DECIPHERING THE ENIGMA OF THE DRAINAGE SLOPE AND OF THE ROAD DJ582D VĂLIUG-LACUL GOZNA, CARAS-SEVERIN COUNTY, ROMANIA

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Abstract: *This paper presents topographic surveys for the road section starting from the crossroad of county roads DJ582 from Resita to Gărâna with DJ582D leading (after turning right from DJ582) to Lake Gozna, Caraş-Severin County, a lake covering 60 ha and measuring 3 km in length. Why this topographic survey? Simply because there are numerous videos, comments and TV programmes on the road section between DJ582 (leading to Slatina Timiș) and the road section DJ582D 4 km from the Village of Văliug and leading to Lake Gozna, along about 700 m,* ***water "flows up the hill"*** *as witnessed by people and videos. Topographic survey necessary to carry out this study was done with a total station Leica TC805 and with an equipment of the GPS Leica 1200 type. The elevation measured with the GPS Leica 1200 equipment at the crossroads of the two roads DJ582 and DJ582D is 605.63 m and that of Lake Gozna is 601.61 m; this points to a level difference of 4.02 m for the county road DJ582D with a slope of 0.6% and a level difference of 9,51‰ for the collecting basin furbished by covering the slopes and the bottom of the canal on the left side of the county road DJ582D when going to Lake Gozna (Văliug) and stretching between 605.63 m at the crossroads of the DJ582 with DJ582D and 599.38 m at the entrance of the collecting canal into Lake Gozna. The claim that* ***on this road section of about 700 m water "flows up the hill" is false****. Parallel with the DJ582D on the left along the entire road is a canal that* ***"goes upwards"*** *according to some, but the difference between the two elevations (start and finish) is 6.25 m, the lowest elevation being determined at the entrance of the canal water into the Lake Gozna and the highest elevation being determined at the crossroads of the two county roads. To carry out the topographic survey, we chose for the total station a road supported at both ends by known coordinates and orientations. The station points were determined with GPS Leica 1200 equipment through the RTK (Real Time Kinematic) method. Besides measurements with a total station, where possible, we used for the measurements a double frequency GPS Leica 1200 equipment to determine both the four station points GPS1, GPS2, GPS300 and GPS400, and to survey the land using the reference stations in Reșița and Făget. Downloading the apparatus was done with a Leica Geo Office Combined programme and turning raw coordinates from WGS 1984 into stereographic coordinates 1970 was done with a TransDatRO programme. In the case of the total station, land measurements were made in a local reference system using as starting coordinates for the station point GPS1 X(m)=20.000, Y(m)=10.000 and for the elevation Z(m)=100. Compensating raw data was done with a TopoSys programme, reporting compensated values and making situation plans was done with TopoLT, and AutoCAD programmes. Road and canal profiles were done with a LISP and a ProfLT programme.*

Key words**:** *Leica TC805, GPS, RTK, ETRS89, WGS 1984, Stereografic 1970, TopoLT, ProfLT, TransDatRO, Toposys, Leica Geo Office Combined*

INTRODUCTION

The tourist place Văliug-Crivaia can be reached by turning to the right after the roundabout downtown Văliug; after one km, we reach the crossroads with the road to Prislop-Semenic where we turn right again; after 500 m, we reach the Lake Gozna dam. Along the section from the crossroads to the lake, ***the road is doubled by a thin watercourse that flows up the hill, defying the laws of gravitation***. The inclination of the slopes of the road on the Drăguţei Hill opposed to the riverbed creates the illusion of a "river that flows up the hill" to the tourists' amazement (https://www.facebook.com/labunavaliug/posts/414498948759425).

The Gozna-Crivaia water storage covers 60 ha and measures 3 km in length. The dam was built between 1948 and 1952 and it is 48 m high (113 m at the basis and 184 m at the top). The lake was filled with water in 1953, storing 10,000,000 cubic m.

Building the dam between the Drăguţei Hill (right) and Stupina Hill (left) is one of the works on the youth working sites of the period – less promoted than those of the railways Bumbeşti-Livezeni and Salva-Vişeu. People from all over the country gathered on the occasion at the foot of the Semenic Mountain and everything was "a huge turmoil that troubled the world and the forests' silence" (Birou V., 1982).

