THE ACHIEVEMENT OF ARCHAEOLOGICAL RESEARCHES DOCUMENTATION USING CAD (COMPUTER AIDED DESIGN)

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Abstract: *The emergence of modern surveying equipment allow to store digital terrain data collected automatically and download them to your computer. The role of digital topography not only reduces to achieve topographic maps but also to provide topographic support for archaeological excavations. For archaeological researche special CAD systems were developed, as ArchaoCAD (Papadopoulos 1998, 1; Gerbasch 1998, 70). This system was used in Germany with good results. It can use other CAD systems (AutoCAD, LisCAD) holding drawing tools of geometry objects.*

Key words: grid, layer, raster, vector

INTRODUCTION

The presence of surveyors on an archaeological site is critical early in the excavation. With the total station can achieve precise drawing research units after a given direction (for drawing systematic research is done for grid site, and for saving research by purpose). After the plotting, planimetry and altimetric data are collected for spatial positioning of research units on the made topographical plan.

Another step is the collection of digital spatial data to achieve a database in the archaeological research, including surveying data (depending on cutting levels), data on site stratigraphy, spatial positioning of discoveries etc. After collecting the data, CAD systems can be carried out stratigraphic thematic designs, according to the requirements of the archaeologist.

For excavations special CAD systems were developed as ArchaoCAD (Papadopoulos 1998, 1; Gerbasch 1998, 70). This system was used in Germany with good results. It can use other CAD systems (AutoCAD, LisCAD) holding drawing tools of geometry objects.

Broadly, design achievement in a CAD consists of a number of layers or groups. These layers include closed areas of geometry, text, or measurement, which is a logical connection or fit for purpose. Layer can be activated or dezactivated them separately or combined, allowing much easier draw. However, all items are on one layer can be changed in terms of alignment or color.

In the CAD systems there are other important functions on achievement of geometry design. They have a variety of drawing commands, building, editing, burning, shading, measurement, etc., allowing the possibility to simplify, speed, data processing and development. Mapping object is to achieve manually so far, much faster. Corrections, additions and merge of databases are always possible. Thematic detail maps listings (paleobotanic maps, the spatial distribution of finds, the complex deployment phases) does not have limitations on the plot.

All these steps, methods and techniques provide the necessary data for graphic and attribute data base to achieve a GIS project.

DIGITAL MAP

From the point of view of topographical survey the map of an objective is the end point of the work.

After field operations – surveying - ended, after the office stage they have gone through the checks and compensation points of support network, approach and lifting, and for the detail points were offset any angles in the station, is move to reporting and drawing up topographical map.

The CAD program, (in our case LisCAD and AutoCAD), based on field sketch and identifiers, after downloading the high points from total station, pass through the union those representing the same detail or details of same type (appeal communication, property, fences etc.), and the application of conventional signs (pipelines, underground tunnels, the electricity poles, hedges, buildings etc.)

Generally, to achieve a digital mape is used all available data sources.

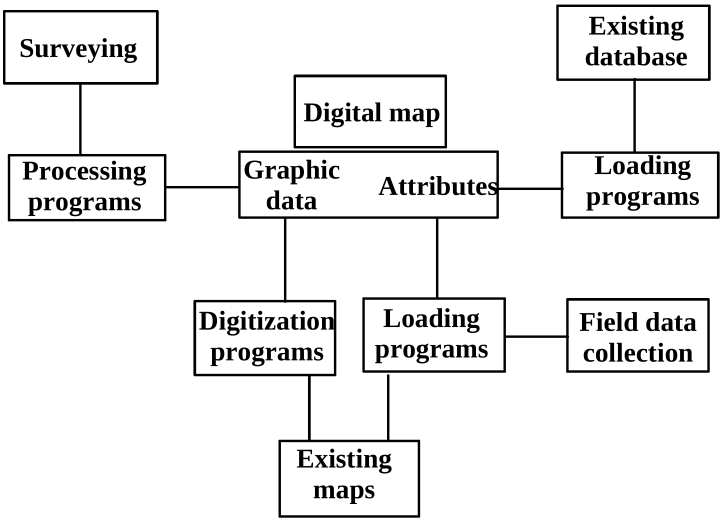


Fig. 1 Data sources used to achieve digital map

Surveying and data collection in the field is the main source of graphics data (first operation) and attributes (second operation). Surveying means the full range of topographic and geodesic operations that run for determining geographical coordinates of points characteristic of the entities identified in the territory of representation on the map of their shape and position.

The data collection means the process of identification and registration of quantitative and qualitative characteristics of geographic entities represented on the map. It has the possibility of direct collection, in the field, and indirect collection, by perform photointerpretation.

Using existing databases relating to the acquisition of territorial cadastral offices of recordings from various registers and detailed maps at different scales, their selection based on the methodology established for the acquisition, validation and registration.

