Graphical Plotting with the Zeiss PLANIMAP System

By Johannes Saile
Carl Zeiss Oberkochen
West Germany
Commission IV

1. Introduction

The conventional method of photogrammetric on-line plotting, i. e. direct transfer of floating-mark movements in the stereoplotter to the drive elements of a tracing table, is being abandoned for the intercalation of a computer. In the digital plotting method the computer cyclically reads coordinate counters to determine the location of the floating mark, and processes the point data in accordance with the operator's specifications. The graphical information obtained in this way is stored and, if desired, plotted in real time. This breakdown of conventional plotting into two separate operations, namely measurement and output, provides processing and photogrammetric workstation equipment advantages.

Digital plotting has been implemented for analog instruments and for the analytical plotters of the Zeiss Planicomp family with the PLANIMAP mapping software. The PLANIMAP programs and their performance are described in the following. The new Zeiss Videomap system for real-time superimposition of measured graphical data with the stereo image is then presented for the first time.

2. Hardware Components

2.1 Stereoplotters

The performance range of the PLANIMAP software is independent of the type of stereoplotter used. As a rule, existing analog plotters can be used for data collection. Field installation of encoders may be necessary. The analog signals from the encoders are digitized by a coordinates counting unit, and the digitized data is transferred to the computer via an interface. A typical configuration is an E3 Planicart with a Direc 2. Instead of an analog plotter, a two-dimensional digitizing table could also be used for data acquisition.

Regarding analytical plotters, the whole Planicomp family may be mentioned /5, 6/, and in particular the cost-effective C 130 Planicomp.

Program handling with the two instrument types is similar. Differences derive from the photogrammetric panel of the Planicomp viewer, which is easily accessible at the operator's workstation and is used for command input and function control.

When an analog instrument is used, the same commands are used but have to be entered with the terminal keyboard keys. This requires looking away from the eyepiece. This disadvantage can be avoided by using a voice recognition unit. It affords faster measuring because it eliminates the time-consuming command keying chore.

2.2 Graphical Periphery

The PLANIMAP software uses the GRAPH F1 library of graphic routines which supports the Hewlett-Packard HP 2648 and HP 2623 graphics CRT terminals and the HP 7580, 7585 and 9872 plotters /1/. Because of their precision and tracing tools, these units can be used only for summary and test plots, but the high plotting speed ensures the short plotting times required for such tasks.

The DZ 7 digital tracing table /4/ can be used for final plotting of the stored data. The DZ 7 has seen considerable detail improvements during the past years. It has recently been enhanced by a tangential control system for chisel-shaped scribers which permits scribing line widths of up to 1.5 mm. The drive of this tangential control system is so designed that two tools of a triple tracing head face in the traveling direction. The use of up to three tools allows plotting in the large-scale range without tool change.

The Zeiss Videomap system, a high-resolution CRT unit for vector graphics superimposition on stereo models, is new. Superimposition is possible with the Planicomp family instruments and with the E3 Planicart. Videomap is described in detail in section 4.

2.3 Computers and Peripheral Equipment

The PLANIMAP software does not place any additional demands on the computers used in the Planicomp family. Even the cost-effective HP 1000 A600 provides sufficient processing power for graphical plotting.

The HP 1000 A600 is also used for plotting with analog instruments. A process-control computer of this size is required for cyclically reading the coordinates of the floating-mark position. When Videomap is used, cyclical control of the display memory is also required. If all plotting instruments are equipped with their own computers, standalone workstations for distributed data processing are obtained.

