STUDY REGARDING THE PREPARATION OF TECHNICAL DOCUMENTATION NECESSARY TO MODERNIZE THE ROAD THAT CROSSES THE BUCOVAT-LEAMNA, DOLJ AGROTURISTIC AREA

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ABSTRACT

The work aims to carry out topo-cadastral surveys for the design of rehabilitation and modernization works of the county road that crosses the Bucovăț-Leamna agrotourism area, near the city of Craiova, which is in full development and evolution. For the field application of all lifting works, a state-of-the-art modern equipment such as GPS technology and total stations was used, and the combined method GPS-Total Stations was used as the surveying method. Their use has led to relevant results in terms of the efficiency, accuracy and effectiveness of such a surveying project. Also, for the data processing, the method of transferring the data measured in the field, from the topographic devices directly to the computer, with the help of special programs was used, after which they were processed automatically obtaining the absolute coordinates of the points with the precision required by the beneficiary, in compliance with all legal requirements, applied to such works. The points were represented with the AutoCad program, obtaining the location and delimitation plan for each large-scale road body, which allows the designer to perform the design work in great detail, with great fidelity and precision. At the same time, it ensures a very high precision of tracing and execution of all the rehabilitation and modernization works of the studied road, of great local and county interest.

INTRODUCTION

The Bucovăț-Leamna agrotouristic area is located 6 km from the city of Craiova. It consists of six villages: Bucovăț, Sărbătoarea, Leamna de Sus, Leamna de Jos, Palilula and Cârligei, with a total area of 8264 hectares. It consists of 664 hectares of urban areas and 7600 hectares of urban areas. The geographical natural setting in which the locality is located is surrounded by forested hills (Adamov, T., et al., 2020). The first attestation of the commune dates from 1897. It is positioned to the North by Predești commune and Breasta commune, to the East by Craiova municipality (Jiu River), to the South by Podari commune and Vârvoru de Jos commune, to the West by Terpezița commune, fig. 2, (Burghilă, C., et al., 2016).

The specific activities of the area are agriculture, animal husbandry (which has recently flourished in terms of raising buffalo, about 80 heads), trade (small industry in the processing of cattle skins) (Dobra C., and Csosz C., 2018). The area also boasts tourist attractions, where you will find: Bucovăț Fossil Point, "Terasa Băniei" Tourist Motel, and within the village of Cîrligei there was the old Getodacian fortress "Pelendava" (Calina, A. and Calina, J., 2019). In the commune of Bucovăț covers an area of 4 hectares, an important fossiliferous point, with a rich fossil fauna of mollusk shells, dating from the late Pleistocene, Romanian floor, discovered in 1949. Due to research and studies published on fossiliferous fauna of existing mollusks here, the area is protected by law (Calina, J. and Calina, A., 2019).

From the studies carried out in the area, it was found that it was absolutely necessary to rehabilitate and modernize the road that crosses this beautiful agrotourism area of Dolj County. In order to carry out the work, the products that must be made for this purpose are: the topographic plan of the land surface that includes the road surface and the safety areas of the road, and that includes all the arrangements related to it; topographic plans of sites managed by CNADNR, County Councils or Local Councils; the minutes of delimitation of the lands and properties adjacent to the road; cadastral documentation for land.

Figure 1. Map of the agrotouristic area Bucovăț - Leamna (processing according to google map also used by Joshi, S., et al., 2020)

MATERIAL AND METHOD

The purpose of the work is to prepare the technical documentation necessary for the modernization and rehabilitation of the county road sector 552 E, which passes through the interior of the Bucovăț - Leamna agrotouristic area.

