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AUTOMATION IN PHOTOGRAMMETRIC CADASTRAL SURVEYINGS

ABSTRACT

It is a special interest in obtaining cadastral point coordinates and data automated processing within photogrammetric cadastral surveyings. Coordinates are derived by analytical and analogical photograph plottings,and existing photomap and plan digitizings, as well.

So-obtained point coordinates as basic data,cadastral map compiled in a plotter and computation programme for limit rectification,division into allotments,land consolidation bring forth,an assisted-computer designing method aiming at land planning, which is the object of the respective protogrammetric cadastral surveyings.

Finally, cadastral map showing expected outlook, new point coordinate inventory and other cadastral data are obtained.

During cadastral development, there are periods of time when no significant changes occur, while important progress events suddenly arise, especially, related to cadastral surveyings.

In the last decade, among the more important technological achievements, we can mention electro-optical measuring equipment,analytical photogrammetric methods,computers and plotter, which are largely used.

These achievements as essential features of the present - day technology give the possibility to automatize cadastral works, being a certain support in real-time data recording,processing and their graphical representation, regarding land resources.

An automatic technological process related to cadastral surveyings, using the above mentioned equipment, entails also designings as regards boundary rectification, division into lots, land consolidation, which, finally, can be computer - assisted land planning designings.

Analysing the main cadastral surveying stages which, nowadays, are mainly carried out using analytical photogrammetric methods, we can draw up the diagram presented in Figure 1.

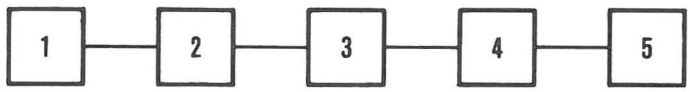


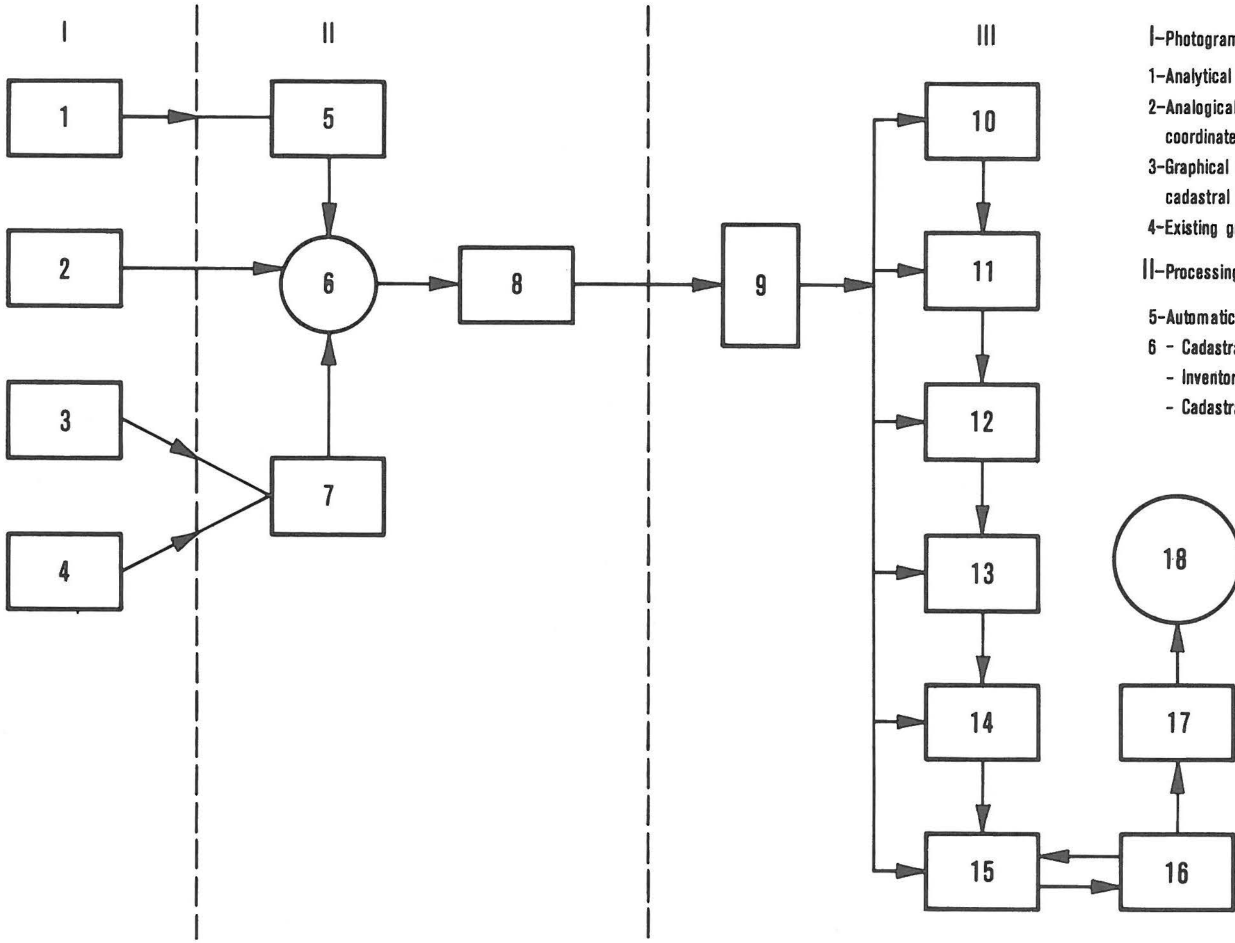
Figure 1 The main stages of the analytical photogrammetric works

