

## TOPOGRAPHIC LIFTING OF A SEWERAGE NETWORK IN SANTAMARIA ORLEA COMMUNE, HUNEDOARA COUNTY

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**Abstract:** From ancient times man wanted to find out and describe the terraforms, routes and other useful elements for his life. The first attempts, in the absence of the mathematical and geometrical knowledge and the appropriate tools, gave rise to very imprecise maps, which did not reach the purpose for which they had been realized. With the passage of time, due to the progress of the sciences, of the means of transport and of the instruments, the work of the map makers has become more and more precise, until nowadays we arrive at current methods of realizing the cartographic representations. If in ancient times the earth measurements were performed manually today everything is done using the latest generation equipment. The topographic elevation represents a set of field and office works necessary for the realization of a topographic plan. Depending on their content, the topographic elevations can be: planimetric elevations when determining only the position in the plane of the points of the topographic surface, leveling elevations when determining only the vertical position of the points, the combined elevation, when determining both the position in the plane, as well as the vertical position of the points. Topographic survey may be necessary to obtain the building permit, demolition permit, PUG, PUD, PUZ; design of electricity, gas, water and sewerage networks; conclusion of rental, leasing, concession contracts; identifying the real owners of the land on which certain investments are to be executed; obtaining a notice of removal from the agricultural circuit; obtaining the decision to award the postal number. The present work was carried out in Santamaria-Orlea commune, Hunedoara county and aims at the topographic elevation of a sewerage network carried out in the commune as well as in the villages belonging to it. This measurement was made using a Hi Target V30 GPS system, which is the perfect combination of the quality of the materials used in its manufacture and the applied technology. Hi-Target V30 receiver for GNSS RTK measurements is a system that receives signals from multiple satellite constellations, designed to work with the network of ROMPOS reference stations. For the production of the receiver special materials were used, due to the fact that the Hi-Target V30 repeater is extremely resistant to the most difficult weather conditions, it can withstand even under water. The working mode with the V30 receiver can be: rover, base or static. All the working methods as well as the control over the GSM module, the internal radio or the external radio are made from the controller that comes with the Hi-Survey software with which you can modify the working mode. After the completion of the field measurements, the office work was completed, where the machine was unloaded and the measurements were completed to complete the work. In order to carry out the work, he used the AutoCAD (computer aided design) program, which is a CAD program used in the design of two-dimensional (2D), less three-dimensional (3D) construction plans, developed and marketed by the American company Autodesk. The measurements were processed in files specific to the "native" system, which are those of type dwg as well as those of dxf (Drawing eXchange Format), extremely widespread.

**Keywords:** GPS, GNSS, RTK, Hi-Survey, ROMPOS, Autodesk, dwg, dxf, GSM.

### INTRODUCTION

In the last years ANCP (Agency for Cadastre and Real Estate Advertising) has realized and included a modernization project specific to the national geodetic network, where it managed to install several equipment's, which are constituted in a geodetic network of permanent stations that can be found. under the name of permanent GNSS stations. With the

completion of the placement of these permanent stations throughout the country, there appeared the problem of uniformization specific to the way of making the GNSS measurement files and all the other documentation using these methods. In accordance with Decision No.1 of 2009 regarding GNSS measurements, in September the ROMPOS (Romanian Position Determination System) system was developed and launched, this system including real-time positioning services and which includes the promotion of the realization determinations coordinated by GNSS measurements (ŞMULEAC, A. ET ALL., 2016, 2017).

**ROMPOS** is a Romanian position determination system that ensures precise positioning in the European reference and coordinate system ETRS89. ROMPOS is based on Global Navigation Satellite Systems including GPS, Glonass and Galileo and based on the national network of permanent GNSS stations. ROMPOS is used especially in geodesy, cadastral, photogrammetry, topography (ŞMULEAC, L. ET ALL., 2016), mapping (NEX, F. AND REMONDINO, F., 2014), GIS (SIMON M. ET ALL., 2017, 2018) works, and can be used in other areas of activity in which the position determination is based on global satellite navigation systems (SMULEAC, A. ET ALL., 2012): terrestrial, maritime and river navigation, disaster management, geodynamics or meteorology (ŞMULEAC, L. ET ALL., 2005, 2017, 3).