The planimetric surveys of the surfaces consisted in carrying out the operations necessary to obtain the topographic plans in the horizontal projection, at a chosen scale. For the realization of the support and thickening network, the method of supported traverse on geodetic points and determined GPS coordinates was used. In the case of planimetric surveys of a land area by this method, a file is drawn up with the basic documentation of the area to be surveyed, which includes higher or lower geodetic points inside the territory and its vicinity, copies of previously executed plans. Once this has been done, we move on to the general recognition of the territory, performing in this sense the following: identification of higher and lower geodetic points on which the planimetric traverse will be supported; establishing the points that the topographic plan must contain (border points, road ends, points that delimit the lands); determining the routes of the traverses and choosing the station points for the routes that will be executed in order to pick up the details; performing topo-geodetic measurements and drawing up location and delimitation plans.

The most well-known methods were used to pick up the details, such as: the polar coordinate method, the radiation method and the rectangular coordinate method, the abscissa and ordinate method or the square point method. The collection of details refers to the determination of the positions of the characteristic points of all the topographic elements that interest us, in the studied area. The characteristic points are points of change of direction, which in number and position are conditioned by the required accuracy and the scale of representation.

RESULTS AND DISCUSSIONS

In order to draw up the technical documentation necessary for the modernization and rehabilitation of the Sărbătoarea-Bucovăț county road, a topographic survey was carried out in the Stereographic Projection System 1970 and the Black Sea Altitude System 1975. In order to effectively achieve the necessary technical documentation, the geodetic network of compaction and lifting was first drawn up, so as to ensure the number of points necessary for topo-cadastral measurements. The equipment used comprises 4 Leica SR530 satellite receivers on 24 channels with two working frequencies (L1 = 1575.42MHz and L 2 = 1227.60MHz), preset recording interval of 5s, elevation angle 15o, measurement method: static. The processing of GNSS databases was done with specialized software (Leica Geo Office), in ETRS89 coordinate system, starting from the permanent Craiova station.

The GPS measurements performed in the field used as fixed station the points "B1" and "TPM", and the transmission of coordinates in the work area was also done by the GNSS method (Global Navigation Satellite Systems) to determine the autonomous geo-spatial position. So:

1. On body 1 (Km 0 + 023 - Km 0 + 098) were determined 3 points with the GPS (1, 3, B2) from which were taken the planimetric details with the total station Leica TCR410.
2. On body 2 (Km 0 + 118 - Km 0 + 453) 6 points were determined with the GPS (1, 3, B2, 20, 21, 22) between which a supported traverse was made, and from the traverse stations the planimetric details with the total station Leica TCR410 were raised.
3. On body 3 (Km 0 + 453 - Km 0 + 625) 6 points were determined with the GPS (1, 3, B2, 20, 21, 22) between which a supported traverse was made, and from the traverse stations the planimetric details with the total station Leica TCR 410 were taken.
4. On body 4 (Km 0 + 625 - Km 0 + 740) 6 points were determined with the GPS (1, 3, B2, 20, 21, 22) between which a supported traverse was made, and from the traverse stations the planimetric details with the total station Leica TCR 410 were taken.
5. On body 5 (Km 0 + 740 - Km 1 + 850) 6 points were determined with the GPS (1, 3, B2, 20, 21, 22) between which a supported traverse was made, and from the traverse stations the planimetric details with the total station Leica TCR 410 were taken.
6. On body 6 (Km 1 + 850 - Km 2 + 220) were determined 6 points with the GPS (1, 3, B2, 20, 21, 22) between which a supported traverse was made, and from the traverse stations the planimetric details with the total station Leica TCR 410 were taken.
7. On body 7 (Km 2 + 238 - Km 3 + 207) 7 points were determined with the GPS (22,23, 24, 25, 26, 29, 30), between GPS points 26 and 29 it was made a supported traverse, and from the traverse stations and GPS points were taken the planimetric details with the total station Leica TCR 410.
8. On body 8 (Km 3 + 207 - Km 4 + 271) 4 points were determined with the GPS (29, 30, B3, B4), between the GPS points a supported traverse was made, and from the traverse stations and GPS points were raised planimetric details with the total station Leica TCR 410.
9. On body 9 (Km 4 + 271 - Km 4 + 500) 4 points were determined with the GPS (29, 30, B3, B4), between the GPS points a supported traverse was made, and from the traverse stations and GPS points were raised planimetric details total station Leica TCR 410.

