International Webinar on “Natural Hazards and Management, 21-22 November 2021

APPRAISAL OF SHEAR STRENGTH USING JOINT ROUGHNESS COEFFICIENT FOR CUT 8 DIP SLOPES, JWANENG DIAMOND MINE, BOTSWANA

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This study is concentrated on Debswana Jwaneng Diamond Mine, which is the largest producer, by value, for Debswana Diamond Company. At the time of the study, the mining activity was going on in two (2) cuts simultaneously. These two cuts are ‘Cut 8’ and ‘Cut 6, with the areas of interest being the North-East (NE), South-East (SE) and South West (SW) sides of these cuts.

Jwaneng Diamond Mine has had a history of a fatal slope failure in the Cut 8 North-East Corner and several cases of rock falls and planar slope failures. The NE, SE, and SW walls of Cut 8 are characterized by bedded dip slopes that daylight into the pit. Dip slopes are slopes that have the same dip direction as that of the underlying strata.

The orientation and geotechnical characteristics of the bedding in these slopes make these slopes highly susceptible to failure under conventional mining methods.

To determine the shear strength of the different rock units in North East, South East and South West walls, the Joint Roughness Coefficient of bedding in the walls have been calibrated in order to determine the factors of safety and probabilities of failure for the dip slopes. Data collection has been done through laser scan mapping of pit walls. The collected laser scans were analysed using ‘Maptek I-Site Studio 7.0’. The roughness data obtained were presented in the form of waviness profiles. Subsequently probabilistic stability analysis was carried out to determine the shear strength values and factors of safety correlating with different roughness coefficients.

Conclusions can be drawn from this study that there is a positive correlation between JRC value, shear strength, factor of safety (FOS) and a negative correlation with the probability of failure (POF). For any given slope, a high JRC value would result in high shear strength and consequently stable benches. JRC values for SW wall range from 0-20, for SE it is 0-10 and for NE it is 0-6. Ideally, a JRC value of above 5 is correlated with higher FOS. The difference

in shear strength and FOS values for failure planes with the same mean JRC values can be attributed to the difference in dip angles and other discontinuities of these failure planes.

The resultant shear strength, FOS and POF from probabilistic analysis using the mean failure plane give a general idea of the slope condition. The facets on NE, SE and SW walls are not having uniform pattern of stability. The sections with high FOS have a very low POF and vice versa. The SW wall has a range of FOS between 0.54 to 2.77 that corresponds to POF between 100 to 0 %. The SE wall has a FOS range between 0.39 to 3.81 and corresponding POF between 100 to 0 %. The NE wall has FOS range between 0.47 to 2.8 and corresponding POF between 100 to 0 %.

It is highly recommended that the JRC values should be taken along as many bedding planes as possible in the dip slope in order to account for variability in that slope hence minimizing chances of failure. Further, a conjugate study comprising the parameters like varying dip angles, presence of other discontinuities along with the joint density and joint roughness Coefficient, must be done in order to generate a detailed ‘Hazard Zonation Map’.