

Technical Design of Pit B Mining PT Indo Muro Kencana Murung Raya Regency, Central Kalimantan Province

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Article Information	ABSTRACT
Article History Received : July 31, 2025 Revised : August 10, 2025 Published : October 02, 2025	This research aims to make a technical design for mining in Pit B, an area planned by PT Indo Muro Kencana to be exploited based on the evaluation of economic ore reserves. Pit B is an area that has never experienced mining activities before. The mine design method involves a technical design process that considers geotechnical, topography, and reserve data aspects to determine an economical and technically feasible mining deadline. The purpose of this method is to produce an optimal and safe mining design, in order to maximize the extraction of mineral reserves by paying attention to work safety. The research method applied is quantitative, used to design pit and waste dump designs and calculate the difference in reserves between the researcher's design results and the company's pitshell data using surpac software. Descriptive analysis is carried out to explain the design process and calculation of the proposal. The pit geometry parameters include a level height of 15 meters, a level width of 5 meters, a slope of 60°, and a ramp width of 15 meters with a slope of 10%, according to the company's operational standards. The results of the calculation of the reserve volume showed that ore amounted to 326,809 tons and waste 4,911,173 tons. The reserve difference between the design and pitshell data is still within the company's tolerance limit of 33%, so this technical design is suitable as the basis for mining operations in the field.
Keywords: <i>Pit Design;</i> <i>Waste Dump Design;</i> <i>Reserve Difference Calculation;</i> <i>Open Pit Mining;</i> <i>Mining Technical Design.</i>	

INTRODUCTION

Mine design is the process of preparing the dimensions of the mine opening based on geological modeling obtained from exploration results, taking into account technical, economic, and occupational safety aspects. Mine design serves as a guideline in mining methods used to exploit reserves, and contains important information such as topographic conditions, reserve block models, geotechnical recommendations related to slope geometry, and equipment availability (Yulhendra, 2019). PT Indo Muro Kencana manages several active pits and plans to develop mining in Block X, including Pit B which has never been mined before. The area was chosen because it contains economical gold and silver reserves, so that it is able to maintain the company's production continuity.

Previous research has shown that mining technical design has been widely applied to various types of commodities and mine sites (I Putu Putrawiyanta, 2023). For example, pit designs in nickel mines (Dasa et al., 2023) that emphasize slope geometry optimization for stability, and gold mine designs (Gumelar et al., 2022) that focus on mining cost efficiency. The advantage of these studies is the application of mining software to maximize design accuracy, but some still have limitations in integrating geotechnical data specific to field conditions, or lack of

consideration for quantitative analysis of reserve differences between the design and the company's pitshell.

Based on the review, the research in the mining technical design was carried out by evaluating the reserve difference between the company's pitshell data and the design results, while maintaining operational tolerance limits. Existing research generally only produces pit designs without conducting measurable quantitative comparisons, so potential deviations in reserve volume are not clearly identified.

The creation of the pit and waste dump design of Pit B was carried out using surpac software, followed by a comparative analysis of the volume of ore and waste reserves between the design results and the company's pitshell data. This approach allows for the verification of the technical feasibility of the design based on the company's tolerance limit of 33%, as well as ensuring operational efficiency and safety in accordance with regulations. The results of the research are expected to be a reference for PT Indo Muro Kencana in the implementation of optimal, safe, and sustainable open-pit mining, including Pit B which allows the company to maintain production continuity in a sustainable manner.

RESEARCH METHODS

The technical design research of the Pit B mining uses secondary data obtained from the company, including topographic data, spare model blocks, and pitshells from previous pit limit optimization. The parameters of the pit slope and waste dump, which consist of the height and width of the level and slope slope, then the recommendation of the road geometry consisting of the width and grade of the mine road, which refers to the company's standard operational recommendations. The topographic data is the result of a survey of the surface of the mine area, while the model block and pitshell are the product of geological studies and pit limit optimization by the company's technical team. The secondary data became the basis for modeling and analysis of pit and waste dump designs developed using surpac software. Verification and validation were carried out to ensure the suitability of the data, including the comparison of the volume of ore and waste reserves between the company's pitshell and the design of the research pit. Although reliance on secondary data quality is a limitation, mitigation is carried out by cross-checking using mining literature and standards. This approach makes an important contribution to improving design accuracy and operational efficiency in Pit B and is the foundation for the development of more comprehensive design methods in the future.

The processing of pit B mining technical design data is carried out using quantitative analysis methods, which include pit and waste dump design design and calculation of the difference between the research design results and the company's pitshell data. The results of data processing are then presented descriptively in the form of a narrative description. The stages of processing mining technical design data consist of the following steps:

- 1) Compile data from literature studies and literature reviews that are considered relevant and support research.
- 2) Consulting with field supervisors as well as company mine plan engineers related to research on the technical design of Pit B mining.
- 3) Based on the literature study and the results of the consultation, the data used in the design consisted of topographic data, pitshells, model blocks, as well as slope geometry and road geometry recommendations that became the basis for making pit designs.
- 4) After the necessary data is collected, data processing is carried out using Surpac software, which includes the creation of pit designs and waste dump designs.
- 5) Calculates the difference in reserve percentage between the company's pitshell data and the results of the developed pit design.

