

ACQUISITION AND PROCESSING OF DATA USING GEOMATIC METHODS FOR OBTAINING THE PERMIT TO EXPLOITATION MINERAL RESOURCES IN THE CICIR HALTA PERIMETER, ARAD, ROMANIA

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Abstract. *The importance and purpose of the study are to highlight the presence of geomatics technology in mining engineering works. Based on the research and studies carried out to obtain the extension of the mining license for the mineral aggregates and existing sand and gravel deposits in the Cicir Halta area, Arad county, the UAV technology in combination with the classic measurement technology, respectively GNSS, data acquisition and processing had. the time factor by the requirements imposed by the entity issuing the notice. The results obtained with the help of UAV technology are orthophoto planes, digital elevation models, or 3D models, which can be easily processed with dedicated software. For example, after the orthophoto plane was imported into AutoCAD, the perimeters of the studied area could be easily vectorized in detail. Once the vectorization of the aggregate quarry was completed, the final plan was obtained, following which the necessary documentation was drawn up to obtain the permit for the exploitation of the sand and gravel resources in the studied perimeter. The necessary documentation has been drawn up regarding the ability to carry out mineral resources exploitation works: useful rocks, through topography and geology works. UAV technology in combination with GNSS technology is the evolutionary step in obtaining precision measurements with a working speed.*

Keywords: *MMS equipment, LIDAR sensor, post-processing steps.*

INTRODUCTION

The importance of the project is based on the research and studies carried out to obtain the extension of the exploitation license for the mineral aggregates and existing sand and gravel deposits in the Cicir Halta area, Arad county.

The documentation necessary for attestation regarding the ability to carry out mineral resources exploitation works: useful rocks, through geological topography works, was drawn up. In order for the study time to be as short as possible, state-of-the-art technologies acquired through classic and modern procedures were used so that the results obtained were as accurate as possible, the use of ultra-modern technologies made it possible to measure areas that have a fairly high inaccessibility factor.

With the help of modern drone technologies and geodetic data processing with GNSS, GPS (RTK) technology, measurements can be made much easier from a physical point of view and much faster from a time point of view.

After the measurements, the documentation containing the drawn and written parts is made, the drawn plans will include the topographic situation plan together with the longitudinal and transversal profiles, and for each separate quarter the volume calculation from the sections will be performed.

MATERIAL AND METHODS

Topographical measurements offered, years ago, information related only to the surface, neighborhoods and openings of a land. Currently, technology allows obtaining complex digital data accessible to all categories of owners or customers. And the whole process depends on a device that seems to be a simple toy.

Current technology offers new opportunities to land owners or customers interested in purchasing: with the help of orthophoto plans, they can obtain clear and objective information about a certain area. Not everyone could have access to such data until now, the procedures being extremely expensive, as the classic methods involved flying planes loaded with sophisticated photogrammetry equipment. Due to costs, materials of this type were only available to large companies or institutions with generous budgets.

Orthophotoplans, or photo maps, which present the situation of a land in detail, are often confused with classic aerial images, but specialists point out that there is a big difference between the two: the orthophotoplan is a map, and at any point we look at, the image is perfectly perpendicular, thanks to the software that corrects each image (a process called ortho correction). On the other hand, measurements could not be made on an aerial image, and the image is not perpendicular at any point, so we will also see buildings from the side.

Such measurements provide valuable information and streamline the work of those who need detailed plans of a certain area, being useful in countless fields, from architecture and construction, to agriculture, transport or tourism. What a few decades ago seemed like a fanciful idea, today is an everyday reality: the measurements are made with the help of an unmanned aerial vehicle, called a "drone", which moves autonomously according to a predetermined flight plan. For centimeter accuracy, before the flight over the target area, some control points are established, measured with topo equipment, which are then marked.

These control points on the ground (Figure 2) must appear in the images because, in the processing phase, their coordinates are declared to the software as a standard.

