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Numerical Modelling of Shear Zone and Its Implications on Slope Instability at Letšeng Diamond Open Pit Mine, Lesotho

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Abstract : Rock mass damage due to shear tectonic activity has been investigated largely in geoscience where fluid transport is of major interest. However, little has been studied on the effect of shear zones on rock mass behavior and its impact on stability of rock slopes. At Letšeng Diamonds open pit mine in Lesotho, the shear zone composed of sheared kimberlite material, calcite and altered basalt is forming part of the haul ramp into the main pit cut 3. The alarming rate at which the shear zone is deteriorating has triggered concerns about both local and global stability of pit the walls. This study presents the numerical modelling of the open pit slope affected by shear zone at Letšeng Diamond Mine (LDM). Analysis of the slope involved development of the slope model by using a two-dimensional finite element code RS2. Interfaces between shear zone and host rock were represented by special joint elements incorporated in the finite element code. The analysis of structural geological mapping data provided a good platform to understand the joint network. Major joints including shear zone were incorporated into the model for simulation. This approach proved successful by demonstrating that continuum modelling can be used to evaluate evolution of stresses, strain, plastic yielding and failure mechanisms that are consistent with field observations. Structural control due to geological shear zone structure proved to be important in its location, size and orientation. Furthermore, the model analyzed slope deformation and sliding possibility along shear zone interfaces. This type of approach can predict shear zone deformation and failure mechanism, hence mitigation strategies can be deployed for safety of human lives and property within mine pits.

Keywords : numerical modeling, open pit mine, shear zone, slope stability
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