RINGKASAN

Penelitian dilakukan di PT Generasi Muda Bersatu (GMB) yang merupakan perusahaan pertambangan galena yang terletak di Desa Cihaur, Kecamatan Simpenan, Kabupaten Sukabumi, Jawa Barat dengan metode *penambangan cut and fill*. Di Blok Sabau pada tahun 2023 sedang membuat akses lubang bukaan *development area* sebagai jalan bagi alat muat dan angkut serta untuk menghubungkan jalan muat dan angkut menuju lubang bukaan produksi. Hasil pengeboran geoteknik di *development area* sekitar lubang bukaan termasuk dalam kelas massa batuan II (*good*), III (*fair*), dan IV (*poor*) berdasarkan klasifikasi massa batuan Rock Mass Rating (RMR). Adanya massa batuan kelas *fair* dan *poor* berdasarkan nilai RMR menunjukkan keberadaan struktur geologi yang buruk, sehingga menyebabkan ketidakstabilan pada lubang bukaan di *development area*. Tujuan dari penelitian ini adalah mendapatkan kondisi awal kestabilan lubang bukaan, rancangan sistem penyangga yang tepat digunakan pada lubang bukaan, dan variasi penggunaan rancangan sistem penyangga berdasarkan lokasi pembuatan lubang bukaan.

Analisis kestabilan lubang bukaan menggunakan metode empirik dan metode analitik. Metode empirik yang digunakan, yaitu klasifikasi massa batuan RMR dan Q-System. Metode analitik yang digunakan, yaitu pemodelan numerik menggunakan metode elemen hingga dengan tipe analisis *plane strain*. Material properties yang digunakan diantaranya bobot isi dan nilai kuat tekan uniaksial yang didapatkan dari data pengujian yang berasal dari *drill log*, Nilai Q dan GSI yang didapatkan dari klasifikasi massa batuan dengan metode RMR dari *coring log.* Adapun untuk menentukan kekuatan batuan digunakan kriteria keruntuhan *Generalized* Hoek-Brown. Sebuah acuan yang digunakan untuk mengetahui lubang bukaan stabil dinyatakan dengan *strength factor* $\geq$ 1.

Hasil analisis kestabilan lubang bukaan didapatkan kondisi tidak stabil terjadi pada klasifikasi massa batuan RMR kelas *poor* di kedalaman 70 m, 130 m, dan 170 m; dan kelas *fair* di kedalaman 130 m dan 170 m. Pada klasifikasi massa batuan Q-System kelas *very poor* di kedalaman 70 m, 130 m, dan 170 m. Rekomendasi sistem penyangga RMR kelas *poor* berupa sistematik *bolts* dengan panjang 4-5 m, spasi 1- 1,5 m di atap dan dinding dengan *wire mesh* di atap, serta *shotcrete* 100-150 mm di atap dan 100 mm di sisi bukaan; kelas *fair* berupa sistematik *bolts* dengan panjang 4 m, spasi 1,5 - 2 m di atap dan dinding dengan *wire mesh* di atap, serta *shotcrete* 50-100 mm di atap dan 30 mm di sisi bukaan. Sedangkan, rekomendasi sistem penyangga Q-System kelas *very poor* menggunakan *bolts* 2,25 m, serta *concrete* 9 – 12 cm. Hasil analisis kestabilan lubang bukaan yang menggunakan sistem penyangga pada klasfikasi massa batuan RMR kelas *poor* di kedalaman 70 m, 130 m, dan 170 m; kelas *fair* di kedalaman 130 m dan 170 m; dan Q-System kelas *very poor* di kedalaman 70 m, 130 m, dan 170 m dinyatakan stabil.

SUMMARY

The research was conducted at PT Generasi Muda Bersatu (GMB), a galena mining company located in Cihaur Village, Simpenan District, Sukabumi Regency, West Java, using the cut and fill mining method. In Block Sabau in the year 2023, an access opening was being created in the development area to serve as a passage for loading and hauling equipment and to connect the haul road to the production opening. The results of geotechnical drilling around the development area opening fell into the rock mass classification classes II (good), III (fair), and IV (poor) based on the Rock Mass Rating (RMR) classification. The presence of rock masses classified as fair and poor based on RMR values indicates the presence of poor geological structures, leading to instability in the development area opening. The objectives of this study were to determine the initial stability conditions of the opening, identify the appropriate support system design for the opening, and assess variations in support system design based on the opening location.

Stability analysis of the mine opening was conducted using empirical and analytical methods. The empirical methods employed were the RMR rock mass classification and the Q-System. The analytical method used numerical modeling with the finite element method in plane strain analysis. Material properties considered included bulk density and uniaxial compressive strength obtained from testing data from drill logs, Q and GSI values derived from the RMR rock mass classification method based on coring logs. To determine rock strength, the Generalized Hoek-Brown failure criteria were used, with a reference indicating a stable opening if the strength factor is > 1.

The stability analysis results indicated unstable conditions in the rock mass classification of RMR class poor at depths of 70 m, 130 m, and 170 m, as well as class fair at depths of 130 m and 170 m. In the Q-System rock mass classification, very poor conditions were observed at depths of 70 m, 130 m, and 170 m. Recommendations for the support system in RMR class poor included systematic bolts with lengths of 4-5 m, spacing of 1-1,5 m on the roof and walls with wire mesh on the roof, and shotcrete of 100-150 mm on the roof and 100 mm on the opening side. For RMR class fair, the recommendations included systematic bolts with a length of 4 m, spacing of 1,5-2 m on the roof and walls with wire mesh on the roof, and shotcrete of 50-100 mm on the roof and 30 mm on the opening side. Meanwhile, the recommended support system for Q-System class very poor included bolts with a length of 2,25 m and concrete of 9-12 cm. The stability analysis results using the support systems for RMR class poor at depths of 70 m, 130 m, and 170 m; class fair at depths of 130 m and 170 m; and Q-System class very poor at depths of 70 m, 130 m, and 170 m indicated stability.