TOPOGRAPHIC WORKS NECESSARY FOR THE STABILIZATION AND GREENING OF THE SLOPES AROUND THE SILVAŞU DE CÂMPIE LAKE IN BISTRIŢA-NĂSĂUD COUNTY

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Abstract. *The geodetic network, made in the classic system of measurements, has served for more than half a century to carry out topographic surveys, constituting an important cartographic and geodetic fund for engineering works and administrative records. The implementation and use of modern technologies in the determination of higher order support networks is a particularly complex process, aiming at the efficiency of topo-geodetic works by adopting an effective work method based on spatial information. It is known that in Romania geodetic works use the Stereographic Projection on a single secant plane developed in 1970 on the Krasovski ellipsoid. For leveling works, the reference plan is the level of the Black Sea, determined in 1975. The technology-method impact can be successfully applied in one of the problems to be solved, namely the one related to the determination of a support network, it has existed until now. Applying another technology, respectively working method, we have to solve the same problem, but in a shorter time and with higher quality results. All fields of activity seek the application of top technologies in the respective field, to reduce costs and the time needed to solve problems by adopting solutions that make the topo-geodetic measurement methods more efficient.*

Key words: *alignment, transcalculation, productivity, geodetic network*

INTRODUCTION

The geodetic network, made in the classic system of measurements, has served for more than half a century to carry out topographic surveys, constituting an important cartographic and geodetic fund for engineering works and administrative records. (AB UNGUR, MA BARB, 2022)

The implementation and use of modern technologies in the determination of higher order support networks is a particularly complex process, aiming at the efficiency of topo-geodetic works by adopting an effective work method based on spatial information. (A SMULEAC ET ALL, 2013)

It is known that in Romania geodetic works use the Stereographic Projection on a single secant plane developed in 1970 on the Krasovski ellipsoid. For levelling works, the reference plan is the level of the Black Sea, determined in 1975.

The fact that there are differences of up to 30 cm between the "H" elevations determined by geometric leveling and those determined by GPS measurements can be due to several causes, among which we can mention:

- The work extends over a very large length, approximately 60 km
- The network of triangulation points used in GPS determinations is not uniform in precision;
- The archives in which information was kept on how to determine the X, Y and H coordinates of these points could no longer provide the necessary elements to evaluate the quality of these reference points;
- Likewise, their reference system is not precisely known; in Romania, two systems are used on the H level, the Black Sea and the Baltic Sea;

- The elevation resulting from the geometric level measurements that ensure precision clearly superior to GPS measurements, and planimetrically, the X and Y coordinates determined by GPS measurements will be used;
- When creating any GPS network, the static determination method should be used to obtain the X and Y planimetric coordinates, respectively for the H elevations the geometric leveling method should be used, thus combining the two types of measurements; both the precision requirements for the two systems and the efficiency of the project are thus satisfied;
- When performing GPS measurements, it is proposed to use dual frequency receivers, which allow the reception of satellite signals on two frequencies L1 and L2.

Perspectives

The technology-method impact can be successfully applied in one of the problems to be solved, namely the one related to the determination of a support network, it has existed until now. Applying another technology, respectively working method, we have to solve the same problem, but in a shorter time and with higher quality results. (T SĂLĂGEAN, ET ALL, 2019) All fields of activity seek the application of top technologies in the respective field, to reduce costs and the time needed to solve problems by adopting solutions that make the topo-geodetic measurement methods more efficient.

Performances

The main quality features of the case study solution are:

- alignment with European techniques, methods and standards;
- homogeneous determinations by connecting to the European reference system ETRS89 and unitary trans-calculation in the projection plan;
- the need to use a modern technology, practically independent of weather conditions;
- increasing productivity and reducing costs;
- availability of services (24 hours for real-time ones);

MATERIAL AND METHODS

Determination

Readings with GPS system: Identification, on the ground, of the appropriate network terminals to create a suitable geometry and indivisibility.

At all terminals, during the recognition phase, a short reception test will be carried out with a GPS reception system to check the absence of disturbing magnetic fields or obstacles of any kind. (A ŞMULEAC, MV HERBEI, ET ALL, 2019)

The measurement method is the static one, which ensures the precision required for the realization of geodetic support networks.

The support points will be determined plan metrically in the Stereographic 1970 coordinate system.