It was the first building of the kind in Romania, designed and built exclusively by Romanian specialists; the lake also had an energetic role since it fed water to the hydroelectric of Crăinicel and Grebla.

The lake stretches upstream Bârzava, dividing along adjacent valleys. Along the lake, the road on the right side curves successively up to the end of the lake where "the alert Bârzava loses its way in the water of the lake. It looks like it turned into stone upon man's order to rest in the mountain's scoop" (https://www.facebook.com/banatulmontan/posts/1149017405125965:0).

The youth camp "Vila Klaus" is located at an altitude of 730 m, in the middle of the nature, surrounded by fir trees, in the Bârzava Valley, at the foot of the Semenic Mountain. The name of the villa comes from the German *klause* 'dam', reminding that there was built the first water reservoir on the Bârzava River, in 1865. The construction was made of stone and fir beams and it measured 76x11.5 m. When the lake was full, the water stretched over 500 m and it stored about 150,000 cubic m.

The Lake Klaus was used to carry timber 1 m long from the forests of the Semenic Mountain to the plants in Reşiţa, where they needed lots of charcoal. When there was enough water in the lake, they opened the dam over 8.5 m and created an artificial wave carrying the logs previously prepared.

After the creation of the canal system Semenic-Grebla, in 1904, they gave up carrying timber with the man-made wave that had been used during the period 1865-1905. When it was useless, the dam was dismantled and nothing reminds of it nowadays except the villa bearing its name.

MATERIAL AND METHODS

Topographic survey in the field was done with both a total station of the Leica TC805 type and an equipment of the GPS Leica 1200 type.

To do the topographic survey, we chose the total station and where we had visibility, we used GPS equipment. To do the topographic survey with the total station, we use the planimetric survey method and the method of road supported by known coordinates and orientations.

In this case, we used for GPS measurements the Stop&Go (or Real Time Kinematic) method using the reference station at Făget (FAGE_2.3) and the reference station at Reşiţa (RESI_2.3).

The measurement engine used by Leica GPS1200 is of the SmartTrack type: it connects to satellites in a few seconds and it is ideal for obstructed areas where other receivers cannot get a position. The antenna used was a double frequency one, of the GX1230 type with SmartTrack: it is designed to capture GLONASS, GPS L15 signals as well as the signals of the future European GPS network GALILEO. Leica GPS1200 uses a keyboard of the QWERTY type, touch screen or un-touch screen depending on preference; it allows direct vision of the topographic survey from the office and it has the functions ZOOM and PAN.

Downloading was done with a ***Leica Geo Office Combined*** programme.

The reference system of the GPS is **WGS 84** (World Geodetic System 1984) defined, like the ITRF system, by land point coordinates.

Processing raw data and turning coordinates from the ***WGS 1984*** system into the ***Stereographic 1970*** system was done with a ***TransDatRO 4.01*** programme, a programme that contains a distortion model of spatial data aiming at maintaining the integrity and the topology of spatial data in each datum. In conclusion, high distortion points are not removed from the transformation but are tested and included in the transformation to describe as realistically as possible the features of each area where there are new points to transform.

After processing the data and after turning the coordinates from ***ETRS89*** into ***STEREO70*** with the application ***TransDatRO 4.01***, we processed raw data from total station measurements. To do so, we compensated the roading with a ***TopoSys*** programme, a special geodesic programme using modern calculus concepts and procedures to solve the geodesic reference of observations with a total station. It is meant for the processing of geodesic networks, for the compensation of observations through static methods, for topographic survey calculus as well as for transforming coordinates. Compensating low observations is done through the method of the least squares, with correction equations created through indirect methods. To filter higher errors, we use the robust (Danish) method and the TAU test to determine the confidence threshold.

Topographic measurements with the total station were made in a local reference system in which we considered X = 20,000 m, Y = 10,000 m and an elevation of Z = 100 m. With the ***TopoSys*** programme, we compensated the values from the field and we transferred the measurements from the local reference system into the stereographic system 1970. After compensating raw data, we exported compensated values that were later reported in ***AutoCAD*** with a ***TopoLT*** programme.

