Georest

GEOSCIENCE AND REMOTE SENSING TECHNOLOGY
ISSN: 2963-7767 (Online) Journal homepage: https://www.geo-rest.org

Received October 20, 2022, Accepted November 13, 2022, date of publication December 25, 2022, date of current version December 25, 2022.
Digital Object Identifier 10.57265/georest.v1i2.7

Comparison of Cut and Fill Volume Using Photogrammetric Measurement and Total Station Measurement

Fajri Ananda[1], Riko Maiyudi[1], Yoszi Mingsi Anaperta[1], and Andres Melbaral[1]
[1]Department of Mining Engineering, Universitas Negeri Padang, 25131, Indonesia.
*Corresponding author: rikomaiyudi@ft.unp.ac.id Orcid ID:

ABSTRACT
Survey activities at the time of mine exploitation aim to map the progress of the mine and to determine the total volume of overburden and coal that has been mined. Currently, the work of mapping surveys has begun to be replaced with observations of recorded data without touching the object, or aerial shooting using aircraft called photogrammetry. The purpose of this study was to determine the difference in volume between autogrammetric processing and survey processing using total stations. The volume results obtained from the photogrammetric measurements will be reduced by the total station survey volume which is considered correct, which is 441,404,769 BCM. The difference between the Cut and Fill Volume of PIT A using Drones and the Volume of Surveys using a Total Station is 166,655,453 BCM or around 37.76%. From the difference in the volume of Cut and Fill generated from photogrammetry using each number of GCP points with the volume of Cut and Fill using total station surveys, it can be concluded that the more the number of GCP points, then the volume will be closer to the survey volume using a Total Station.

INDEX TERMS ***Comparison, Photogrammetry, Total Station.***

I. INTRODUCTION
The technology in mapping surveys has developed along with the development of current technology. One of which is photogrammetry where the operation is carried out using remote mapping techniques. The results of photogrammetric data processing are able to meet all mapping needs in a shorter time and with cheaper costs. There are several methods that are commonly used nowadays when mapping with photogrammetry, one of which is unmanned aircraft, namely using drone vehicles or unmanned aerial photo methods which are often referred to as Unmanned Aerial Vehicles (UAVs) / drones.

Likewise with developments in photogrammetric data processing, it is proven that using the output of photogrammetric data processing, especially air picture data, can meet a lot of requirements. One form of processing according to photogrammetry is Digital Elevation Model (DEM) data. DEM gives information of the elevation of an area at the top of the earth that is stored digitally in a polygon-based vector shape (Trisakti, 2010).

Mapping survey activities are supporting activities in mining companies. These activities are very important to be carried out at the preparation stage (exploration), during operational activities, or at the step of mine closure (postoperative). Map surveys are used to roughly understand the shape of the earth's surface, and topographic maps can be created based on survey data.

Survey activities at the time of mine exploitation aim to map the progress of mining, to find out the total volume of excavated material (Overburden), and also to be able to find out the remaining reserves of excavated material that have not been Exploited.

II. RESEARCH LOCATION
The Research Location is in PIT A PT. Tempirai Energy Resources is located in the Tungkal Jaya District area which includes Heritage Village and Suka Damai Village, Musi Banyuasin Regency, South Sumatra Province. To get to the location to the TER site, it can be reached from the city of Padang using a four-wheeled vehicle for a 15-hour drive with a distance of ± 613 kilometers and continued with a trip down the candle river using a speedboat for 30 minutes with a distance of ± 15 kilometers.

III. METHODE
3.1 Data Collection Techniques The data needed in this study is

a. Primary Data
   1) Aerial photographs
   2) GCP point coordinates
b. Secondary Data
   1) Topographic maps
   2) Boundary mine progress
   3) *PIT* A volume fr-om survey measurements using total station

Digital Object Identifier 10.57265/georest.v1i1.3

Published by: EarthCare

3.2 Data Analysis Techniques

In analyzing data, the author uses a way of combining theory with data in the field that has been processed, so that from both the author can get solutions from case studies which is discussed.

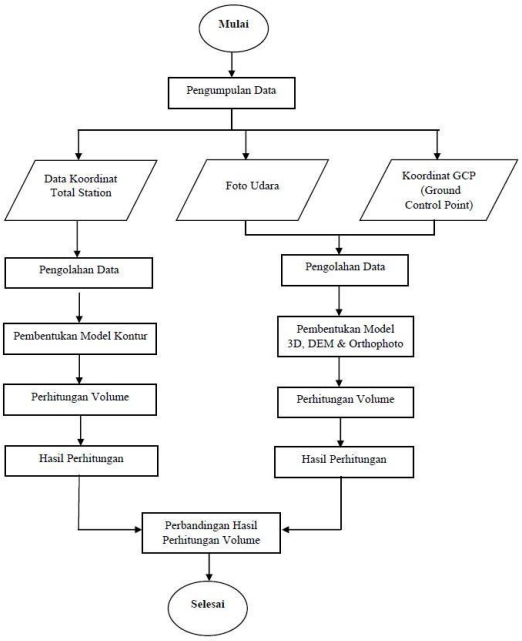

Figure 1. Flowchart

a. Photogrammetric *Measurements Using the DJI Mavic Air 2 Drone*
Photogrammetric measurement or aerial photographs is a measurement process using an unmanned aircraft (drone), in this study the author used the DJI Mavic Air 2 Drone to take aerial photos on *PIT* A PT. Mandiangin Batubara (Thriveni Group).