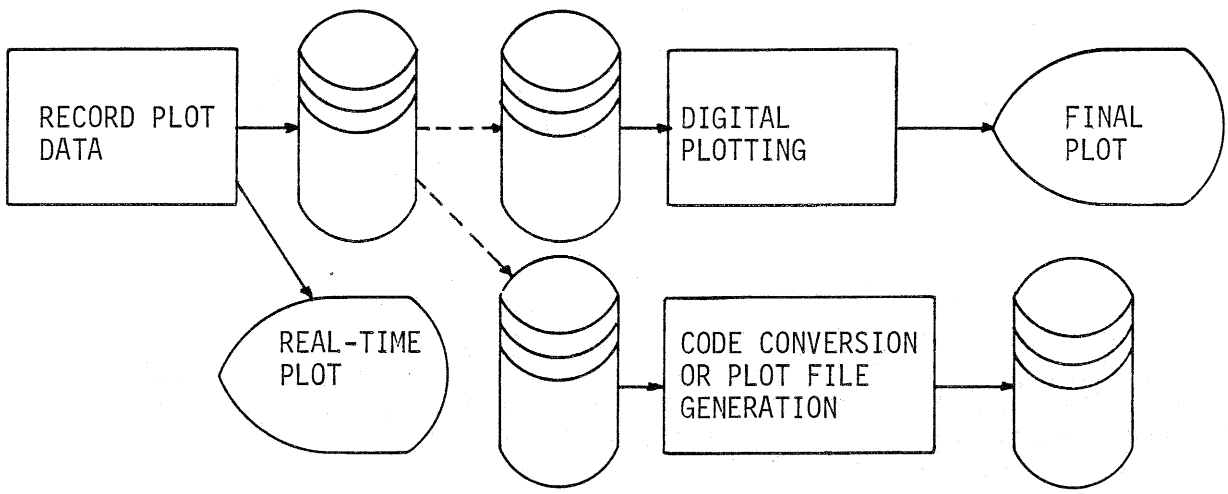
The whole range of disk drives offered by Hewlett-Packard is available for mass storage. The storage capacities currently range from 10 MB to 132 MB. The new Winchester disks have backup facilities which not only permit data backup but also data interchange between workstation. Data interchange is also provided by magnetic tape units and computer interconnection /6/.

3. PLANIMAP Software

3.1 Survey

The PLANIMAP software consists of two parts - a data collection part and a plotting part. The collection part (RECORD PLOT DATA) serves to measure the graphical elements, to store them in a file, and to output them in real time to Videomap and a plotter (DZ 7 or HP plotter) or HP graphics terminal if desired.

PLANIMAP creates files with identical format regardless of the instrument it is used with. The file content consists of the ground coordinates of the measured points and of the control codes entered by the operator. The plotting part (DIGITAL PLOTTING) outputs the data to the devices mentioned in section 2.2. Code conversion for other data bases and plot file creation for other plotting systems can be programmed.



3.2 RECORD PLOT DATA

The RECORD PLOT DATA program can be started at the photogrammetric panel of the Planicomp or with a PLANI-AS command if an analog instrument is used /2/. The operator then selects a measuring mode and records measured points by foot switch depression. Over 15 measuring functions are available in five groups.

Single points

Every measured point is represented by a symbol. The symbols can be defined freely and are read from the symbol library by means of their numbers. The measured points can also be labeled with their elevation or number.

Open lines

In this mode the measured points are interconnected either with vectors, arcs, or splines. Another connection type can be selected at any time. A parallels mode can be activated in addition. The line types range from simple solid lines through interrupted lines to symbol lines. In the latter, symbols from the symbols library are plotted at specified intervals either automatically or individually. In the trace mode, points are recorded automatically depending on curvature and are interconnected by vectors. With some restrictions this mode simulates the former direct hook-up of the tracing table with the plotter.

Closed lines

This group covers two-dimensional objects. In addition to the boundary lines, which are plotted as open lines, areas can be hatched or filled with symbols, and specific enclosed areas (islands) can be kept clear.

In addition to a simple measuring procedure for rectangular objects which computes the fourth corner after three corners have been measured, there is a comfortable measuring function for complex buildings /3/. It allows the data of buildings with any number of corners to be collected by measuring either the corners or the sides. The program automatically recognizes right angles and parallels and corrects the measured data accordingly. The buildings can also be aligned with a reference line in direction and distance.

Slopes

Data of such objects, which occur frequently in large-scale maps, is collected by measuring the upper and lower edges. These break lines can be represented as open lines. The slope hatchings proper are executed in accordance with specific parameters which define the slope representation. The slope algorithm /7/ normally generates good cartographic representations, but manual corrections may be required in a small number of exceptional cases.

Texts

Texts are properly positioned by measuring the direction and the begin point. Plotting parameters specifying the size, slant and aspect ratio of the lettering allow font variations.

In addition to these measuring commands there are help commands which inform the operator of the current status of a selected function and of the current parameter settings.

By means of remarks, the operator can also store numeric codes, e. g. for object coding or position marking, which are skipped during plotting with DIGITAL PLOTTING. These codes facilitate fast direct positioning and can also be used for control functions in user programs.