The ***TopoLT*** programme functions under AutoCAD or IntelliCAD. It can help those that design topographic or cadastral plans in digital format. The functions of this programme are direct reporting in AutoCAD of the points in the coordinate file, the direct introduction of points in the drawing, the reception of measurements on the serial support of the instrument, the development of 3D models of the land, the development of level curves at a certain equidistance, 3D visualisations, and automatic drawing of the grid.

RESULTS AND DISCUSSIONS

This paper presents topographic measurements of the road section from the crossroads of county roads DJ582 from Resita to Garâna and DJ582D from DJ582 to the right, to the Lake Gozna, Caraş-Severin County, a lake that covers 60 ha and measures 3 km in length (Figure 1).

The route section between DJ582 and DJ582D where **water "flows up the hill"** (Figure 2): we can see the canal on the left side of the county road DJ582D leading to Lake Gozna.

Topographic survey was done along a section of about 0.7 km that starts from the crossroads of the county road DJ582 (Văliug-Gărâna, in fact a road that leads to Slatina-Timiș) with the county road DJ582D that leads to Lake Gozna and goes along the River Bârzava.

The reference stations used for the topographic survey with the GPS equipment were the reference station at Făget (FAGE1_2.3) and the reference station at Reşiţa (RESI1_2.3) (Table 1).

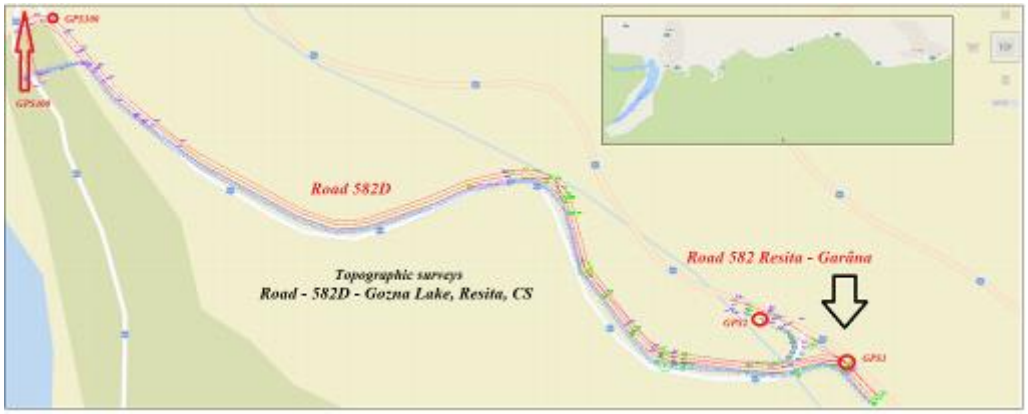


Figure 1 - Route of the topographic survey

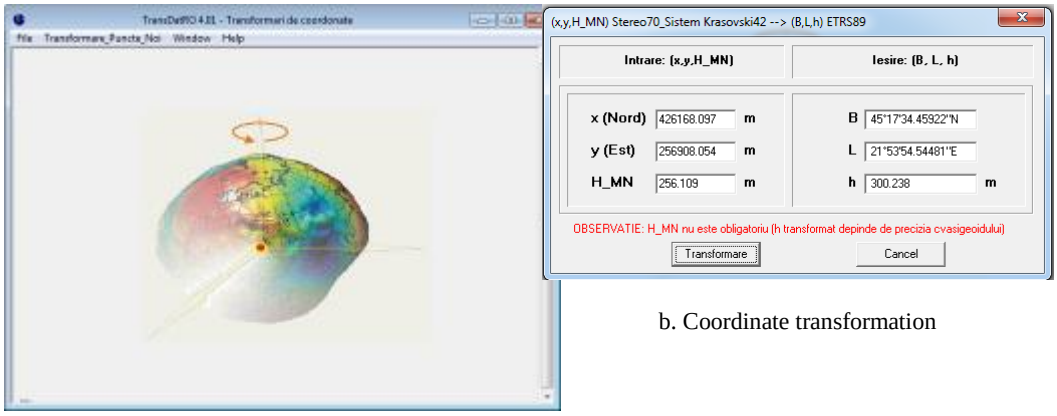
Figure 2 - The canal "flowing up the hill" on the left side of the DJ582D