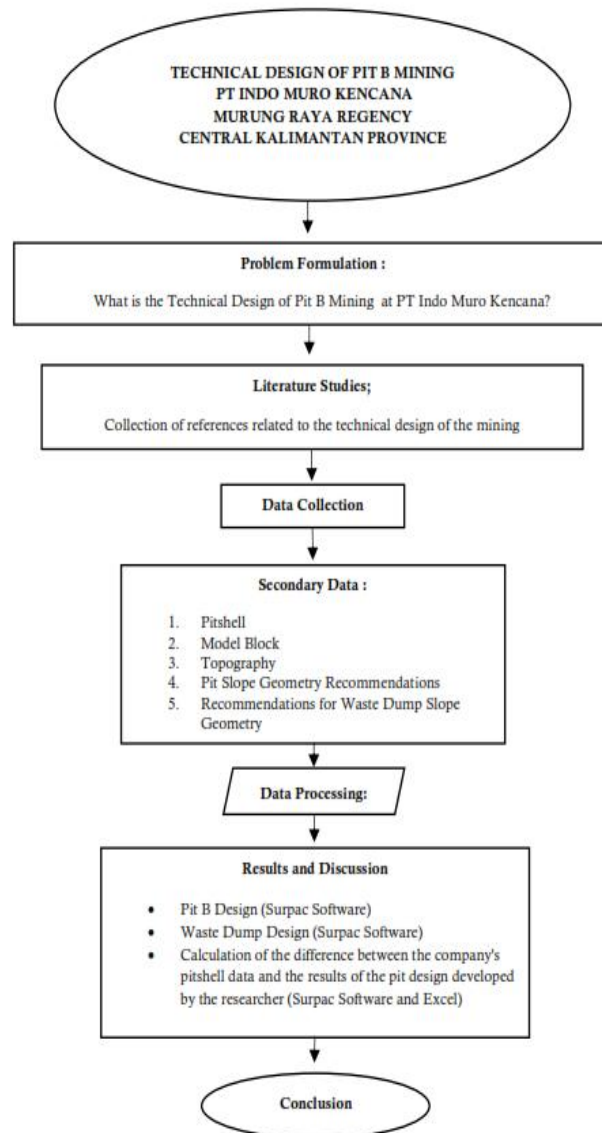


Figure 1. Research Flow Chart

RESULTS AND DISCUSSION

Pit B Design

The creation of pit B design was designed with the help of surpac software using the main data in the form of topographic data that functions as the surface basis in the pit design and adapts the design to the existing land conditions. Furthermore, model blocks are used to show the distribution of the quality and quantity of the excavated material reserves. Meanwhile, the pitshell is the result of optimization of the model block that determines the end limit of the mine economically. The parameters used in making pit B design include slope geometry recommendations sourced from geotech and hydro engineering of PT Indo Muro Kencana, which can be seen in Table 1. Then for the road geometry recommendations used in making the pit design, the road has a road width of 15 meters and a slope of 10%, in accordance with the provisions of PT Indo Muro Kencana's engineering mine planning in designing the pit design.

Table 1. Recommendations for Pit Slope Geometry B

Location	Domain	Single Slope°	Bench Height	Berm Width
Pit B	Soil	40 - 45	15	5
	Transition - Oxide	50 - 55	15	5
	Fresh	55 - 60	15	5

Source : Engineering Geotek & Hydro PT Indo Muro Kencana

Based on the main data and main parameters owned, the design design of Pit B can be seen in Figure 1. In the Pit B design, the upper surface elevation is at an altitude of 239 meters, while the bottom elevation is at an altitude of 120 meters, with an estimated ore volume of 326,809 tons based on calculations made using Surpac software.

**Figure 2.** Pit B Design

Waste Dump Design

The waste dump design is made using the terraced dump method, which is a heap that is built from the bottom up by forming several levels of landfill. Based on the company's provisions, the slope geometry used in the waste dump design design includes a level height of 15 meters, a level width of 5 meters, and a slope slope of 25%. For the width and slope of the road used in the design of the waste dump, follow the same provisions as the making of the pit design, namely the road width of 15 meters and the slope of the road 10%, in accordance with the recommendations of road geometry applied by engineering mine planning PT Indo Muro Kencana in the design of pit and waste dump designs.

The waste dump design made using the terraced dump method can be seen in Figure 2. Based on the slope geometry and road geometry that has been used in the design of the waste dump, calculations are carried out through trial and error methods with the help of Surpac software. The calculation results show that the waste dump design is able to accommodate as much as 1,908,824 tons.



Figure 3. Waste Dump Design

Comparison of Pitshell Data and Pit Design

The comparison between the pitshell data used by the company as an economic reference and the pit design results made in this study was carried out to determine the difference in the volume of ore, waste, expit, and stripping ratio (SR) in the research area, in pit B. This comparison is calculated in the form of a percentage difference between the two data.

