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Increasing geotechnical data confidence through the Integration of laser scanner face mapping data into the Sishen iron ore mine geotechnical database

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ABSTRACT

Face mapping is a simple but invaluable means of geological and geotechnical data acquisition whereby intact rock properties, rock mass properties, discontinuity properties and structural orientation can be assessed. Although traditionally done via direct contact with the mapping face through techniques such as line mapping or window mapping, remote face mapping using various digital techniques has become increasingly popular in recent years. Sishen Mine is a large open pit mining operation requiring a comprehensive geotechnical data set to evaluate pit wall design and stability with the necessary level of confidence. Geotechnical borehole data, face mapping data, geotechnical lab testing data and implicit structural models provide the main sources of this information. Although a large geotechnical borehole database has always been maintained at the mine, face mapping has in the past been restricted to sporadic and isolated stability assessments. In 2013 the mine acquired a Maptek 8810 terrestrial laser scanner with the resolution, photographic capabilities and software required to carry out geotechnical face mapping. The aims of this research project were to evaluate the capabilities of the Maptek scanner and system, set up a standard face mapping procedure, integrate face mapping data in the mine's geotechnical database and compare face mapping acquired rock mass data with the mine's existing borehole data set. Further potential uses for the laser scanner system and face mapping data were also explored throughout the course of the dissertation. A face mapping procedure was set up and faces were mapped from 86 individual scans, acquired between October 2015 and April 2017. The mapping data obtained from the scans was integrated into the Acquire Geological Data Management System, a purpose designed Structured Query Language (SQL) database system used for storing the mine's geotechnical data. Open Database Connectivity (ODBC) database links with the Micromine Computer Aided Design (CAD) package allowed for spatial overlays of mapping data with other geotechnical data as well as survey and mine planning data. In terms of data analysis mapping parameters such as joint spacing, Rock Quality Designation and Rock Mass Rating could be directly compared with borehole logging values for the same rock types. The comparison indicated that in general borehole measurements tend to slightly under estimate joint spacing and rock mass rating values while face mapping assessments tend to slightly over estimate these values. This is due to various intricacies of the two data capture techniques that tend to skew the data in one way or the other. Face mapping data was compared with Sishen's existing structural model, which is based mainly on interpretation and implicit data. Structural orientations and features correlate well between the implicit model and actual mapped values gathered during the data collection phase of this project. Within the geotechnical design process, having actual mapping data in combination with increased confidence in the structural model allows for better definition of geotechnical design sectors. Overall the face mapping and geotechnical analysis features of the Maptek 8810 terrestrial laser scanner make it an invaluable geotechnical data capture tool, providing a system is in place to store mapping data in a manner that allows for meaningful rock mass and structural information to be produced.