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FINAL PIT PLANNING COAL MINING IN 16 PHASE 2 SEAMS IN PT. KTC COAL MINING & ENERGY, KECAMATAN. PALARAN, SAMARINDA, EAST KALIMANTAN

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Abstract

Mining stage design which is a complex problem in terms of three-dimensional geometry that is always changing, then in this thesis the pit limit, mine sequence design or mining stages are in accordance with the tolerance stripping ratio recommended by the company and the production equipment to be used in order to obtain production targets the optimal. The research was conducted using software to design the final pit and block model method to calculate the volume. The results of the research that have been carried out obtained 752,930 MT of mined reserves and Over Burden (OB) volumes of 4,439,394 BCM and Stripping Ratio (SR).

***Keywords**: Block model, Final Pit, stripping ratio, Volume*

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INTRODUCTION

The mining industry is known to be a capital intensive and technology intensive industry, which also has a very high work risk. Therefore, it is necessary to have good management in the mining process to get maximum benefits and of course pay attention to security and fluency in operations.

The first stage in implementing the final pit planning process is to get the entire reserve in the pit with more regular planning. In the final pit planning, pit, ramp, disposal, road, and drainage designs will be made for each sequence. The data needed to make the mining stages, in the form of geological data, geotechnical data, morphological data, and BESR values will be used as a basis for determining stripping ratios at each mining stage. The method used to calculate the volume in this study is to use the block method, so it is very necessary to reconstruct the topography contour and the contour of the coal structure.

The output obtained in this study is in the form of volume, tonnage and stripping ratio at each mining stage. In addition to this, the mining stage will be obtained based on the predetermined production targets, which consist of ramp, haul road, bench width, slope height, slope angle and width of the mining level. Also planned disposal area, planned disposal dimensions based on shrinkage factor and distance from the ultimate pit limit.

THEORETICAL BACKGROUND

Open Mine Design

Mining by the method of open mining is an activity of extracting minerals such as coal, ore (ore), and stone and so on where the workers deal directly with the outside air and climate. In the process, the pit is dug into the ground according to the design form until mining ends. The shape and size of the pit depends on several factors that must be understood in its planning [1].

Level Geometry

Level geometry consists of height, single slope angle, and catch bench width. The level geotechnical design is usually expressed in terms of parameters for these three aspects, namely the height, the slope angle, and the width of the level. Factors that influence level geometry, namely [4]:

1) Production

One of the objectives of determining the dimensions of the level is to be able to produce the desired production, so the level to be made needs to consider the amount of production desired. In general, the amount of production has an effect on determining the level of dimensions to be made, meaning that the accurate size of the level depends on the amount of production.

2) Material Conditions

Existing material / rock conditions can determine the equipment that must be used so that activities suitable for the production undertaken can be determined. Rock conditions that are more dominant include rock strength, development factors, rock density, and existing geological structures. Based on these material conditions can help estimate the production equipment used. In soft materials, excavation can be done directly on the surface of the material (work surface), so the distance and height of the excavation need to be taken into account in estimating the width and height of the level.

3) Production Equipment

In general, the production equipment to be used / selected is adjusted to the desired production capacity and according to the material to be worked on. With these considerations, the level dimension has good working conditions, which will affect work efficiency.

Dimension levels that are taken into account include width, length, and height. The length and width are determined by the method of dismantling the material (using mechanical or blasting tools), the ability of the loading equipment, the movement pattern of the loading and hauling equipment, as well as the location of the loading and hauling equipment used at the same time during mining and production targets and ex-mining land use plan. Here are some parameters for determining the level dimension, namely [4]:

• The range of digging tools
• Tools that work on a bench
• The depth of the drill tool used
• Consideration of the amount of reserves

Overall slope is a combined slope of several levels between haul roads. The overall slope angle is the actual angle of the entire pit wall, taking into account the haul road, catchment level and all other profiles on the tier wall. The following is a visual overall slope angle shown in Figure 1.