The points related to a route or a location will be framed in a unitary network measured with instruments and methods that ensure an internal plan metric accuracy of ± 5 cm and an altimetry accuracy of ± 1 cm (precision planimetric guidance, triangulation, GPS, geometric leveling) . The observations made in the respective support networks will be processed by the least squares method. If the relative precision of the points in the state network used to determine the support network do not allow ensuring the mentioned internal precisions, the support network will be processed as a free network framed on the points of the state network. (HERBEI R.C. ET ALL, 2020)

Location

It is indicated that the stations should not be obstructed in terms of visibility above the elevation of 15-20 degrees; if the station is portable, it is good to find the area with the lowest degree of obstruction.

Too dense vegetation can create visibility problems for GPS stations; tree leaves and branches can block satellite signals. Deforestation is carried out in the respective area, based on the agreement obtained from the legal authorities. Also, avoid locating stations near tall buildings or vertical walls that may interfere with the received signal, as well as high-power transmitters (TV). In this phase, an obstruction diagram or a polar diagram is drawn up, in order to determine the optimal period of stationary on the point, when the visibility of the satellites is the best.

Terrain recognition

Visiting the stations is mandatory for each point to be stationed, before the actual start of the measurement project.

It is recommended that all team members participate in this reconnaissance in the field and at the same time analyze the obstruction diagram on site.

Based on this recognition of the land, the following can be precisely determined:

• the most convenient access to the point
• the complete sketch of the land with the important directions of access
• marking mode, to facilitate the recognition of the point
• obtaining the access agreement in the area, in the case of private properties

Throughout this station identification, weather conditions that do not affect the GPS system or receivers, but may affect station accessibility, will be taken into account.

Also in the recognition phase, point signaling systems are identified, taking precautionary measures for those on the roads (through directional arrows) or those that will be stationed at night (appropriate lighting systems).

Plan metric control points

A minimum of three support points are required for full 3D compensation. The larger the project, the more support points must be included. In the case of suspecting certain points with low precision, it is recommended to expand their number, for additional control - in this situation, the results are estimated with a high degree of precision.

The placement of these support points is done as follows:

- the N-S line is drawn through the center of the project;
- then draw the E-V line, obtaining four equal quadrants.

Three of these must contain, each, at least one support point; they can be both inside and outside the designed perimeter.

In order to have a better control over the network, it is recommended to keep a distance of 60km or even less between a support point and an unknown one.

In the case of travel, these three support points will be located at the ends of the route and one in the middle of it. For long journeys, the support points will be found at a maximum distance of 60 km.

Planning a measurement session

The session is defined as the period when two or more receivers simultaneously collect the data provided by the satellites. The beginning of this "session" depends on several factors, the most important being related to the availability of the satellite, i.e. its optimal broadcast period.

Planning a GPS project consists in choosing an optimal measurement method, the necessary equipment, as well as planning observations.

The planning differs from the planning of classical geodetic observations, as GPS measurements can be performed practically in any weather and at any time of the day. In addition, there must be no visibility between the grid points, but a free horizon to the sky from an elevation is claimed of 150 and up.

When planning observations in a GPS project, several factors must be taken into account:

1. Configuration of satellites;
2. The number and type of receivers available;
3. Economic aspects.

Network configuration plays a smaller role in GPS measurements, it only needs to be taken into account when the GPS network needs to be linked to the national network. For this, we must have at least 3 known points well distributed in relation to the GPS network.

The planning of a satellite measurement session is done with special programs delivered by the construction companies together with the processing software.

The first phase in the design foresees the choice of an optimal period for carrying out the measurements, which will be subdivided into working sessions. The optimal period is characterized by a sufficiently large number of visible satellites, which are studied on a graph and a PDOP value as small as possible (between 1 and 5).

The design of GPS observations therefore consists in choosing an optimal working period supported by graphic representations. These representations are essentially based on the calculation of the azimuth and elevation for each satellite depending on the time and place where the observations are made. It should be noted that the study of the satellite constellation and the PDOP values must be carried out for the entire group of points that will be stationed in one session. The position of the points must be known only with a precision of km.

The second phase of planning for observations refers to the distribution of receivers by teams and the programming of points for each team. As a rule, a table is drawn up, in which it is provided which team, in which session, must station at a point.

The minimum number of sessions in a network with p points and using r receivers is determined with the relationship: $\boldsymbol{s = (p - n) / (r - n)}$

whetre n represents the number of connection points between sessions.

The sessions must be chosen in such a way that there is contact with at least 4 common satellites at an elevation of over 150 in all points included in a session, and the PDOP factor is not greater than 4 for the entire measurement duration.