Data editing and measuring error correction are enabled by the GEFIL program. Errors can be located by means of the mentioned marks or with SEARCH POINT. The SEARCH POINT program uses a geometric position entry and the digitized coordinates to determine the record number of the nearest point in the file.

3.3 DIGITAL PLOTTING

The DIGITAL PLOTTING program outputs the stored map content to a graphical output device.

In the orientation section, parameters are used to relate the ground system to the table system. These parameters are computed either by matching to an existing map, e. g. a map plotted with the SHEET program, or by matching to a window selected at the plotter.

The content of the data file, i. e. the digital map, is edited for the selected output device by means of numeric codes contained in the plot instructions. Several files can be plotted with the same orientation parameters. The data volume thus can be broken down into smaller applicationoriented lots during collection, e. g. by object types or subareas of a model.

It is also possible not to plot the digital map but to convert it with a modified program for further processing with different systems.

4. Videomap

4.1 Objective

Videomap is a system for superimposing digital data onto the left photo of the stereomodel. Superimposition enables the operator to directly compare the aerial photograph and the digital data set.

This enables him to perform the following operations in an easier, quicker and more convenient way:

- Completeness check
  Comparison by direct vision is more effective and reliable because alternation between the model and the plotter or CRT screen is avoided.

- Avoidance of double measurements
  Direct superimposition permits unambiguous labelling of every object.

- Measurement accuracy check
  This is particularly valuable while measuring with adjustment algorithms, e. g. building measurement, because the computation result can be compared directly with the original object.

- Measurement improvement
  Linkage with already measured situations, e. g. connection of lines at intersections, is much easier and more precise.

Videomap can replace real-time plotting units which basically perform the same function but require the operator to divert his attention from the eyepiece image. A considerable saving in time can be expected for the above reasons particularly if in addition data collection is voice-controlled.

4.2 Videomap Description

Videomap consists of a Hewlett-Packard high-resolution vector display unit and a Zeiss control unit. The control unit connects to the computer through an HP IB interface (IEEE 488).

The graphical data set transferred by the computer is stored in the display memory. This display memory has an address range of about 1000 mm x 1000 mm, a resolution of 0.064 mm (both referring to the screen) and a capacity of about 20 000 vectors. The Videomap microprocessor scans the display memory with a frequency exceeding 1.5 Hz and transfers the data required for the display window to a separate display memory.

The display window (size about 65 mm x 65 mm) is represented with a reduction of about 2.5x and is continually shifted so that it always matches the current eyepiece image. The display memory content is displayed on the CRT screen with a refresh rate of about 100 Hz. This high refresh rate ensures a stable and clear display. Display window shifting can be initiated by encoder signals or by means of shift vectors transferred over the computer interface.

The vector line width on the screen is about 0.1 mm. Converted to the eyepiece image, this results in a line width of about 40 micron, i. e. the line width is about the same as the floating-mark diameter.

If the operator should find continuous superimposition inconvenient, he can temporarily disable superimposition by means of a foot switch. This does not affect the Videomap memory content.

Videomap allows texts to be fixed, i. e. texts are not shifted with the carriage motion. The PLANIMAP software uses this feature for input acknowledgment. This acknowledgment method is particularly appropriate when voice input is used. The operator can check visually that the commands have been recognized properly or make any corrections that might be required.

The comprehensive set of Videomap instructions comprises instructions for

- executing vectors and displaying texts and point symbols,
- representing texts, stationary on the screen,
- shifting the display window and
- controlling the display.

The interface for programming and controlling the Videomap system is similar to the DZ 7 or HP plotter interfaces. Thus Videomap can also be controlled by user-written programs processed by HP or other computers.

5. Conclusions

The PLANIMAP software opens up new roads in photogrammetric plotting. Digital storage facilitates later data transfer to interactive graphic systems for further cartographic processing. PLANIMAP and Videomap and the new compact computers call for reconsideration of current stereoplotter workstation configurations.