#### MATERIAL AND METHODS

The topographic survey of the sewerage network was carried out in Santamarie-Orlea commune in Hunedoara county and was used to measure the Hi Target V30 GPS equipment.



Fig. 1 The Hi-Target V30 GPS equipment

The Hi-Target V30 receiver is a perfect combination of the quality of the materials used in its manufacture and the technology applied. Hi-Target V30 (figure 1) receiver for GNSS RTK measurements is a system that receives signals from multiple satellite constellations, designed to work with the network of ROMPOS reference stations. For the production of the receiver special materials were used, due to the fact that the Hi-Target V30 repeater is extremely resistant to the most difficult weather conditions, it can withstand even under water.

In the first stage of the work we used to perform GPS measurements the dynamic method for data acquisition. The working mode with the V30 receiver can be: rover, base or static.

All the working methods as well as the control over the GSM module, the internal radio or the external radio are made from the controller that comes with the Hi-Survey software with which you can modify the working mode. No key combinations are required to enter static mode, for example. At the same time, the measurement software shows the battery level of both the receiver and the controller.

For the postprocessing of the data obtained from the field, the RINEX data from the Permanent Stations were also acquired, which together with the data acquired on the field was done post-processing and obtaining WGS 1984 coordinates of the stationed terminals (figure 2).



Fig. 2 GPS measurements using satellite

In the second stage we went to the office work where the raw data transformation (RAW DATA) from the ETRS89 system to the STEREO'70 system was performed, which was carried out during the work with the TransDatRO program, after which the points in AutoCAD were reported with TopoLT program help and comparison with RTK values obtained from readings. The data comparison was made between the GOS RTK values obtained, the Static GPS values obtained from the post-processing and the GPS Radio values obtained from the post-processing.

The coordinate transcalculation from the ETRS'89 reference system to the Stereographic '70 system was made using the TransDAT 4.01 software produced by A.N.C.P.I.

## RESULTS AND DISCUSSIONS

In order to make the measurements, the following steps have been taken:

1. Planning of GPS measurements - for this stage, the time intervals during which the GDOP (Precision Geometric Dilution) value is small have been used. With the help of this value one can analyze the influence of the geometry of the available satellites on the respective work area. In order to achieve this method it is advisable to use working sessions in which there are at least 5-6 satellites and a height that is over 20 degrees, all these things being specific for the mobile and reference station (figure 3 and 4).

