ASPECTS RELATING TO TECHNOLOGY TOPOGRAPHIC DETAILS G.N.S.S. POSITIONING SYSTEM G.P.S. IN THE FORESTRY MASSIVE

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Abstract

Determining the spatial position of the various details (characteristic points) topographic now can be done using modern technologies related work sector terrestrial measurements. As a result, these activities can be used total station, G.P.S. system, laser scanners, digital cartographic products (ortho, digital maps) georeferenced and combinations thereof.

Use of G.P.S. system for positioning of details in the forestry sector has a number of features, having in view the specific working conditions in areas with forest vegetation and that appropriate technical characteristics of satellite technologies work.

Different activities of the forestry sector involve determining the coordinates of specific points of interest applied to production activities and/or research to achieve the objectives related to current and future forestry strategy.

The case study was conducted in the County Forest Administration Bihor, Forest District Săcuieni, Production Unit Sîniob, June-July 2015 with the objective like to determine the space of a point to infill positioning court related of forest cottage and three permanent sample plots, which examines possible new methods of seed regeneration of oak trees in the national forest.

For the realization of these study case were used four receivers G.P.S. Trimble R3, with a certain frequency and programs related to data collection and processing. As a result, the static method used to quickly positioning satellite, and data processing parameters recorded were used local (zonal) transformation obtained in earlier studies for this area.

Based on the final results (the coordinates offset in the national reference) were drawn digitally positioned building plan (yard of forest cottage) and the three experimental devices. It has also been materialized sketch, digital point of thickening network of support and the plot that was materialized with a terminal type FENO.

The characteristic point positioned spatially related analyzed details of the forest can be identified with high efficiency and that for various reasons they are not materialized on the ground, using for this purpose receivers G.P.S. with simple and/or dual frequency, as necessary and appropriate positioning methods respectively.

Key words: terrestrial measurements, total station, G.P.S. system, laser scanners, digital cartographic products.

INTRODUCTION

Determining the spatial position of various informations (characteristic points), topographic now can be done using modern technologies related work sector terrestrial measurements (Adam et. al., 2004).

Therefore, these activities can use total stations, GPS systems, laser scanners, digital cartographic products (ortho, digital maps) georeferenced (Crainic, 2011, Sabău, 2010, Sabău, Crainic, 2006) and combinations thereof.

Using GPS for positioning the details in the forestry sector has a number of features, having you residence specific working conditions in areas with forest vegetation and that appropriate technical characteristics of satellite technologies work (Crainic, Damian, 2011).

Various activities of the forestry sector is to determine the coordinates of specific points of interest applied to production activities and/or research to achieve the objectives related to current and future forestry strategy (Bodog, Crainic, 2016).

MATERIAL AND METHOD

The case study was done in Bihor Forest Department, Forest District Săcuieni, Production Units I Sîniob, during June-July 2016.

Photo.1- Location of the study case (http://saniob-bh.pe-harta.ro/)

The case study has three main objectives:

-determination of the thickening space of a geodesic network point that is located inside the massive forest (stand);

-positioning a building, represented by the court of forest cottage named Cabana which is located in the stand of the wedge (u.a.) 39;

-the positioning of three permanent sample surfaces in the parcel array (u.a.) 40, where experiments, researches and studies are carried out concerning the regeneration of oak stands.

The research methods used for the case study are represented by the bibliographic documentation, the observation on the itinerary, the observation in the stationary, the experiment, the simulation, the comparison, the recording on digital support.

To achieve the proposed objectives, appropriate logistics, consisting of five G.P.S. TRIMBLE R3 used for satellite positioning, Trimble Digital Fieldbook program for recording satellite data (raw data), Trimble Total Control program for transferring, checking and processing of recorded data. Planimetric reporting of positioning points was performed with the MapSys program.

The points in the geodetic network (support network) that were used to achieve the objectives proposed in the case study were positioned with the GNSS technology, the GPS system, static method (Chiţea G., Vorovenci I., Mihăilă M., Chiţea C.G., 2011; Păunescu C., Mocanu V., Dimitriu S.G., 2006), on the occasion of complex studies carried out in the period 2000-2011 in this area, to analyze the possibilities of modernizing the topo-geodesic works in the forestry sector. (Crainic, 2011).