Literature:

/1/ Hobbie, D.: Weiterentwickelte Graphik zum PLANICOMP Bildmessung und Luftbildwesen, Heft 1, 1984

/2/ Hobbie, D.: Das Zeiss-AS Programmsystem zur interaktiven Messung von Photogrammetrischen Daten, Kommission III, 14. Kongreß der ISPRS, 1980 Hamburg

/3/ Kröll, F.: Zur Orthogonalisierung photogrammetrisch bestimmter Gebäudekartierungen Allgemeine Vermessungs-Nachrichten, Heft 6, 1980

/4/ Lorch, W. und Schwebel, R.: DZ7, ein Digitalzeichentisch für die graphische photogrammetrische Auswertung, Kommission II, 14. Kongreß der ISPRS, 1980, Hamburg

/5/ Rüdenauer, H.: Die PLANICOMP-Familie, Merkmale und Neuerungen Bildmessung und Luftbildwesen, Heft 1, 1984

/6/ Hobbie, D. und Rüdenauer, H.: The ZEISS Planicomp-Family: A User-oriented solution to practical requirements, Commission II, 15. Congress ISPRS, 1984 Rio de Janeiro

/7/ Pointer, P. und Leberl, F.: Automatische Böschungsflächen-Schraffur Allgemeine Vermessungs-Nachrichten, Heft 8, 1982.

Abstract

The PLANIMAP software package supports large-scale photogrammetric plotting with analog instruments and with the analytical plotters of the Planicomp family. Collected graphical data is stored on magnetic disk for further processing. Concurrently with storage, the data can be put out to graphical equipment, e. g. the new Zeiss Videomap system for superimposing digital data onto the left eyepiece image of the stereomodel. The PLANIMAP editing functions allow measuring data errors to be corrected before plotting. This facilitates photogrammetric manuscript plotting in virtually final form.

