ANINA LOCAL PROJECTION SYSTEM AND THE CONNECTION TO GAUSS KRUGER AND STEREOGRAPHIC 1970 SYSTEMS

Anamaria NEDA[1], Andrada Mădălina Maria STOICONI[1], M.V. HERBEI [1,*]

Banat University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, Timisoara, 300645, Romania
[1)] Department of Sustainable Development and Environmental Engineering
[*]Corresponding author: ***mihai_herbei@yahoo.com***

Abstract *By applying modern technology, it is felt to increase the speed of execution of complex topographic works, such as the connections between adjacent mining perimeters, but different as a topographical reference system. Due to these types of works there are problems of extending the topographical network within the mine field and beyond its limits. It should be borne in mind that the topographic network was constituted at that time in the applied reference system, either locally or localized to the national one. Regarding these aspects, the need to find ways of homogenization between the different reference systems applied in the territory of our country appeared. In this study, we discuss the coordinate transformation module from a local reference system in the national systems, Gauss Kruger and STEREOGRAFIC 70, for the Anina mining field. For the Anina mining field, the name of the reference system was given by the Ministry of Mines with the name of the plain mine and the year of construction, namely ANINA 17. The ANINA 17 reference system was materialized through a complex topographic triangulation network. Adopting the initial coordinate system is a step forward in the direction of sorting topographic projects. With the expansion of these works in adjacent areas, attention was drawn to the difficulties encountered in the calculations and graphical interpretations in the four quadrants of the coordinate system. Finally, the existing mining system is adopted by changing the values for the origin point S from the initial coordinates YS = 0.000 and XS = 0.000, then YS = 5.000,000 and XS = 5.000,000, so that in the end the coordinates of the origin S are YS = 50.000,000 and XS = 50.000,000, Y remains pointing to north, and Z is set against the middle level of the Adriatic Sea. This new Reference System was called* ***the Popului Projection****. The link between the* ***Popului Projection*** *and the national reference system was achieved by transformation the coordinates of this project into the Gauss 1962 projection through the analytical method based on common point pairs.*

Keywords: *ANINA 17, mining field, projection plan*

INTRODUCTION

The need to establish the topographical elements for defining a reference system Anina 17 and the transcalculation of the coordinates in the national system arose with the issuance of DECREE 305/1970 on the adaptation throughout Romania of a design and reference system STEREOGRAPHIC 1970. By linking this requirement with the political and economic situation, refers first and foremost to the methods of implementing the cadastre and technical and topographical issues.

With the help of this type of work, in which we carried out the translating of the coordinates belonging to the Anina 17 reference system, in geographic coordinates, then in the coordinates of the national reference system STEREGOGRAFIC 1970, there were cadastres works for establishing the patrimony of commercial companies, updating topographical plans, establishing deposits quality, reconstitution of membership and preparing documentation on possible market economy concessions.

MATERIAL AND METHOD

In order to carry out this work, we are considering the following phases of research:

- Analysis of the Topography Reference System of the Anina Mining Field;
- Analysis of the possibilities of connecting the reference system to the Gauss-Kruger and Stereographic systems 70.

The research proposed for solving is to analyze the existing system, to verify the existing topographic base, to find the relations of calculation and to translate the coordinates from one system into another and to use the computing technique in solving the work.

The Anina Mining Field Reference System (Fig.1) is described by the following generalities:

a) performing all surface and underground measurements through a single reference system that is used throughout the mining activity;
b) drawing up the basic plans according to the unique rules for type protection, according to a plan of connection of the plans;
c) recording on the graphical documents (plans, maps, etc.) of the localization elements within the reference system bearing the topographical designation of the document.

