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# THE STUDY ON THE USE OF THE TOPOGRAPHIC METHOD COMBINED GPS-TOTAL STATION IN THE WORKS OF FORESTRY CADASTRE

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***Abstract***

*The paper aims to present a modern method of topo-cadastral lifting of land surfaces in the forest area, which involves the use of the combined technology of the type of global GPS positioning systems and total stations, to ensure accuracy, efficiency and very high efficiency of the works. Following the study, it was found that the method used is fully applicable and useful to forestry surveys, as relevant and significant results were obtained regarding the accuracy, correctness and speed of execution of the field and office operations (data processing and preparation plan). The obtained documentation fits perfectly with the requirements of the norms and regulations imposed by the legislation in force, in the field of forest cadastre. The precision obtained by the combined method in terms of distances and surfaces is of the order of millimetres, and in terms of angles it is below 5cc. Finally, it was found that the documentation obtained is very good for the proposed purpose, ie the first registration in the Land Book because, subsequently, a verification of the obtained results was carried out, by consulting the cadastral documentation registered with OCPI Dolj with no. 77401/2007 and it was found that there is no overlap, and the surfaces obtained were those registered in the deed of ownership.*

***Key words****: cadastral survey, forest area, GPS systems, precision, total stations.*

## INTRODUCTION

The purpose of the procedure is to implement the provisions of art. 121 of the Law no. 46/2008 - The Forest Code, with the subsequent modifications and completions (Bădescu et al., 2009).

(1) The public property right of the state or of the administrative-territorial units on the forest fund is tabulated in the integrated cadastre and land book system at the request of the forest fund administrators, public property of the state, respectively of the owner, in the case of public property of the administrative territorial units, based on the property documents and the cadastral documentation drawn up according to the legal provisions (Law no. 46/2008).

(2) By exception from the provisions of par. (1), in the absence of the ownership documents, the provisional registration is made, based on the valid forestry arrangement, not updated. In this situation, the coordinates of the points on the limit of the respective property will be determined, in Stereographic System 1970, by vectorization, at the level of administrative-territorial unit. Any disputes regarding possible overlaps are settled amicably or through the court according to the regulations provided by the Law on cadastre and real estate advertising no. 7/1996, republished, with subsequent amendments and completions (Burghilă et al., 2016).

(3) Justification of the provisional registration for the situations provided in par. (2) is made on the basis of the valid updated forest management of the forest fund public property of the state or of the administrative-territorial units, which confirms the surface and the identity between the building from the cadastral documentation and the one highlighted in the updated forest management. The procedure is applied within the subordinate institutions A.N.C.P.I.

## MATERIALS AND METHODS

The cadastral documentation for the first registration in the integrated system of cadastre and land book for the buildings that are the object of art. 121, para. (2) of Law no. 46/2008 - The Forest Code contains the pieces provided in

art. 83, para. ('1) of the Regulations, except those provided in letter. e), h), i), p), as well as the copy of the plan with the certified forestry arrangement, "in accordance with the original" and the document by which the administrator/owner of the forestry fund, as the case may be, confirms the location, surface and identity between the building from the cadastral documentation and the one highlighted in the forest management plan (Law no. 46/2008). The coordinates of the points on the boundary of the building are determined in the national reference system, by vectorization, at UAT level. The location and delimitation plan will bear the mention "Real estate registered in the cadastral plan with graphically determined coordinates, according to art. 121, para. (2) of Law no. 46/2008 - "The Forest Code". This mention is also made in the digital documentation, under the "comments" section, in the section "Textual data of the land" (Bădescu et al., 2018).

The administrator / owner of the forestry fund, as the case may be, signs the declaration regarding the consequences of the mention "Building registered in the cadastral plan with graphically determined coordinates, according to article 121, paragraph (2) of Law no. 46/2008 - Forest Code", respectively the possibility to change the geometry, the dimensions of the sides and the surface resulting from vectorization. The mention is deleted based on the report drawn up by the inspector and approved by the chief engineer, when updating the related cadastral documentation, by carrying out field measurements (Law no. 46/2008). Verification of the geometry of the building - forest fund, according to art. 46, para. (1), lit. g) from the Regulation, is made including on the basis of the digital graphic support for Law no. 165/2013 regarding the measures for completing the process of restitution, in kind or by equivalent, of the buildings taken abusively during the communist regime in Romania (Călina and Călina, 2019), with the subsequent modifications and completions, respectively annex no. 9, to the Norms of application of Law no. 165/2013.

