World Academy of Science, Engineering and Technology
International Journal of Geological and Environmental Engineering
Vol:19, No:06, 2025

Structural Analysis and Modelling in an Evolving Iron Ore Operation

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Abstract : Optimizing pit slope stability and reducing strip ratio of a mining operation are two key tasks in geotechnical engineering. With a growing demand for minerals and an increasing cost associated with extraction, companies are constantly re-evaluating the viability of mineral deposits and challenging their geological understanding. Within Rio Tinto Iron Ore, the Structural Geology (SG) team investigate and collect critical data, such as point based orientations, mapping and geological inferences from adjacent pits to re-model deposits where previous interpretations have failed to account for structurally controlled slope failures. Utilizing innovative data collection methods and data-driven investigation, SG aims to address the root causes of slope instability. Committing to a resource grid drill campaign as the primary source of data collection will often bias data collection to a specific orientation and significantly reduce the capability to identify and qualify complexity. Consequently, these limitations make it difficult to construct a realistic and coherent structural model that identifies adverse structural domains. Without the consideration of complexity and the capability of capturing these structural domains, mining operations run the risk of inadequately designed slopes that may fail and potentially harm people. Regional structural trends have been considered in conjunction with surface and in-pit mapping data to model multi-batter fold structures that were absent from previous iterations of the structural model. The risk is evident in newly identified dip-slope and rock-mass controlled sectors of the geotechnical design rather than a ubiquitous dip-slope sector across the pit. The reward is two-fold: 1) providing sectors of rock-mass controlled design in previously interpreted structurally controlled domains and 2) the opportunity to optimize the slope angle for mineral recovery and reduced strip ratio. Furthermore, a resulting high confidence model with structures and geometries that can account for historic slope instabilities in structurally controlled domains where design assumptions failed.

Keywords : structural geology, geotechnical design, optimization, slope stability, risk mitigation
Conference Title : ICGGS 2025 : International Conference on Geology, Geotechnology and Seismology
Conference Location : Toronto, Canada
Conference Dates : June 15-16, 2025