Topographic elevation of watersheds

- In this case, the topographical operations refer to:
- Elevation of details for the preparation of the situation plan on a scale of 1: 10,000÷1: 1,000 on level curves in the area of hydrographic basins with an area of up to 2-3 kmp. For larger areas, the existing maps 1: 25,000÷1: 10,000 are used or special photogrammetric flights are made

- Determining the limits of watersheds – roads with transverse profiles along the valleys
- Determining the surface areas of hydrographic basins - on plans and maps through planimetry
- Determining the slopes of the slopes and the transverse profiles on the valleys, ravines and creeks of the basin.

A high-performance GPS was used for the exact delimitation of the perimeter of the lake bed and the wetlands. The bathymetric measurements were carried out using the Valeport Midas

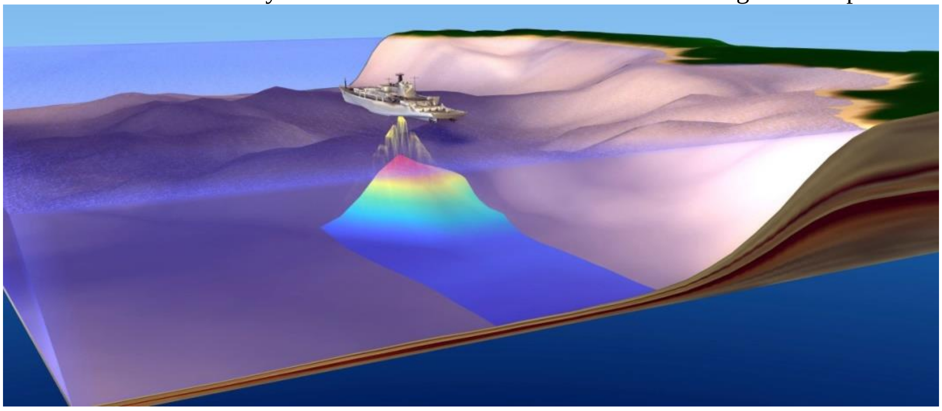

Fig. 1. Surveyor echo sounder (Bathy-500DF Dual Frequency Hydrographic Echo Sounder).

Fig. 2 Ecosonda Valeport Midas Surveyor

- The resolution of this echo sounder is ±1 cm and it has GPS navigation. The contour of the lake was delimited based on topographical measurements and GPS. The entire lake surface was swept with the help of sonar. In this case, over 80,000 points were indexed and approx. 50,000 were interpolated in graphs.
- Some difficulty in determining the depths correctly were the fact that the sonar signal can penetrate unimpeded the extremely watery silt on the bottom of the lake. In this case, the thickness of the sediment is taken as depth and not as consolidated substrate. For this reason, some corrections have been applied. As a result of the fact that the lake still retains a multitude of trunks, bathymetry measurements are difficult.

- In order to avoid some erroneous data, the "parasites" that frequently appear in the measurement operation were eliminated.

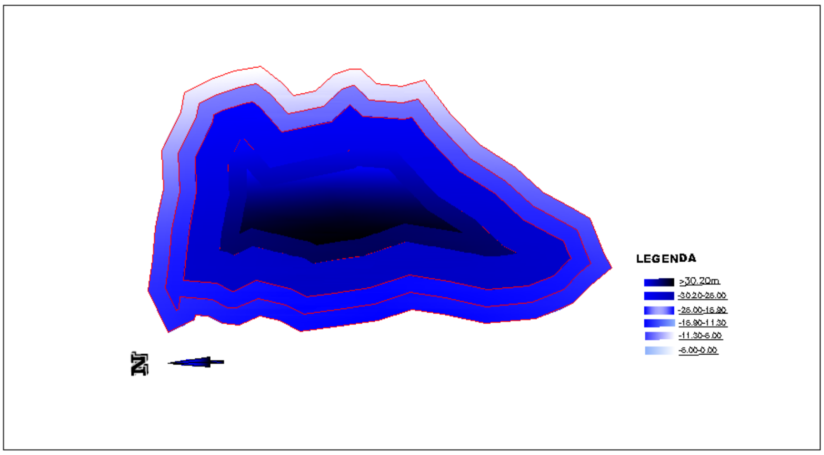

Fig. 3. Bathymetry of the lacustrine basin

RESULTS AND DISCUSSIONS

Solving the problem of stabilizing the slopes consists in:
- execution of monolithic concrete walls.
- gabion walls filled with dry rough stone masonry placed in areas with ravines on the slope.
- reinforcement walls made of raw stone masonry that come into direct contact with the slope.
- rough stone dry masonry work behind the gabions
- retention works of the deluge that will slide over time, with gabions placed on the filling behind the concrete wall and gabions.