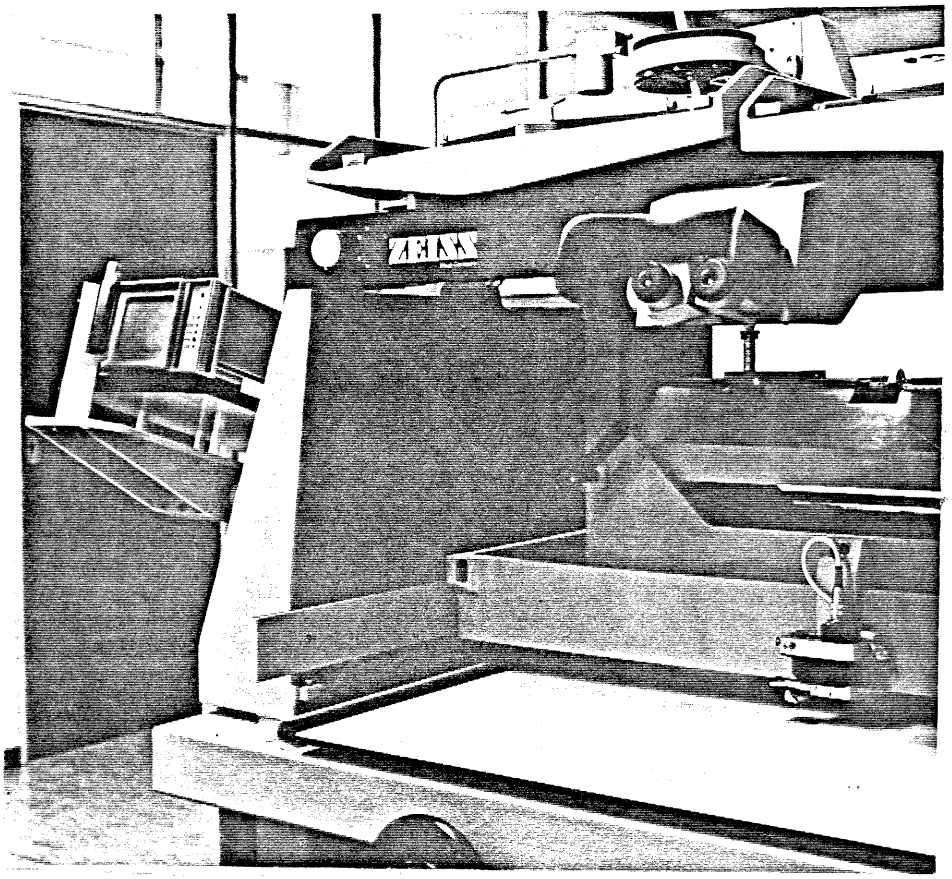


Fig. 1: Planicart E3 with the Videomap screen

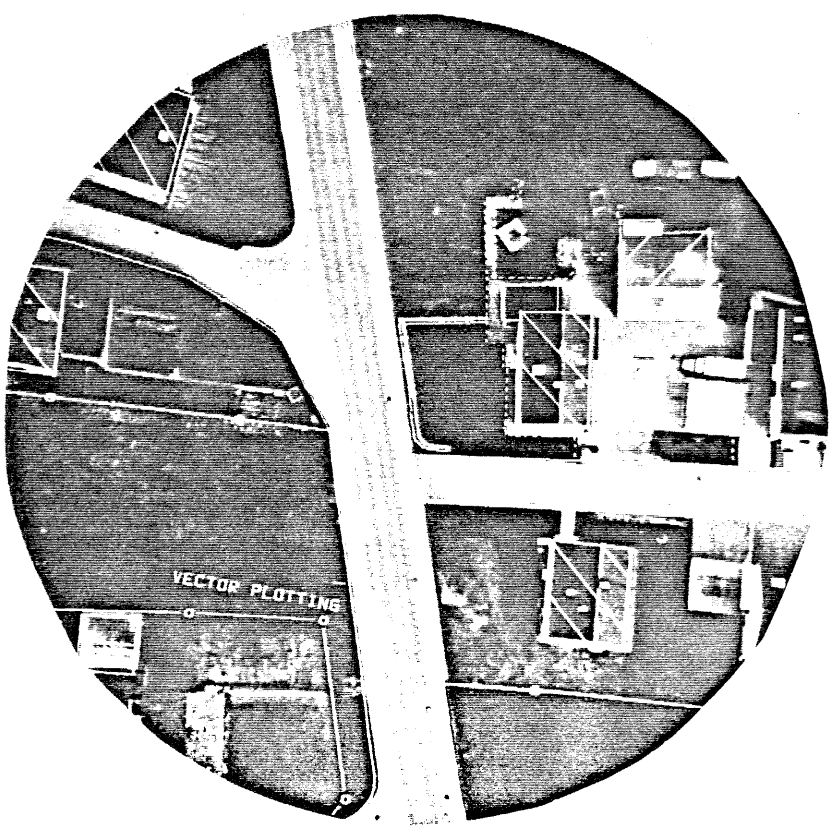


Fig. 2: Superimposition of digital data on aerial photo