The steps leading to data retrieval and processing are as follows:

- The target area is determined and the flight plan is created, which is loaded into the autopilot
- During flight, the drone captures 70% overlapping images and records the geographic position of each capture
- After landing, the images and data from the autopilot are downloaded, after which they are correlated, using a pre-processing software
- Image processing is done with the help of state-of-the-art programs and involves three important steps: aligning the images using common points between them (the result being a cloud of points); the geometric reconstruction by which the three-dimensional position of each point is calculated (the result being a three-dimensional model); exporting results in formats compatible with analysis/design software.



Figure 1. Drone-Dji Phantom 4



Figure 2. System GNSS Leica GS 08, Drone-Dji Phantom 4, GCP (Ground Point Control)

The undeniable benefits of this measurement method are given by the quality and quantity of the topography data, as well as the high resolution of the photo map. With the classical topo measurement methods, to obtain such quantity and quality of data (but without images) for 1 square kilometer, it would be necessary for the GPS station to be placed in approximately 10 million points, which is impossible, from the perspective of specialists in the field of engineering measurements.

RESULTS AND DISCUSSIONS

The studied area is located in Romania, North West Region, Arad county, and the main object of exploitation is the sand and gravel deposit from the Cicir Haltă perimeter, used in concrete and mortars with mineral binders, as ballast for foundation layers, for road layers.



Figure 3. Zoning plan for the district Cicir Haltă[own source]

The name of the exploitation perimeter is CICIR HALTĂ, it is identified by no. topographical 4068 - 16 and is located in the Mureș hydrographic basin, in its major basin, Arad county, approx. 25 km east of the municipality of Arad. From an administrative point of view, the perimeter belongs to Vladimirescu commune. The Cicir Haltă exploitation perimeter has an area of approx. 0.60 km² and has been exploited since 2003.

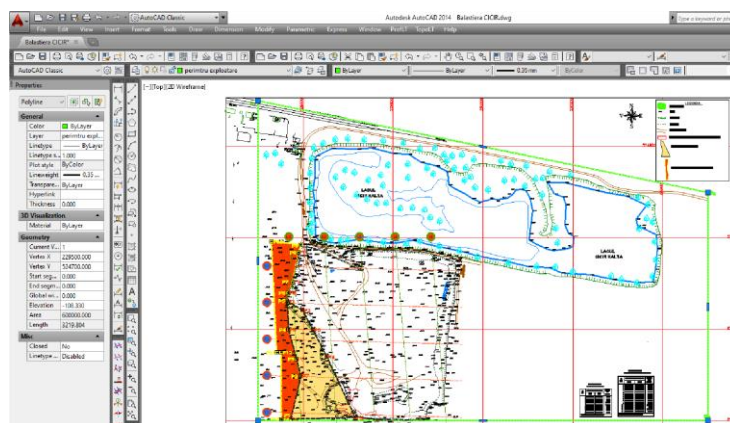


Figure 4. The geometric form represented in the plan for the studied area [own source]

And the points that delimit the exploitation perimeter, in STEREO 70 coordinates, are presented in table 1.

Table 1

Stereo70 coordinates, of the Cicir Haltă perimeter

Point No.	X	Y
1	524700	229500
2	524500	230500
3	524000	230500
4	524000	229500

In order to ensure the continuity of exploitation from the scheduled opening works, it was planned to carry out some works to uncover the deposit. The technical documentation from the topographical perspective had as its foundation a previous documentation, which through works that subscribe to the field, was updated and submitted to the institution authorized to issue the exploitation permit. The requirements for completing the documentation from a topographical point of view consisted in the development of up-to-date situation plans, with the works executed by quarterly stagger, longitudinal profiles, transversal profiles, as well as volume calculation from the obtained profiles.

In order to be able to accurately establish the stages that will form the basis of the final products, preliminary steps were taken through the recognition of the land and the establishment of the strategic starting points of the topographic measurements, the consultation of the previous topo cadastral plans, made available by the beneficiary. The

prior recognition of the terrain in the topo-cadastral perspective was carried out with the help of UAV technology, using a small aircraft, DJI Phantom 4 (Figure 1), to capture as many details as possible from the terrain that can be useful in classic topographic measurements.