Table 1

Permanent GNSS station used to carry out topographic surveys

ELLIPSOID COORDINATES				
Permanent station	Class	B[m]	L[m]	He[m]
Reşiţa (RESI1_2.3)	A	45°17'34.45922"N	21°53'54.54481"E	300.238
Făget (FAGE1_2.3)	A	45°51'16.42753"N	22°10'37.78287"E	216.490
STEREOGRAPHIC COORDINATES 1970				
Permanent station	Class	X(m)	Y(m)	Z(m)
Reşiţa (RESI1_2.3)	A	426168.097	256908.054	256.109
Făget (FAGE1_2.3)	A	487749.641	280960.451	173.080

We then turned the coordinates WGS 1984 after measuring with GPS equipment with a TrasDatRO 4.01 programme. We used the transformation method from ETRS89 into Stereo70 (Figure 3).



a. Programme interface

b. Coordinate transformation

Figure 3 - TransDatRO 4.01 Programme

Figure 4 presents the location of the reference stations and the place where the topographic survey was done.

Figure 4 - Location of reference stations

In order to achieve the survey, we used 4 old known coordinate points that we determined with a Leica 1200 GPS equipment; transforming WGS 1984 coordinates was done with a TransDat Programme into Stereographic 1970 coordinates (table 2).

We then proceeded to the processing and compensation of the points (field notes) with a TopoSys programme.

We imported determined points (Figure 5) GPS transformed, the ASCII File with old points (GPS determined points).

Table 2

Points determined with GPS (Leica 1200) equipment

GPS - Station point	Field mark	X(m)	Y(m)	Z(m)
(GPS) 1	Metal bolt	417219.291	267143.438	**605.630**
(GPS) 2	Metal bolt	417244.985	267088.839	**600.477**
(GPS) 300	Metal bolt	417438.182	266638.488	**602.130**
(GPS) 400	Metal bolt	417501.070	266605.139	**601.610**

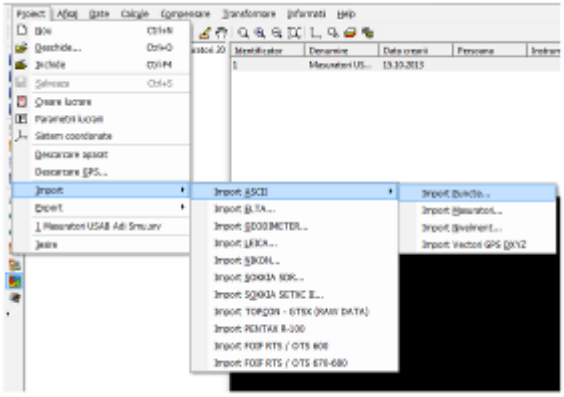


Figure 5 – Import of ASCII File with old points

Point deletion was done automatically with a TopoSys programme. Because manual deletion is done for each station point and information are numerous, we present only partial automatic deletion (Figures 6, 7).

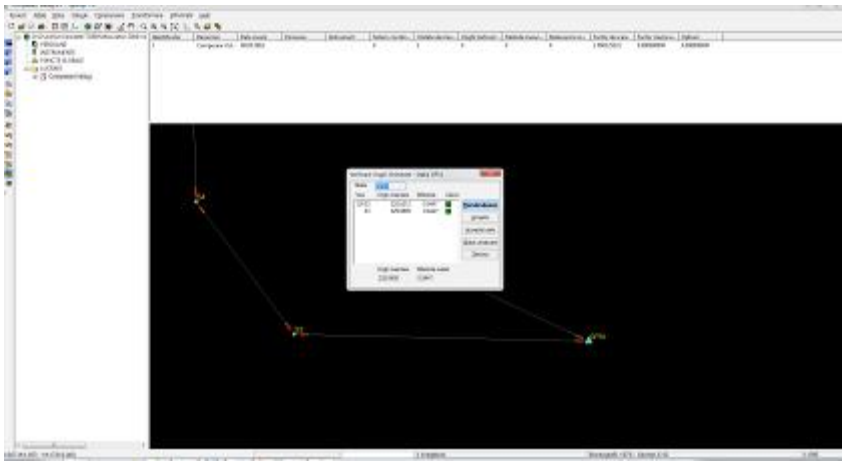


Figure 6 - Manual deletion in the station point GPS1

MANUAL DELETION with the TopoSys Programme - GPS1 Station

GPS1

Orientation

Medium orientation angle 328.8458

Npv	Direction	Z enith angle	Distance	Orientation	Orinetation angle	Difference[gr]
GPS2	0.0004	105.5119	60.360	328.0016	328.0012	-0.8447
S3	371.7906	100.5161	114.393	301.4811	329.6905	0.8447