10. On body 10 (Km 4 + 500 - Km 4 + 621) 4 points were determined with the GPS (29, 30, B3, B4), between the GPS points a supported traverse was made, and from the traverse stations and GPS points were raised planimetric details with the total station Leica TCR 410.

11. On body 11 (Km 4 + 621 - Km 6 + 974) were determined 11 points with GPS (B3, B4, 38, 40, 41,45, 46, 47, 53, 54, 55), between the GPS points were made supported traverse, and from the traverse stations and GPS points the planimetric details were taken with the total station Leica TCR 410.

12. On body 12 (Km 6 + 974 - Km 11 + 870) 11 points were determined with GPS (45, 46, 47, 53, 54, 55.58, 59, 60), between GPS points supported traverse were made, and the planimetric details with the total Leica TCR 410 station were taken from the traverse stations and GPS points.

At the topographic surveys for roads, the precision of determination, the density of the surveyed details, the represented elements, will be corresponding to the execution plans drawn up on a large scale, of 1: 500. The planimetric details were also provided with apparatus and methods to ensure an accuracy of at least ± 5 cm. Finally, the technical documentation must include in the topo-cadastral plans drawn up the following basic elements:

- *road axis* - is the line that defines the geometric characteristics in horizontal and vertical plane of the road route. The actual length of the road is measured on the axis.

- *roadway* - is the area of the road platform intended for the movement of vehicles.

- *road platform* - in addition to the roadway, the other elements that make up the road platform are also surveyed, such as: sidewalks, sidewalks, parking spaces, green spaces between lanes or between the roadway and sidewalk lanes reserved for the movement of other vehicles (bicycles, trams, tractors and wagons, etc).

- *property limits*.

- *kilometer and hectometric terminals*.

- *works of art and specific arrangements* - the shape and position in plan of all constructions belonging to the road (bridges, footbridges, viaducts, tunnels, retaining walls, gutters, etc.) are determined by measurements.

- *related facilities* - these types of works include intersections with other roads, railways, special lanes, parking spaces, sidewalks, green spaces, gas stations, road fences, etc.

- *construction*.

- *mileage* - for each milestone the nominal value of the mileage (length written on the milestone) and the actual value of the mileage (actual length measured on the axis of the road from its origin) shall be recorded.

Field operations for the construction of the support network were performed with the GPS device Leica GS 08 Plus GNSS - points: 1, 3, B2, 20, 21, 22, 23, 24, 25, 26, 29, 30, B3, B4, 38, 40, 41, 45, 46, 47, 53, 54, 55, 58, 59, 60 (method also used by Pop, N., et al., 2019). Following these determinations resulted the X, Y, Z coordinates of the points (tab.1,2 and 3) To determine the details the total station LEICA TCR 410 was used, which was located in the known station points: the first point was B2, aiming point 1 for guidance. The device was placed on station point B2, from the main menu was selected "FILE MANAGEMENT" - (F1) JOB, then a new "JOB" was created with the name "Bucovăț". The name of the operator, the height of the device and also some remarks given by special codes were entered.

After finishing the operations, press OK and return to the previous menu. Select from the main menu "FILE MANAGEMENT" - F2 FIXPOINTS-F3 NEW and create point B2, followed by enter. The values of the EAST (X), NORTH (Y), HEIGHT (Z) coordinates previously determined with the GPS device are assigned. Then press F2, which allows orientation on the known coordinate point and enter the number of the orientation point (1), as well as its coordinates determined by GPS. The height of the reflector was entered, followed by confirmation, after which it was pressed (ALL), measured in the first position of the telescope, the telescope was turned over in the second position and measured again and then recorded. We return to the previous menu where we choose the new known coordinate point (3) that will be targeted and perform the same operations as for point (1). For all stations performed, the procedures are analogous to those at station B2.

