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**Comprehensive solutions for underwater tunnels in rock masses with different GSI values considering blast-induced damage zone and seepage forces.** (English) Zbl 1481.74551

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Summary: Rock excavation using drill and blast method is commonly used in tunneling world-wide. Drill and blast method has inherent disadvantage of deteriorating surrounding rock mass due to development of a blast-induced damage zone with reduced strength and stiffness parameters and increased permeability. Traditional tunnel analysis adopts same parameters for the entire rock mass, leading to the underestimation of tunnel stability. The blast damage zone with finite thickness is significant in tunnel stability. Tunneling below the groundwater table affects the hydraulic equilibrium. This will, in turn, cause seepage into the tunnel through the pores and discontinuities in the rock masses. The developed seepage force should be considered as an additional body force acting on both damaged and undamaged rock masses. This study presents a new analytical closed-form solution for the determination of stresses, strains, and displacements around a circular deep underwater tunnel with the consideration of the seepage forces and the damaged zone. The solutions are presented for tunnels excavated in pervious elastic-brittle-plastic rock masses with Mohr-Coulomb failure criterion. The damaged zone is assumed to have cylindrical shape with finite radius. The plastic zones may be formed in both damaged and undamaged rock masses, independently. In order to solve the proposed problem, three different paths for plasticity evolution including six different states that can possibly be encountered in the problem are considered. The results indicate that the seepage and the damaged zone have significant effects on the tunnel convergence and the distribution of stresses in the rock mass.

**MSC:**

74L10 Soil and rock mechanics

**Keywords:**

drill and blast method; blast-induced damage zone; tunnel analysis; seepage force; GSI value; plastic zones

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