Calculated points

Nrp	X	Y	Z	dX	dY	dZ
GPS2	417245.715	267089.169	600.471	0.730	0.330	-0.006
S3	417220.435	267029.051	604.783	-2.063	23.414	0.000
1.1	417199.718	267164.590	607.736			
1.2	417197.721	267162.559	607.756			
1.3	417195.766	267160.346	607.794			
1.4	417193.627	267158.169	607.778			
1.25	417240.912	267099.131	601.561			
1.26	417217.857	267123.928	604.521			
1.27	417216.937	267119.520	604.399			
1.28	417215.836	267114.691	604.293			
1.29	417238.650	267103.857	602.082			
1.55	417211.531	267087.274	604.184			
1.56	417214.146	267084.813	604.331			
1.57	417219.717	267044.320	604.504			
1.58	417216.829	267131.972	605.824			

Step : 1

Total calculated points : 58

From the station point GPS1, we deleted with the total station Leica TC805, 55 points that are only presented partially because of the lack of space. Below we present the automatic deletion method with the TopoSys programme (Figure 6).

Figure 7 - Automatic deletion method with the TopoSys programme

AUTOMATIC DELETION with the TopoSys Programme - GPS1

GPS1
Orientation
Medium orientation angle 328.8459

Npv	Direction	Z enith angle	Distance	Orientation	Orinetation angle	Difference[gr]
* GPS2	0.0004	105.5119	60.360	328.0016	328.0012	-0.8447
* S3	371.7906	100.5161	114.393	301.4811	329.6905	0.8446
1.1	218.6866	95.5290	28.818	147.5324	328.8458	-0.0000
1.2	224.9818	95.4855	28.825	153.8276	328.8458	-0.0000
1.3	231.4801	95.4265	28.971	160.3260	328.8459	-0.0000
1.4	237.9818	95.5561	29.591	166.8277	328.8459	-0.0000
1.5	238.8342	95.6090	29.860	167.6800	328.8458	-0.0000
1.6	239.2731	96.1034	29.969	168.1189	328.8458	-0.0000
1.7	239.9225	96.1105	30.103	168.7684	328.8459	-0.0000
1.8	240.3658	94.2338	30.349	169.2116	328.8458	-0.0000
.....						
1.50	366.2691	101.3665	65.300	295.1149	328.8458	-0.0000
1.51	366.0102	101.9928	65.331	294.8561	328.8459	-0.0000
1.52	365.4793	101.9322	65.511	294.3252	328.8459	-0.0000
.....						
1.56	365.5812	100.9499	58.851	294.4271	328.8459	-0.0000
1.57	371.4278	100.4534	99.119	300.2737	328.8459	-0.0000
1.58	357.6888	96.6653	11.727	286.5346	328.8458	-0.0000

