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Parametric Study of Underground Opening Stability under Uncertainty Conditions

Authors : Aram Yakoby, Yossef H. Hatzor, Shmulik Pinkert

Abstract : This work presents an applied engineering method for evaluating the stability of underground openings under conditions of uncertainty. The developed method is demonstrated by a comprehensive parametric study on a case of large-diameter vertical borehole stability analysis, with uncertainties regarding the in-situ stress distribution. To this aim, a safety factor analysis is performed for the stability of both supported and unsupported boreholes. In the analysis, we used analytic geomechanical calculations and advanced numerical modeling to evaluate the estimated stress field. In addition, the work presents the development of a boundary condition for the numerical model that fits the nature of the problem and yields excellent accuracy. The borehole stability analysis is studied in terms of (1) the stress ratio in the vertical and horizontal directions, (2) the mechanical properties and geometry of the support system, and (3) the parametric sensitivity. The method's results are studied in light of a real case study of an underground waste disposal site. The conclusions of this study focus on the developed method for capturing the parametric uncertainty, the definition of critical geological depths, the criteria for implementing structural support, and the effectiveness of further in-situ investigations.

Keywords : borehole stability, in-situ stress, parametric study, factor of safety
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