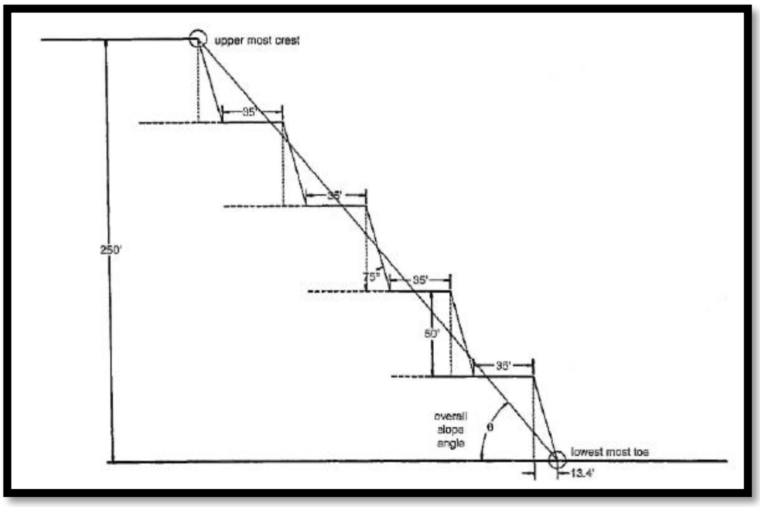

Figure 1. Overall slope angle [3]

The overall slope angle is the slope angle of the entire level made on the mining front. This slope is measured from the top crest to the last toe from the mining front.

Overall slope which in several (two) parts of the level is used as a working bench. The slope of the angle is measured from the top crest to the lowest toe from the existing level. Leveling must be engineered to have safe conditions to avoid accidents during mining operations, the stability of a slope is expressed in an index called a safety factor [2].

Dumping Design

According to Kennedy (1990), pile design is an attempt to determine the location of a pile of material resulting from the excavation and transportation of material, both valuable and not valuable, including determining the volume or tonnage, design of the pile form and time of its implementation [5].

Heap Design Parameters

The process of hoarding material, both valuable and unworthy material must consider several factors that influence, as for several pile design parameters, among others [5]:

a) Heap slope angle

Run (mine) dry rock in general has a slope angle between 34o-37o. This angle is affected by dump height, irregularity of rock blocks and dumping speed.

b) Material development factor (swell factor)

Development factors in hard rock are generally between 30% - 45% at 1m3. In situ material will expand to 1,3-1,45m3 loose material. While the material can be compressed around 5-15%.

c) Distance from the pit limit

The minimum distance is enough room for the haul road between the pit limit and the dump toe. The stability of pits due to pile must be taken into account the distance equal to or greater than the depth of the pit will reduce the risk associated with the stability of the pit slope.

d) Rise toward the dump crest

A slight incline is recommended in the direction of a dump crest with consideration of drainage and safety. Rainwater runoff is designed away from the crest. Dump trucks must use engine power to get to the crest and not glide freely. This will also reduce the risk of the vehicle being parked sliding from the peak of the waste dump (crest).

METHOD

This research was conducted in several stages including the preparation stage, the data collection stage, and the data processing and analysis stage. Data collection methods in research conducted at PT. KTC Coal Mining & Energy is done by collecting the necessary data where overall data collected includes: geological data, geotechnical data, morphological data, BESR values, production targets and others.

The data that has been collected is then processed using Surpac 6.2 software, this program is widely used because of the level of reserve analysis that approaches the actual situation in the field. In addition to analyzing, this software is used for coal mining planning and modeling.

Data processing is done by processing the model and calculations using software, while the calculation steps are as follows:

a. Topographic data

The topographic data obtained is in the form of design (str). The topographic data is then imported into a surpac basis, which is then used as a surface boundary to calculate the volume of overburden and stripping ratio.

b. Drilling database creation

Drilling data consist of coordinates, seam, depth and thickness of coal. To begin modeling using the Surpac software, a drill hole database is first prepared to be imported into the project. For making drill hole database data, there are two data formats that must be prepared, namely collar format, geology and survey format. Making this drill hole database using Microsoft Excel program which is then saved with the format (formatted tech comma delimited).

c. Making contour structure and crop line

Structure contour map is a map that illustrates the position / location of coal that is below the surface. The purpose of making a contour structure map is to determine the pattern of spread of the coal roof (top layer), floor (bottom layer), and provide a large depiction of the coal slope. While crop line is made with the aim of knowing the initial limit of mining.

d. Determination of pit limits

To determine the pit limit is to limit the population of area blocks that have an average stripping ratio of 10: 1. In this case, also consider the situation map of the study area.

e. Block modeling in surpac

A block model was created using surpac to calculate the SR value in the mining sequence so that BCM overburden and MT Coal were obtained. If the SR or production target does not match the company request, the sequence design will be repeated until the design is appropriate.

f. Disposal planning

Obtained the number of BCM overburden in the appropriate sequence design, then disposal planning is made. For disposal, planning is done by designing based on overburden which has been multiplied by the swell factor so that it gets its LCM value, calculated the disposal volume with the menu block model to get the disposal volume.

g. Planning haul road

The haul road design is made after the pit, and the disposal is finished, making it easier for planning. Haul road is designed to have a grade that does not exceed the ability of the tool to facilitate mining vehicles in the process; haul road design will be made based on the calculation of the geometry of the road in accordance with the type of vehicle used.

