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CALCULATION OF CUT AND FILL VOLUMES USING MINING SOFTWARE AT PT BARAMULTI SUKSESSARANA

PERHITUNGAN VOLUME CUT AND FILL MENGGUNAKAN SOFTWARE MINING DI PT BARAMULTI SUKSESSARANA

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Abstract

Cut and fill calculation is an essential stage in open-pit mining activities to determine the volume of soil or rock that must be excavated (cut) and deposited (fill) based on elevation changes between the actual topographic conditions and the planned mine design. This study aims to analyze the results of cut and fill volume calculations using GEOVIA Surpac software in a coal pit area. The data used include topographic maps obtained from RTK (Real Time Kinematic) surveys. The calculation results show a total cut volume of 805.42 MT and a fill volume of 2.09 MT, with a net volume of 803.33 MT, using a rock density of 1. The use of Surpac has proven effective and accurate in calculating material volumes and supporting the optimization of mine design.

Keywords : Cut and Fill, Surpac, Volume, Open-Pit Mining, Topography.

Abstrak

Perhitungan cut and fill merupakan tahapan penting dalam kegiatan penambangan terbuka untuk menentukan volume tanah atau batuan yang harus digali (cut) dan ditimbun (fill) berdasarkan perubahan elevasi antara kondisi topografi aktual dengan rencana desain tambang. Penelitian ini bertujuan untuk menganalisis hasil perhitungan volume cut and fill menggunakan perangkat lunak GEOVIA Surpac pada area pit tambang batubara. Data yang digunakan meliputi peta topografi hasil RTK (Real Time Kinematic). Hasil perhitungan menunjukkan total volume cut sebesar 805,42 MT dan fill sebesar 2,09 MT dengan volume neto 803,33 MT, dengan mengunakan density batuan 1. Penggunaan Surpac terbukti efektif dan akurat dalam menghitung volume material serta membantu optimalisasi rancangan tambang.

Kata Kunci : Cut and Fill, Surpac, Volume, Tambang Terbuka, Topografi.

1. INTRODUCTION

Mine planning activities require accurate geometric analysis between the actual surface conditions and the planned mine design. One of the key aspects in this process is the cut and fill calculation to determine the amount of material that must be moved. The measurement of mine

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progress in each area experiencing changes is carried out using a total station, with the output data consisting of Northing (N), Easting (E), and Elevation (Z) coordinates (Sujiman, 2018).

Coal volume calculation plays a crucial role in determining the quantity of a mineral deposit. Accurate estimation is required to obtain a reliable coal tonnage. This calculation involves complex challenges, and excavation volume significantly influences coal resource estimation. Therefore, volume calculations must be carried out with precision to ensure correct results for both volume and tonnage. Accurate calculations provide the foundation for companies to make strategic decisions regarding whether mining operations should continue or not. To achieve reliable coal volume estimation, mining software is required to facilitate the intended objectives. In this study, the software used is Gemcom Surpac (Gideon Samari Suno et al., 2025).

GEOVIA Surpac is one of the most widely used mining software applications for surveying and mine planning, as it is capable of processing topographic data, generating Digital Terrain Models (DTM), constructing Triangulated Irregular Networks (TIN), and automatically calculating volumes using the cut and fill method (Maulana & Kholiq, 2025; Elwisa et al., 2022).

2. RESEARCH METHOD

a. Tools and Materials

The software used in this study was **GEOVIA Surpac 2024**, operated on a high specification computer, along with topographic base data to generate both the Digital Terrain Model (DTM) base surface and the DTM mine design surface. The data were obtained from coordinate measurements (X, Y, Z) using **RTK GPS**, which provides high accuracy and is commonly applied in mining surveys (Syetiawan et al., 2016).

b. Research Location

PT. Baramulti Suksessarana is located in Batuah Village, Loa Janan District, Kutai Kartanegara Regency, Samarinda City, East Kalimantan Province. The mining permit (IUP) covers an area of 2,459.8 hectares. The site is easily accessible as it lies along the main Samarinda–Balikpapan highway.

