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A Semi-Automated GIS-Based Implementation of Slope Angle Design Reconciliation Process at Debswana Jwaneng Mine, Botswana

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Abstract : The mining of pit slopes is often associated with some level of deviation from design recommendations, and this may translate to associated changes in the stability of the excavated pit slopes. Therefore slope angle design reconciliations are essential for assessing and monitoring compliance of excavated pit slopes to accepted slope designs. These associated changes in slope stability may be reflected by changes in the calculated factors of safety and/or probabilities of failure. Reconciliations of as-mined and slope design profiles are conducted periodically to assess the implications of these deviations on pit slope stability. Currently, the slope design reconciliation process being implemented in Jwaneng Mine involves the measurement of as-mined and design slope angles along vertical sections cut along the established geotechnical design section lines on the GEOVIA GEMS™ software. Bench retentions are calculated as a percentage of the available catchment area, less over-mined and under-mined areas, to that of the designed catchment area. This process has proven to be both tedious and requires a lot of manual effort and time to execute. Consequently, a new semi-automated mine-to-design reconciliation approach that utilizes laser scanning and GIS-based tools is being proposed at Jwaneng Mine. This method involves high-resolution scanning of targeted bench walls, subsequent creation of 3D surfaces from point cloud data and the derivation of slope toe lines and crest lines on the Maptek I-Site Studio software. The toe lines and crest lines are then exported to the ArcGIS software where distance offsets between the design and actual bench toe lines and crest lines are calculated. Retained bench catchment capacity is measured as distances between the toe lines and crest lines on the same bench elevations. The assessment of the performance of the inter-ramp and overall slopes entails the measurement of excavated and design slope angles along vertical sections on the ArcGIS software. Excavated and design toe-to-toe or crest-to-crest slope angles are measured for inter-ramp stack slope reconciliations. Crest-to-toe slope angles are also measured for overall slope angle design reconciliations. The proposed approach allows for a more automated, accurate, quick and easier workflow for carrying out slope angle design reconciliations. This process has proved highly effective and timeous in the assessment of slope performance in Jwaneng Mine. This paper presents a newly proposed process for assessing compliance to slope angle designs for Jwaneng Mine.

Keywords : slope angle designs, slope design recommendations, slope performance, slope stability
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