According to the company's standards, if the difference in comparison results is at a maximum of 33%, then the pit design made is still considered suitable for use in mine planning. However, if the difference exceeds 33%, the pit design is considered unfeasible and needs to be revised or re-evaluated. For the table of comparative calculation results between pitshell data and pit design, you can see table 3 and table 4.

Table 4. Pitshell Data Calculation and Pit Design

Ore Pitshell Pit B						
Wow85	Volume	Tons	Wow85	Auppm	AGPPM	Dbdensity
0.5 -> 1.0	53462	109,287	0.773	0.66	9.8	2.06
1.0 -> 2.0	54257	113,884	1.43	1.21	18.6	2.11
2.0 -> 5.0	38061	80,548	2.979	2.68	25.4	2.12
5.0 -> 999.0	6563	13,860	6.051	5.72	28.1	2.11
Grand Total	152,342	317,580	1.798	1.59	17.7	2.1
Ore Pit Design B						
Wow85	Volume	Tons	Wow85	Auppm	AGPPM	Dbdensity
0.5 -> 1.0	56,106	115,022	0.764	0.64	10.1	2.07
1.0 -> 2.0	54,963	115,485	1.417	1.2	18.5	2.11
2.0 -> 5.0	38,922	82,402	2.969	2.67	25.5	2.12
5.0 -> 999.0	6,582	13,901	6.048	5.72	28.1	2.11
Grand Total	156,573	326,809	1.775	1.57	17.7	2.1

Table 4. Comparison of Pitshell Data and Pit Design

Ore Pitshell Pit B And Pit B Design						
Wow85	Volume	Tons	Wow85	Auppm	AGPPM	Dbdensity
0.5 -> 1.0	4.71%	4.99%	1.18%	3.13%	2.97%	0.48%
1.0 -> 2.0	1.28%	1.39%	0.92%	0.83%	0.54%	0.00%
2.0 -> 5.0	2.21%	2.25%	0.34%	0.37%	0.39%	0.00%
5.0 -> 999.0	0.29%	0.29%	0.05%	0.00%	0.00%	0.00%
Grand Total	2.70%	2.82%	1.30%	1.27%	0.00%	0.00%

Based on the calculation results using surpac software, the pitshell of Pit B shows ore reserves of 317,580 tons, material waste of 3,302,106 tons, total expit of 3,619,686 tons, and stripping ratio of 10.40. Meanwhile, in the Pit B design, the available ore is 326,809 tons, waste is 4,911,173 tons, the total expit is 5,237,982 tons, and the stripping ratio is 15.03.

The difference between pitshell and pit design for ore is 2.82%, waste 32.76%, expit 30.90%, and stripping ratio 30.81%. This difference is still below the company's tolerance limit of 33%, so the pit design made by the researcher can be considered feasible and feasible for use in future mining planning.

The ore value represents the amount of ore that can be economically mined, while waste indicates the volume of overhead material that must be moved. Total expit is the total mass of material (ore + waste) that must be managed during operation. A high stripping ratio (10.40 to 15.03) indicates a large stripping cost, so planning must take into account the efficiency of mining costs to remain economical.

When compared to similar studies, the ideal stripping ratio is generally below 5 to maintain operational efficiency. However, a higher figure is still acceptable if supported by favorable commodity prices and efficient technology. The use of surpac as software helps to generate accurate reserve estimates and pit designs, reinforcing the validity of the results of this study.

Thus, the resulting B-pit design meets technical and economic feasibility standards in accordance with the company's tolerances, while providing a realistic planning basis for mining operations. Evaluation and updating of the design are still necessary to accommodate changing field conditions and economic factors.

CONCLUSION

The technical design of the Pit B mining has been prepared taking into account geotechnical aspects, topography, and backup data from the model block and pitshell. The height of the level is set at 15 meters with a width of 5 meters and a slope of 60°. The mining road has a width of 15 meters and a grade of 10%, in accordance with applicable operational standards. The results of the calculation of the reserve volume showed that ore was 326,809 tons and material waste was 4,911,173 tons. The difference between the design and the pitshell is still within the tolerance limit of 33%, so that the mining design of Pit B is categorized as feasible and can be used as the basis for operations in the field. The mine design methods used in this study have the potential to be applied and further developed in open-pit mine planning in various regions with different geological characteristics. The application of a quantitative approach that integrates geotechnical, topography, and backup modeling data using software such as Surpac can improve design accuracy and operational efficiency. For further research, this method can be expanded by combining long-term economic analysis, environmental impact evaluation, and more detailed mining stage planning simulations (mine sequence). In addition, the development of the integration of cutting-edge digital technologies such as the application of machine learning or

artificial intelligence in mining modeling can also improve the ability to predict and optimize design. Thus, the method used in this study is expected to be the foundation for more sustainable, safe, and economical mine design innovations in the future.

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