Photo 2 - TRIMBLE R3 receivers used for spatial positioning of details the spatial positioning of the new points was made with the G.P.S. by the static method.

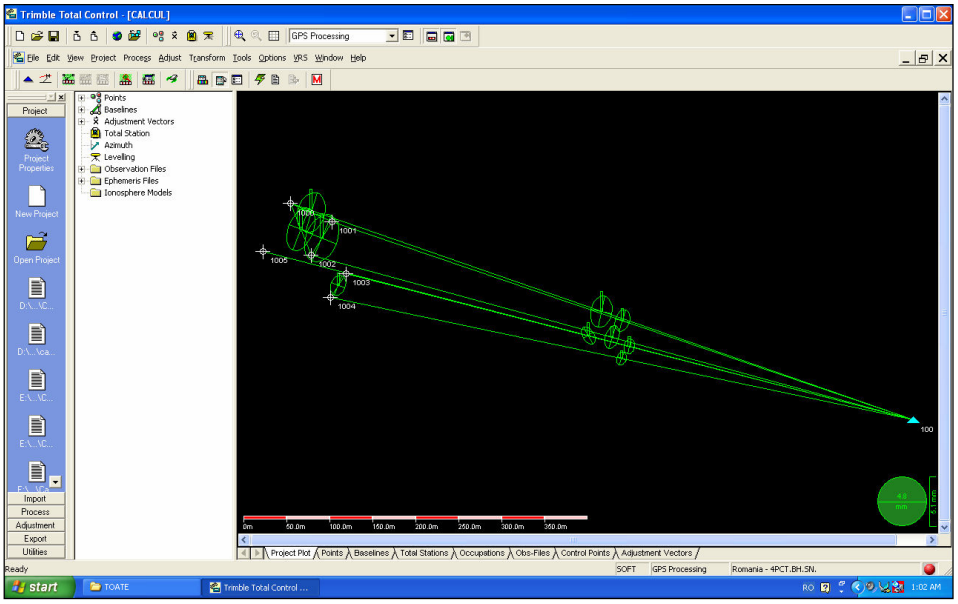

Photo.3 - Trimble Total Control interface

Points that have been spatially positioned with G.N.S.S. the G.P.S. (Crainic, 2011) were graphically reported with the MapSys program (Marton, 2007).

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Nr.pct	X(m)	Y(m)	Z(m)	Cod
100	644977.220	281606.988	114.929	1
101	645476.991	281928.501	116.098	1
102	646215.119	278303.458	128.318	1
103	646415.388	278284.559	146.183	1
106	644304.050	278087.824	179.553	1
107	644457.407	278531.631	182.329	1
104	644836.725	278550.022	172.603	1
105	644834.466	278625.106	180.939	1
108	644614.587	279218.477	184.071	1
109	644551.196	279161.748	182.879	1
170	646282.698	281348.314	164.610	1
171	646230.396	281399.172	163.158	1
180	646742.474	280736.578	164.859	1
181	647065.174	280564.817	177.304	1
314	645399.911	279494.696	182.313	1
800	645205.720	279561.727	182.622	1
190	644810.435	280867.626	166.289	1
150	645371.119	277801.910	145.743	1
151	645257.173	277360.069	137.011	1
111	644633.633	279750.257	182.974	1
112	644564.852	279764.458	183.895	1
113	644581.814	279838.558	179.999	1

Photo.4 - Points network support positioned GNSS technology, GPS system, used for coordinate transformation in the national reference

