Incremental procedure method for the analysis of ground reaction due to excavation of a circular tunnel by considering the effect of overburden depth

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Abstract

The improvement to convergence-confinement method (CCM) applied in boring a circular tunnel through a rockmass in the initially isotropic stress state affected by the overburden depth is proposed in this paper. Three different boundary conditions concerning the location of ground surface, tunnel spring line and deep point are postulated to take into account this overburden effect. The closed-form analytical solutions of the stresses/displacements in the elastic and plastic regions for the ground reaction are presented in a theoretically consistent way. The incremental procedure method implements an analytical solution for executable calculations that can be estimated using a simple spreadsheet. The validity of the procedure for the analytical solution was examined by the numerical analysis to investigate the distribution of stresses/displacements particularly along the overburden pressure line on the cross-section of a circular tunnel. The agreement between the finite element analysis results and the closed-form solutions interpreted by the incremental procedure method was found to be excellent.

Keyword: Tunnel analysis; incremental procedure method; overburden depth; confinement loss; convergence-confinement method; finite element analysis.