Figure 4. Image captured with UAV technology - Cicir Haltă [own source]

In determining the exploitation areas, the observance of the control points materialized in the field was taken into account, points that represent the outline of the exploitation perimeter, proposed for the year 2022. In order to prepare the documentation according to the technical regulations, the measurements were performed in the Stereographic 1970 coordinate system, with the Black Sea 1975 level reference, using the RTK (Real Time Kinematic) method, obtaining corrections in real time, and to obtain the coordinates of the points, stationing in points for 3 seconds.

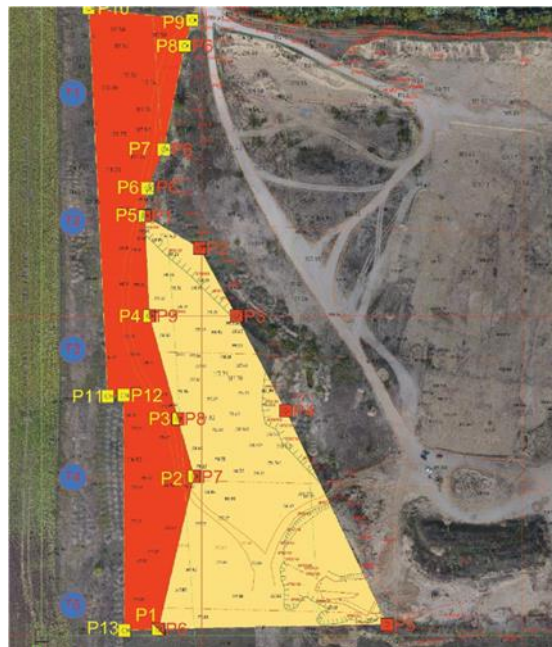


Figure 5. Contour points for the areas proposed for exploitation [own source]

The points resulting from their processing constituted the basis by which the topographical situation plan was created up to date with the surfaces, the executed works, as well as the proposal to expand the Cicir Haltă exploitation perimeter.

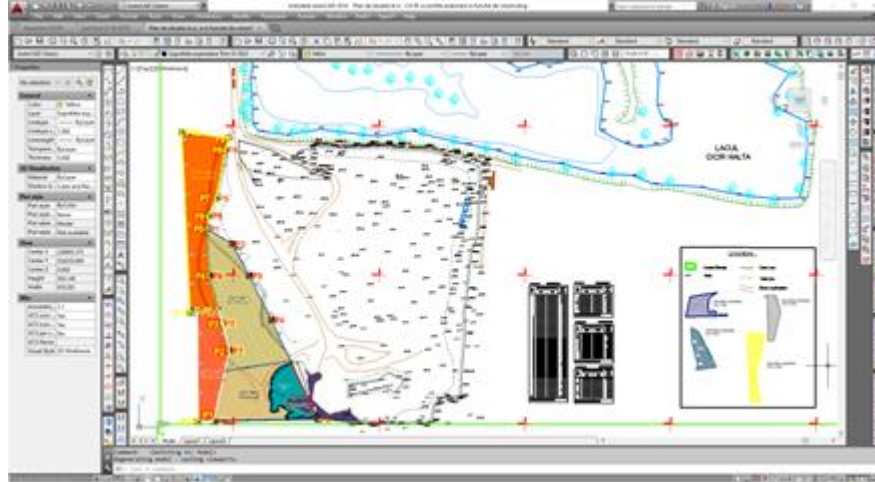


Figure 6. Up-to-date situation plan with the phasing of the areas to be exploited [own source]

With the result of the processed data, the up-to-date topographical situation plan with longitudinal and transversal profiles through the Cicir Haltă exploitation is made, a plan that is the basis of the staggered volume calculation for each quarter.