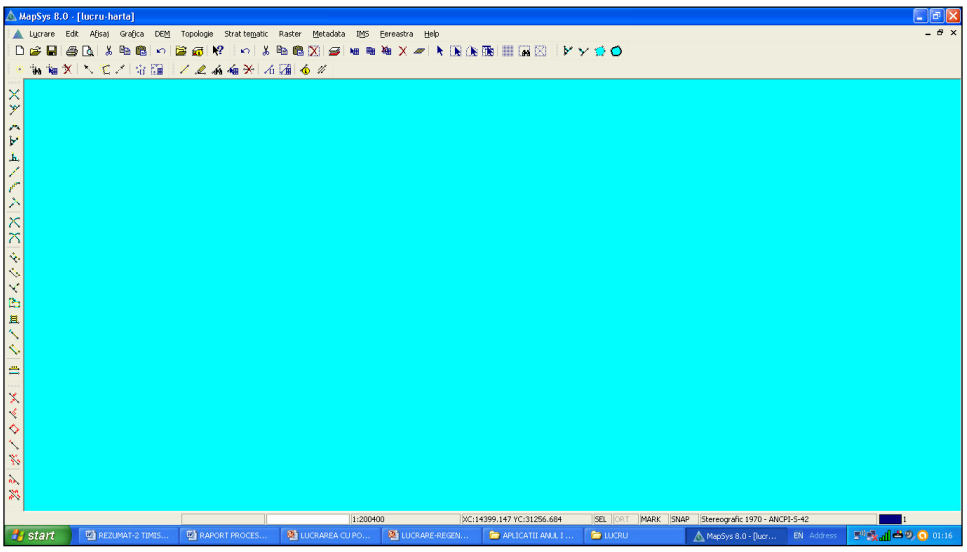

Photo.5 - Program interface MapSys 8.0

RESULTS AND DISSCUSION

Trimble Total Control (T.T.C.) was used to process the recorded data, and for the transformation of the coordinates in the national reference system (Tămâioagă,Tămâioagă, 2007), the local (zonal) transformation parameters obtained from previous studies for the area were used.

This is the data processing report with Trimble Total Control (T.T.C.).

2. Baselines Input in WGS84 (Components and Std.Dev.)

Observation	ΔXm	σmm	ΔYm	σmm	ΔZm	σmm	Solution
100-200	1130.5268	39.3	-2727.5596	26.9	74.1564	31.8	Double Diff. / Fixed / L1
100-5000	1129.1110	81.7	-2725.3324	49.1	75.7567	53.9	Double Diff. / Fixed / L1
100-5001	1153.1952	77.4	-2759.3556	41.6	65.4406	52.4	Double Diff. / Fixed / L1
100-5002	1172.2825	77.9	-2731.6354	37.1	39.7915	53.9	Double Diff. / Fixed / L1
100-5003	1148.4825	59.3	-2701.1422	34.2	49.0658	44.2	Double Diff. / Fixed / L1
5000-200	2.7975	66.5	-1.3913	46.3	-1.1742	48.2	Double Diff. / Fixed / L1
5001-200	-21.8348	99.6	32.0461	64.0	8.8875	58.7	Double Diff. / Fixed / L1
5001-5000	-25.1367	73.9	33.6824	38.4	9.4446	48.3	Double Diff. / Fixed / L1
5002-200	-42.0363	98.7	4.2186	53.1	34.1922	69.3	Double Diff. / Fixed / L1
5002-5003	-24.5673	119.8	30.3466	74.8	8.8468	86.4	Double Diff. / Fixed / L1
5003-200	-17.4742	81.5	-26.1298	53.7	25.3240	57.5	Double Diff. / Fixed / L1

- Standard deviations of the static baselines have been multiplied with the factor 10.00.

1. Fixed Transformation Parameters WGS84->National:

Parameter	Value	σ
Scale	1.000000495	0.000000000
Rotation X	2.1924"	0.0000"
Rotation Y	-2.7177"	0.0000"
Rotation Z	-1.0512"	0.0000"
Translation X	-71.0581m	
Translation Y	55.5504m	
Translation Z	148.2930m	

3. National Control Points Input (Plane Coord. and Std.Dev.)

Point	Northing	σ	Easting	σ	Elevation	σ
100	644977.2200m	0.0mm	281606.9880m	0.0mm	114.9290m	0.0mm

