Determination of Packfilling Width and Stability Control for Retained – GOAF Side – Gate Road Based On Numerical Simulation of Shallow Y-Type Longwall Coal Mine in A Weak Rock Mass Condition

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ABSTRACT

1. Introduction

As one of the effective efforts to face the increasing global needs of coal, underground coal mining needs to be developed. U-type longwall mining is one of the most common underground mining methods that is used to mine flat lying and horizontal coal deposit. However, this type of longwall mining has several sustainability and safety issues. As an alternative to overcome these issues, Y-type longwall mining has been proposed (Figure 1). This study is then conducted to further understand the implementation of Y-type longwall mining in shallow mining environment with weak rock mass condition, especially in terms of packfilling width determination and stability control of RGSG.

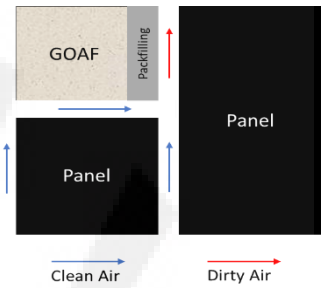

Figure 1. Y-type longwall

2. Data and Methods

To obtain comprehensive guideline in determining adequate packfilling width and to analyze the stability of RGSG, a numerical simulation is carried out to perform the whole mining process of Y-type longwall mining in shallow mining environment and weak rock mass condition. The numerical model is built using FLAC with plane strain assumption (Figure 2). The initial stress is applied as a field stress with four different cases of overburden depth: 50 m, 100 m, 200 m, and 300 m. Mechanical parameters that are used in the numerical simulation are shown on Table 1. Steel sets support are used as primary and initial support system with mechanical parameters shown on Table 2. During the panel extraction process, packfilling is constructed between the GOAF zone and RGSG with six scenarios of width: 1 m, 2 m, 3 m, 4 m, 5 m, and 6 m. The analysis that are used in this study are vertical stress redistribution analysis, safety factor analysis based on Mohr-Coulomb failure criterion, and support capacity analysis.

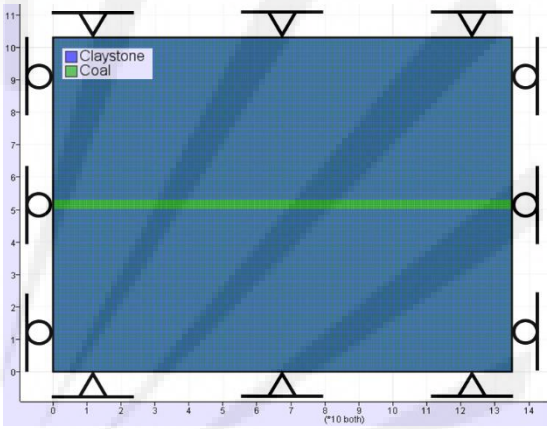

Figure 2. Numerical model

Table 1. Mechanical parameters in numerical simulation

Rock	Density (ρ) kg/m3	Young's Modulus (E) MPa	Poisson's Ratio (v) -	Cohesion (c) MPa	Friction Angle (ϕ) °
Claystone	2140.00	1095.00	0.28	0.60	38.38
Coal	1380.00	1296.00	0.32	2.63	45.70
GOAF	1700.00	15.00	0.25	0.001	25.00
Packfilling	2420.00	3378.00	0.23	7.92	32.66

Table 2. Mechanical parameters of steel sets

Dimension (mm)	Area (cm2)	Young's Modulus (E) MPa	Poisson's Ratio (v) -	Unit Weight (kg/m)	Yield Strength MPa
95 x 115	36.51	200,000	0.30	28.70	554

3. Results

For overburden depth of 50 m and 100 m, the adequate packfilling width is start from 3 m. For overburden depth of 200 m and 300 m, the adequate packfilling width is start from 4 m. However, there are still instability and failure zones surrounding the RGSG that need to be considered. This study adopts rock bolting system as additional support system for roof and side walls with the assumption that mechanical excavation is the solution for floor heave. The application of rock bolt as an additional support causes the decrease in failure and unstable zones, reduces the RGSG closure and improve the performance of steel sets as primary support system.