Simulation of 3D Pore-Pressure Distributions for Slope Stability Analysis

MINEDW™

This project involved constructing and conducting a three-dimensional groundwater flow model and providing model-simulated pore-pressure distributions as the input to slope-stability analyses.

Project Background

This project involved the simulation of pore-pressure distributions at the Chuquicamata open-pit mine slope in Chile, which is the largest copper mine in the world by excavated volume.

Model Description

A three-dimensional (3D) groundwater flow model was constructed using *MINEDW*. Three main factors required the implementation of a 3D model: 1) discrete zones of recharge in the gravel unit lead to a non-uniform flow field; 2) the low-permeability west fault and shear zones maintain the non-hydrostatic pore-pressure distributions with depth during mining; and 3) the drainage gallery causes localized depressurization. In addition, the development of the zone of relaxation (ZOR), according to the mining schedule, is simulated. The model was calibrated against measured water levels, flow rate from drains, and seepage rates.

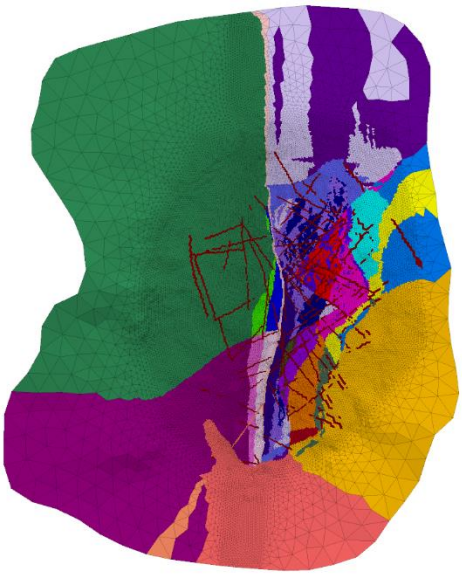

Figure 1. Plan view of model grid and simulated geologic units.

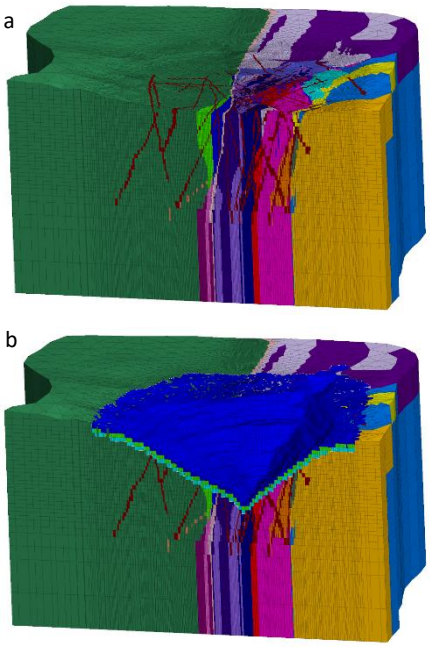

Figure 2. Cross-sections: a) before mining; b) during mining (with ZOR).

Results

The calibrated model was used for the prediction of pore-pressure distributions in the pit slopes for different time periods. The model was able to capture the non-hydrostatic, transient nature of the pore pressures with depth in the granodiorite west of the shear zone, in the shear zone, and along the west fault. The exported pore-pressure distributions were used as an input to the *3DEC* slope-stability analyses.

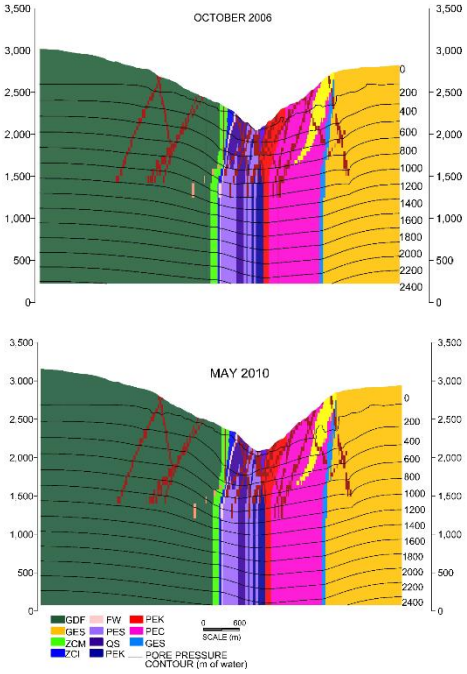

Figure 3. Simulated pore-pressure distributions.

Summary

The 3D groundwater flow model was constructed to represent the major geologic units and simulate the major hydraulic stresses. The model was reasonably calibrated to the measured water levels in the southwest corner. Consequently, the model reasonably simulates the temporal change of pore-pressure distributions.

References

Liu, H., F. Durán del Valle, J. Xiang and B. Sener Kaya. (2012) "Simulation of Three-Dimensional Pore-Pressure Distribution for Slope-Stability Analysis," in ***46th U.S. Rock Mechanics/Geomechanics Symposium (Proceedings, ARMA, Chicago, June 2012)***. Paper No. 12-452. Alexandria, Virginia: ARMA.