4. Adjusted Baselines in WGS84 (Components and Std.Dev.)

Observation	ΔX	σ	ΔY	σ	ΔZ	σ
100-200	1130.7176m	146.5mm	-2727.4349m	93.1mm	74.2408m	110.3mm
100-5000	1128.2790m	222.3mm	-2725.7055m	136.0mm	75.3607m	153.1mm
100-5001	1153.1145m	237.3mm	-2759.3644m	135.4mm	65.6052m	157.7mm
100-5002	1172.5578m	258.3mm	-2731.6271m	133.1mm	39.9392m	181.4mm
100-5003	1148.3331m	212.6mm	-2701.1970m	126.8mm	48.9850m	155.7mm
5000-200	2.4386m	216.8mm	-1.7295m	138.0mm	-1.1200m	150.9mm
5001-200	-22.3969m	240.7mm	31.9294m	142.8mm	8.6355m	159.5mm
5001-5000	-24.8355m	245.7mm	33.6589m	137.4mm	9.7555m	162.7mm
5002-200	-41.8402m	268.2mm	4.1922m	144.4mm	34.3016m	189.6mm
5002-5003	-24.2247m	297.6mm	30.4301m	166.9mm	9.0458m	211.9mm
5003-200	-17.6155m	226.9mm	-26.2380m	140.6mm	25.2558m	165.7mm

5. Baseline Residuals (Residuals and Standardized Res.)

Observation	Northing Res.	Stand. Res.	Easting Res.	Stand. Res.	Height Res.	Stand. Res.	Rel.No.
100-200	-107.0mm	-1.525	43.7mm	0.542	213.7mm	1.750	1.17
100-5000	400.6mm	2.057	-32.5mm	-0.195	-909.2mm	-2.965	1.87
100-5001	169.0mm	0.912	22.2mm	0.157	67.9mm	0.266	1.64
100-5002	-89.4mm	-0.552	-95.9mm	-0.904	283.6mm	1.143	1.31
100-5003	62.0mm	0.513	5.5mm	0.062	-167.3mm	-0.951	1.14
5000-200	374.5mm	2.126	-178.2mm	-1.323	-272.2mm	-1.240	1.59
5001-200	243.8mm	0.891	103.5mm	0.589	-568.3mm	-1.438	2.01
5001-5000	12.4mm	0.083	-135.1mm	-1.096	411.7mm	1.826	1.32
5002-200	-51.9mm	-0.215	-98.3mm	-0.569	196.9mm	0.514	1.89
5002-5003	-121.2mm	-0.367	-51.6mm	-0.202	382.9mm	0.784	2.19
5003-200	79.8mm	0.401	-47.1mm	-0.282	-166.6mm	-0.520	1.86

6. Adjusted Points in WGS84 (Cart. Coordinates and Std.Dev.)

Point	X	σ	Y	σ	Z	σ
100	4017039.0688m	0.0mm	1632108.7517m	0.0mm	4662161.9079m	0.0mm
200	4018169.7863m	146.5mm	1629381.3167m	93.1mm	4662236.1487m	110.3mm
5000	4018167.3478m	222.3mm	1629383.0462m	136.0mm	4662237.2686m	153.1mm
5001	4018192.1833m	237.3mm	1629349.3873m	135.4mm	4662227.5131m	157.7mm
5002	4018211.6266m	258.3mm	1629377.1245m	133.1mm	4662201.8470m	181.4mm
5003	4018187.4019m	212.6mm	1629407.5547m	126.8mm	4662210.8929m	155.7mm

7. Adjusted Points in WGS84 (Geogr. Coordinates and Std.Dev.)

Point	Latitude	σ	Longitude	σ	Height	Elevation	σ
100	N 47° 16' 05.46194"	0.0mm	E 22° 06' 42.23936"	0.0mm	155.8714m	114.9290m	0.0mm
200	N 47° 16' 06.57191"	98.9mm	E 22° 04' 21.78901"	87.5mm	225.2753m	184.3273m	157.7mm
5000	N 47° 16' 06.63481"	155.3mm	E 22° 04' 21.90885"	126.1mm	225.0055m	184.0576m	226.5mm
5001	N 47° 16' 06.17389"	165.4mm	E 22° 04' 19.98106"	126.2mm	224.8744m	183.9259m	237.1mm
5002	N 47° 16' 04.93350"	174.4mm	E 22° 04' 20.85626"	123.9mm	225.3210m	184.3717m	267.6mm
5003	N 47° 16' 05.39422"	148.0mm	E 22° 04' 22.63079"	115.4mm	224.4917m	183.5429m	224.3mm

