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Study the Difference Between the Mohr-Coulomb and the Barton-Bandis Joint Constitutive Models: A Case Study from the Iron Open Pit Mine, Canada

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Abstract : Since a rock mass is a discontinuum medium, its behaviour is governed by discontinuities such as faults, joint sets, lithologic contact, and bedding planes. Thus, rock slope stability analysis in jointed rock masses is largely dependent upon discontinuities constitutive equations. This paper studies the difference between the Mohr-Coulomb (MC) and the Barton-Bandis (BB) joint constitutive numerical models for lithological contacts and joint sets. For the rock in these models, generalized Hoek-Brown criteria have been considered. The joint roughness coefficient (JRC) and the joint wall compressive strength (JCS) are vital parameters in the BB model. The numerical models are applied to the rock slope stability analysis in the Mont-Wright (MW) mine. The Mont-Wright mine is owned and operated by ArcelorMittal Mining Canada (AMMC), one of the largest iron-ore open pit operations in Canada. In this regard, one of the high walls of the mine has been selected to undergo slope stability analysis with RS2D software, finite element method. Three piezometers have been installed in this zone to record pore water pressure and it is monitored by radar. In this zone, the AMP-IF and QRMS-IF contacts and very persistent and altered joint sets in IF control the rock slope behaviour. The height of the slope is more than 250 m and consists of different lithologies such as AMP, IF, GN, QRMS, and QR. To apply the B-B model, the joint sets and geological contacts have been scanned by Maptek, and their JRC has been calculated by different methods. The numerical studies reveal that the JRC of geological contacts, AMP-IF and QRMS-IF, and joint sets in IF had a significant influence on the safety factor. After evaluating the results of rock slope stability analysis and the radar data, the B-B constitutive equation for discontinuities has shown acceptable results to the real condition in the mine. It should be noted that the difference in safety factors in MC and BB joint constitutive models in some cases is more than 30%.

Keywords : barton-Bandis criterion, Hoek-brown and Mohr-Coulomb criteria, open pit, slope stability
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