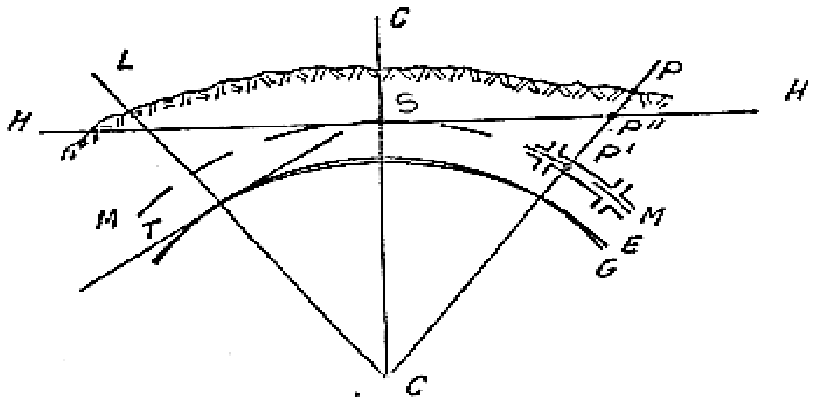


Figure 1 Central azimuthal projection (geomechanical) with secant plane

From the general defining elements, the projection Anina 17 mining system is the central (geomechanical) azimuthal projection with the secant plane, a projection system characterized by (Fig.1):

- the reference mining area (M.M);
- the reference mining plan (H.H);
- plane coordinate system;

- level area (for quotas);
- name of the reference system.

The reference mining area (M.M) is a level surface area, of quota Zm equal to the average ensemble of the mining works. The level of this surface has been set for the Anina mining basin as Zm = 0 m.

The topographic (P) points in the field project on this surface after their vertices. (Fig.2)

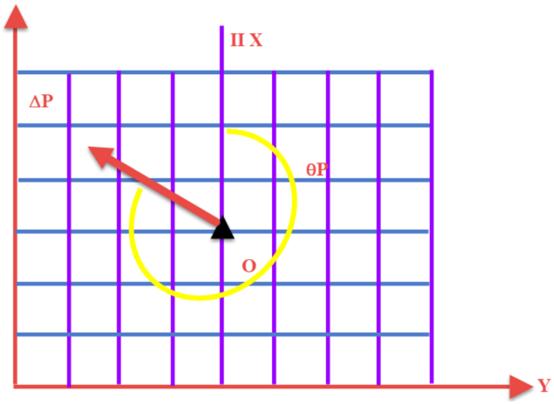


Figure 2 O, P - points that materialize the coordinate plan system of the Anina mining field

The mining projection plan is a plane tangent to the reference surface in the plane O (S) which is the projection of a point located approximately in the center of the basin (S). With the design of the points as components of the projection system, angles and rails are projected.

The planar coordinate system was constituted as a local system around 1890, with a point in the middle of the mining basin being given the coordinates X = 0.000 m and Y = 0.000 m, Y pointing northwards. When establishing this reference system these values were maintained and the coordinate system is set in the projection plane HH by the coordinates of the origin point O = S and the orientation value of a direction supported by the origin point (O) and a point P = U, Yu = -1741, 699m and Xu = -451.501m. After 1900, the local coordinate system was remodeled by changing the values for the central point S, namely Y = 5.000.000 m and X = 5.000.000 m.

Table 1

	Local coordinates in 1912		Local coordinates after 1917	
	X	Y	X	Y
S	0,000	0,000	5.000,000	5.000,000
U	-451,501	-1741,699	4548,499	3258,301

With the expansion of these works and adjacent areas, attention was paid to the weights encountered in the calculations and graphical interpretations in the four quadrants of the coordinate system. In this case, the existing mining system was adopted by changing the values for the S-point, namely Y = 50,000,000 and X = 50,000,000, the Y still remaining northwards, and the Z-share is taken from the average level of the Adriatic Sea.

The Gauss-Kruger representation system belongs to the conforming cylindrical projection system, i.e. it keeps the angles undeformed. The application of the Gauss-Kruger projection in Romania was made in 1948 by the necessity of connecting the map of Romania to the map of the world.