At this work for the first registration in the Land Book it was necessary to verify the geometry of the building by measurements made on the ground. For this purpose, for lifting the forested area, a support network was established using GPS measurements, using the static method, so that the collected data is as accurate as possible (Bergerman et al., 2016; Braun et al., 2018). The surface studied being large, for determining its geometry, several closed traverse were used, supported on the starting point, following and precisely determining all the contour points that make up the boundary of the surface. The works of topographic measurements by the traverse method were performed with total stations SOKKIA SET 610 and SOKKIA SET 630 R, of very good accuracy (Sălăgean et al., 2011; Rodriguez-Moreno et al., 2017).

The planimetric details were collected by specific methods such as polar coordinates methode, obtaining all the data necessary to draw up a complete topographic plan, which corresponds technically, to all the precision requirements and the norms imposed for such work (Călinovici and Călina, 2008; Gonzalez-de-Santos et al., 2017). In order to record as accurately as possible and the possibility of easily recovering the border points, the topographic specialists made a detailed description of the geodesic points, a very important aspect especially in the case of forested lands (Geipel et al., 2016; Radu et al., 2017).

## RESULTS AND DISCUSSIONS

At the request of the owner it was decided to survey the immovable property, which is a forested area located on the territory of Ghercești - Dolj commune, with a view to its first inscription in the Land Book. The topo-geodesic works were carried out in such a way that the provisions of the Cadastre Law and the real estate advertising no. 7/1996, republished, with the subsequent modifications and completions, Law 46/2008 - the Forest Code, with the subsequent modifications and completions and the Government Decision no. 1288/2012 for the approval of the Regulation for the organization and functioning of the National Agency for Cadastre and Real Estate Advertising.

In order to be able to perform the topo-geodesic survey in the best conditions, with high accuracy and maximum efficiency, the surveyors used to raise the support network and the detail points a new topographic method such as the Global

Positioning Systems (GPS) combined with total stations. The topographic apparatus used for the support and thickening network is modern and high performance GPS-type from Leica (Sui, 2014; Sala et al., 2020).

GPS measurements were performed using the static method using records from the permanent stations CRAI (CRAIOVA), SLAT (SLATINA), as well as the recording at the triangulation point of the first order Cârcea, obtaining the following GPS points: 1, 2, 3, 4, 5, 6 (Figure 1).