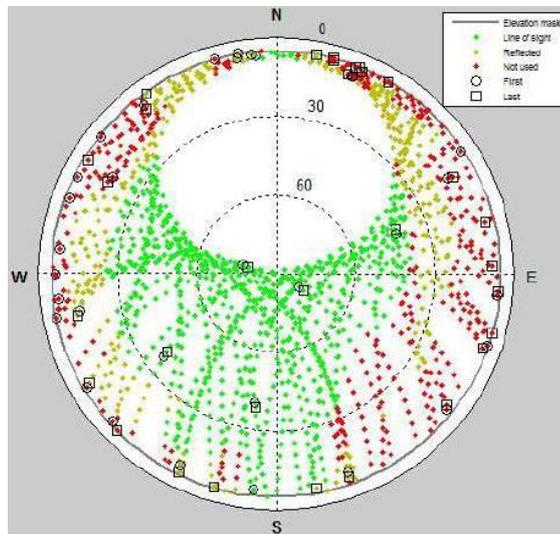


Fig. 3 Constellation and trajectory

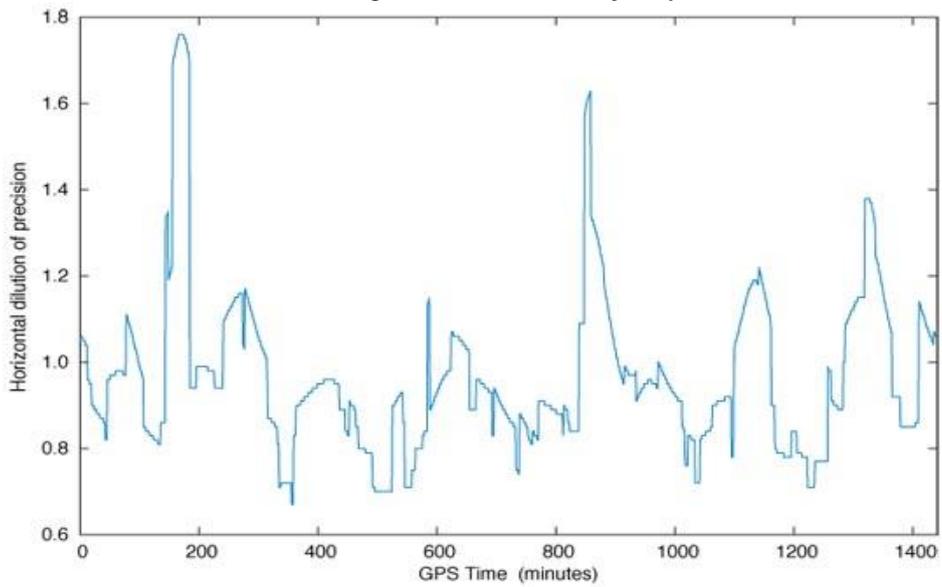


Fig. 4 GDOP values chart

2. Preparatory step - in this stage the working method and the equipment used are established.

3. The field stage - the first thing that was accomplished in this phase was the recognition and identification of the land, which will then be followed by the following steps: putting in the theme of the authorities with this work, identify the possible access routes to the old points of of the state geodetic network, the coverage area is checked with the GSM system, the potential risks that may occur during the measurements were checked (figure 5).

The second phase is represented by the office work where the processing of the measurements taken from the field is carried out. Here all the files were carefully and meticulously completed.

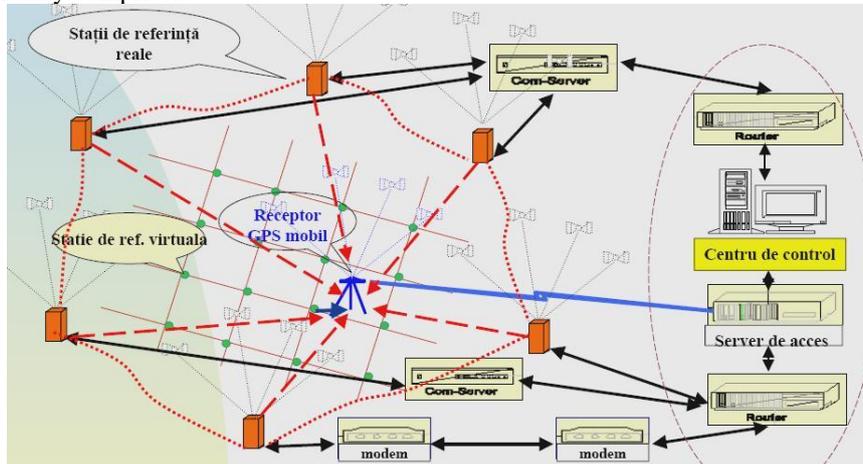


Fig.5 Presentation of the reference stations

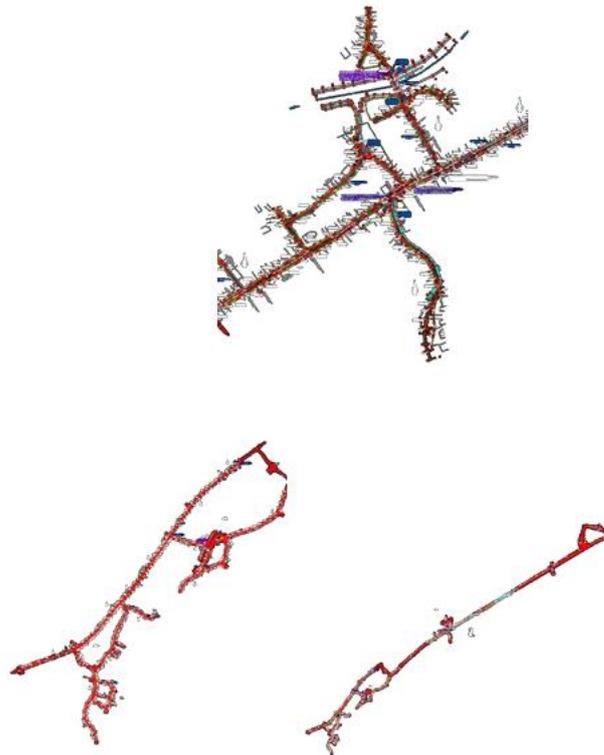


Fig. 6 Graphical representation of the topographic measurements

4. Office stage - this stage aims to process the data, which represents the last and most important stage in the work and for this reason must be done with great care.