The paper presents only the stages completed for road bodies 3 and 9, because due to the volume of data the work would have been too large. For body 3 of the road, a supported route was made between the points determined with the GPS device: 1,3, B2,20,21,22. Point 6 was thus determined. Visas were taken from the station points and the coordinates of the detail points from Table 2 were determined.

For body 9 of the road, a supported traverse was made between the points determined with the GPS device: 29, 30, B3, B4. Point 36 was thus determined. Visas were taken from the station points and the points from table 3 were radiated (method also presented by Calinovici, I. and Călina, J., 2008, Maciel, A.Z., et al., 2020). The data recorded in the LEICA TCR 410 total station was transferred to the computer using the Leica Geo OFFICE program. Thus, for importing the observations in TopoSys format, the steps are followed (method also used by Sala, F., et al., 2020):

1) Connect the station using your own software (Leica Survey Office) by loading the TopoSys mask (toposys.frt) in the total station at Profile 2. This operation is done only once.

2) When downloading, select the TopoSys format in the Leica software. Thus, the resulting ASCII file will have the format supported by TopoSys (Călina, J., et al., 2020).

3) The downloaded file is edited in a text editor (eg Notead), and if necessary, the missing or extra characters are corrected, namely: - if the file starts with the line '9999 0 0 0 0 C, in this line is deleted - missing character '---' is replaced with null values (0.00 or any text)

4) Save the file and import it in the TopoSys job with the function IMPORT-ASCII - Measurements.

After the data has been transferred to the computer, they are processed with the TopoSys specialized program, obtaining the absolute coordinates of the support and detail points in the Stereo 1970 system (tables 1, 2 and 3).

Table 1

Inventory of supported traverse coordinates.

No.	X(m)	Y(m)	Z(m)	No.	X(m)	Y(m)	Z(m)
1	311492.519	399714.155	79.462	40	312134.539	395505.802	99.775
3	311630.098	399670.350	77.547	41	312176.314	395276.633	97.106
B2	311573.819	399719.059	79.136	45	312175.521	394710.727	101.226
20	313058.796	398662.046	79.807	46	312179.700	394534.050	100.096
21	313105.338	398573.999	80.122	47	312273.533	394366.661	101.510
22	313158.366	398446.634	79.016	53	312267.095	393473.800	133.772
23	313176.144	398390.874	77.673	54	312238.547	393362.733	141.255
24	313166.558	398281.136	77.868	55	312201.793	393219.174	152.455
25	313170.443	398192.941	78.445	58	312032.713	392932.620	168.856
26	313165.488	398078.944	81.862	59	311997.250	392823.648	169.498
29	313049.726	397787.110	91.463	60	311955.062	392647.415	170.557
30	312977.162	397668.913	95.601	64	311886.937	391810.047	177.544
B3	312306.401	396377.188	93.858	65	311888.020	391638.444	178.290
B4	312225.267	396112.059	98.383	B5	311862.129	392336.466	176.314
38	312173.518	395850.080	97.864				

Table 2

Inventory of coordinates for the road body 3

No.	X(m)	Y(m)	Length	No.	X(m)	Y(m)	Length
1083	311858.554	399539.737	18.67	1308	311947.723	399394.651	2.78
1270	311869.378	399524.530	42.63	1272	311950.377	399395.467	50.52
1272	311893.685	399489.509	19.27	1314	311938.687	399444.621	20.32
1280	311905.444	399474.240	17.70	1315	311928.440	399462.164	36.24
1281	311916.645	399460.541	14.93	1316	311905.261	399490.020	32.00
1290	311924.818	399448.050	14.28	1317	311887.513	399516.649	34.80
1298	311930.306	399434.862	38.38	1082	311868.161	399545.570	1.58
1304	311937.664	399397.194	5.36	1074	311866.814	399544.752	1.83
1271	311938.782	399391.950	1.83	1073	311865.247	399543.800	2.96
1305	311940.548	399392.443	3.15	1072	311862.716	399542.263	2.70
1306	311943.563	399393.371	2.95	1071	311860.406	399540.861	2.17
1307	311946.379	399394.237	1.41				
Total measured area = 1828 sqm							