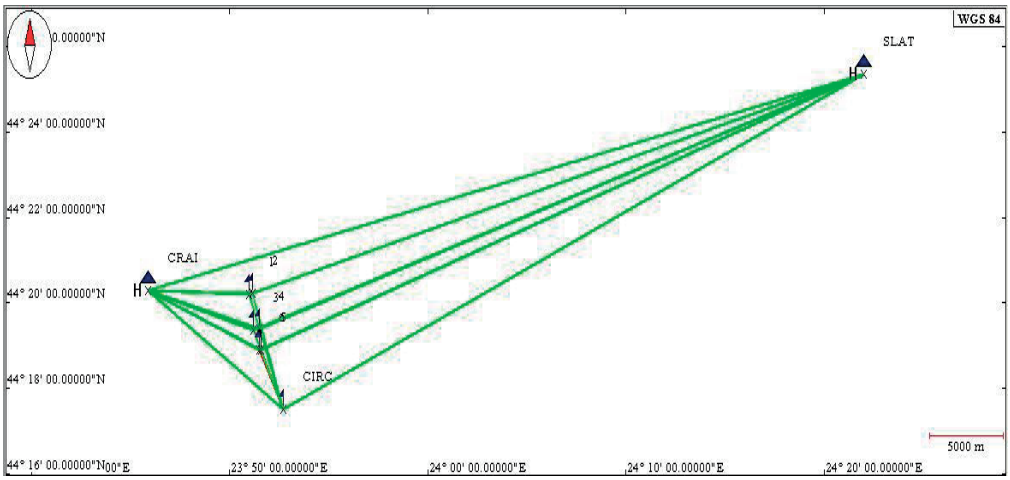


Figure 1. GPS support network

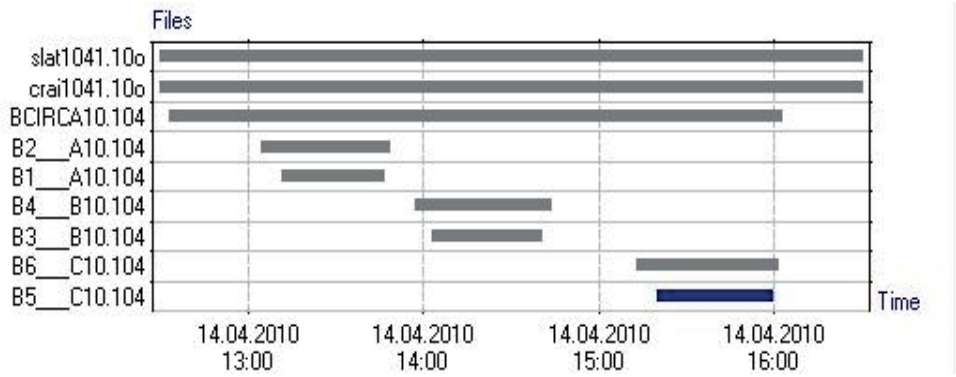


Figure 2. Stationary times in the GPS support network

Using these old points determinations of new support points were made near the detail points from where detailed measurements had to be made, for the elaboration of the plan of location and delimitation on a large scale. Measurements for the determination of new support points were carried out using GNSS (Global Navigation Satellite Systems) methods for determining the autonomous geo-spatial position (Mihai et al., 2015). The equipment used comprised 4 Leica SR530 satellite receivers, on 24 channels with two working frequencies, the measurement method - static. The processing of the GNSS bases was done with specialized software (Leica Geo Office), in the ETRS 89 coordinate system, starting from the permanent station of Craiova and Băilești. Taking into account their lengths, the short bases (less than 20 km) were processed separately from the long bases, the bases with unresolved ambiguities in the processing were not taken into account when compensating (Călina et al., 2018).

First we obtained - geocentric cartesian coordinates - ellipsoid WGS 84/GRS 80 - XW, YW, ZW, for points 1, 2, 3, 4, 5, 6, and ellipsoidal coordinates - ellipsoid WGS 84/GRS 80 - (BW, LW, HW) (Table 1), then using the 7 parameters of a 3D Helmert transformation (dX, dY, dZ, m, rx, ry, rz), the coordinates of points 1, 2, 3, 4, 5, 6, were transformed into Stereographic system 1970 and Black Sea 1975 quota system (Table 2).

Table 1. Calculation of GPS support network

| Name | Long | Lat | Ellips height | Status | Constraints | Surv_ Horz_ Conf | Surv_ Height_ Conf | Type |
|---|---|---|---|---|---|---|---|---|
| 1 | 23° 50' 59"E | 44° 20' 13"N | 246.272 | Adjusted | No constraints | 0.003 | 0.01 | Logged Point |
| 3 | 23° 51' 11"E | 44° 19' 22"N | 206.101 | Adjusted | No constraints | 0.003 | 0.01 | Logged Point |
| 6 | 23° 51' 30"E | 44° 18' 55"N | 205.694 | Adjusted | No constraints | 0.003 | 0.01 | Logged Point |
| 2 | 23° 51' 09"E | 44° 20' 14"N | 246.663 | Adjusted | No constraints | 0.004 | 0.01 | Logged Point |
| 4 | 23° 51' 29"E | 44° 19' 23"N | 227.157 | Adjusted | No constraints | 0.003 | 0.01 | Logged Point |
| 5 | 23° 51' 35"E | 44° 18' 54"N | 207.321 | Adjusted | No constraints | 0.003 | 0.01 | Logged Point |
| CIRC | 23° 52' 42"E | 44° 17' 30"N | 246.56 | Adjusted | No constraints | 0.004 | 0.01 | Logged Point |
| CRAI | 23° 45' 52"E | 44° 20' 17"N | 150.16 | Adjusted | Horiz. Fixed (2D) | 0 | 0.01 | Control Point |
| SLAT | 24° 22' 01"E | 44° 25' 21"N | 235.972 | Adjusted | Horiz. Fixed (2D) | 0 | 0 | Control Point |