8. Adjusted Points in National System (Plane Coord. and Residuals)

Point	Northing	Easting	Elevation	Northing Res.	Easting Res.	Height Res.
100	644977.2200m	281606.9880m	114.9290m	-0.0mm	-0.0mm	-0.0mm
200	645120.4185m	278657.3680m	184.3273m	N/A	N/A	N/A
5000	645122.2664m	278659.9578m	184.0576m	N/A	N/A	N/A
5001	645109.5448m	278618.9263m	183.9259m	N/A	N/A	N/A
5002	645070.5746m	278635.8913m	184.3717m	N/A	N/A	N/A
5003	645083.4098m	278673.7027m	183.5429m	N/A	N/A	N/A

9. Adjusted Points in National System (Plane Coord. and Std.Dev.)

Point	Northing	σ	Easting	σ	Height	Elevation	σ
100	644977.2200m	0.0mm	281606.9880m	0.0mm	127.6631m	114.9290m	0.0mm
200	645120.4185m	98.9mm	278657.3680m	87.5mm	197.0317m	184.3273m	157.7mm
5000	645122.2664m	155.3mm	278659.9578m	126.1mm	196.7620m	184.0576m	226.5mm
5001	645109.5448m	165.4mm	278618.9263m	126.2mm	196.6301m	183.9259m	237.1mm
5002	645070.5746m	174.4mm	278635.8913m	123.9mm	197.0761m	184.3717m	267.6mm
5003	645083.4098m	148.0mm	278673.7027m	115.4mm	196.2476m	183.5429m	224.3mm

Inventory positioned with GPS coordinates and processed in accordance with the technical rules in force in national reference system (stereograph-1970 plan and those odds BLACK SEA-1975) are as follows spread sheet.

10. Adjusted Points Error Ellipses

Point	Semimajor Axis	Semiminor Axis	Angle	95% confidence radius
100	0.0mm	0.0mm	90.0°	0.0mm
200	99.8mm	86.5mm	15.0°	228.7mm
5000	155.4mm	126.0mm	-3.9°	347.7mm
5001	165.5mm	126.1mm	2.0°	363.1mm
5002	174.4mm	123.8mm	-1.1°	375.7mm
5003	148.4mm	114.8mm	-7.2°	327.2mm

Table 1

Inventory coordinates minutiae related court of forest cottage

Punctul	X(m)	Y(m)	Z(m)
100	644977.2200	281606.9880	114.9290
200	645120.4185	278657.3680	184.3273
5000	645122.2664	278659.9578	184.0576
5001	645109.5448	278618.9263	183.9259
5002	645070.5746	278635.8913	184.3717
5003	645083.4098	278673.7027	183.5429

Table 2

Inventory related minutiae coordinate sample surfaces

Punctul	X(m)	Y(m)	Z(m)
200	645120.6168	278657.4908	184.3512
2000	645067.9502	278749.8365	183.6462
2001	645071.7685	278740.8098	183.4580
2002	645090.4117	278749.5207	183.2425
2003	645086.4009	278758.5764	183.3682
3000	645087.0660	278739.7169	183.4857
3001	645093.0924	278731.7619	183.4051
3002	645110.0666	278742.9483	182.9728
3003	645103.8650	278751.0137	183.1073
4000	645100.9123	278754.3630	183.1904
4001	645109.5296	278760.2358	183.0058
4002	645097.0857	278775.9594	183.1794
4003	645088.8610	278770.1337	183.2745