In the transverse cylindrical projection, the entire earth surface of the globe is represented on the deployed surface of a cylinder whose axis makes a right angle with the axis of the poles and which is tangent to the Equator only at two points, namely at the intersection of the mean tangent meridian with the Equator. This meridian is the contact line of the cylinder on the land surface and which remains unformed in the projection.

The application of this projection was made taking into account the fact that two Gaussian trapezoids defined by two Gaussian 6 ° fuse passes pass through our country, namely: the 4th axial point of 21 ° EST to Greenwich and the 5th axial meridian of 27 ° EST relative to Greenwich, separated by meridian marginal common 24 ° TSE relative to Greenwich and the L band (φ = 44 °, λ = 48 °).

The Anina mining field is comprised between the number 4 (21 °) and the L-band. This spindle has the coordinates for X against the Equator X = 0 km and for Y at origin Y = 4,500 km. As Anina 17 was defined, only one S-point for co-ordinates and one B-side for orientation were used. It should be noted that the coordinate pairs were calculated in the Gauss-Kruger projection for the points belonging to the Anina topographic network and the mining mine own mining system.

The azimuthal projection of the oblique stereographic perspective, with the 1970 Single Sectional Projection Plan, also called the "STEREO-70 Projection", has been used since 1973 to draw up basic topographic plans at 1: 2,000, 1: 5,000, 1:10 000, as well as the cadastral map at 1:50 000 scale. This projection system was adopted based on the elements of the Krasovski-1940 ellipsoid and the Black Sea-1975 reference plan.

Stereographic Projection System 1970 is based on the principles and formulas applied in the 1930 stereographic projection system as defined by the French geodesist H. Roussilhe in 1924. Stereographic 1970 projection parameters were determined according to the elements of the reference ellipsoid, the position of the center point Q 0 (φ0, λ0) and the depth of the single secant plane from the tangent plane from the central point. The central point of the projection is a fictitious point (landless), located approximately in the geometric center of Romania, north of the town of Fagaras, which allows Romania's territory to be represented in a circle with a radius of 400 km. in principle, and satisfies the optimal requirements of cartographic representation.

The geographic coordinates of the center point of the projection, also called the projection pole Q0 (φ0, λ0), are the following:

φ_0 = 46s 00’ 00’’, 000 NORTH LATITUDE

λ_0 = 25s 00' 00'', 000 EST LONGITUDE GREENWICH

The Krasovski-1940 reference ellipsoid, which was used in the Gauss projection during 1951-1973, was also maintained in the 1970 Stereographic projection, oriented to PULKOVO (RUSSIA) and having the following basic parameters:

Large Semiax: a = 6 378 245, 000 000 m
Small Semiax: b = 6 356 863, 018 770 m
Geometric flattening: α = 0, 003 352 329 869
First eccentricity: e^2 = 0, 006 693 421 623
Average bend radius: R_0 = 6 378 956, 681 m

RESULTS AND DISCUSSIONS

When the plane coordinates x, y of an arbitrary point on the terrestrial surface in the transverse cylindrical projection were calculated, it was necessary to know the geographic coordinates of the point. The problem can be examined and vice versa, i.e. knowing the coordinates x, y of a point in the projection plane can determine the geographical coordinatesφ, λ of the corresponding point located on the ground surface.

Calculation formulas with constant coefficients

$$f = (\varphi - \varphi_0)'' \cdot 10^{-5}$$
$$l = (\lambda - \lambda_0)'' \cdot 10^{-5} \qquad (1)$$
$$X = x_0 + \Delta x$$

xo = +5096175.747

λ, φ - Geographical coordinates of the transformed point;

λ_0, φ_0 - Geographical coordinates of the origin of the calculation;

In this sense, the logical scheme for the automated calculation of geographic coordinate coordinates from Gauss Kurger coordinates.

