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Enhancing the Collection of Rock Mass Fabric Data for Open Pit Mines

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"Due to limited access to pit walls and reachable height restrictions, a larger area of the rock face was mapped through photogrammetry. Only 189 discontinuity features were measured using conventional mapping compared to 1170 from photogrammetry."

"An issue often encountered during conventional mapping is the disturbance of compass readings due to magnetic properties of a rock mass"

"In terms of personnel required to complete manual structural mapping and photogrammetric mapping, for efficiency and safety reasons, two field staff were appointed for each method. Both of these techniques also required the support of surveyors on site. Generally, mapping through photogrammetry requires less time in the field and more time in the office to process the data, in comparison to line mapping. As a result, it is often favourable to conduct surface structural mapping using photogrammetry to limit the risk of personnel working near unstable rock faces or in regions which are difficult to access, as well as (in this case) limit the disruption to the operational mine activities."

"One of the main benefits of photogrammetric mapping is that it offers large coverage in a short span of time. Photogrammetry could also be incorporated into monitoring programs at operational mines, to provide detailed records of any changes seen in pit walls."

"Although the analysis of the line mapping and photogrammetry data produced analogous results, approximately six times the number of structural features were recorded with the photogrammetric method, with the same amount of time spent in the field for both techniques. The entire slope face can be mapped with photogrammetry, given that there is sufficient space to capture the rock face with the camera and the availability of the appropriate fixed focal length or zoom camera lenses. Whereas line mapping is limited to areas which are safely accessible and dependent on structural features that intersect the survey line (unless window style mapping is used). As a result, photogrammetric mapping can easily identify the critical discontinuity sets for slope stability, and this information is useful in validating the minor and major sets interpreted from geotechnical drilling.

In summary, there are limitations and benefits associated to each structural data collection technique. Traditional line mapping is simple, requiring little more than a compass, survey line and field staff. However, the risk associated with personnel approaching potentially unstable rock faces can limit coverage. Geotechnical drilling with core orientation offers structural data at depth and knowledge of in situ rock mass fabric conditions. Using this knowledge, shear strength data can be assigned to the major and minor discontinuity sets in the rock mass. The main drawback to geotechnical drilling is that it does not provide a clear insight to discontinuity persistence. 3D photogrammetric mapping can measure persistence and spacing, along with the orientation of discontinuity features but lacks the capability to describe shear strength properties and other joint surface and rock mass characteristics. Photogrammetric mapping also offers large coverage in a short span of time, at distances away from potentially unstable rock faces. However, this method is limited to good weather conditions, clean slopes (few obstructions) and areas where a camera can easily capture the rock face.

Overall, photogrammetric mapping was a very useful tool in determining the major discontinuity sets seen in the existing open pit mine and complementing the other existing structural data collection techniques. In addition, it significantly improved the health and safety working conditions for the geotechnical field team, where access to the pit wall proved to be difficult and risky."