1 - Photogrammetric and ground cadastral data collection works
2 - Data preparation for aerial triangulation, photogrammetric plotting, used in cadastre and cadastral map compilation
3 - Photogrammetric computations used in establishing aerial triangulation point network and in photogrammetric plotting, to be used in cadastral works
4 - Cadastral map compilation
5 - Obtained cadastral data processing and their use

Stages (1), (2), (3) and somewhat stage (4) have been previously investigated [1] , [3] ; their results have been put into practice, using the technological equipment existing in those days. Coming into existence of digitizing, computation and plotting equipment brings forth conditions to approach cadastral data processing, considering their various applications [5] .

The diagram of such technological process, aimed at land planning designing, using cadastral data processing of the respective zone and a plotter is illustrated in Figure 2.

Although this technological process has been initially achieved as a sequence of a former technological process for cadastral surveyings, using analytical photogrammetry [2] , it can use cadastral map or inventory of point coordinates determined by photogrammetric or even topographical methods as input data(I). Depending on cadastral data features obtained during measure-



I–Photogrammetric cadastral measurement results

1–Analytical stereoplotting (Inventory of measured cadastral point coordinates is obtained)

2–Analogical stereoplotting (Cadastral map and inventory of measured cadastral point coordinates are obtained)

3–Graphical stereoplotting, photorectifying or ortophotorectifying (graphical or photographic cadastral map is obtained)

4–Existing graphical cadastral maps

II–Processing related to data preparation necessary in land planning

5–Automatic cadastral map drawing, using a plotter

6 – Cadastral map
- Inventory of point coordinates
- Cadastral data

7 – Cadastral map digitizing and obtaining inventory of point coordinates

8 – Area computations

III–Land planning designing

-Algorithms and programmes used in cadastral data processing, aiming at land planning

10–Establishing the possible terrain exchanges among administrative units and landed property units

11–Boundary changes among administrative units and landed property units

12–Private road network designing

13–Rough graphical designing of new configuration, considering landowners and land uses

14–Digitizing the designed configuration and area computations, considering plots, land uses and landowners

15–Comparison among areas of the data area register and those obtained after digitizing

16–Computation of the established point coordinates, satisfying data area register requirements and the imposed conditions

17–Automatic cadastral map drawing, showing designed land planning

18–Final results
- cadastral map showing designed land planning
- inventory of point coordinates
- other cadastral data regarding new situation

