World Academy of Science, Engineering and Technology
International Journal of Civil and Architectural Engineering
Vol:17, No:12, 2023

Modelling of Pipe Jacked Twin Tunnels in a Very Soft Clay

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Abstract : Tunnelling and pipe jacking in very soft soils (fat clays), even with an Earth Pressure Balance tunnel boring machine (EPBM), can cause large ground displacements. In this study, the short-term and long-term ground and tunnel response is predicted for twin, pipe-jacked EPBM 3 meter diameter tunnels with a narrow pillar width. Initial modelling indicated complete closure of the annulus gap at the tail shield onto the centrifugally cast, glass-fiber-reinforced, polymer mortar jacking pipe (FRP). Numerical modelling was employed to simulate the excavation and support installation sequence, examine the ground response during excavation, confirm the adequacy of the pillar width and check the structural adequacy of the installed pipe. In the numerical models, Mohr-Coulomb constitutive model with the effect of unloading was adopted for the fat clays, while for the bedrock layer, the generalized Hoek-Brown was employed. The numerical models considered explicit excavation sequences and different levels of ground convergence prior to support installation. The well-studied excavation sequences made the analysis possible for this study on a very soft clay, otherwise, obtaining the convergency in the numerical analysis would be impossible. The predicted results indicate that the ground displacements around the tunnel and its effect on the pipe would be acceptable despite predictions of large zones of plastic behaviour around the tunnels and within the entire pillar between them due to excavation-induced ground movements.

Keywords : finite element modeling (FEM), pipe-jacked tunneling, very soft clay, EPBM
Conference Title : ICTUCE 2023 : International Conference on Tunnel, Underground and Construction Engineering
Conference Location : New York, United States
Conference Dates : December 11-12, 2023