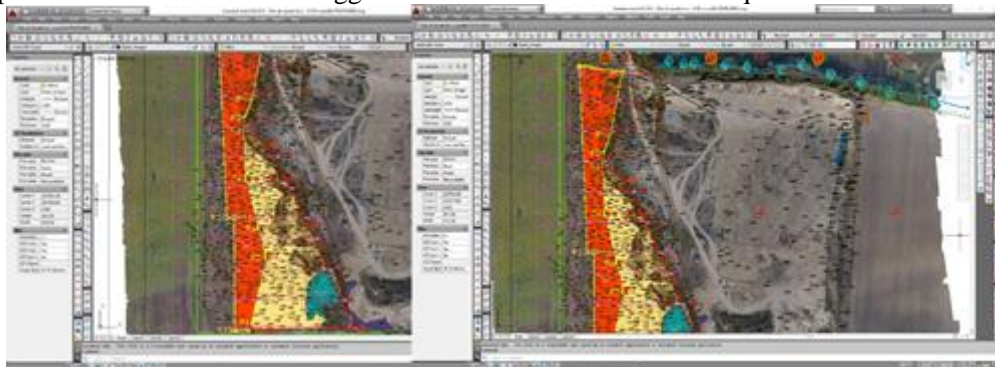


Figure 7. Situation plan with transverse and longitudinal profiles through exploitation [own source]

Within the exploitation perimeter, 11 transversal profiles and 3 longitudinal profiles were established, of which 1 longitudinal profile through the area where the deposit will be excavated, based on the hearth of the quarry, at an elevation of +109.5 m.

The calculation method for exploited volumes, the section method/block method, was imposed by the institution issuing the notice.

So, the surfaces resulting from the profiles were calculated, they were multiplied by the applicable distance of each section, resulting in the total mining volume.

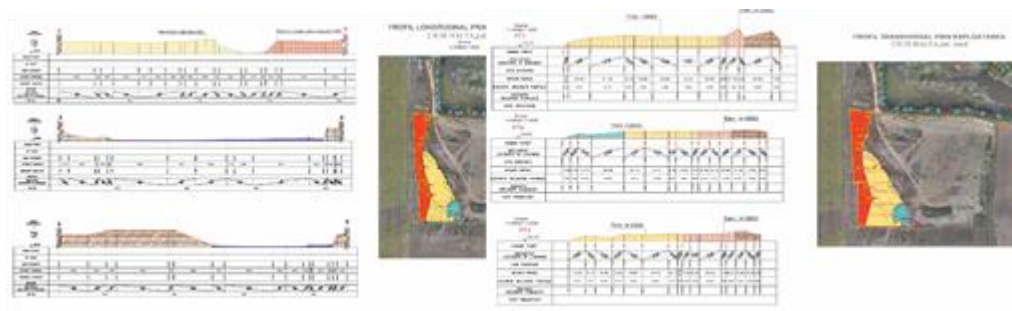


Figure 8. Transversal profiles and longitudinal profiles by operation [own source]

CONCLUSIONS

In conclusion, the current study is based on the premise of rational exploitation, which aims at the possibility of exploitation of mineral aggregates and their valorization from the deposit of sand and gravel in the perimeter, given the fact that during the third quarter of 2022 the exploitation license 1.374 / 2000 of the Cicir Halta perimeter expires.

The main reason for an efficient and forward-looking exploitation is to stagger the works only on the first III quarters for this permit, following as after obtaining the extension of the exploitation license for another 5 years. Given these premises, the topographical works are executed in accordance with the requirements imposed by the authority issuing the notice, the development perspective of the exploitation, as well as of the beneficiary.

In order to carry out the activity of extraction, transport and delivery of the deposit of sand and gravel from the Cicir Halta exploitation perimeter, the necessary documentation was drawn up for its attestation regarding the ability to carry out specific works for the development and exploitation of mineral resources - useful rocks , through topography, geology, etc.

The results obtained were based on the use of state-of-the-art technologies in the field of geodetic engineering, using classic acquisition procedures and modern procedures, considering that the achievement of the objectives should be easy, and the time factor for retrieval and processing should be relatively small.

The use of such technologies from the field of modern ones make it possible to measure areas that have a fairly high inaccessibility factor.

With the help of modern drone technologies or geodetic data collection with GNSS, GPS (RTK) technology, some can be done from a distance, leaving no traces during the measurement, and the other data collection in a very short time interval with high precision. Geodetic data processing software is part of the modern component of packages, thus intervening in the process of making results more efficient.

With the result of the processed data, the topographical documentation containing all the drawn parts is created, starting with the up-to-date topographical situation plan with

longitudinal and transversal profiles through the Cicir Haltă exploitation, up to the calculation of volume from sections, staggered volume for each quarter.

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