Incorporating waviness in rock mechanic strength models = steeper slopes

Today the mining industry is less focussed on building new mines, and more focussed on sweating their current assets for increased returns.

One way to minimise costs and maximise ore recovery is to increase the steepness of the designed slopes.

Until now, the optimisation of slope design angles was missing a key component – the ability to calculate waviness. Using televiewer surveys to gain high accuracy structural orientation can allow this missing component to be calculated.

Waviness, or the roughness of the surface over large areas, is a component of defect plane shear strength that traditionally can't be assessed prior to mining.

At Coffey, we've developed a method to assess this waviness from televiewer data that can be incorporated in rock mechanic strength models - resulting in upgraded strengths, and steeper slopes.

The days of overly conservative slope design are over

Many of our clients excavate open pits in bedded, highly anisotropic materials, where rock strength varies due to the layered nature of the materials. Above the footwall rests layers of rock – or stratigraphy – that make up the mineral deposit. Dip slope mining is often used to mine in parallel with the natural layering. Variation in orientation of the layers means it is often necessary to cut through these materials, and the planes of weakness, such as bedding planes, that lie between them. This can cause instability– especially where sliding of blocks of rock on these bedding planes can occur.

Previous excavations often demonstrate these materials exhibit 'folding' at a smaller scale than inferred within the original geological or structural model - this is known as waviness. In the past, quantifying this waviness at the design stage wasn't possible, as only traditional drill core data was available.

When waviness can't be quantified, lower defect plane strengths are used to inform design. This leads to overly conservative slope design, with significant excess volumes of waste rock requiring blasting, excavation, movement and ultimately disposal.

Waviness is an important component of the shear strength of bedding planes and other fractures within the rock mass. Without incorporating the waviness component, the shear strength of these discontinuities can be underestimated.

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In order to avoid overly conservative slope design, assessing waviness should be considered in the design phase.

The resulting effect on deposit economics can be great.

Every additional degree of slope steepening achieved has the potential to save millions of dollars as the handling of waste rock is reduced, and/or ore recovery is increased.

Our solution

We've developed a process of interpreting waviness from televiewer data. This allows us to determine small scale variations of bedding angle as a result of the larger scale tectonic regime. The data is analysed to determine a traditional waviness angle, which can be incorporated into defect plane shear strength models to influence steeper slope designs.

Deriving waviness angles from televiewer data, and incorporating this information into strength models, means we're able to deliver a strength profile that's more representative of the stratigraphy. Slope stability modelling using this methodology will result in mine designs with steeper slopes being generated.

If your rock mass is anisotropic, and instability along the structural fabric is a limiting factor to design, a waviness assessment can help.

For more information, please contact Rob Thomas via email or call M +61 428 933 135.

View our geotechnical slope optimisation study.

Reference

Thomas, R., King, A. & Neilsen, J., 2014, *"Assessing waviness from televiewer data for incorporation in defect plane shear strength models".* In Proc. of 48th US Rock Mechanics/Geomechanics Symposium, 1-4 June, Minneapolis, Minnesota.