DISPLACEMENTS AND STABILITY ASSESSMENT IN THE PORTAL OF TUNNEL 3, "EL SILLAR", THROUGH THE FINITE ELEMENT METHOD

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ABSTRACT

As an application of geotechnical engineering, an analysis of portal stability of the exit of Tunnel 3, in the construction of the double lane central section "El Sillar" Cochabamba - Santa Cruz highway is presented. This study is carried out by using the finite element method FEM with the PLAXIS 3D software to determine the areas where slope stabilization of the portal is needed and the definition of the excavation construction method along with the support system for the tunnel. Later, the tunnel structure is evaluated. Initially, data compilation from geotechnical studies is done (pits, geomechanical stations, geophysical survey, in situ and laboratory tests on drilled rock cores) contrasted with proper bibliographic referenced ranges to obtain initial geomechanical conditions. Subsequently, mechanical parameters of the rock are calibrated by means of real deformations caused by the excavation of the tunnel in the portal with a plastic-type calculation. The calibrated model achieves the average measured deformation on the tunnel: 5 mm. Then, the stability analysis is carried out by means of a safety-type calculation to obtain global safety factors where different stabilization alternatives are assessed. In this way, the modification of the slope geometry is revealed as the most optimal solution. Subsequently, the construction stages of the tunnel are simulated by adopting the Belgium method, the largest number of supports is required, because it is a very unstable area. Finally, principal effective stresses and deformations for static and pseudo-static conditions are calculated and reach admissible values (6, 12 mm maximum deformation in the vault) and minimum safety factors were above minimum factors required by NSR-10: 1,25 and 1,0; assessing most optimal geometry considering reinforced and non-reinforced conditions in the tunnel at three different depths and lateral covers for the tunnel.

Keywords: Portal Stability Analysis, Tunnel, Finite Elements, Factor of Safety, Excavation, Support.