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Evaluation of Tunnel Stability by Numerical Methods

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Abstract : Excavating a tunnel releases a large amount of pre-existing stress, causing the material to deform by arching or squeezing effect depending on the depth of the tunnel. Shallow tunnels fail by arching, while deep underground tunnels fail by squeezing effect. There have been many failures recorded around the world, among them Ethiopia's biggest hydroelectric power station, Gillgel Gibe II, has been shut down due to a tunnel collapse weeks after its official opening. Nowadays, the country is constructing a new railway route at Awash-Kombolcha-Haragebeya to connect the towns with the ports of neighboring countries. Tunnel 04, having a maximum overburden of 320m is the focus of this study. The stability of the tunnel is analyzed by incorporating a pseudo-static analysis using the two finite element software, and the most favorable supports are selected. Based on the analysis made all three numerical analysis software's give nearly the same output results. Using Roc support, it is found that the displacement is 0.017, having a strain value of 0.35%, which is less than one exhibiting few stability problems with no squeezing potential where the tunnel can be supported by shotcrete and rockbolt. Therefore, the analysis from Phase 2 and Plaxis 3D shows a displacement of 0.022 and 0.0231m, respectively, after adding 30cm shotcrete and diameter 32 bolt. From the parametric study done, as the value of the young's modulus decreases, the displacement around the tunnel opening increases.

Keywords : squeezing, finite element method, deformation, support
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