Table 2. Stereo 70 coordinates of the support points

| PUNCT | X | Y |
|---|---|---|
| 1 | 315883.617 | 408409.431 |
| 2 | 315927.458 | 408609.398 |
| 3 | 314324.347 | 408627.900 |
| 4 | 314335.323 | 409037.578 |
| 5 | 313450.775 | 409147.079 |
| 6 | 313465.358 | 409055.788 |
| CIRC | 310844.716 | 410600.274 |

Next, to determine all the bending and contour points, the total stations of the same precision were used SOKKIA SET 610 and SOKKIA SET 630 R, on the directions the accuracy was 1.9 mgon and on the distances the accuracy was 3 + 2 ppm, with data processing on the computer. (Călina et al., 2018).

By analyzing and interpreting very correctly and realistically the situation on the ground, it was concluded that four contour traverses supported on known GPS coordinate points must be made, these points being oriented and verified on the points of the state triangulation network (Figure 3).

**Traverse pd** - supported on Landmark 1 (GPS determined point) oriented on T110 and T109 with closure on Landmark 4 (GPS determined point), with orientation on Landmark 3 (GPS determined point). By this route were determined the stations: 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, and from the station 106 was given a station thrown on point 121 (Figure 3).

**Traverse pd1** - supported on Landmark 2 (GPS determined point) oriented on T5, T109, T110, Teisi Hill Pyramid and Teișani Pyramid with closing on Landmark 4 (GPS determined point), with orientation on Landmark 3, T33, T114 and T116. Through this process were determined the points: 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220 (Figure 3).

**Traverse pd2** - supported on Landmark 4 (GPS determined point) oriented on Landmark 3 (GPS determined point), T33, T114, T116 with closure on Landmark 5 (GPS determined point) with orientation on Landmark 6 (GPS determined point) and T114. Through this process were determined the points: 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211 (Figure 3).

**Traverse PD3** - supported on the Landmark 3 (point determined GPS) oriented on Landmark 4 (determined GPS point), T33, T109, T110, closing on the terminal Landmark 6 (point determined GPS) oriented on the Landmark 5 (determined GPS point). By this route were determined the stations: 101, 102, 103, and from Landmark 6 was given a thrown station 121, from Landmark 5 (GPS determined point), was given to the thrown station 122 (Figure 3).

For a precise and rigorous verification of the measurements made, a series of old geodesic

points of known coordinates, from the state geodetic network, taken over by OJCPI Dolj were used: T109 - COS FUM ENERG; T110 - COS FUM TERMOFICARE; T14 - DEALUL TEIS; T5 - FABRICA DE AVIOANE; T33- BLOC A1 ROVINE; T114 - CA FRIGORIFER; T116 - SFERA METEO, TEIȘANI (Figure 3). At these points the stability and the degree of confidence had to be checked, finding that their condition was good.

Based on the measurements made on the field (distances and orientations), the relative and absolute rectangular coordinates of the points were calculated and entered in Table 3. In order to be used in other later topographic surveys, it was necessary to compensate and verify them. Only then can they be safely used in new topographic elevations. According to the sketch in Figure 3, it is found that for the determination of all contour and detail points, the method of polar coordinates was applied to the field. From the support points, rays were taken to all the detail points and based on the measured data on the field, the absolute coordinates of the points were obtained, which were passed in Table 4.