19–Use of the land planning design on the ground

Figure 2 Technological process diagram for a land planning design based on cadastral data processing, using a plotter ments (I), their previous processing is carried out,in order to prepare input data necessary to design land planning, such as: cadastral map, catalogue of point coordinates, cadastral area cards. A plotter is used in map drawing and digitizing, as well as, special cadastral computations, in order to perform these preparatory works. Designing concerning land planning consists of a multitude of cadastral works, aimed at esta - blishing the best conditions to develop land resources within the administrative units (districts, communes, villages) and land holding units (state agricultural units, agricultural farms, forest units, landowners), respectively.

Cadastral work categories provided by the technological pro-cess illustrated in Figure 2/III are further briefly presented.

Possible terrain exchanges among various land holding units, to be taken into account in boundary rectification are carried out, before the required cadastral works are accomplished.

Criteria, proper algorithm and computation programme conside-ring fixed and free points,minimum side length ranging from a unit to another, as regards zone features, and minumum angle value between adjacent sides are established, in order to rec-tify boundaries among the administrative units and the adja-cent land holding units. Boundary parts to be exchanged, but keeping areas, areestablished depending on the proper algo-rithm, by comparing the above mentioned parameters with the corresponding elements of the true polygonal line.

Road network designing is achieved using standards related to minimum and maximum plot sizes, considering land uses, private road width , terrain configuration, the best route, and compu-tation of elements to be implemented on the ground.

Plot configuration designing is initially carried out graphi-cally and then analytically, using succesive approximations, considering the new road network,limits and fixed points exis-ting on the ground,land configuration,areas by landowners and land uses as parameters. Computation process comes to an end when differences among plot areas to be computed using the new coordinates and areas existing in the cards suit to the established tolerances.

Finally, coordinate catalogue,cadastral map giving the designed situation , area cards by landowners and land uses and other data regarding point implementations on the ground, as angles distances, are obtained.

A 1:2,000 scale cadastral map part derived by analytical photogrammetry is shown in Figure 3. We have used a Stecometer to make measurements,Felix 256 computer to make computation for aerial triangulation and analytical stereoplotting and ARISTO plotter to draw up a map.

Processings necessary to establish the best plot configuration, in order to efficiently develop land resources of the considered area have been accomplished, regarding process presented in Figure 2 and cadastral plan, inventory of point coordinates, area cards [1] , using algorithms and programmes established.

The new designed plot configuration is presented in Figure 4 for the same terrain part shown in Figure 3.

Essential area data considering land uses in the old condition as against the new one are illustrated in the Table 1 , just to make a comparison.

Table 1

Area (ha) / Polygon number	Land uses									Total area / polygon
	Arable A	Pasture P	Hayfield F	Vineyard V	Orchard L	Buildings C	Water H	Roads D	Barren ground N	
Old condition	11.9496 / 16	0.5325 / 1	3.3629 / 5	1.1834 / 3	2.0257 / 5	1.7690 / 19	0.3731 / 5	1.6209 / 7	2.2203 / 9	25.1998 / 70
New condition	12.2811 / 8	0.5425 / 2	5.4575 / 12	1.7949 / 4	1.3707 / 2	1.7103 / 19	0.3731 / 5	1.6591 / 7	—	25.1972 / 59

Final documentation (diagram in Figure 2/III) consists of maps giving the new designed plot configuration,inventory of point coordinates, distances among points giving limits,angle values among adjacent limits necessary in the design implementation, data regarding land uses by landowners, a.s.o.

