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2021
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THE GEOTECHNICAL DESIGN OF THE HIGHWALL MINING LAYOUT: A CASE STUDY AT THE 5 SEAM OPERATION OF GLENCORE COAL SA

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A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfilment of the requirements for the degree of Master of Science in Engineering.

Johannesburg, 2020

Declaration

I declare that this research report is my own unaided work. It is being submitted to the Degree of Master of Science to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

…….
(Signature of Candidate)

…….. day of …….. *(*Month)…… (Year) at ……..

Abstract

The highwall mining method was adopted as an alternative method for extracting the remaining No.5 coal seam reserves at the 5 seam operation. There is currently a limited practical knowledge on the rockmass response to this mining method on various mining geometries. A great deal of experience has been derived and documented over the years in Australia and the USA, for instance and a number of empirical methods have been derived for pillar strength estimation. These require validation and verification against the local conditions and design geometries.

This research project is aimed at determining and validating the suitable pillar dimensions and spacing at various panel geometries. A hybrid methodology was adopted comprising of empirical and numerical modelling approaches. Pillar safety factor was determined using the Mark- Bieniawski pillar strength empirical formula and pillar stress obtained from UDEC numerical modelling software. For stability assessment, a threshold safety factor of 1.3 was adopted from the ARMPS-HWM minimum safety factor guidelines based on the panel span. Furthermore, the UDEC modelling outputs were closely monitored to ascertain the stress distribution and plastic (yielding) conditions as indication of potential instability. These results were validated by means of using the available instrumentation results that were obtained as the mining progresses using Geokon Stressmeter.

Based on the safety factor assessment, the minimum web pillar width at which the threshold safety factor of 1.3 is attained is 1.2m. This is achieved at a panel width of 28m (6 cuts / 5 pillars per panel) up to the maximum cover depth of 50m, which corresponds with the cover depth obtained from the geological information. The UDEC modelling assessment results depicted mainly potential shear failure mode, which is indicative of the presence of confinement. As a result, a 28m panel width comprising of 5 x 1.2m web pillars was selected for the initial pillar design layout and for instrumentation. The mining height of 1.8m was used based on the thickness of the coal seam and cover depth ranging from 40m to 45m. The available strain measurement results indicate the maximum web and barrier pillar stresses are less than 0.3xUCS

(8.33MPa) and no failure or crack initiation was expected on the pillars. This was also confirmed during the actual mining activities, where no pillar fracturing occurred. These results present opportunities for layout optimization at various geometries.