OVERBURDEN VOLUME CALCULATION USING CUT AND FILL METHOD AT RHML JOBSITE (RIUNG HARAPAN MITRA LESTARI) PT. RIUNG MITRA LESTARI, TAPIN REGENCY, SOUTH KALIMANTAN PROVINCE

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ABSTRACT

Overburden is all layers of soil/rock that are above and directly cover the layer of valuable mining materials so that they need to be removed first before being able to dig up the valuable mining materials. In the process of removing overburden, its volume needs to be calculated. One method that is often used is the cut and fill calculation method. The cut and fill calculation method can be done using several software, including Surpac and Civil 3D. This study discusses the calculation of overburden volume based on data obtained from detailed topographic measurements of the situation at PT. Riung Mitra Lestari jobsite RHML located in Tapin Regency, South Kalimantan. This data consists of situation coordinate data from July 29 - August 21, 2024. The purpose of this report is to calculate overburden using Surpac and Civil 3D software. From the calculations, the overburden volume was obtained as much as 309,569 BCM in Surpac software and 310,548 BCM in Civil 3D software.

Keyword: Cut and fill, overburden, volume

Introduction

Indonesia is a country that has a variety of natural resources that have the potential to be utilized, one of which is coal. Coal can be used as the main fuel for power plants and industrial commodities. The coal industry commodity in Indonesia is one of the main pillars of the economy which makes a major contribution to Gross Domestic Product (GDP), job creation, and state revenue through exports. In taking coal commodities, mining activities are needed. Based on data from the Ministry of Energy and Mineral Resources (ESDM), Indonesia has verified coal reserves of around 30.22 billion in December 2024.

Mining activities are activities to extract minerals from the earth. Mining activities in the coal sector aim to extract coal material covered by layers of topsoil and overburden. In this mining activity, the role of surveyors is needed. Surveyor activities include measurements, calculations, and mapping that serve the purpose of obtaining information at all stages of prospecting for exploitation. Some of the surveyor's duties in mining activities are slope monitoring activities, land acquisition, production rate measurements, and asset and equipment management. This is in line with the science of Geomatics Engineering which is a field of science that presents mapping, modeling, and spatial data analysis to obtain supporting information through measurement activities.

In this research activity, it was carried out at PT. Riung Mitra Lestari site RHML located in Tapin Regency, South Kalimantan Province. PT. Riung Mitra Lestari is a contractor company in the coal industry (Riung Mitra Lestari, 2024). The scope and volume of this research work include daily survey and weekly survey activities in the form of front excavator monitoring, situation measurement, sample vessel measurement, and situation data processing to obtain overburden and sample vessel volumes.

Methodology

Topographic Survey

Survey aims to observe the conditions in an area which includes data collection (consisting of direction,

distance and elevation data) in the area using certain methods. Topographic Map is a visual representation that depicts significant physical features in an area, with special attention to elevation details (Basuki, 2006). Topographic measurements are generally carried out using three popular methods, namely terrestrial methods, photogrammetry methods and remote sensing methods. Terrestrial methods are used to produce large-scale topographic maps and this method is the most common method carried out directly in the field (Sobatnu, 2018).

To conduct measurements in the field using a total station, namely an integrated angle and distance measuring tool in one unit of equipment that is equipped with a processor so that it can calculate the distance of coordinate plains and height differences directly (Adi and Aghastya, 2017). Total Station is a design for measuring horizontal and vertical distances as well as slopes, angles and heights in topographic survey work (Rahayu, 2015).

Using the tachymetry method is very useful in determining the location of a large number of topographic details, both horizontally and vertically with transit or planet. In urban areas, reading angles and distances can be done more efficiently and quickly than recording measurements and making sketches by the recorder (Purwaamijaya, 2008).

Tachymetry Method

Calculation of soil volume involves a complex process because the elevation of the ground surface varies between different surfaces. The first surface generally reflects the natural topography of the site or existing topography, while the second surface describes the design or plan of excavation and filling to be carried out. Measurement of the height of detailed points in the measurement area is spread according to the conditions of the area (Nurjati, 2004).

Field data collection was carried out using the tachymetry method. The tachymetry method is a measurement using optical, electronic, and digital tools. Detailed measurements of the tachymetry method begin with the preparation of the measuring instrument above the tie point and the placement of the marker at the aiming point. After the tool is ready for measurement, it begins with recording data where the tool stands, aiming at the measuring marker, observing the azimuth and recording data on the BT, BA, BB markers and the oblique angle (Purwaamijaya, 2008).

The tachymetric method is based on the principle that in similar triangles, corresponding sides are proportional. Most tachymetric measurements are with oblique sights due to the variety of topography, but the intersection of the stadia threads is read on the plumb line and the oblique distance is "reduced" to the horizontal and vertical distances.