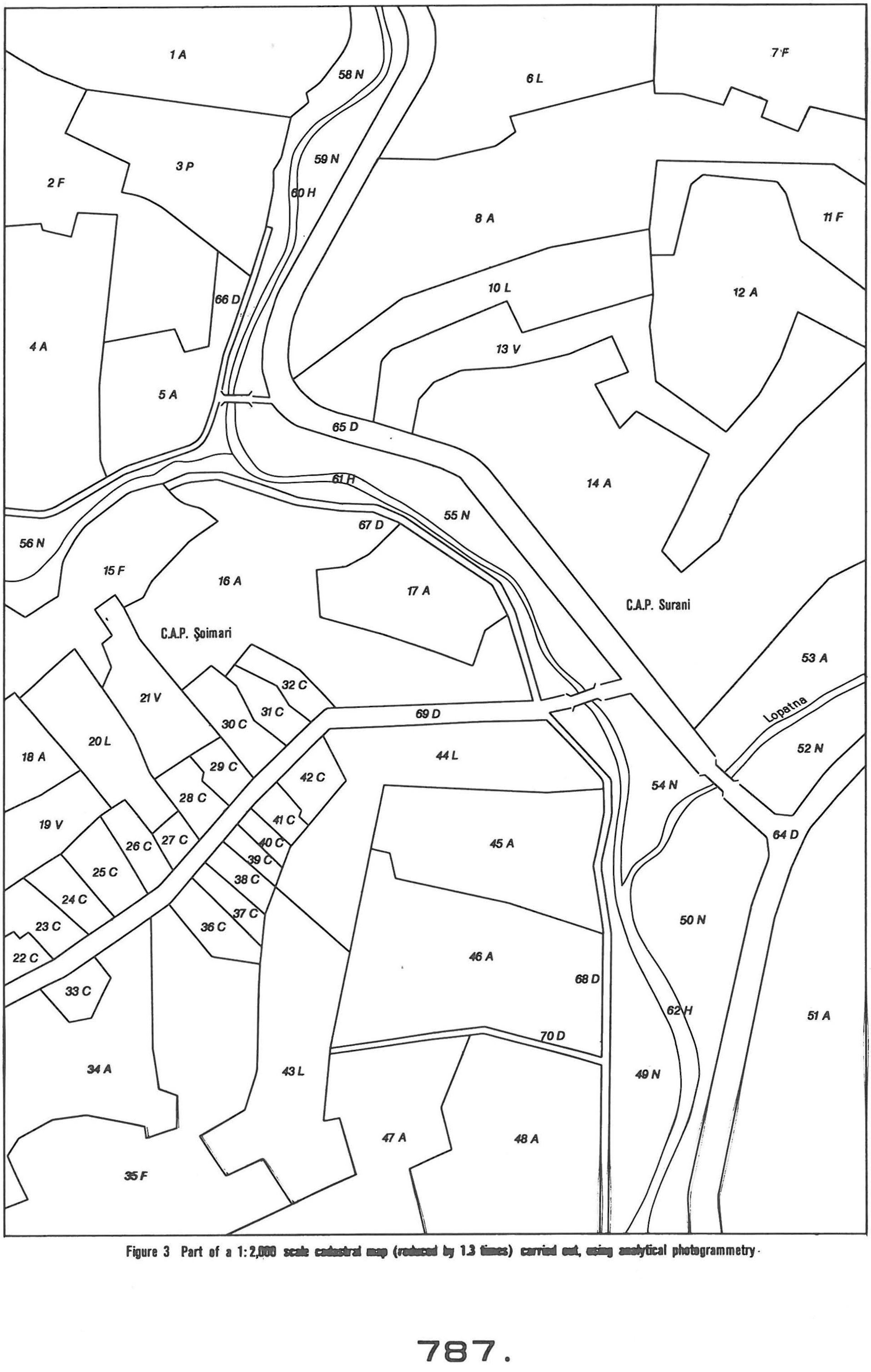


Figure 3 Part of a 1:2,000 scale cadastral map (reduced by 1.3 times) carried out, using analytical photogrammetry.