THE DIGITAL MAP STRUCTURE

By digitally geographical date (or spatial date, or geo-referenced date) means a date (shape, size, object, name, etc.) belonging to a geographical entity, ie a material element or phenomenon, natural or artificial, existing on fild and can be represented on the map.

The main components of a digital geographic data are:

- the geographical position - expressed by coordinates;
- attributes - expressed by values that characterize the object;
- spatial relationships - expressed through the neighborhood;
- time - expressed through the date on which it was found there entities.

These four components of a geographic data are expressed numerically in the case of a digital database, the values held in a specific structure that forms a specific database. It contains data defining the position and shape of the entities represented (graphic data), and data that expresses the characteristics of these entities (attributive or contextual data).

Graphical data - There are two primary ways in which graphic information contained in cartographic representation can be stored in a computer or on tape in a digital plane.

The raster - In the simplest form, raster consists of a regular grid of square or rectangular cells. Location of each element, called pixels, is defined by its position in the row and column. The value attributed to cell indicates the attribute value it represents.

With this model, a territory is split into several cells forming a rectangular grid of a certain size. Each such square is characterized by a numerical value expressing a characteristic of the territory represented. The accuracy of representation depends on the grid density, and this feature is called „resolution”.

The vector - With this model, the contents of the map is split into basic geometrical structures:

- point - defined by its coordinates in a reference system;
- line - or arc, defined by a sequence of points;
- polygon - defined by the sequence of lines that it borders.

In the vector method, graphical contents of the digital map is represented by a set of pairs of coordinates, defining points, grouped into subsets ordered to determine how the union of those points.

The raster is appropriate reproductive phenomena evenly covering a given area, while the vector model is virtually compulsory for linear and point objects representation.

Whatever the model used, geographic data are organized in several thematic layers. In this project, the map was drawn up taking into account the following structure recommended:

Layer 1 - old triangulation points - used;

Layer 2 - lifting points network;

Layer 3 - the limits of legal documents that prove ownership or right to use the site;

Layer 4 - symbol which marks the raised point position;

Layer 5 - number of raised points;

Layer 6 - rate of raised point;

Layer 7 - old site perimeter;

Layer 8 - vegetation;

Layer 9 - hydrographic;

Layer 10 - road communication routes;

Layer 11 - platforms;

Layer 12 - construction;

Layer 13 - pipelines, underground tunnels;

Layer 14 - accommodation, systematization;

Layer 15 - overground network;

Layer 16 - underground network;

Layer 17 - outdoor storage;

Layer 18 - primary circuit, electricity;

Layer 19 - rail communication routes;

Layer 20 - cadastral numbering;

Layer 21 - parcels of land (background enslave) found in the influence area of archaeological objective (the dominant background) and the easement area;

Layer 22 - definition toward of land parcels to neighboring site with details of owners.

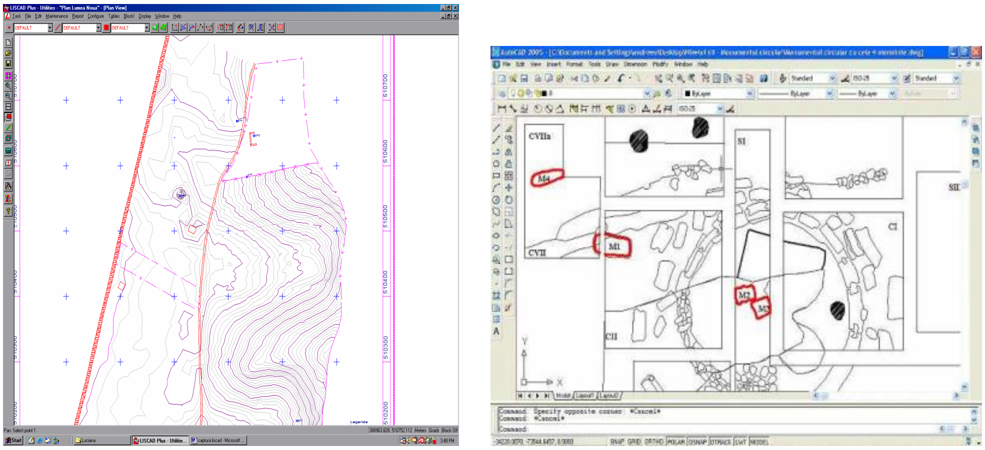
By overlap of successive layers obtain the complete map.

The map may then be split into several components, similar to transparent sheets, each containing an independent cartographic representation of a particular category of data covering the same area of land.

Usually, one layer contains a single fundamental graphical form (point, line, polygon). From this approach follows a number of advantages, such as:

- easily obtain of derived maps, consisting only of some components;
- digitization facilities, updating, editing;
- higher possibilities of analysis.