The shape of the masonry was adapted according to the configuration of the land, resulting in an architecture special

- The flexible structure for stabilizing slopes prone to degradation is made of wire mesh anchored in rock or soil, with joining elements and DDRESSING
- The curtain-type protection structure ensures the prevention of accidents caused by the fine or coarse material detached from the slope. It consists of a mesh of the high resistance wire with rhomboidal mesh covering the slope, being anchored perimeter in rock or soil.

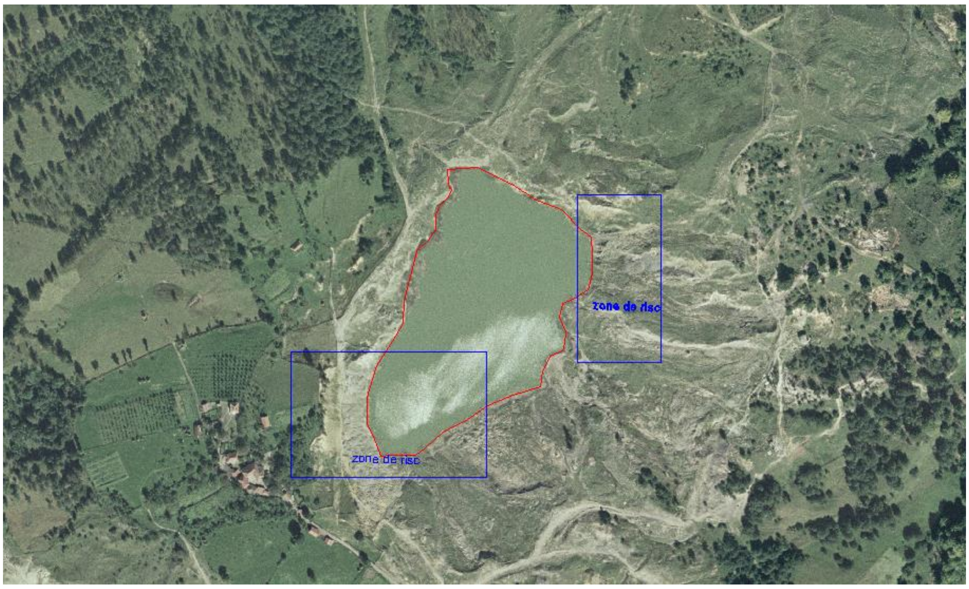

Fig. 4. Risck Zones

Technical, production and economic advantages

This plant-based soil reinforcement technology, which uses a
mix of plant species with deep roots, allows problem solving
related to erosion and often completely eliminates (with considerable advantages for the beneficiaries and the companies carrying out the works) additional materials, works and costs, due to:

• the added vegetable land (because they grow even in completely sterile environments, such as tailings, slag, ash...)

• the surface of the slopes (which should preferably be deforested, rough and irregular)

• traditional hydro-seeding, enriched with fibers, etc. (which solves the problem of erosion)

The duration of the works and the risks related to their realization are considerably reduced and the periodic maintenance costs are eliminated. (HERBEI R.C. ET ALL, 2020)

Advantages regarding the environment and landscaping of the area:

PRATI ARMATI is a completely natural technology that allows the complete and very fast re-naturalization of sterile areas and the avoidance of impacts with negative effects on the environment, which characterize geogrids, geotextiles, etc.

The PRATI ARMATI mixture is mostly composed of C4 plants, very efficient at absorbing CO2 from the atmosphere (they absorb 30% more CO2 from the atmosphere than ordinary plants), thus contributing to the requirements set by the Kyoto Protocol and, especially in in the case of road works, when building infrastructures compatible with the environment.

There were used perennial plants with very deep roots used at stabilization and vegetation of sloping, degraded areas or dry.

CONCLUSIONS

Plant consolidation technology can apply for:
• the slopes of road and railway embankments; • the banks of torrents, canals, rivers, slopes near the sea - cliffs;
• consolidation and protection of slopes affected by landslides;
• restoration and revegetation of surface mines, polluted areas.

The implementation technology provides for a simple and quick construction site with the spreading of a mixture of water, certain fertilizers, natural glue, and a mixture of technical seeds with the characteristics described in the following, on the surface subject to the intervention. These are hydro-seeds that are spread with specialized equipment, equipped with tanks from 1000 l to 10000 l, placed on vehicles, 4X4 or even attached to tracks. To cross bumps, or in the case of construction sites with difficult access, long hoses up to 300 m are used.

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