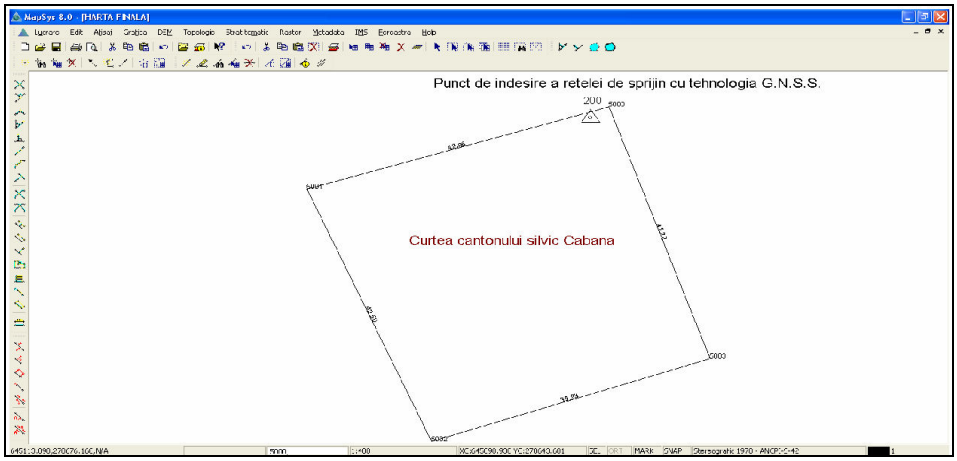

Photo.6 - Minutiae related court-reporting of forest cottage with MapSys8.0 program.

From the analysis of the image in photo.6 we can see the position in which the sample surfaces were located within the experimental device in which the regeneration of the oak stands is studied.

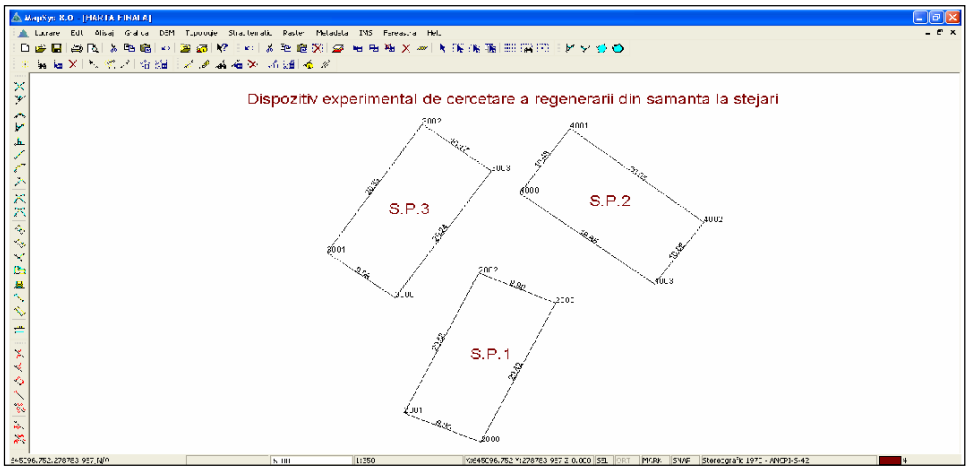

Photo.7- Reporting of determined sample points for test surfaces in the experimental device with MapSys 8.0

