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Investigating the Tunnel Closure using Convergence Confinement Method and 2D Plane Strain Finite Difference Analysis

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ABSTRACT

The Convergence Confinement Method (CCM) is one of the frequently used methods that considers the ground response to the advancing tunnel face. The CCM analytical solutions represent stress relaxation on circular tunnel walls in a rock/soil media. The CCM analytical solutions is based on circular tunnel geometry and consider a hydrostatic stress field in a homogeneous isotropic rock mass condition. However, non-circular tunnel geometries, non-hydrostatic stress field, staged excavation process in a discontinuous anisotropic non-linear rock mass conditions are usually ignored in these analytical solutions. In this paper, we investigate the performance of the existing CCM analytical solutions developed for elastic and elasto-plastic ground behaviour for circular tunnels. For this purpose, a finite difference analysis is conducted to compare the analytical results with the results obtained from Finite Difference Method (FDM) for a chosen rock mass condition. Results obtained from the investigation shows that floor, crown and wall displacement are 30%, 10% and 23% more, respectively, in a horse-shoe relative to a circular tunnel. This indicates that the application of analytical formulation tailored for circular tunnels would lead to inaccurate quantification of wall convergence in horseshoe-shaped tunnels.