Calculated points

Nrp	X	Y	Z	dX	dY	dZ
GPS2	417245.715	267089.169	600.471	0.730	0.330	-0.006
S3	417220.435	267029.051	604.783	-2.063	23.414	0.000
1.1	417199.718	267164.590	607.736	-0.000	-0.000	0.000
1.2	417197.721	267162.559	607.756	-0.000	-0.000	0.000
1.3	417195.766	267160.346	607.794	-0.000	-0.000	0.000
1.4	417193.627	267158.169	607.778	-0.000	-0.000	0.000
.....						
1.55	417211.531	267087.274	604.184	0.000	-0.000	0.000

```
  1.56  417214.146  267084.813   604.331     0.000    -0.000     0.000
  1.57  417219.717  267044.320   604.504     0.000    -0.000     0.000
  1.58  417216.829  267131.972   605.824     0.000    -0.000     0.000

S3
Orientation
Medium orientation angle  331.4445

  Npv   Direction    Z enith   Distance  Orientation  Orinetation  Difference[gr]
                      angle                             angle

* GPS1  171.7894   99.1031   114.403  101.4811  329.6917   -1.7528
*   S4   26.3046   99.9911    78.405  359.5019  333.1973    1.7528

Calculated points

   Nrp        X           Y         Z        dX        dY        dZ

  GPS1  417216.689  267119.892   605.619    -2.602   -23.546    -0.011
    S4  417284.260  266957.338   604.018    -0.266    -2.487     0.000
   3.1  417228.087  267016.207   603.841
   3.2  417226.573  267015.751   604.375
   3.3  417223.991  267015.169   604.469
   3.4  417221.738  267014.808   604.547
.....................................

S4
Orientation
Madium orientation angle  339.8458

  Npv   Direction    Z enith   Distance  Orientation  Orinetation  Difference[gr]
                      angle                             angle

*   S3  226.3047   99.3838    78.422  159.5019  333.1972   -6.6486
*   S5   51.5413  100.0403    60.994  398.0356  346.4943    6.6486

Calculated points

   Nrp        X           Y         Z        dX        dY        dZ

    S3  417216.930  266999.586   604.770    -5.568    -6.051    -0.012
    S5  417344.962  266951.599   603.973     9.108    -6.642    -0.047
   4.1  417321.546  266957.828   603.602
   4.2  417321.249  266955.720   603.569
   4.3  417321.242  266960.119   603.608
.........................................

S5
Orinetation
Medium orinetation angle  359.1184

  Npv   Direction    Z enith   Distance  Orientation  Orinetation  Difference[gr]
                      angle                             angle

*   S4  251.5441   99.6113    60.994  198.0356  346.4915  -12.6269
*   S5  228.2547   97.7492    14.594  200.0000  371.7453   12.6269

Calculated points

   Nrp        X           Y         Z        dX        dY        dZ

    S4  417275.714  266948.073   603.571    -8.811   -11.752    -0.447
```

