

## INTISARI

Pertambangan batu kapur memiliki peran penting dalam pemenuhan kebutuhan industri bangunan, semen, hingga bahan kimia, sehingga keberadaannya bernilai ekonomis tinggi. PT Anindya Mitra Internasional (AMI) mengelola lahan tambang batu kapur di Kalurahan Bedoyo, Kapanewon Ponjong, Kabupaten Gunungkidul, dengan luas Izin Usaha Pertambangan 4,892 hektar. Meskipun wilayah tersebut memiliki cadangan batu kapur yang melimpah, hingga kini estimasi volume galian pada area tambang belum dilakukan. Padahal, estimasi volume sangat krusial untuk mendukung perencanaan produksi, pengendalian operasional, dan keberlanjutan aktivitas penambangan. Proyek akhir ini bertujuan untuk membuat *Digital Terrain Model* (DTM) dari foto udara, menghitung ketelitian dengan acuan Peraturan BIG nomor 18 Tahun 2021, dan menghitung estimasi volume tambang batu kapur menggunakan DTM dari foto udara. Pada pelaksanaannya estimasi volume dilaksanakan dengan proses akuisisi data, pengolahan data, dan penghitungan volume.

Akuisisi data dilakukan pada tanggal 23 Mei 2025 dengan menggunakan *Unmanned Aerial Vehicle* (UAV) *Quadcopter* untuk pemotretan udara. Akuisisi *Ground Control Point* (GCP) sebanyak tujuh titik dan *Independent Control Point* (ICP) sebanyak empat titik menggunakan *Global Satellite Navigation System* (GNSS) metode *rapid static*. Foto udara diperoleh sebanyak 1.186 foto, Data foto udara diolah dengan algoritma *Structure from Motion* (SfM) untuk menghasilkan *Digital Terrain Model* (DTM). Proses klasifikasi *point clouds* dan penghitungan volume dilakukan pada perangkat lunak Komersial dengan metode *surface to surface* berbasis *Triangulated Irregular Network* (TIN). Uji ketelitian model DTM dilakukan dengan pendekatan CE90 dan LE90 mengacu pada Peraturan Kepala BIG No. 18 Tahun 2021.

Hasil dari model DTM menunjukkan nilai ketelitian CE90 sebesar 0,026 m dan LE90 sebesar 0,052 m. Nilai ketelitian dari DTM memenuhi standar ketelitian peta kelas 1 pada skala 1:1000 berdasarkan Peraturan BIG nomor 18 Tahun 2021. Ketelitian dari DTM menunjukkan bahwa DTM dapat digunakan untuk penghitungan volume batu kapur. Hasil penghitungan estimasi volume galian batu kapur di area tambang batu kapur Bedoyo pada batas elevasi galian 379,900 m didapatkan volume sebesar 914.198,4 m<sup>3</sup> dengan kedalaman maksimum galian mencapai 57,172 m, kemudian pada batas elevasi galian 342,346 m didapatkan volume sebesar 2.546.016,1 m<sup>3</sup> dengan kedalaman maksimum galian mencapai 94,726 m.

**Kata kunci** : UAV, *Structure from Motion*, DTM, estimasi volume, batu kapur.

## ABSTRACT

*Limestone mining plays a vital role in meeting the demands of the building materials, cement, and chemical industries, thus holding high economic value. PT Anindya Mitra Internasional (AMI) manages a limestone mine site in Bedoyo Village, Gunungkidul Regency, spanning a Mining Business Permit area of 4.892 hectares. Although the region possesses abundant limestone reserves, the estimation of excavation volume on the mine site has not yet been conducted. Accurate volume estimation is crucial for supporting production planning, operational control, and ensuring the sustainability of mining activities. This final project aims to create a Digital Terrain Model (DTM) from aerial photographs, calculate its accuracy with reference to BIG Regulation Number 18 of 2021, and determine the limestone mine excavation volume estimation using the generated DTM. The overall estimation process involved three primary stages: data acquisition, data processing, and volume calculation.*

*Data acquisition was performed on May 23, 2025, utilizing an Unmanned Aerial Vehicle (UAV) Quadcopter for aerial photography. To ensure high geometric accuracy, seven Ground Control Points (GCP) and four Independent Control Points (ICP) were acquired using a Global Satellite Navigation System (GNSS) with the rapid static method. A total of 1,186 aerial photos were obtained, which were then processed using the Structure from Motion (SfM) algorithm to generate the Digital Terrain Model (DTM). The subsequent processes, including point cloud classification and volume calculation, were conducted using commercial software, employing the surface-to-surface method based on the Triangulated Irregular Network (TIN). The accuracy test of the DTM model was carried out using the Circular Error (CE90) and Linear Error (LE90) approaches, as mandated by the Head of BIG Regulation No. 18 of 2021.*

*The results obtained from the DTM model show accuracy values of CE90 at 0.026 m and LE90 at 0.052 m. These figures confirm that the model meets the map accuracy standards for Class 1 maps at a scale of 1:1000. The achieved accuracy indicates that the DTM is suitable for limestone volume calculation. With the validated DTM model, the estimation of limestone excavation volume successfully yielded 914,198.4 m<sup>3</sup> for the 379.900 m excavation elevation limit and 2,546,016.1 m<sup>3</sup> for the 342.346 m excavation elevation limit. These quantitative findings confirm that the integration of UAV technology and the SfM-TIN method is a highly effective and precise approach, providing crucial spatial data required by PT AMI to optimize production planning and ensure the sustainability of mining operations.*

**Keyword** : UAV, Structure from Motion, DTM, volume estimation, limestone.