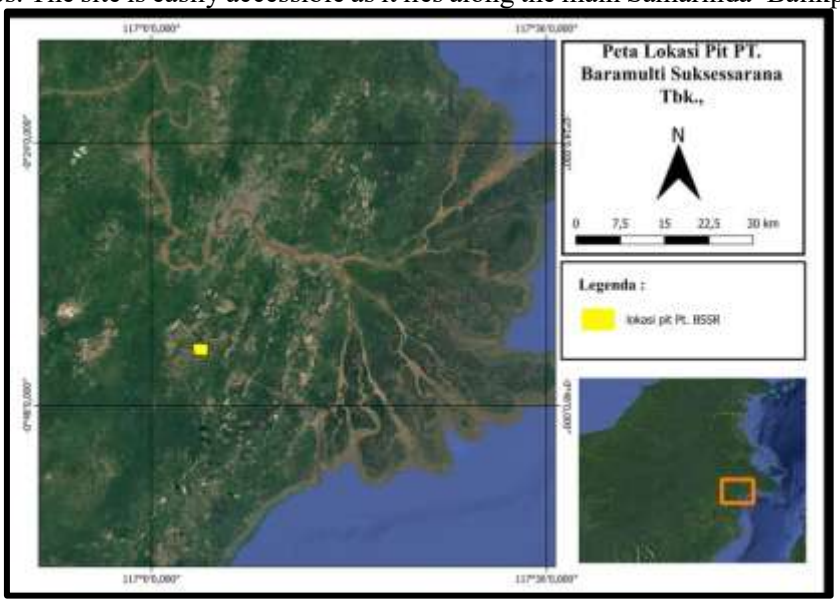

Figure 1. Research Location

c. Methods

The research method applied in this study involves a comparison of two surfaces, namely the Digital Terrain Model (DTM) surface (upper) and the DTM base (lower). A Digital Terrain Model (DTM) represents a digital topographic surface generated from string data. The principle of the calculation is to determine the elevation difference between two digital surface models and then integrate these differences to obtain the volume. The calculation steps are as follows: **Data Import**:

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Topographic data in string format (STR) were imported into Surpac. **DTM Creation**: A digital terrain surface was generated using the *Surface Create Digital Terrain Model from Layer* function. **Pit Design Import**: The pit design (STR) was added into the workspace. **Design Surface Generation**: A mine design surface (Design DTM) was created. **Volume Calculation**: The volume between the two DTMs was calculated by defining the topographic surface as the first DTM (Data Top) and the base surface as the second DTM (Data Base). **Data Analysis**: The results were analyzed to determine cut, fill, and net volume values. This procedure is commonly applied in weekly or monthly overburden volume studies (Ariyaini & Cahyadi, 2025).

3. RESULT AND DISCCUSSION

To determine the volume of soil or rock to be excavated and deposited, **GEOVIA Surpac** software was applied in the coal pit area. GEOVIA Surpac is a 3D mining software specifically designed for geological planning and modeling in the mining industry. The volume was obtained from processing topographic maps derived from **RTK (Real Time Kinematic) GPS** field measurements.

Real Time Kinematic is a satellite navigation technique used to improve the accuracy of positional data obtained from satellite-based positioning systems. The measurement is based on carrier-phase signal observations, which rely on interpolated virtual stations that provide real-time corrections. This method enables centimeter-level accuracy, making it highly reliable and widely applied in mining surveys. The measurement data, consisting of coordinate values, were converted from raw data into **Topcon Link** software. The coordinates (X, Y, Z) were then exported into **CSV format** and subsequently imported into the **Surpac application**. The processed data were opened in **Excel** for tabular representation and further analysis.