Table 3

Inventory of coordinates for the road body 9

No.	X(m)	Y(m)	Length	No.	X(m)	Y(m)	Length
2831	312371.107	396628.363	33.02	2882	312322.707	396404.928	2.61
2565	312363.959	396596.125	11.44	2881	312325.268	396404.400	5.67
2573	312361.738	396584.900	0.70	2880	312330.817	396403.255	50.33
2571	312362.415	396584.728	3.99	2816	312348.126	396450.519	44.97
2572	312361.570	396580.824	0.70	2807	312357.683	396494.459	98.29
2882	312360.893	396580.996	30.10	2564	312377.605	396590.710	5.92
2577	312354.692	396551.537	55.36	2563	312378.847	396596.495	28.45
2809	312342.632	396497.503	16.30	2830	312385.552	396624.140	5.99
2810	312338.716	396481.679	77.60	2583	312379.799	396625.822	2.91
2827	312316.56	1396407.30	1.11	2582	312377.006	396626.639	2.75
2879	312316.139	396406.283	4.04	2581	312374.369	396627.409	3.40
2883	312320.096	396405.467	2.67				
Total measured area = 3513 sqm							

Based on the absolute coordinates of the points, the location and delimitation plans were drawn up for all the bodies that make up the road route, which crosses the Bucovăț - Leamna agrotourism area (figure 2). On the topographic plan were represented the topographic points with the elements through which are determined bridges that connect the communal road to the neighboring properties, concrete pillars of the overhead electrical network, metal poles, gutters, road ramps, road axis, wells, limits of the property's axis adjacent the communal road (figure 3).

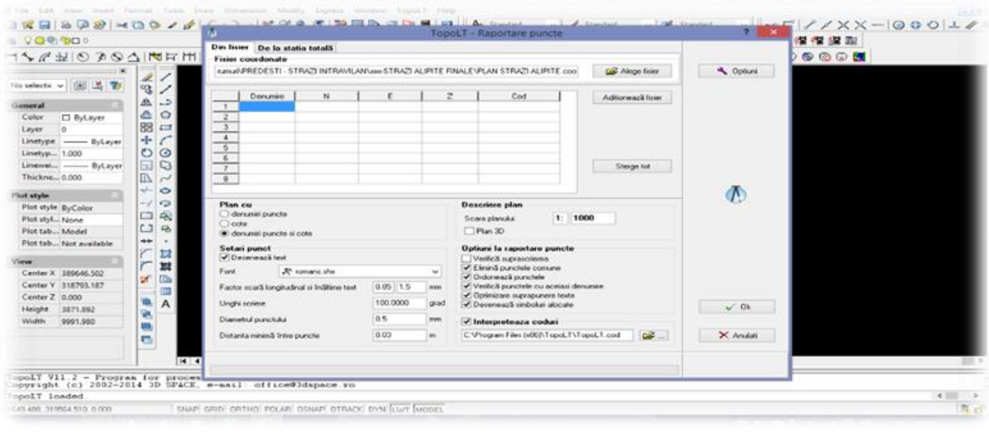

Figure 2. How to enter data in AutoCad

All the plans were divided into 10x10 cm squares, unique and mandatory in topography. To the resulting grid is attached the rectangular coordinate system, with the X-axis on the abscissa and the Y-axis on the ordinate and to the right (figs. 4 and 5). The axis of the road was picketed with iron bolts. The raising of the detail points was done starting for each transverse profile, perpendicular to the road axis, at a distance of 15-30 meters between the profiles.