b. Creation of DEM from Aerial Photographs
After conducting aerial photos using the DJI Mavic Air 2 Drone, the author then processed the results of the aerial photos into DEM data for the GCP points totaling 19 GCP points. Furthermore, from this DEM data, *PIT* A Volume will be obtained with the help of other software such as Global Mapper and Geovia Surpac

6.6.2. For the processing of DEM data, the author uses Agisoft photoscan Software.

After processing the data to get the DEM data , the DEM results are obtained for each number of GCP points as below:

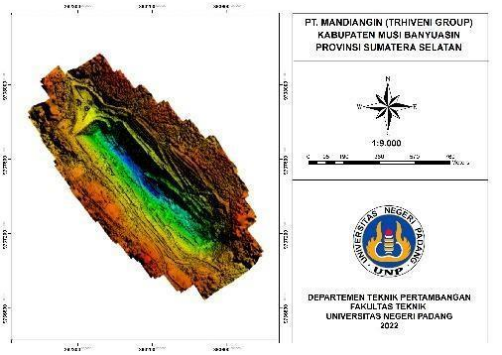

Figure 2. DEM from Aerial Photographs

From this DEM data, it will be processed using *Global Mapper software* into DXF data, then from the DXF data it can be formed into DTM data to get volume from *PIT* A using Geovia Software Surpac 6.6.2.

c. DTM Creation and Cut *and Fill* Volume Calculation
After being processed from DEM data into DXF data using Global Mapper software, then the author processes DXF data into DTM and processes so that Cut and Fill volumes are obtained from *PIT* A using Geovia software Surpac 6.6.2.

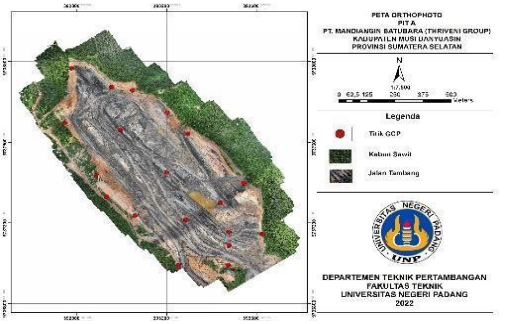

Figure 3. Orthophoto map

IV. RESULTS AND DISCUSSION

Based on the processing using some software, the final result will be in the form of volume *cut and fill*. From this processing, *the volume of PIT* A was obtained from photogrammetric measurements, which is 608,060,222 BCM.

From the volume results obtained, it will be reduced by the survey volume that is considered correct, which is 441,404,769 BCM.

TABLE 1
VOLUME OF PHOTOGRAMMETRIC MEASUREMENTS WITH *TOTAL STATION*

No	Measurement	Volume (BCM)
1	Photogrammetry	608.060,222
2	Total Station	441.404,769

Difference = V2 – V1..... ..... (1)
Where :

- V1 = Volume Survey
- V2 = Photogrammetric volume

Difference = V2 - V1
= 608,060,222 BCM - 441,404,769 BCM
= 166,655,453 BCM Percentage difference.....= $\frac{V2 - V1}{V1} \times 100\%$..... (2)

$$= \frac{608.060,222 - 441.404,769}{441.404,769} \times 100\%$$

= 37.76 %.

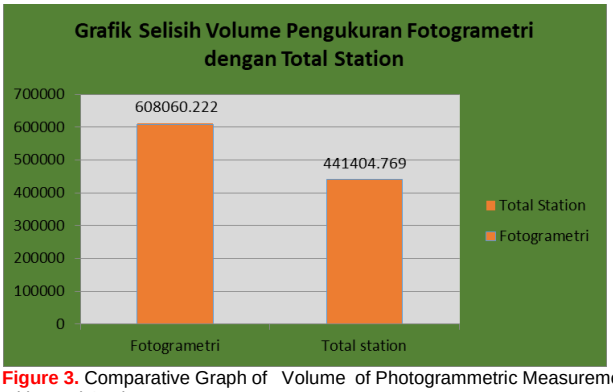

Figure 3. Comparative Graph of Volume of Photogrammetric Measurements with Total Station

The difference between *Cut and Fill PIT* A volume when using GCP points is 19 points with Survey Volume using *Total Station* , which is 166,655,453 BCM or around 37.76%.