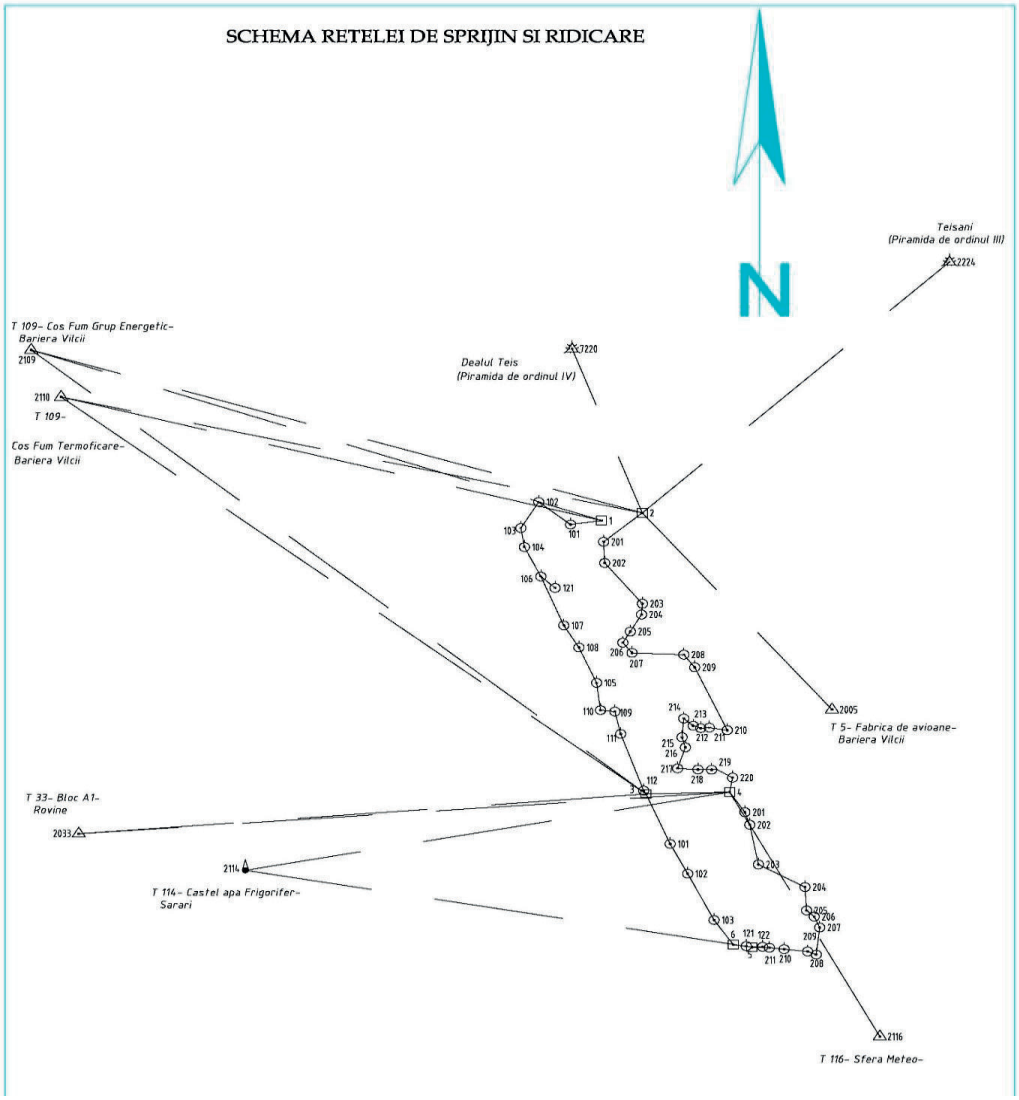


Figure 3. Outline of the support network and lifting of the studied surface

Table 3. Calculation of the supported traverses based on known coordinate points

| Station point | Target point | Visa | Reduced distance | DX | DY | X | Y |
|---|---|---|---|---|---|---|---|
| 2 | 1 | 286.260 | | | | 315927.458 | 408609.398 |
| 2 | 201 | 254.478 | 251.377 | -164.813 | -189.808 | 315762.632 | 408419.572 |
| | | 0.002 | | -0.013 | -0.018 | | |
| | | 254.480 | | -164.826 | -189.826 | | |
| 201 | 202 | 197.091 | 121.009 | -120.883 | 5.520 | 315641.743 | 408425.083 |
| | | 0.004 | | -0.006 | -0.009 | | |
| | | 197.095 | | -120.889 | 5.511 | | |
| 202 | 203 | 157.171 | 296.793 | -232.140 | 184.924 | 315409.588 | 408609.986 |
| | | 0.006 | | -0.015 | -0.021 | | |
| | | 157.177 | | -232.155 | 184.903 | | |
| 203 | 204 | 204.443 | 61.935 | -61.784 | -4.327 | 315347.800 | 408605.655 |
| | | 0.008 | | -0.003 | -0.004 | | |
| | | 204.451 | | -61.787 | -4.331 | | |
| 204 | 205 | 232.773 | 111.650 | -97.171 | -54.987 | 315250.624 | 408550.660 |
| | | 0.010 | | -0.006 | -0.008 | | |
| | | 232.783 | | -97.177 | -54.995 | | |
| 205 | 206 | 233.356 | 73.354 | -63.506 | -36.712 | 315187.114 | 408513.942 |
| | | 0.012 | | -0.004 | -0.005 | | |
| | | 233.368 | | -63.510 | -36.717 | | |
| 206 | 207 | 157.989 | 73.522 | -58.097 | 45.059 | 315129.013 | 408558.996 |
| | | 0.015 | | -0.004 | -0.005 | | |
| | | 158.004 | | -58.101 | 45.054 | | |
| 207 | 208 | 102.532 | 254.124 | -10.169 | 253.920 | 315118.831 | 408812.898 |
| | | 0.017 | | -0.013 | -0.018 | | |
| | | 102.548 | | -10.182 | 253.902 | | |
| 208 | 209 | 159.283 | 89.836 | -72.095 | 53.598 | 315046.731 | 408866.489 |
| | | 0.019 | | -0.005 | -0.006 | | |
| | | 159.302 | | -72.100 | 53.592 | | |
| 209 | 210 | 173.298 | 392.399 | -358.437 | 159.686 | 314688.274 | 409026.147 |
| | | 0.021 | | -0.020 | -0.028 | | |
| | | 173.319 | | -358.457 | 159.658 | | |
| 210 | 211 | 310.446 | 89.288 | 14.617 | -88.083 | 314702.887 | 408938.058 |