The location and delimitation plan is designed using the topoLT program that allows us to report points in AutoCad, process them at a convenient scale, generate points and calculate surfaces (Braun, J., Kremen, T. and Pruska, J., 2018).

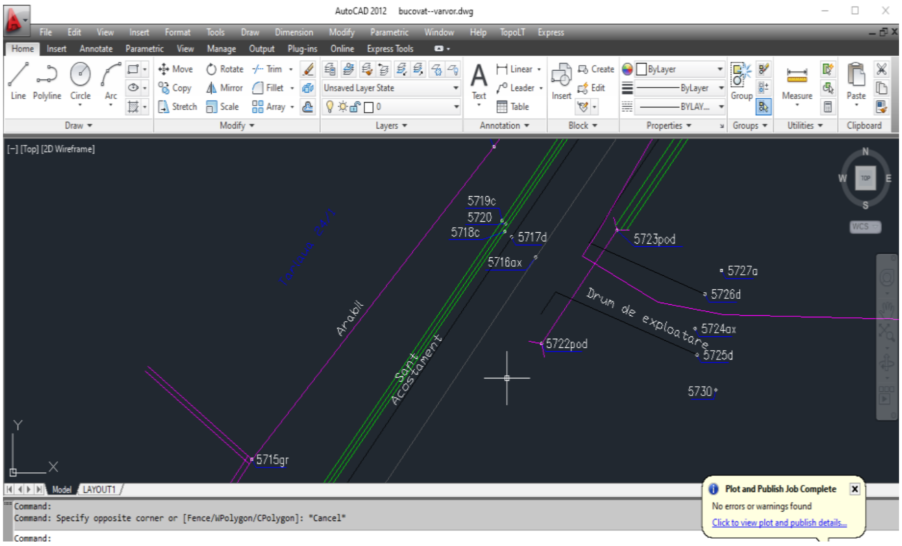

Figure. 3. Representation of support and detail points in AutoCad

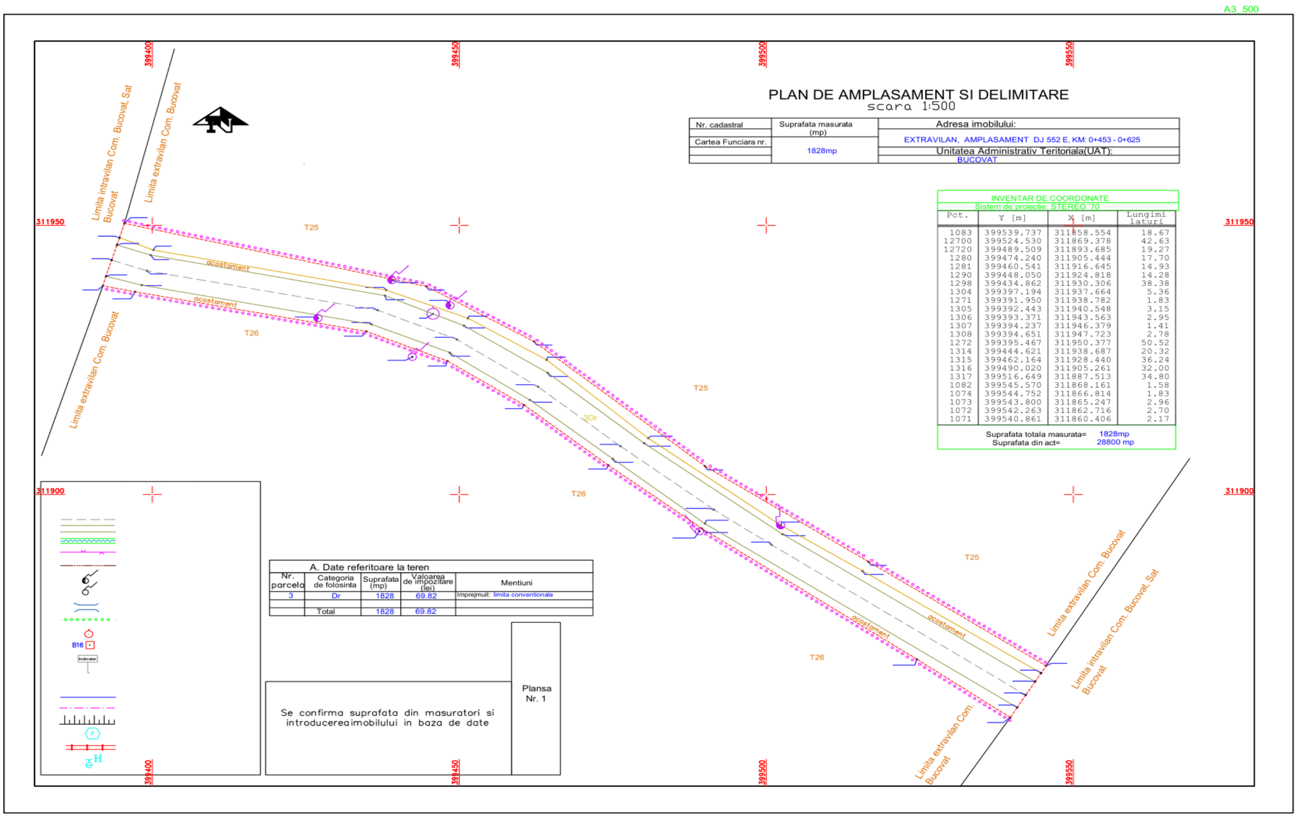

Figure. 4. Location and delimitation plan for road body 3

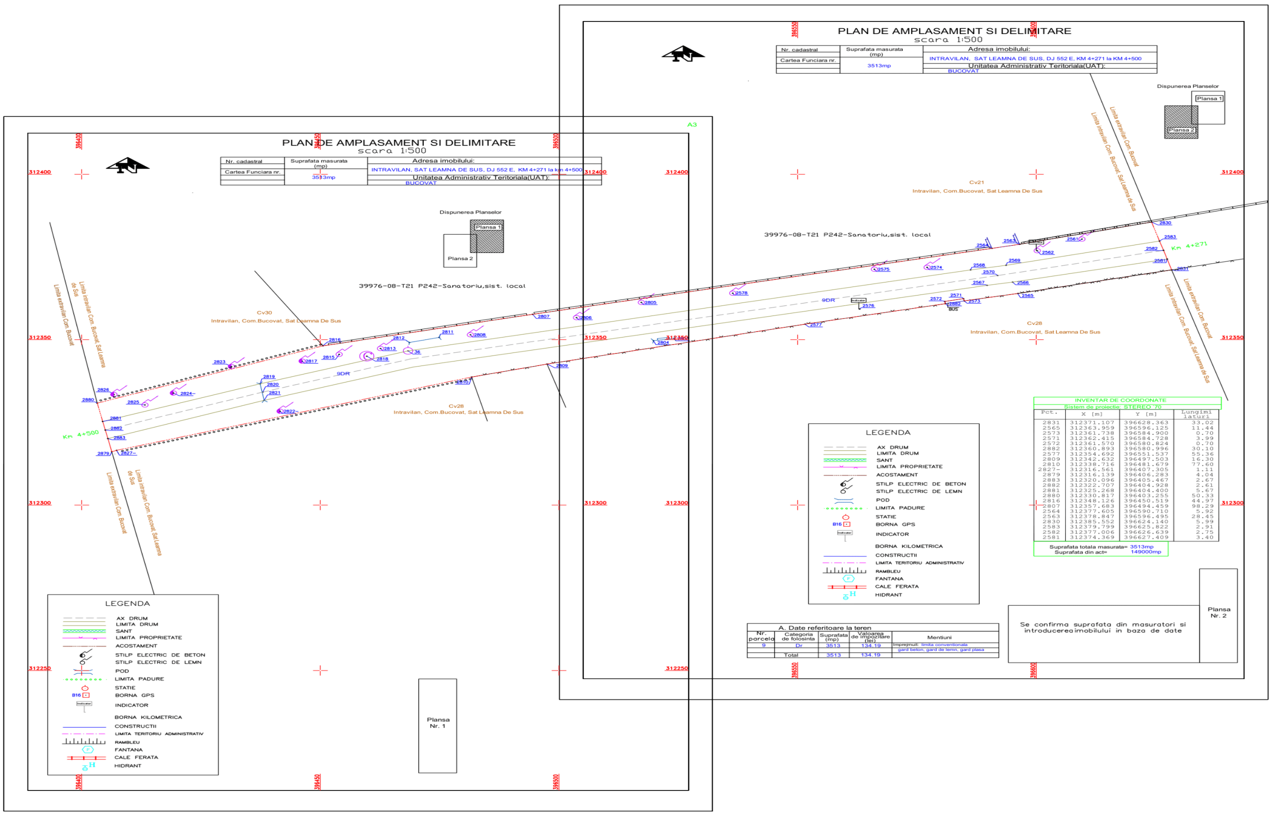

Figure. 5. Location and delimitation plan for road body 9

The surface calculation was performed using the TopoLT 10 program, which works over the AutoCAD platform (Mihai D., et al., 2014). The TopoLT 10 program is an indispensable tool in the field of topography and cadastre, fulfilling all the necessary requirements for field-office work. It is a specialized program that provides tools for 2D or 3D applications with which you can create topographic or cadastral plans, make 3D models of terrain and contours, also calculate areas and volumes or insert georeferenced images (appearance also reported by Sui D., 2014).

The areas were calculated automatically from the coordinates of the points, with the application presented above and were centralized in table 3.