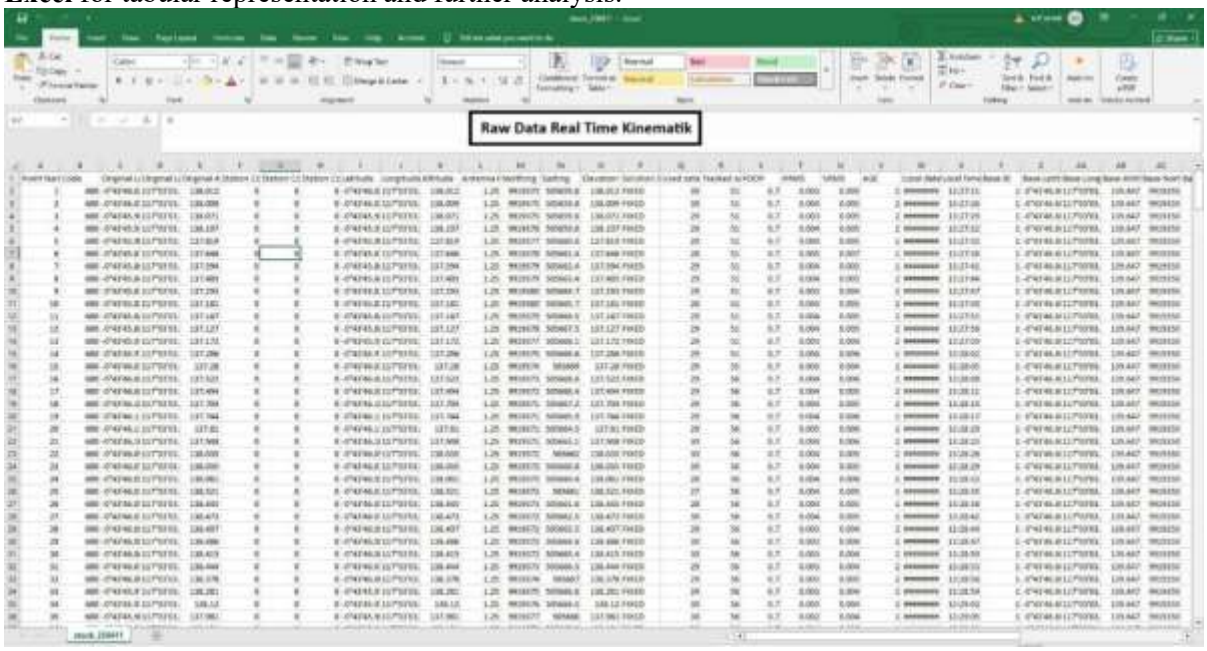

Table 1. Raw Data

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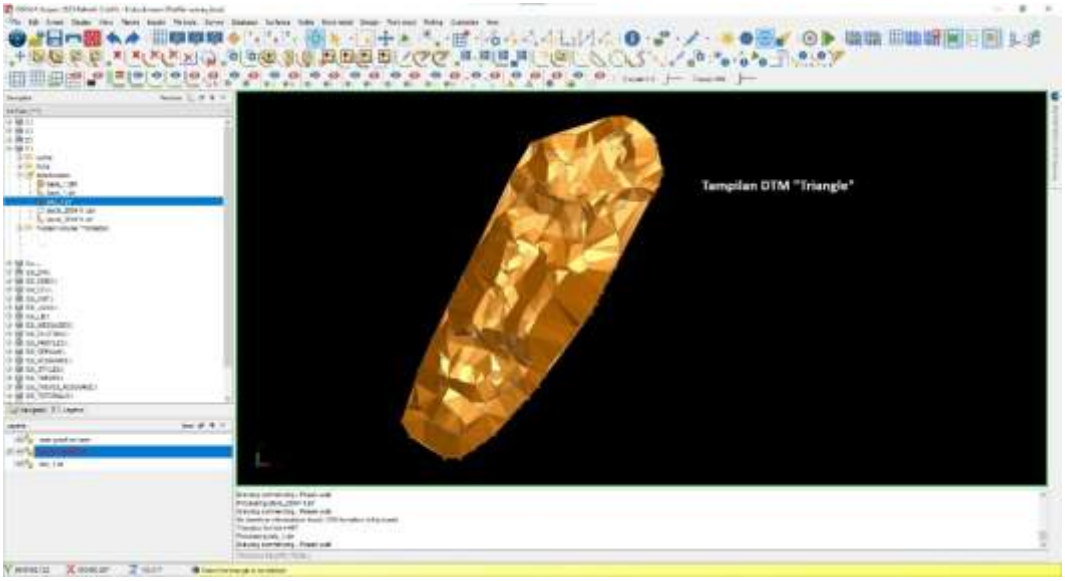