| | | 0.023 | | -0.005 | -0.006 | | |
| | | 310.469 | | 14.612 | -88.089 | | |
| 211 | 212 | 295.304 | 42.083 | -3.085 | -41.970 | 314699.799 | 408896.085 |
| | | 0.025 | | -0.002 | -0.003 | | |
| | | 295.328 | | -3.087 | -41.973 | | |
| 212 | 213 | 322.290 | 39.463 | 13.552 | -37.063 | 314713.349 | 408859.019 |
| | | 0.027 | | -0.002 | -0.003 | | |
| | | 322.317 | | 13.550 | -37.066 | | |
| 213 | 214 | 346.419 | 62.108 | 41.400 | -46.298 | 314754.746 | 408812.717 |
| | | 0.029 | | -0.003 | -0.004 | | |
| | | 346.448 | | 41.397 | -46.302 | | |
| 214 | 215 | 205.023 | 107.029 | -106.692 | -8.487 | 314648.049 | 408804.222 |
| | | 0.031 | | -0.006 | -0.008 | | |
| | | 205.054 | | -106.698 | -8.495 | | |
| 215 | 216 | 182.471 | 60.380 | -58.114 | 16.386 | 314589.932 | 408820.604 |
| | | 0.033 | | -0.003 | -0.004 | | |
| | | 182.504 | | -58.117 | 16.382 | | |
| 216 | 217 | 219.599 | 125.666 | -119.737 | -38.146 | 314470.188 | 408782.449 |
| | | 0.035 | | -0.006 | -0.009 | | |
| | | 219.634 | | -119.743 | -38.155 | | |
| 217 | 218 | 104.023 | 100.207 | -6.386 | 100.003 | 314463.797 | 408882.444 |
| | | 0.037 | | -0.005 | -0.007 | | |
| | | 104.060 | | -6.391 | 99.996 | | |
| 218 | 219 | 101.357 | 66.886 | -1.467 | 66.870 | 314462.327 | 408949.310 |
| | | 0.039 | | -0.003 | -0.005 | | |
| | | 101.397 | | -1.470 | 66.865 | | |
| 219 | 220 | 126.088 | 112.189 | -44.765 | 102.871 | 314417.556 | 409052.172 |
| | | 0.041 | | -0.006 | -0.008 | | |
| | | 126.129 | | -44.771 | 102.863 | | |
| 220 | 4 | 211.136 | 83.512 | -82.228 | -14.590 | 314335.323 | 409037.576 |
| | | 0.044 | | -0.004 | -0.006 | | |
| | | 211.179 | | -82.232 | -14.596 | | |
| 4 | 3 | 298.249 | | | | | |
| | | 0.046 | | | | | |
| | | 298.295 | | | | | |

| | | | |
|---|---|---|---|
| **Stations no.** | **22.000** | **dif x:** | **-0.135** |
| **Azimuthal error:** | **0.0456** | **dif y:** | **-0.188** |
| **Orientation tolerance:** | **0.0469** | **Coord er:** | **0.231** |
| **kx:** | **-0.00005100** | **Coord tol:** | **0.676** |
| **ky:** | **-0.00007200** | | |