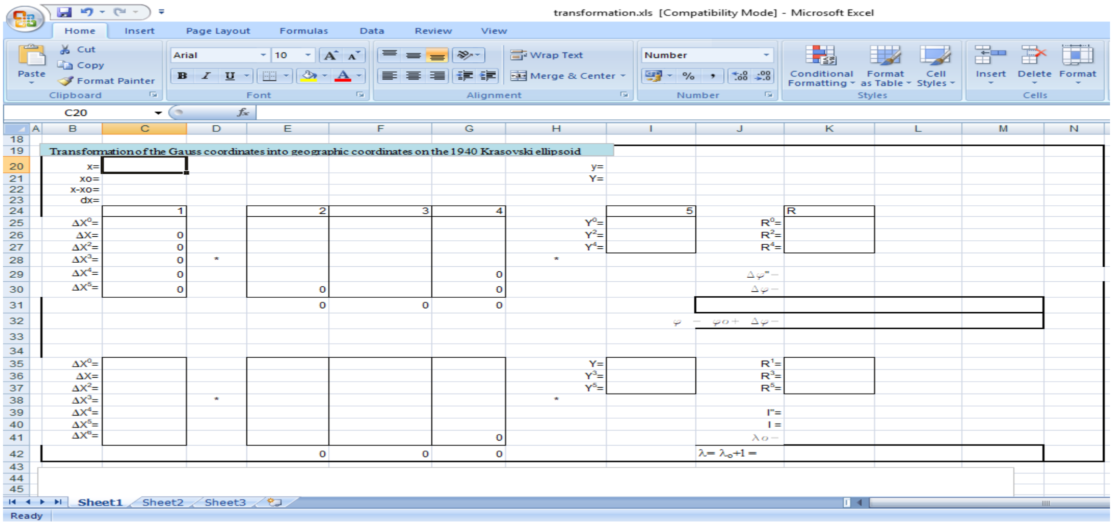


Figure 3 Transformation diagram of Gauss plane coordinates in geographic coordinates in the Microsoft Office Excel program

Transformation of the rectangular planar coordinates Stereo 1970 from geographical coordinates shall be carried out in a standard form, where the numerical values of the constant coefficients (2) are entered and in which the geographical coordinates, the point number, the nomenclature and the trapezoidal scale are recorded.

$$X < 70 > = X0 + Xsec$$
$$Y < 70 > = Y0 + Ysec \qquad (2)$$

where:

X_0 = 500 000, 000 m and Y_0-500 000,000m.

φ= 44°55'04",7 **Punctul: A** λ=23°27'04",7

φ_0=46⁰ λ_0=25⁰

Δφ=φ-φ_o= 1⁰04'55,3" **Trapezul: 1:25.000** Δλ= λ- λ_0= 1°32'55,3"

f''=Δ φ''x10^{-4}= 0,38953 c=0,999750000 1 ''=Δλ ''x10^{-4} =- 0,55753

Calculul lui x

1	2	3	4	5	6	r
f^0=1	0	+ 3 752,145 7111	+ 0,335 9127	- 0,000 0575	l^0 = 1	r_0 = 120285.8701
f^1=0.38953	+ 308 758,9579813	- 99,928 0966	- 0,062 2287	0	l^2 = 0.310839701	r_2 =1153.90027
f^2=0.151733621	+ 75,358 4967	- 6,674 8691	+ 0,000 2261	0	l^4 = 0.09662132	r_4 =0.030115353
f^3=0.059104797	+ 60,216 2733	- 0,071 3046	0	0	l^6 = 0.030033742	r_6 = -0.0000017269
f^4=0.023023092	- 0,014 8571	- 0,002 5911	0	0		
f^5=0.008968185	+ 0,014 2609	0	0	0		
f^6=0.003493377	- 0,021 5834	0	0	0		

S_0=120285.8701 S_2=3712.203643 S_4=0.311684352 S_6 =-0.0000575

x[tg]= 121439.8005

$X_{[s]}$= x[tg]•c= 121409.4405

X[translatat]= $X_{[s]}$ + 500.000 = 621409.4405

Figure 4 Example of a standard form for coordinate transformation

The transformation of the geographic coordinates into the Stereo 1970 plane coordinates, using formulas with constant coefficients, is made with a precision of ± 0.01 m.