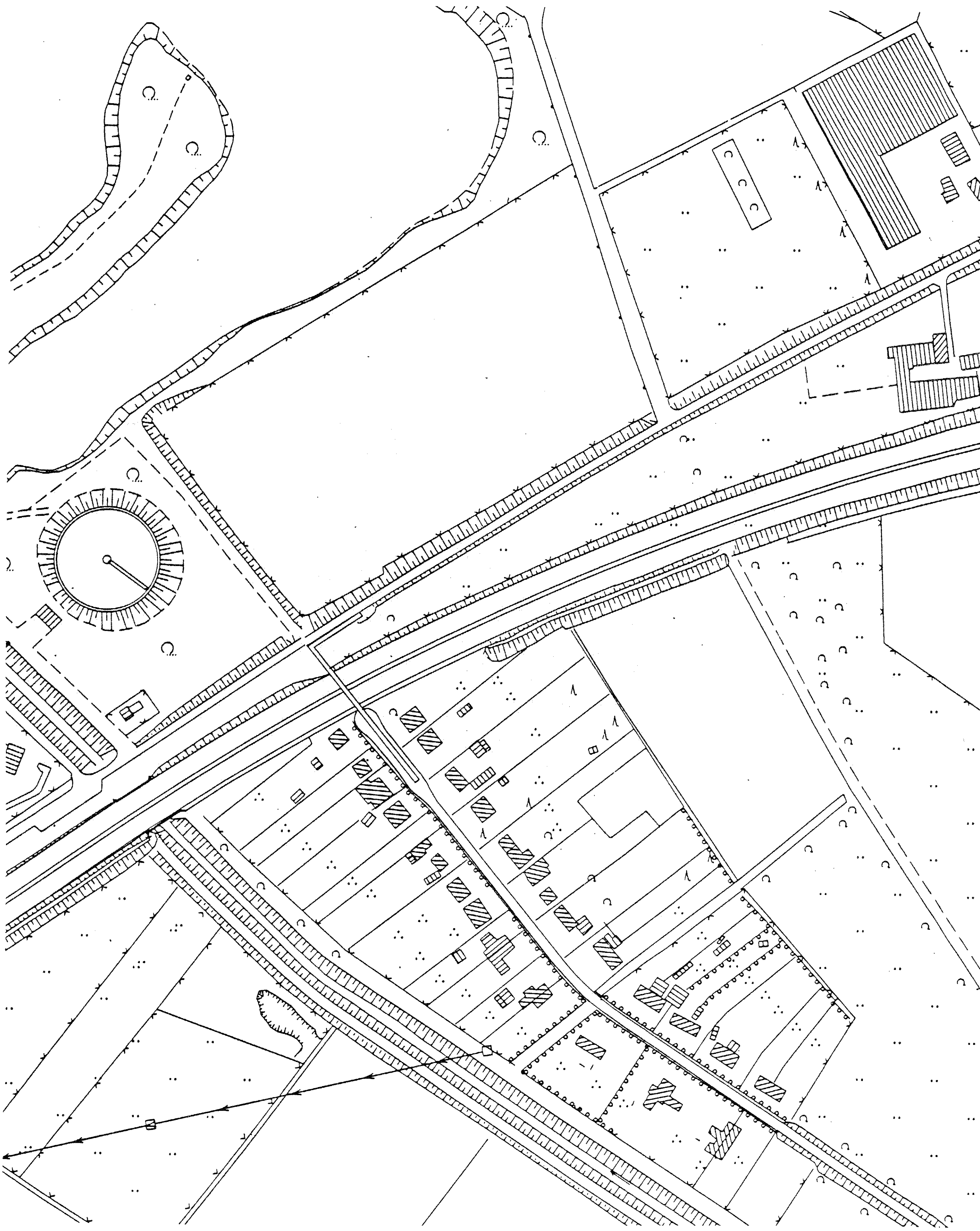


Fig. 3: Large-scale mapping with Planimap and DZ7

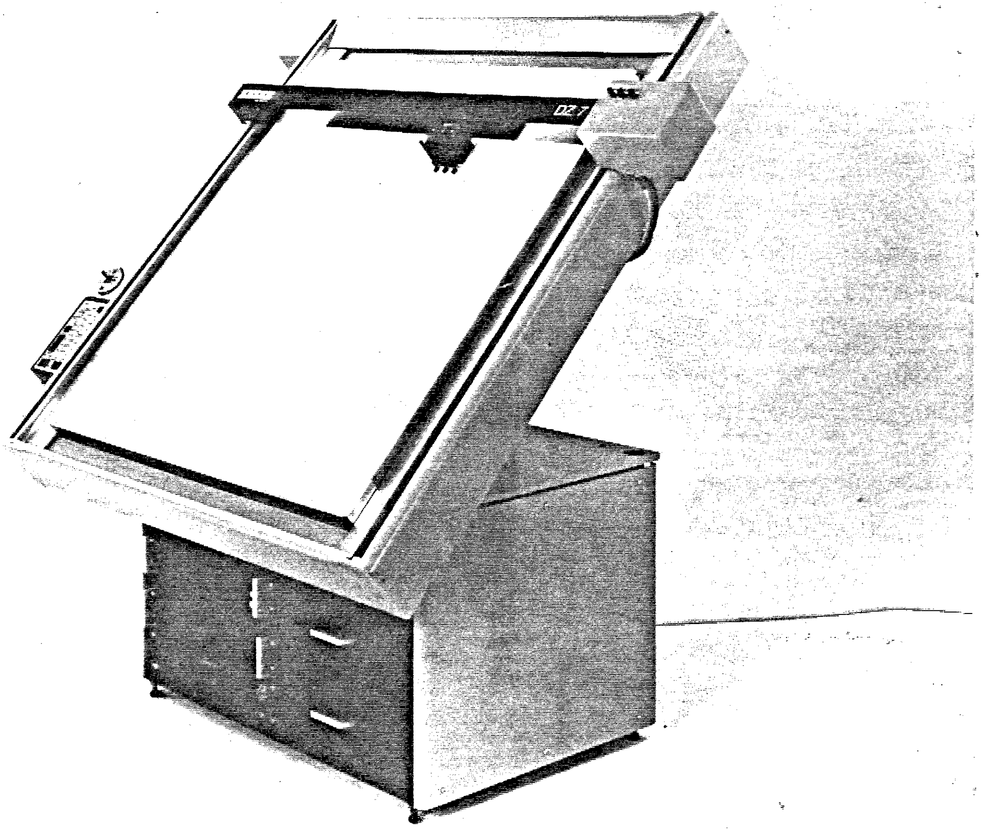


Fig. 4: Digital drawing table DZ7