RESULTS AND DISCUSSION

Results and discussions include the morphology of the study area, geological modeling, mining geometry planning, disposal geometry, road geometry, mine drainage systems, block models, and long-term design.

Morphology Research Area

Topographic maps with contour lines that describe the appearance of the earth. Topographic maps can be used to process data in the design stages of mining, and mining roads. Surface in concessions of PT. KTC Coal Mining & Energy in the Tani Bhakti Block in the form of hills with a slope of 5-50 °. The maximum elevation reaches 130 masl the minimum elevation reaches 30 masl.

Overall mining concessions of PT. KTC Coal Mining & Energy is divided into 3 big blocks, namely: Simpang Pasir Block, Tegal Anyar Block, and Tani Bhakti Block. Whereas the boundaries of the research area are only in the Bhakti Farmers' Block with an area of 415.2 Ha.

Geological modeling

Seam coal in the study area is only one seam, which has a thickness of ≥ 5.1 m, with the general direction of coal distribution that is relatively north south, with a slope towards the southeast ranging from 17 ° - 20 °. In the design of mining stages in the research, area is based on the results of coal seam modeling that already exists. PT. KTC Coal Mining & Energy has drilled more than 70 drill holes to find out the spread of coal deposits in the Tani Bhakti Block.

Mining Geometry Planning

The mining technical plan is carried out to simplify the mining process and obtain reserve calculations that are in accordance with the production target, in accordance with the direction of coal distribution. The mining technical design requires several important parameters, these parameters include:

a. The monthly production target is 63,000 tons
b. Stripping Ratio (SR) ≤ 5.9: 1
c. Geotechnical recommendations for level height (10 m)
d. Geotechnical recommendations for final width (5 m)
e. Geotechnical recommendations for single slope 60 °

Disposal Geometry

The technical design of overburden hoarding requires several important parameters, these parameters use include:

a. Purpose of landfill area (waste dump)
b. Geotechnical recommendations for level height (5 m)
c. Geotechnical recommendations for level widths (5 m)
d. Angle of repose of overburden material (50 °)
e. Material swell factor determined (80%)

Mining Road Geometry Design

In the design of the mine road in this study, because the largest hauling device that passes through the mine road is the Volvo A40E brand with a width of 3.7 meters, and it is planned to use two lanes then the mine road width is used: 3.7 x 3.5 = 12.95 ≈13 meters. The width of the road is 13 meters including the shoulder of the berm safety, drainage, and for two lanes. While the berm safety geometry used uses 66% of the conveyance tire diameter (1.6 meter tire diameter), namely: 66% x 1.6 = 1.06 meters Safety tilt used outside berm (facing the road) with an angle of 56o and the inside with an angle of 18o. while for drainage, the width and depth of the drainage are adjusted to the grader's ability to form puritans, which are 0.5 meters wide and 0.3 meters deep, in the form of triangles. Cross slope used in haul road planning is 3%, maximum grade of haul road is 8%.

Mining Flow System

Efforts to channel water into the wells and prevent standing water at the level are carried out by making a trench near the foot level. Planning for flowing at the level of the foot can be seen in Figure 2 as follows:

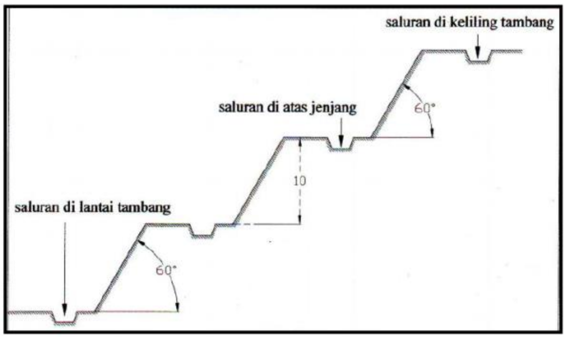

Figure 2. Channel Design

Sump (sump) is a water storage pond created for holding runoff water that is made temporarily before the water is pumped, and can function as a mud settler. The placement of wells is determined and not too close to the working area of the equipment or the mine's progress limits.

Model Block

Block model is a method used to determine the volume of material inside a block with a predetermined dimension. Material inside the block will be divided according to volume at the specified elevation.