Table 3.

Centralizing table with measured areas

No.	Denumire teritoriu	Total surface	Section surface	Section surface	Km	Finally km
1	BUCOVAT	**177800**	1400		0+023	0+098
2			5200		0+118	0+453
3				2000	0+453	0+625
4			1700		0+625	0+740
5				11800	0+740	1+850
6			5700		1+850	2+220
7			15600		2+238	3+207
8				12900	3+207	4+271
9			3700		4+271	4+500
10				2100	4+500	4+621
11			36500		4+621	6+974
12			79200		6+974	11+870
			149000 sqm	**28800 sqm**		

CONCLUSIONS

The Bucovăț - Leamna agrotourism area is an area in full development that until now has not benefited from an easy accessibility due to the extremely precarious condition of the road that crosses this territory. For this, it was concluded that it is absolutely necessary to rehabilitate and modernize this road of great local interest. In this sense, the team of specialists had to draw up a project of topographic survey necessary for the technical documentation for the rehabilitation and modernization of the county road Sărbătoarea-Bucovăț, Dolj county, the beneficiary of the work being the mayor of Bucovăț commune (method also presented by Călina, J., et al ., 2018).

The technical documentation had to be made in the best conditions, in compliance with all legal norms of precision and rigor imposed on such works. The topo-geodetic surveys were carried out using a modern and current method, such as GPS technology combined with the total station. The method allowed the precise and expeditious determination of the points of the support network and those on the main axis with the help of GPS technology, after which from those points were determined the points of all details, which had to be located on topographic planes, using total stations, by radiation method.

Data processing was performed automatically by transferring data from the work equipment using specialized transfer programs in high-performance computers with high processing power, which with the help of Toposys, TopoLT and AutoCad, were processed very quickly and accurately obtaining the absolute coordinates of the babies in the Stereo 1970 system and the 1975 Black Sea reference system. Based on the absolute coordinates of the points thus determined, the location and delimitation plan for the entire 1: 500 large-scale road route was drawn up expeditiously and very precisely, which allowed the designer to make a precise and detailed design of all road construction elements (figures 4 and 5).

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