**Post-processing of data:**

In the post-processing phase of the data, all the data files downloaded from the receivers into the software are loaded, the field files are carefully followed. In our case, we closely watched the completion of the data relating to our device with which the measurements were made.

After processing the data, we proceeded to adjust the network with the Leica Geo Office Combined program with the **ADJUSTMENT** option.

<b>Observations:</b>	10		
Reflector height / type:	0.0000 m / Reflectorless		
Coordinates:			
Easting:	270292.4573 m		
Northing:	355936.9977 m		
Height:	531.6771 m		
Quality:	Sd. E: 0.0001 m	Sd. N: 0.0030 m	Sd. Hgt: 0.0005 m
Observations in Face I:	H <sub>z</sub> : 1° 53' 08.5" Az: 15° 37' 19.2"	V: 99° 39' 51.6" H. Dist: 10.1378 m	S. Dist: 10.2825 m Ht. Diff: -0.2502 m
<b>Observations:</b>	11		
Reflector height / type:	0.0000 m / Reflectorless		
Coordinates:			
Easting:	270291.0456 m		
Northing:	355940.9554 m		
Height:	531.5615 m		
Quality:	Sd. E: 0.0004 m	Sd. N: 0.0030 m	Sd. Hgt: 0.0004 m
Observations in Face I:	H <sub>z</sub> : 351° 45' 05.8" Az: 5° 29' 16.4"	V: 97° 36' 40.7" H. Dist: 13.7842 m	S. Dist: 13.9051 m Ht. Diff: -0.3658 m
<b>Observations:</b>	12		
Reflector height / type:	0.0000 m / Reflectorless		
Coordinates:			
Easting:	270289.1133 m		
Northing:	355931.9175 m		
Height:	531.8871 m		
Quality:	Sd. E: 0.0010 m	Sd. N: 0.0027 m	Sd. Hgt: 0.0009 m
Observations in Face I:	H <sub>z</sub> : 338° 47' 39.9" Az: 352° 31' 50.5"	V: 107° 47' 55.6" H. Dist: 4.7231 m	S. Dist: 4.9600 m Ht. Diff: -0.0402 m
<b>Observations:</b>	13		
Reflector height / type:	0.0000 m / Reflectorless		
Coordinates:			
Easting:	270300.9474 m		
Northing:	355939.1724 m		
Height:	531.5457 m		
Quality:	Sd. E: 0.0015 m	Sd. N: 0.0026 m	Sd. Hgt: 0.0004 m
Observations in Face I:	H <sub>z</sub> : 29° 29' 17.5" Az: 43° 13' 28.1"	V: 96° 28' 10.0" H. Dist: 16.3831 m	S. Dist: 16.4862 m Ht. Diff: -0.3815 m
<b>Observations:</b>	14		
Reflector height / type:	0.0000 m / Reflectorless		
Coordinates:			
Easting:	270298.1969 m		
Northing:	355934.6312 m		
Height:	531.7320 m		
Quality:	Sd. E: 0.0017 m	Sd. N: 0.0025 m	Sd. Hgt: 0.0005 m
file:///C:/Users/Scanner/AppData/Local/Temp/~Rpt/0.html			
10/18			

## CONCLUSION

Considering the accuracy of the measurements obtained on each point following the network compensation, and comparing the data we can specify the following:

- for the accomplishment of the topographic survey (HERBEI, M. V. ET ALL., 2010, 2016), of the sewerage network in Santamaria-Orlea commune, the following measurements were made in the field:

a) the values obtained from the GPS measurements, by RTK (Real Time Kinematic) method

b) the values obtained from the GPS measurements by the dynamic method,

- The method is practical, but requires the respect of the conies regarding the correct and efficient planning of a GPS campaign

- GPS support points can be used in the topographic surveys, regardless of the method used, in the occurrence of Santamaria-Orlea Hunedoara county

- from the technical point of view the work ensures the specifications required by the specifications and the technical norms in force

- the results obtained after the verification highlight the good quality of the GPS determinations, especially the dynamic ones.

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