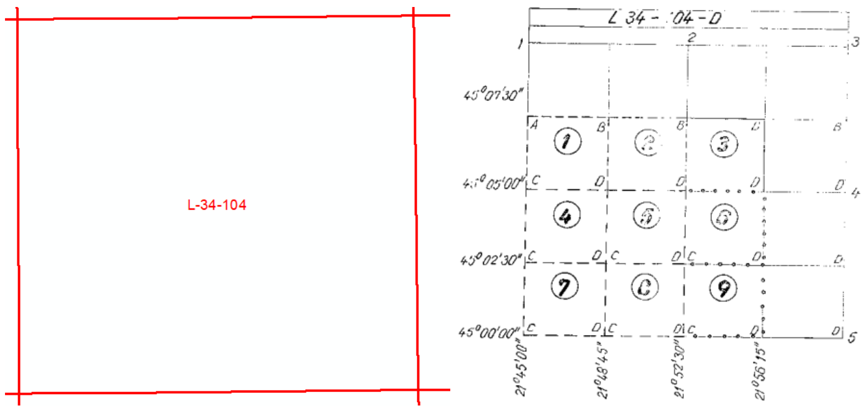
Table 2

Transcalculating the main points in the Anina mining field

	The name point	Stereographic Coordinates 1970		Geographical coordinates		Local Coordinates	
		X	Y	φ	λ	X	Y
0	**PUNCTUL S**	401603.100	251862.462	45°4'14.3060	21°50'53.1435	4993232.848	4566788.533
1	**TÂLVA MARE**	401492.506	244773.406	45°4'1.5859	21°45'29.6099	4992796.930	4559714.808
2	**VÂRFUL MAIAL**	401773.997	252974.675	45°4'21.2746	21°51'43.6331	4993358.818	4567890.728
3	**STEIERDORF**	399874.440	251334.916	45°3'17.7048	21°50'32.6144	4991480.837	4566357.693
4	**DEALUL CRIVINA**	397004.297	250298.913	45°1'43.4875	21°49'50.0330	4988562.657	4565455.739
5	**VÂRFUL MORII**	399983.535	251915.703	45°3'21.9614	21°50'58.4793	4991618.158	4566922.219
6	**IUDINA**	397986.328	253189.973	45°2'18.9419	21°52'0.2214	4989687.016	4568294.018
7	**TÂLVA VACII**	396746.352	248375.907	45°1'32.6731	21°48'22.7452	4988209.497	4563548.219

CONCLUSIONS

The adoption in 1951 of the Gauss Kruger projection contributed to linking the map of Romania to the Map of the World, but this projection poses a great inconvenience in transcending co-ordinates from one spindle to another. The proposal in 1970 of the stereographic projection with a secant plane and its legislation by Decree 305/1971 represents a perfectly adaptable way to the conditions of our country, as well as the form of use, accessibility, rationality and economic adaptability of cartographic projections used up to the day today. Through this paper the framing of the Anina 17 mining topographic system was performed in the current National Stereographic System 1970 with the help of the coordinate transcalculation.



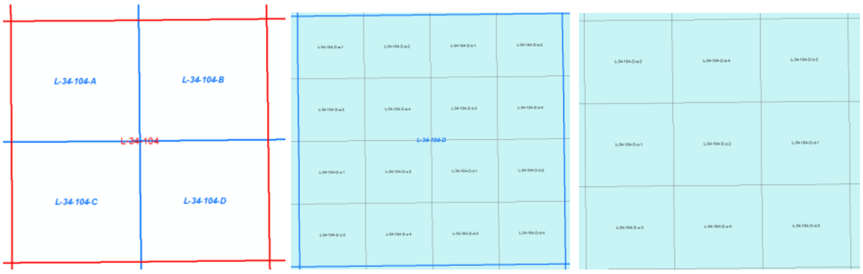


Figure 5 The connection of local projection to national projection system

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