Cut and Fill Method

One of the implementation methods that can be used to improve the condition of the soil is by carrying out the process of excavating the soil (cut) and filling the soil (fill) (Ir. Irwandy Arif, 2016). The cut and fill method are to calculate the area of two cross-sections and the distance between the upper and lower cross-sections. By knowing the data of the upper and lower cross-sections, the area of each cross-section can be calculated. The volume is calculated from the DTM formed from the triangular net (TIN). This triangular net will form a prism geometry from two surfaces. Surfaces are divided into two, namely design surface and base surface. The design surface is the surface whose volume will be calculated while the base surface is the surface that is used as the base.

Result and Discussion

Overburden Volume Results

The volume of soil referred to here is when you want to dig or fill soil in a place (cut and fill) or to calculate solid excavation materials (Yuwono, 2004). Comparison of the results of calculating overburden volume using two different software, namely Surpac and AutoCAD Civil 3D, shows relatively close numbers but there are small differences each week. The limits of the volume measurement area in week 1 can be seen in Figure 1.

Based on the data obtained, in the first week (July 29 - August 07, 2024), the results of the volume calculation using Surpac were 93,398.042 m^3, while using AutoCAD Civil 3D was slightly higher, namely 93,755.93 m^3. This difference can be caused by the calculation method or algorithm used by each software in modeling and calculating soil volume.

In the second week (August 8-14, 2024), the volume calculated using Surpac was 121,788.790 m^3, while AutoCAD Civil 3D recorded a slightly lower volume, namely 121,315.19 m^3. The limits of the volume measurement area in week 2 can be seen in Figure 2.

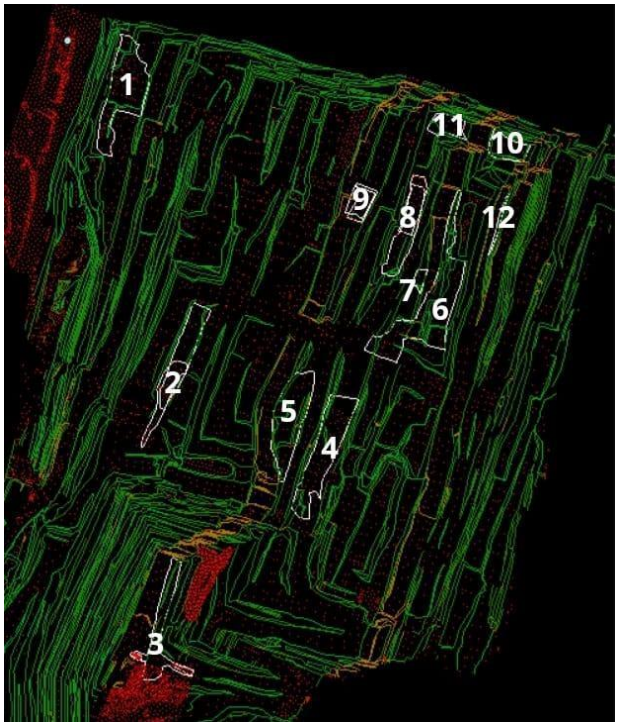

Figure 1. Volume Boundaries Week 1

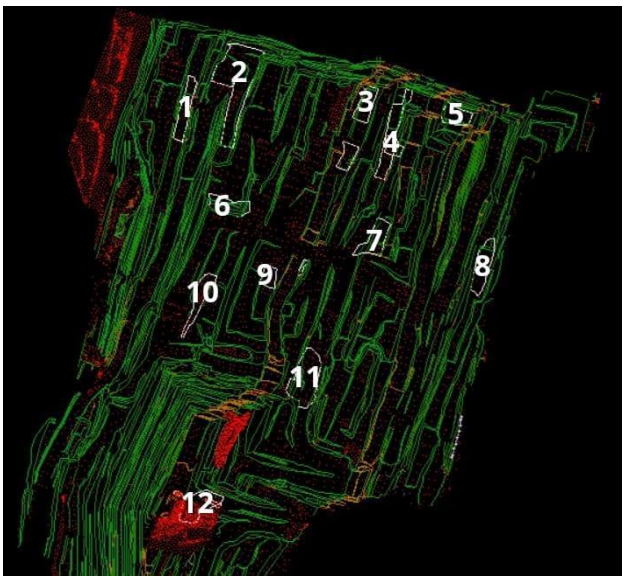

Figure 2. Volume Boundaries Week 2

Likewise in the third week (15 - 21 August 2024), the volume using Surpac was recorded at 94,382.575 m³, while AutoCAD Civil 3D produced 95,477.59 m³. The limits of the volume measurement area in week 3 can be seen in Figure 3.

Overall, the total overburden volume calculated using Surpac reached 309,569.407 m³ which can be seen in table 1, while AutoCAD Civil 3D produced a total volume of 310,548.83 m³ which can be seen in table 2.

Figure 3. Volume Boundaries Week 3

Table 1. Total overburden volume using surpac software**.**

Weekly Data	**Volume (BCM)**
Week 1 (July 29 - August 07, 2024)	93.398,042
Week 2 (August 08 - 14, 2024)	121.788,790
Week 3 (August 15 - 21, 2024)	94.382,575
TOTAL VOLUME	**309.569,407**

Table 2. Total overburden volume using Autocad Civil 3D software.