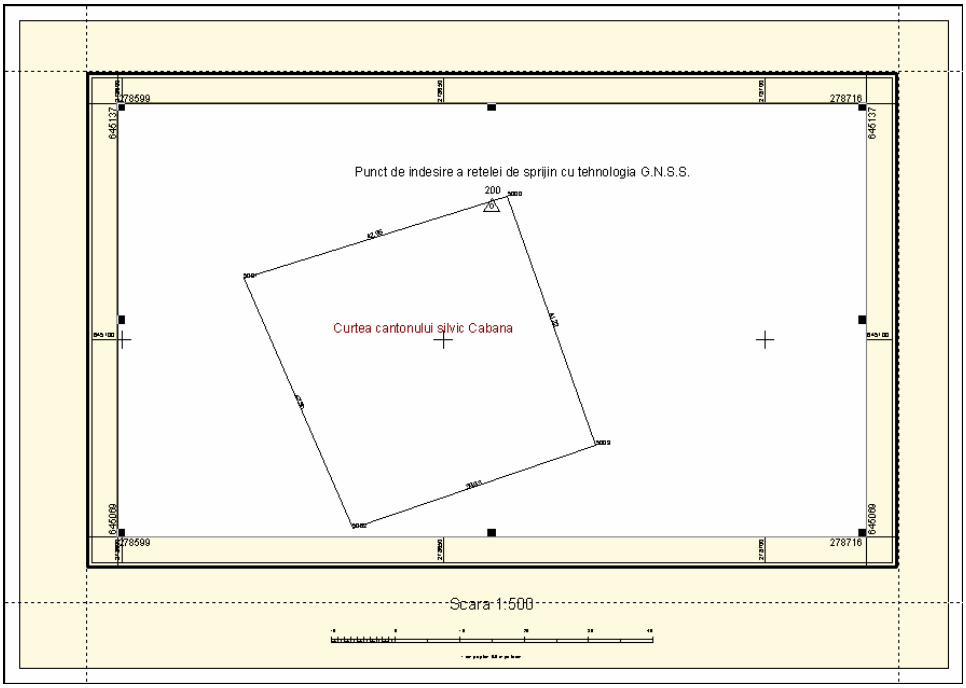

Photo.8- Topographic plan for the canton court

The topographic plan will be made according to the experimental device.

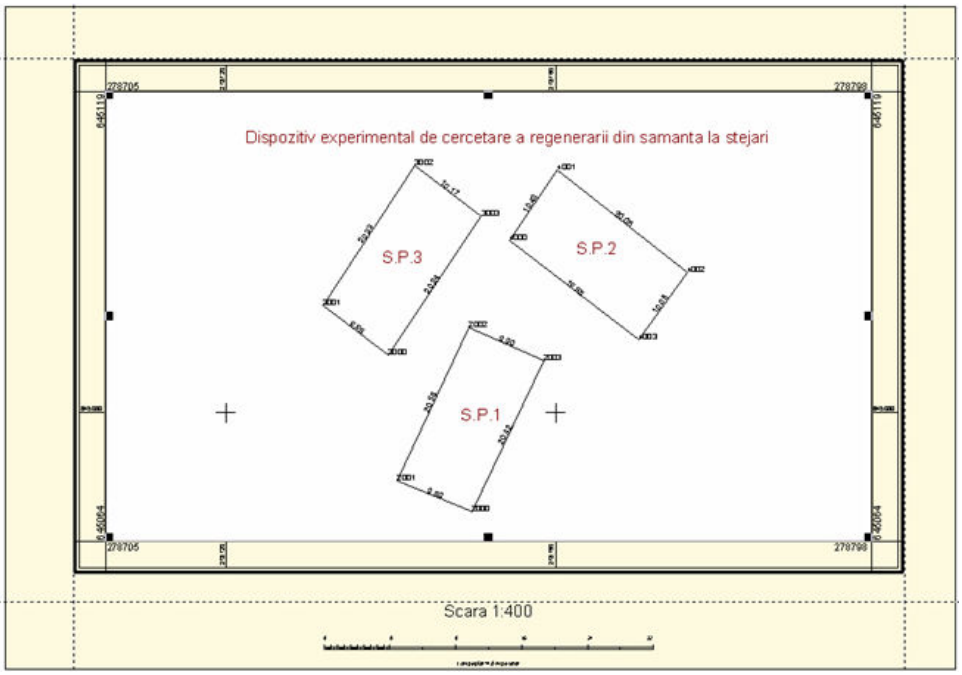

Photo.9 - The topographic plan corresponding to the associated sample surface the experimental device for studying the regeneration of oak stands

CONCLUSIONS

Positioning the GPS points of detail, in particular working conditions, is achieved with great precision and high accuracy, whether the use of appropriate methods.

The GPS system can be used for spatial positioning in the massive forest and growing season, high efficiency, if recorded data processing is done with established programs this flow sheet.

Using the local transformation parameters (area), obtained from common points determined rigorously, allows the production of precise coordinates.

In order to verify accuracy and position accuracy of detail points, one or more points that have been determined with the G.P.S. system can be repositioned by post-processing with high precision.

Support points that are located in and/or at the boundary of the forest massifs need to be discreetly marked and signaled (currently with FENO type terminals), not to attract attention, which leads to stability and perennially.

Points thickening network support will be placed as far as possible like glades, pockets, mesh regeneration, to position with high precision.

If there are inside or/and at the limit of the forest massifs, layouts made of concrete or carved stone, and they are properly fixed in the soil, they will try to position them precisely so that the geo-referential map can be subsequently mapped area, the common points thus determined.

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