```
    S5  417321.546  266961.117   603.714   -14.308     2.876    -0.306
    S6  417321.889  266960.183   603.704
    S7  417322.317  266958.010   603.619
    S8  417322.355  266955.789   603.528
    S9  417322.540  266955.857   603.538
   A11  417357.537  266906.378   603.417
   5.1  417320.136  266955.735   603.016
   5.2  417320.036  266960.328   603.235
   5.3  417323.888  266955.592   603.012
   5.4  417324.238  266960.219   603.218
   ....................................................................
   ....................................................................

GPS300  417438.182  266638.488   602.130
GPS400  417501.070  266605.139   601.610

Pas                    : 1
Total calculated points : 388
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We used the ***2D compensation method constrained on fixed points***.

After the calculus of compensation we passed to the export of the values measured and compensated in the Stereograhic 1970 System (Figure 8) and to the development of the situation plan. Then we passed to the representation of the level curves and of the 3D model of the land (Figure 9).

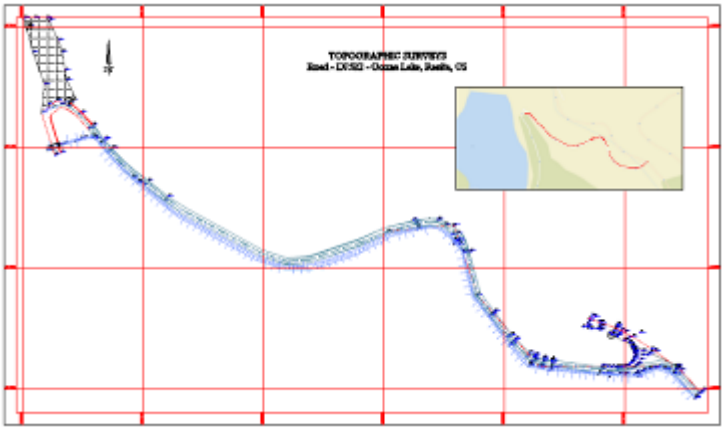

Figure 8 - Situation plan of the km 6 DN Timişoara-Arad

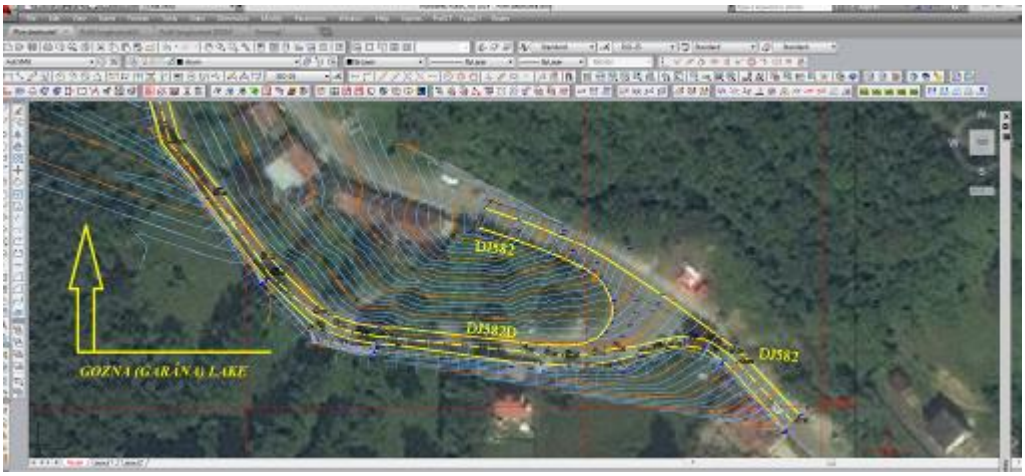

Figure 9 - Level curves and measurement checking by overlapping measurements and otrhophotoplan

The level difference was emphasised by the longitudinal profiles along the entire county road DJ582D by taking into account the road axis along the road section of about 700 m (Figures 10, 11). We also designed a longitudinal profile of the collecting canal (Figures 12, 13).

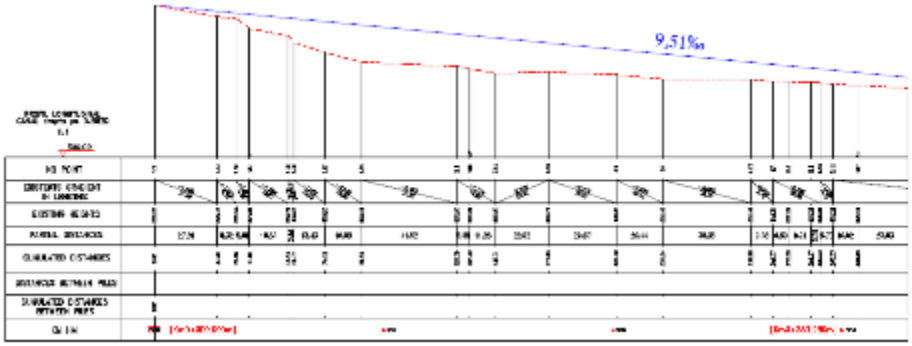

Figure 10- Longitudinal profile – Canal on the right of the DJ582D (1)

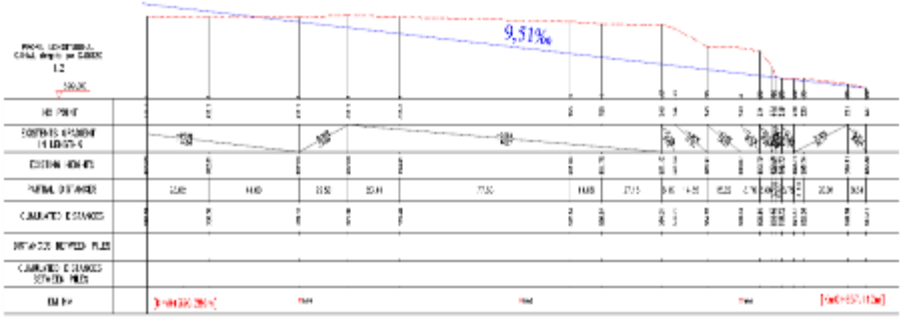

Figure 11 - Longitudinal profile – Canal on the right of the DJ582D (2)

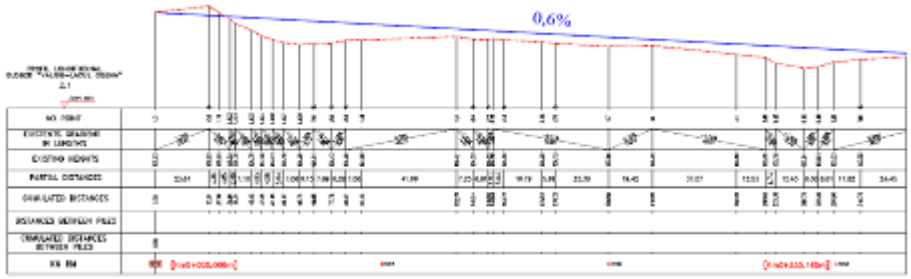

Figure 12 - Longitudinal profile – County road DJ582D (1)

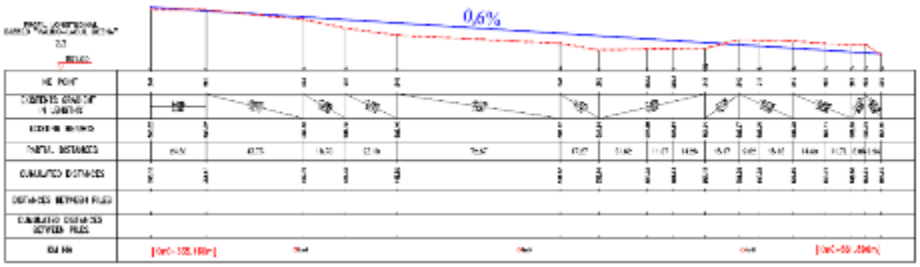

Figure 13 - Longitudinal profile – County road DJ582D (2)

CONCLUSIONS

Land survey was done to develop a situation plan of the land slope, i.e. of the county road DJ582D and of the collecting canal on the left side of the road to Lake Gozna.