Figure 2. *Digital Terrain Model* Triangel

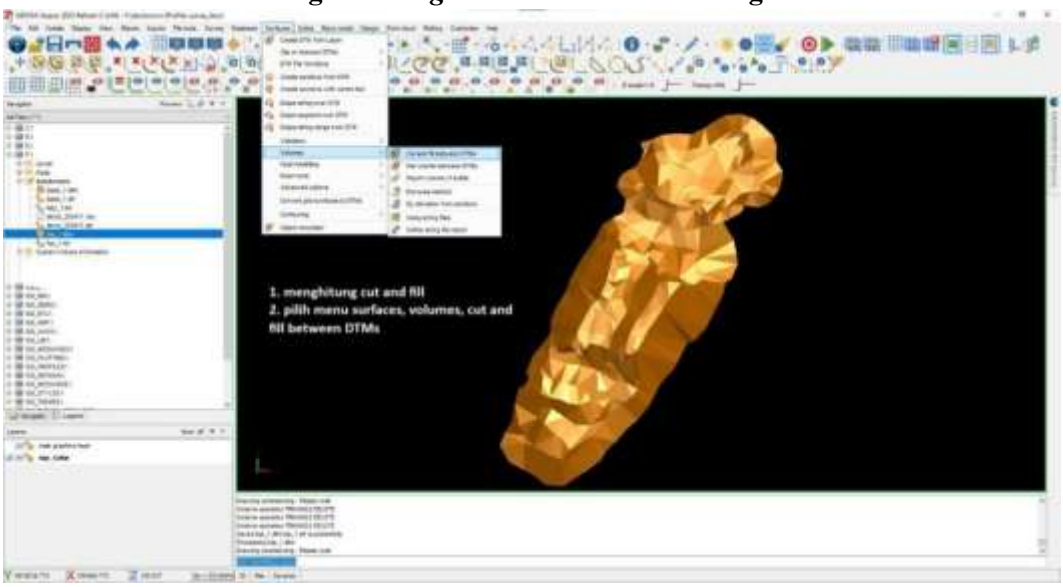

Figure 3. Cut and Fill antara *Digital Terrain Model* (top) and *Digital Terrain Model* (base)

After all data were converted into point format, they were subsequently transformed into a **Digital Terrain Model (DTM)** and contour lines. The DTM provides elevation data that serve as the basis for contour generation, thereby enabling the visualization of the mine's topographic surface, as illustrated in Figures 2 and 3.

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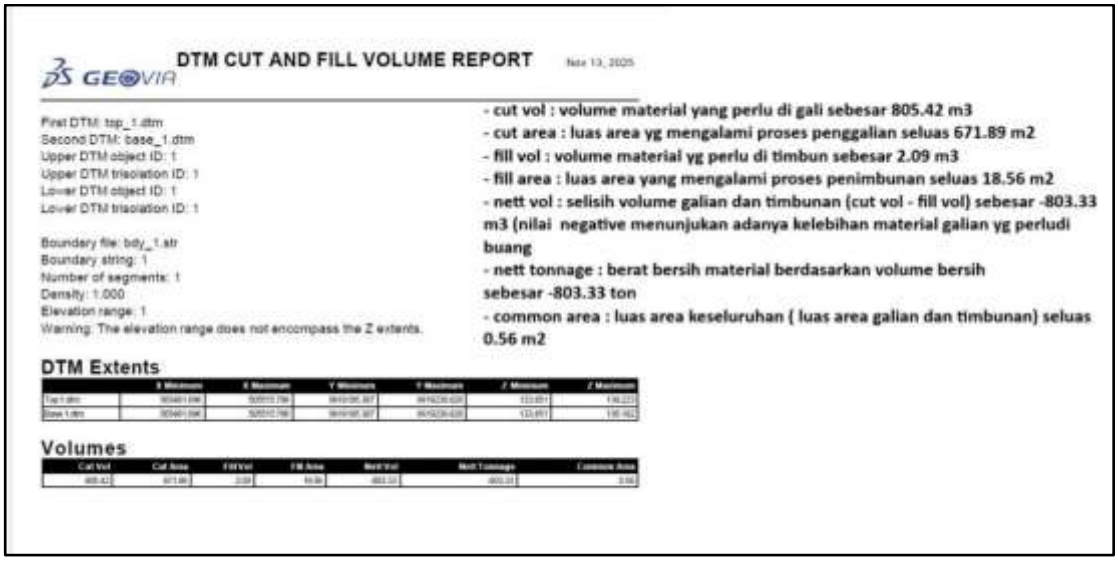

Figure 4. Results of Cut and Fill Calculation

The calculation results indicate a total **cut volume of 805.42 MT** and a **fill volume of 2.09 MT**, yielding a **net volume of 803.33 MT**. A rock density value of 1 was applied, meaning that the volume is assumed to be equivalent to tonnage. These values demonstrate the dominance of excavation activities in the study area. Comparable studies have reported consistent findings in cut and fill analysis using **Surpac software** (Maiyudi et al., 2023). Furthermore, the use of **Digital Terrain Models** has proven to be more accurate than conventional interpolation methods such as gridding, and more reliable in predicting elevation changes over time (Ramadhan et al., 2022; Sens et al., 2021).

4. CONCLUSION

The application of **GEOVIA Surpac** enabled rapid and accurate calculation of cut and fill volumes based on topographic data and pit design. The results show a **total cut volume of 805.42 MT** and a **fill volume of 2.09 MT**, highlighting the dominance of excavation activities in the study area. The use of Surpac is recommended in the mine design evaluation process to improve time efficiency and enhance data accuracy.

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