Weekly Data	**Volume (BCM)**
Week 1 (July 29 - August 07, 2024)	93.755,93
Week 2 (August 08 - 14, 2024)	121.315,19
Week 3 (August 15 - 21, 2024)	95.477,59
TOTAL VOLUME	**310.548,83**

Table 3. Difference in overburden volume between Surpac and Autocad Civil 3D software.

Weekly Data	**SURPAC Volume (BCM)**	**CIVIL 3D Volume (BCM)**	**Deviation (BCM)**
Week 1	93.398,042	93.755,93	357,89
Week 2	121.788,790	121.315,19	-473,60
Week 3	94.382,575	95.477,59	1.095,02
TOTAL	309.569,407	310.548,83	979,30
PERCENTAGE DEVIATION			**1,03 %**

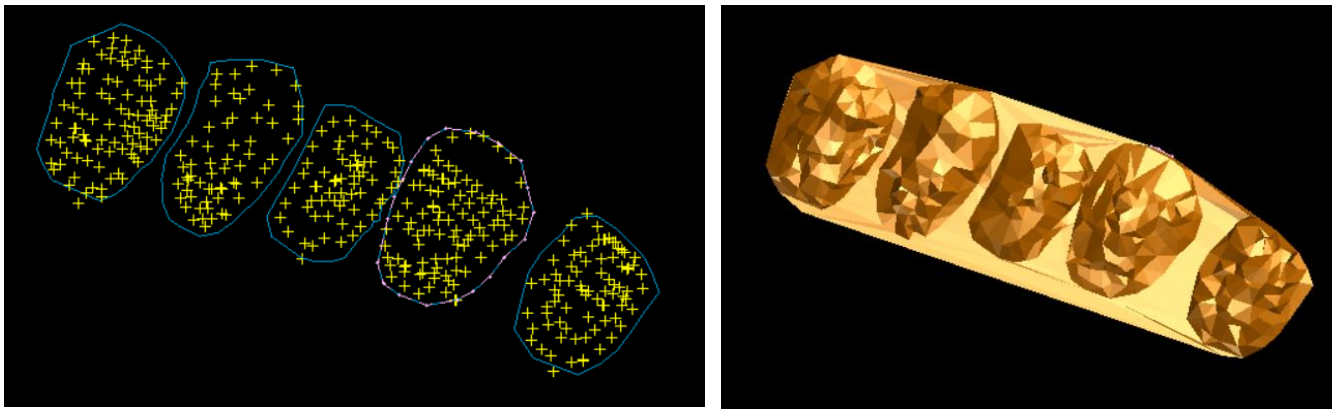

Figure 4. Boundary Volume Vessel Sampling

Table 4. Total overburden volume using surpac software.

VESSEL SAMPLING RESULT DATA VOLVO AND HINO PT RML DT							
Date	**Measurement Location**	**RD**	**Survey Volume**		**Truck Count**	**Deviation VS Truck**	**No. DT**
			LCM	BCM	BCM		
20-08-24	Mahoni RL 65	1.25	17.866	14.292	14	0.292	3293
20-08-24	Mahoni RL 65	1.25	17.670	14.136	14	0.136	3294
20-08-24	Mahoni RL 65	1.25	17.140	13.712	14	-0.288	3254
20-08-24	Mahoni RL 65	1.25	16.951	13.560	14	-0.440	3293
20-08-24	Mahoni RL 65	1.25	18.511	14.808	14	0.808	3255
Rata-Rata	17.627	14.102					
Total			**88.138**	**70.508**	**70**	**0.508**	

Both of these software can be relied on in calculating overburden volume, with each having different advantages in accuracy and efficiency, depending on the needs and type of mining project being carried out.

Vessel Volume Sampling Results

Volume vessel sampling data collection was carried out using a total station. The vessel sampling data collection process was carried out at the disposal site for dumping Overburden (OB) material by Dump Truck (DT). The truck hull number was recorded when the truck dumped material so that the name of the operator driving on that shift could be known. The purpose of vessel sampling itself is to monitor the Overburden (OB) load transported by Dump Truck (DT). The measurement boundary area is shown in Figure 4.

Meanwhile, the results of the vessel sampling volume that have been calculated can be seen in table 4.

Conclusion

From the research activities conducted at PT. Riung Mitra Lestari at the RHML jobsite, the following conclusions were obtained:

1. The use of Total Station was successfully used to measure overburden volume data during this research period. This technique allows for accurate measurements in the field, which are then processed using software such as Surpac and Civil 3D to obtain overburden excavation volume results.
2. The use of drones in collecting sample vessel data has proven effective in producing aerial photography data. This data is then processed with Agisoft Metashape to monitor the volume of material transported by dump trucks.
3. Volume processing using Surpac produced a total volume of 309,569.407 m^3, while AutoCAD Civil 3D produced a total volume of 310,548.83 m^3. The percentage difference in the total volume of the two software is 1.03%.
4. Processing of overburden volume during vessel sampling obtained an average result of 14.102 BCM with a large deviation with truck load of 0.508.

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