS parameters obtained from a selected empirical correlation showed good agreement with construction-monitored ground movements. The application range of the values of contraction ratio was from 0.3 to 0.95%.

Keywords

Contraction method; Finite Element Analysis; Hardening Soil (HS) model; Kenny Hill Formation; Twin tunnel