The area of the final pit on seam 16 phase 2 is 196,943 m2 while the area to be carried out back filling is seam 13 phase 6 with an area of 231,659 m2 and seam 16 phase 1 with an area of 110,622 m2. The dimensions of the blocks used in the pit design are 100m x 100m with the translation of material volume at every 10m.

The number of blocks used to calculate the volume in seam 16 phase 2 is 36 blocks, in the area to be performed back filling ie seam 16 phase 1 is 16 blocks and in seam 13 phase 6 is 33 blocks. Data from the block model can be seen in Figure 3

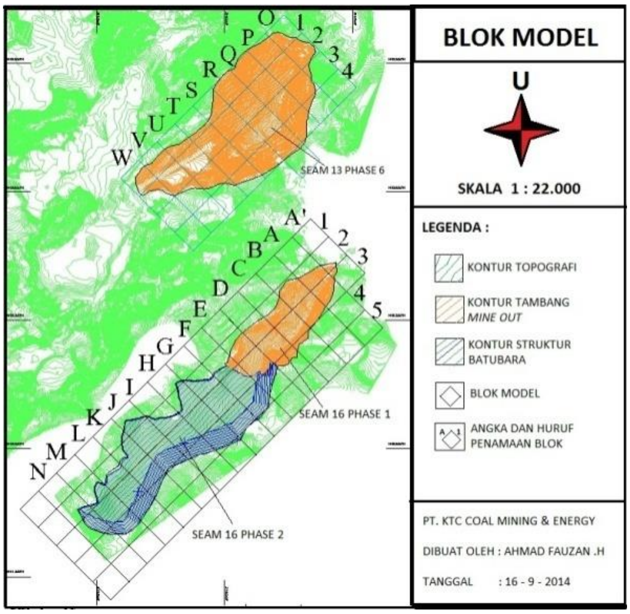

Figure 3. Block model

Long Term Design

Long-term design is long-term pit planning, which is usually designed until mine out. Long-term planning is done before making the mining sequence planning. In the final pit design plan, the BESR value plan given by PT. KTC Coal Mining & Energy is 5.9. The final pit design in the results of this study is the design of mining in seam 16 phase 2 with 752,930 MT of mined reserves and OB 4,439,394 BCM as shown in Figure 4 as follows:

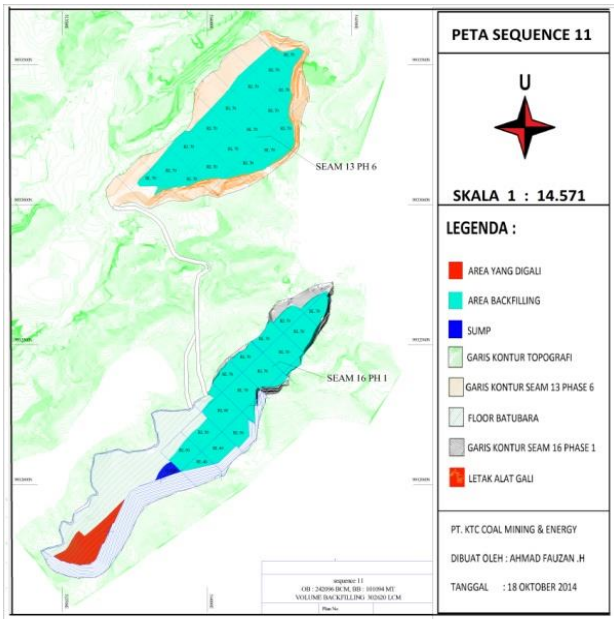

Figure 4. Final Pit Maps

CONCLUSION

From the results of research conducted on the planning of the final pit of coal mining in Seam 16 phase 2 at PT. KTC Coal Mining & Energy, the following conclusions can be made: 1. The final planned coal mining pit planned to obtain 752,930 MT of mined reserves and an Over Burden (OB) volume of 4,439,394 BCM and Stripping Ratio (SR). 2. The results of haul road planning are as follows: • Road width of 13 meters. • Safety height of 1,06 meters with an angle of 56o on the outside (facing the road) and 18o on the inside. • Drainage is triangular and has a width of 0.5 meters with a depth of 0.3 meters. • Cross slope 2% -3%. • The maximum grade of haul road is 8%. Level geometry parameters are as follows: • Geotechnical recommendations for level heights (10 m) • Geotechnical recommendations for final level width (5 m) • Geotechnical recommendations for single 60 ° slopes 3. Design disposal using the backfilling method for each stage of mining the following parameters: • Geotechnical recommendations for level heights (5 m) • Geotechnical recommendations for level widths (5 m) • Angle of repose of overburden material (50 °) • Swell factor determined material (80%)

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