Why this topographic survey? Because of the numerous videos, comments and TV shows about the road section between county roads DJ582 and DJ582D, along 700 m, where **water "flows up the hill"**. The starting elevation measured with a GPS Leica 1200 equipment at the crossroads of the county roads DJ582 and DJ582D is 605.63 m and the elevation of the Lake Gozna is 601.61 m, i.e. a difference of level of 4.02 m for the county road DJ582D with a slope of 0.6%, and a level difference of 9.51‰ for the collecting canal on the right side of the county road DJ582D between the elevation 605.63 m at the crossroads of the county roads DJ582 and DJ582D and the elevation of 599.38 m at the entrance of the collecting canal into the Lake Gozna, as shown after processing the data from the total station and from the GPS equipment, a clear visualisation of the slope and of the canal with the help of longitudinal profiles.

The county road DJ582D is paralleled on its left side by a water canal that **"flows up the hill"** according to people's comments, but the level difference between the starting elevation and the arrival elevation is 6.25 m. The lowest elevation was measured at the entrance of the water from the collecting canal into Lake Gozna and the highest elevation was measured at the crossroads of the two county roads.

Observations in the field and measurements made and compensated show that the county road DJ582 from Văliug to Gărâna is sloping and the county road to Lake Gozna is also sloping creating an optical illusion. If you go on the county road DJ582D to Lake Gozna and follow the county road DJ582, you feel like going up because the county road DJ582 really goes up. If we changed the slopes we could say that the county road DJ582 descended from

Văliug-Gărâna and then the county road DJ582D would go up to the lake. Unfortunately, the road where **water "flows up the hill"** is just an optical illusion and the myth according to which cars climb the hill or that water flows up the hill is not real.

To do topographical surveys with a total station Leica TC805 we chose the roading supported at both ends by known coordinate points and orientations where we determined, in the field, with a GPS Leica series 1200 equipment, four supporting RTK determined points (Real Time Kinematic). These points were turned from the WGS 1984 system into the Stereographic 1970 system with a TransDat programme. To download the total station and the GPS equipment, we used the Leica Geo Office Combined programme. The measurement file GSI from the total station were transformed with a DXF Generate programme into a DXF file and later into a DWG file. After compensating with the TopoSys programme, the points were exported as a TXT file an then reported in AutoCad with a TopoLT programme; then we united the points measured, we achieved the 3D model of the land, the elevation plan, and the situation plan with level curves.

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