V. CONCLUSION

From the research activities that have been carried out by the author in the PT. Mandiangin Batubara (Thriveni Group) site Tempirai Project, Suka Damai, Kab. Musi Banyuasin, South Sumatra can be concluded:

1. The cut and fill volume of photogrammetric measurements was 608,060,222 BCM.
2. The cut and fill volume obtained using the total station was 441.404.769 BCM.
3. The difference between the cut and fill volume of photogrammetric measurements and the total station measurements is 166,655,453 BCM or about 37.76%.

REFERENCES

[1] Ferdiansyah Novriza, Roni Agusmaniza. 2020. Pemetaan Topografi Menggunakan Total Station Pada Komplek Sekolah Terpadu Teuku Umar Aceh Barat. Akademi Komunitas Negeri Aceh Barat. Vocatech: Vocational Education and Technology Journal 2, 1 (2020): 41-48.

[2] Syarifa Naula Husna, Sawitri Subiyanto, Hani'ah. 2016. Penggunaan Parameter Orientasi Eksternal (Eo) Untuk Optimalisasi Digital Triangulasi Fotogrametri Untuk Keperluan Ortofoto. Program Studi Teknik Geodesi Fakultas Teknik Universitas Diponegoro. Jurnal Geodesi Undip.

[3] Zulkadri A Hasim, Moch. Abdul Basyid. 2021. Kajian Perbandingan *Digital Elevation Model* (Dem) Uav Dengan *Digital Elevation Model* (Dem) Topografi (Studi Kasus: Pt. Torganda Kawasan Industri Lubuk Gaung Tanjung Penyembal – Sungai Sembilan Kota Dumai). Seminar Nasional dan Diseminasi Tugas Akhir 2021.

[4] Edy Nursanto, Faishal Insanul Jamal, Nur Ali Amri. 2018. Analisis Produksi Pada Kemajuan Tambang Menggunakan Metode Fotogrametri UAV (Unmmaned Aerial Vehicle) di Kuari Batu Gamping PT Semen Indonesia (Persero) Pabrik Tuban Jawa Timur. Jurusan Teknik Pertambangan, Fakultas Teknologi Mineral, UPN "Veteran" Yogyakarta. Jurnal Teknologi Pertambangan Vol. 4 No. 2 Periode September 2018 - Februari 2019.

[5] Yulia Savira Rachma*) , Yudo Prasetyo, Bambang Darmo Yuwono. 2018. Analisis Akurasi Ketelitian Vertikal Menggunakan Foto Udara Hasil Pemotretan Pesawat Tanpa Awak Untuk Pembentukan Digital Terrain Model (Dtm). Departemen Teknik Geodesi Fakultas Teknik Universitas Diponegoro. Jurnal Geodesi Undip.

[6] Iqbal Yukha Nur Afani*) , Bambang Darmo Yuwono, Nurhadi Bashit. 2019. Optimalisasi Pembuatan Peta Kontur Skala Besar Menggunakan Kombinasi Data Pengukuran Terestris Dan Foto Udara Format Kecil. Departemen Teknik Geodesi Fakultas Teknik Universitas Diponegoro. Jurnal Geodesi Undip.

[7] Escolastico Fortunato Soares Sequeira Alves 2019. Perbandingan Antara Dem Foto Udara Dengan Dem Topografi (Studi Kasus: Kecamatan Lowokwaru, Kota Malang, Jawa Timur). Skripsi thesis, ITN MALANG.

[8] Bambang Rudianto. 2011. Analisis Pengaruh Sebaran Ground Control Point terhadap Ketelitian Objek pada Peta Citra Hasil Ortorektifikasi. Jurusan Teknik Geodesi – FTSP Institut Teknologi Nasional, Bandung. Jurnal Rekayasa Intitut Teknologi Nasional.

[9] Drone DJI Mavic Air 2s. Fitur Dji Mavic Air 2. Diakses 5 Maret 2022. https://www.plazakamera.com/shop/dji-mavic-air-2/.

[10] Total Station Sokkia FX-101. Fitur Total Station Sokkia FX-101. Diakses 25 Maret 2022.https://dndsurvey.id/p/total-stationsokkia-fx-101/.

[11] Rochmadi, Sunar. 1993. " Perkembangan Teknologi Pemetaan dan Kaitannya dengan Pendidikan" Cakrawala Pendidikan : Nomor 1, Tahun XII.

[12] Soendjojo, Hadwi; Akhmad Riqqi. 2012.Kartografi. Penerbit ITB Bandung

[13] Purworahardjo, U.U, (1986), Ilmu Ukur Tanah Seri A – Pengukuran Horisontal, Jurusan Teknik Geodesi,FTSP, ITB, Bandung.

[14] Yulianto, W. (2003). Aplikasi AutoCAD 2002 untuk Pemetaan dan SIG. Jakarta: PT. Elex Media Komputindo.