Attributive data - attributes are values that express qualitative and quantitative characteristics of an entity. If digital maps based on vector format, attribute values are stored in separate files, called attributive data files (or nongrafice data files). Each layer is accompanied by an attributive file, and, in principle, to each record, representing a fundamental graphical form of a graphics file, corresponds an entry in the attributive file, representing shape’s characteristics.



a) b)

Fig. 2. Window design programs
a) LisCAD; b) AutoCAD

Preparation of topographical plans, whether traditional or modern methods must correspond certain requirements. So, the coordinates should be represented to an orthogonal system. This creates a framework as a grid, with mesh of 10cm x 10cm - established conventional and single. Basically, is made a mold with grid, which must ensure orthogonality of grid lines. This matrix will be chosen so as to have basis by 80cm , 60cm height and 1m diagonals.

After the grid lines (or only crosses marking their intersection) are passed on the map, to switch to represent points.

Din inventarul de coordonate se caută coordonata X cu valoarea cea mai mică, atribuindu-se pentru linia de caroiaj din partea. Tot aşa se procedează şi pentru axa Y, numai ca evoluţia este din stânga spre dreapta planului. Dacă axa X-lor este rotită faţă de verticală a desenului, este obligatoriu desenarea nordului topografic. Valorile liniilor de caroiaj se înscriu întotdeauna, pentru ordonată pe partea dreaptă a desenului, iar pentru abscisă pe partea de jos a desenului.

By the coordinate inventory is seeking coordinated with the lowest X, assigning it to the grid line. So it shall and Y axis, just as evolution is from left to right map. If the X-axis is rotated to the vertical design is required northern topographic drawing. Values of grid lines always fall, for the orderly on the right side of drawing, and for the abscissa on the bottom of the drawing.

Hit map will be accompanied in the lower right corner of a cartridge indicator, whose format is used in drafting maps.

AUTOMATIC GENERATION OF DIGITAL TERRAIN MODEL

Model of an object is a material or imaginary system on a direct correlation matching with the object that it replaces the knowledge process. By modeling object creates the possibility of obtaining new data about real objects studied, and include these data in the models themselves.

Digital model of an object or phenomenon consists of information stored systematically on elements and links contained in an analogy to the structure and function of the properties that describe, an arbitrary or private three-dimensional coordinate system, shape and characteristics of the object.

As basic information unit, a classical vector consisting of coordinates (X, Y, Z) may include in its representation different information, technological data, geological, geothermal, etc.. In this context, digital terrain model is the spatial distribution f (X, Y, Z) of a complex of features of land, with adequate precision in points or any part of the attached model.

The process for generating digital terrain model includes 3 steps:

- data acquisition;
- grid generation ;
- extracting information from the grids.

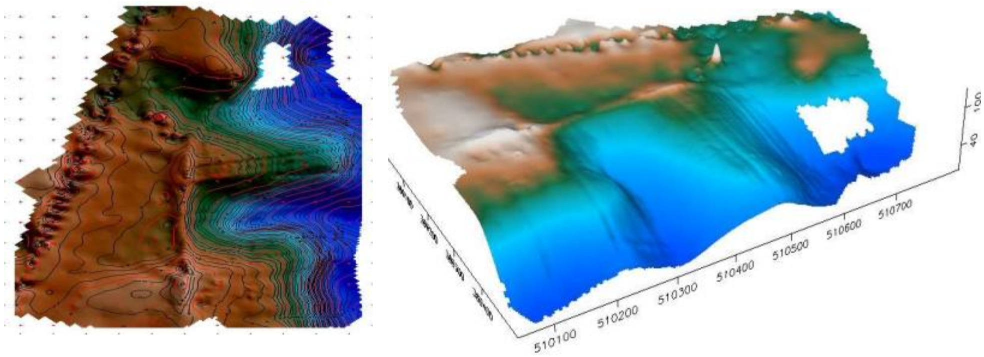
In this case too, data acquisition methods may be direct or indirect. From obtained data is generated digital terrain model, allowing to determine rates at any point of given coordinates (X, Y).

There are two basic concepts by which these models can be generated:

1. digital models irregular, consisting of a grid of planar and spherical triangles, points measured representing grid nodes;

2. regular digital models, using „mesh” diagrams that forms a planimetric grid.

Rates of grid points are interpolated using reference points and geomorphological data.



a) b)

Fig. 3 Digital models - New World archaeological site, Alba Iulia
a) 2 D digital model b) 3 D digital model

CONCLUSIONS

Using CAD systems allows the possibility to simplify, speed, data processing and development. Mapping object is to achieve manually so far, much faster. Corrections, additions and merge of databases are always possible. Thematic detail maps listings (paleobotanic maps, the spatial distribution of finds, the complex deployment phases) does not have limitations on the plot.

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