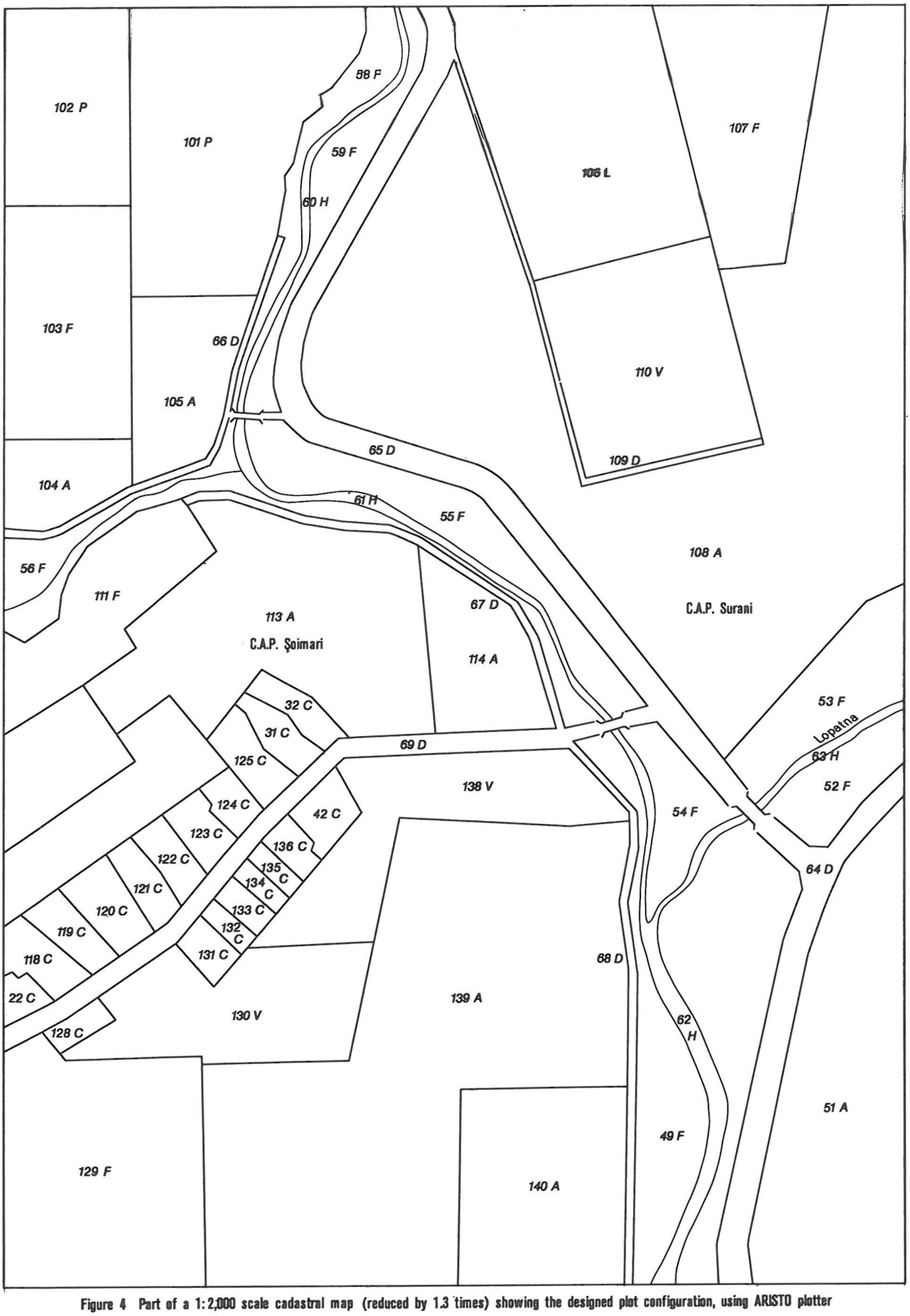


Figure 4 Part of a 1:2,000 scale cadastral map (reduced by 1.3 times) showing the designed plot configuration, using ARISTO plotter

This technology aimed at automatizing photogrammetric cadastral surveyings and at designing new plot configuration, providing an efficient development is in its experimental stage. This technology used in various larger works is considered to be a real help in improving the established algorithms and programmes, which could solve problems imposed by practical activities in the mentioned field of activity.

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