Table 4. Calculation of the detail points

| Point no. | Coordinates | | Point no. | Coordinates | |
|---|---|---|---|---|---|
| | X (m) | Y (m) | | X (m) | Y (m) |
| 782 | 314914.857 | 408849.229 | 816 | 314680.671 | 409017.117 |
| 783 | 314892.761 | 408844.100 | 817 | 314669.785 | 409046.329 |
| 784 | 314824.685 | 408839.362 | 1121 | 314911.260 | 408848.394 |
| 785 | 314799.595 | 408836.905 | 1123 | 314903.181 | 408852.717 |
| 786 | 314766.083 | 408834.185 | 1124 | 314881.215 | 408870.431 |
| 787 | 314710.639 | 408826.726 | 1126 | 314854.565 | 408894.006 |
| 788 | 314670.716 | 408824.161 | 1128 | 314828.186 | 408917.813 |
| 789 | 314740.992 | 408830.675 | 1131 | 314789.426 | 408951.748 |
| 807 | 314760.771 | 408977.957 | 1135 | 314754.100 | 409001.342 |
| 808 | 314739.058 | 408998.361 | 1136 | 314756.928 | 409007.892 |
| 809 | 314699.386 | 409014.297 | 1137 | 314760.018 | 409020.590 |
| 810 | 314682.152 | 408888.311 | 1139 | 314756.342 | 409021.856 |
| 811 | 314678.147 | 408931.981 | 1141 | 314741.738 | 408997.980 |
| 812 | 314674.203 | 409002.150 | 1143 | 314704.650 | 409013.626 |
| 813 | 314678.679 | 409004.974 | 1221 | 314670.871 | 408839.595 |
| 814 | 314681.817 | 409009.284 | 1222 | 314688.451 | 408840.848 |
| 815 | 314680.114 | 409014.968 | 1223 | 314684.367 | 409007.119 |

After accurately determining all the contour points, based on their absolute coordinates, the total area of the building was calculated, this being 24925 sqm (Table 5).

Table 5. Surface calculation

| Point no. | Coordinates | | Distance (m) | Point no. | Coordinates | | Distance (m) |
|---|---|---|---|---|---|---|---|
| | X (m) | Y (m) | | | X (m) | Y (m) | |
| 1121 | 314911.260 | 408848.394 | | 812 | 314674.203 | 409002.150 | 5.29 |
| 1123 | 314903.181 | 408852.717 | 9.16 | 811 | 314678.147 | 408931.981 | 70.28 |
| 1124 | 314881.215 | 408870.431 | 28.22 | 810 | 314682.152 | 408888.311 | 43.85 |
| 1126 | 314854.565 | 408894.006 | 35.58 | 1222 | 314688.451 | 408840.848 | 47.88 |
| 1128 | 314828.186 | 408917.813 | 35.53 | 1221 | 314670.871 | 408839.595 | 17.62 |
| 1131 | 314789.426 | 408951.748 | 51.52 | 788 | 314670.716 | 408824.161 | 15.43 |
| 807 | 314760.771 | 408977.957 | 38.83 | 787 | 314710.639 | 408826.726 | 40.01 |
| 1141 | 314741.738 | 408997.980 | 27.63 | 789 | 314740.992 | 408830.675 | 30.61 |
| 808 | 314739.058 | 408998.361 | 2.71 | 786 | 314766.083 | 408834.185 | 25.34 |
| 1143 | 314704.650 | 409013.626 | 37.64 | 785 | 314799.595 | 408836.905 | 33.62 |
| 809 | 314699.386 | 409014.297 | 5.31 | 784 | 314824.685 | 408839.362 | 25.21 |
| 1223 | 314684.367 | 409007.119 | 16.65 | 783 | 314892.761 | 408844.100 | 68.24 |
| 813 | 314678.679 | 409004.974 | 6.08 | 1121 | 314911.260 | 408848.394 | 18.99 |
| Surface 24925 sqm | | | | | | | |

For the first registration in the Land Book the team of specialists had to draw up the large scale location and delimitation plan 1:2000 (Figure 4). Due to the fact that a new, combined technology was used, such as global positioning systems (GPS) and total stations, as well as state-of-the-art topographic equipment and specialized processing programs, it was possible to draw up a very easy plan with a high precision, which made it possible to strictly comply with all the norms and regulations imposed by the laws and government decisions in force, in the field of forest cadastre.

Also due to this method of measurement and the experience in the field of the working team it was found that the area taken into study was correctly and precisely determined because subsequently a verification of the obtained results was carried out, by consulting the cadastral documentation registered with OJCPI Dolj with no. 77401/2007 and it was found that there was no overlap.

PLAN DE AMPLASAMENT SI DELIMITARE A IMOBILULUI
SCARA:1:2000
(extravilan)

| Nr. cadastral | Suprafata masurata [mp] | Adresa imobilului |
|---|---|---|
| | 24925 | Extravilan Comuna Ghercesti, tarla 41, parcela 478, jud. Dolj Ocolul Silvic Amaradia, Amenajamentul U.P. IV Viisoara, u.a. 58B |
| Carte Funciara nr. | | UAT GHERCESTI |

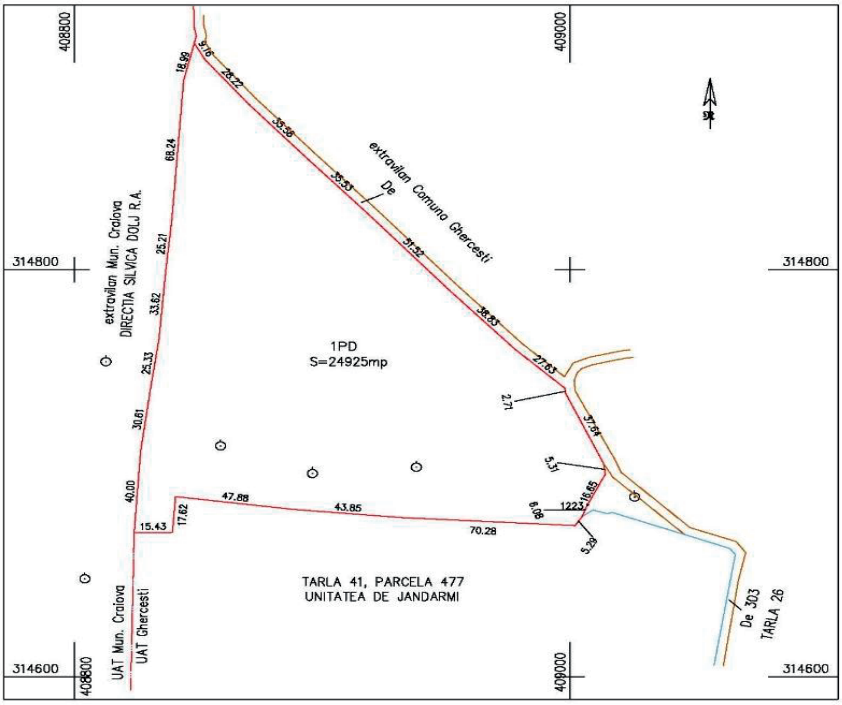


Figure 4. The plan of location and delimitation on scale 1:2000 of the studied surface

## CONCLUSIONS

First of all, it was found that the combined topo-cadastral method used by the team of surveyors was very well adapted to the situation existing on the ground, to the type of work that had to be performed, namely the first registration in the land book of a forestry property, as and the precision required for such a work.

Using GPS technology, a network of new support points could be built very quickly and precisely, which formed the backbone of subsequent lifting, with the help of total stations. With the support network built precisely and with maximum efficiency, it was possible to carry out its thickening, four traverses supported on the GPS points, previously determined.

All the support points were located near the details that were to be picked up by other methods, which allowed their visibility and accessibility to be raised, an aspect that essentially contributed to the increase of the precision and efficiency for topographic work performed with the total stations.

The processing of the measured data was carried out automatically with the help of the Toposys program, which allowed the export of all the results obtained in Autocad, a program with which the plan of location and delimitation of the studied real estate was drawn up and correct (also noted by Călina and Călina, 2019).

The remarkable results obtained by applying this combined method, namely high precision, correctness, accuracy and high efficiency, makes this method one that is required as a representative and relevant method for the execution of the cadastral measurements in the forest cadastre.

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