O9-1 THE ELECTRICAL RESISTIVITY METHOD - A USEFUL TOOL IN EVALUATING GEOLOGICAL AND GEOTECHNICAL CONDITIONS FOR CONSTRUCTION AND ENGINEERING PROJECTS

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Maximum rainfall in Greece occurs during the period of November through April followed by a relatively dry period. The lack of vegetation combined with steep, or relatively steep slopes in the mountain and hilly areas create conditions of atmospheric precipitation fast run-off. A significant amount of the rainfall flows towards the sea, while another portion of the water (depending on lithology) infiltrates through permeable formations and discontinuities to the lower layers (subsurface formations). It is important to notice that even water that infiltrates in the deeper formations may be finally discharged, through springs and streams, to the sea (especially where carst formations are present). Within these regions, the creation of "water tanks" (artificial lakes) by utilizing dams of low or, medium height is a good solution to exploit surface water and enrich (artificially recharge) the water table (aquifer).

The geological, hydrogeological, geotechnical, geomorphological and environmental parameters (aspects of an engineer and a geologist) are examined for the dam construction. The goal is to detect if Site conditions are suitable to place the dam and therefore achieve water detention and enrichment of the water table. These parameters are taken by:

- **geological survey** (geological formations, fault system, slope stability, landslides, composition and degree of weathering of rocks, etc.)
- **geomorphological survey** (general characteristics, qualitative analysis of hydrographic networks: density, frequency, slope gradient)
- **hydrogeological survey** (hydrological characterization of all site formations, hydrologic balance: climatic data, evaporation-transportation-sublimation, infiltration, runoff and spring discharge)
- **geotechnical survey** (geotechnical behavior of soil and the existing geological formations)
- **environmental survey** (evaluation of site conditions and impact of dam construction on the environment)
- **Seismic hazard assessment**
- **Hydraulic study** (height, positioning and other dam characteristics, estimated water volume to be collected)

Valuable data for the above parameters are taken with **geophysical methods**. The electrical resistivity method is a good tool for the detection of geological layers that have respective hydrogeological identities. The **"Combined Schlumberger & Dipole-Dipole" array (CSDD)** [Apostolopoulos, 1996] detects the underground in three directions, vertically and diagonally. Since the dipole-dipole values are transformed to Schlumberger values then, for a profile with in line CSDD soundings the apparent resistivity section made by many input values (Schlumberger and transformed dipole-dipole ones) can be interpreted by a 2-D technique [Apostolopoulos, 1996]. The result of such a resistivity survey is 2D sections and 3D presentation of the underground with the layers and their respective geophysical parameters.

A geophysical survey (Fig. 1) was part of a geotechnical project for the construction of an artificial lake that will irrigate nearby fields in the Central Greece. Five resistivity profiles with in line CSDD soundings supplied after the 2-D interpretation valuable information that may be used to evaluate geotechnical conditions. The most important findings are the following : **a)** the presence of limestone between the centers of "MIL-2" and "MIL-1" profiles. This limestone is in the vicinity of the future dam axis (west slope of dam foundation)

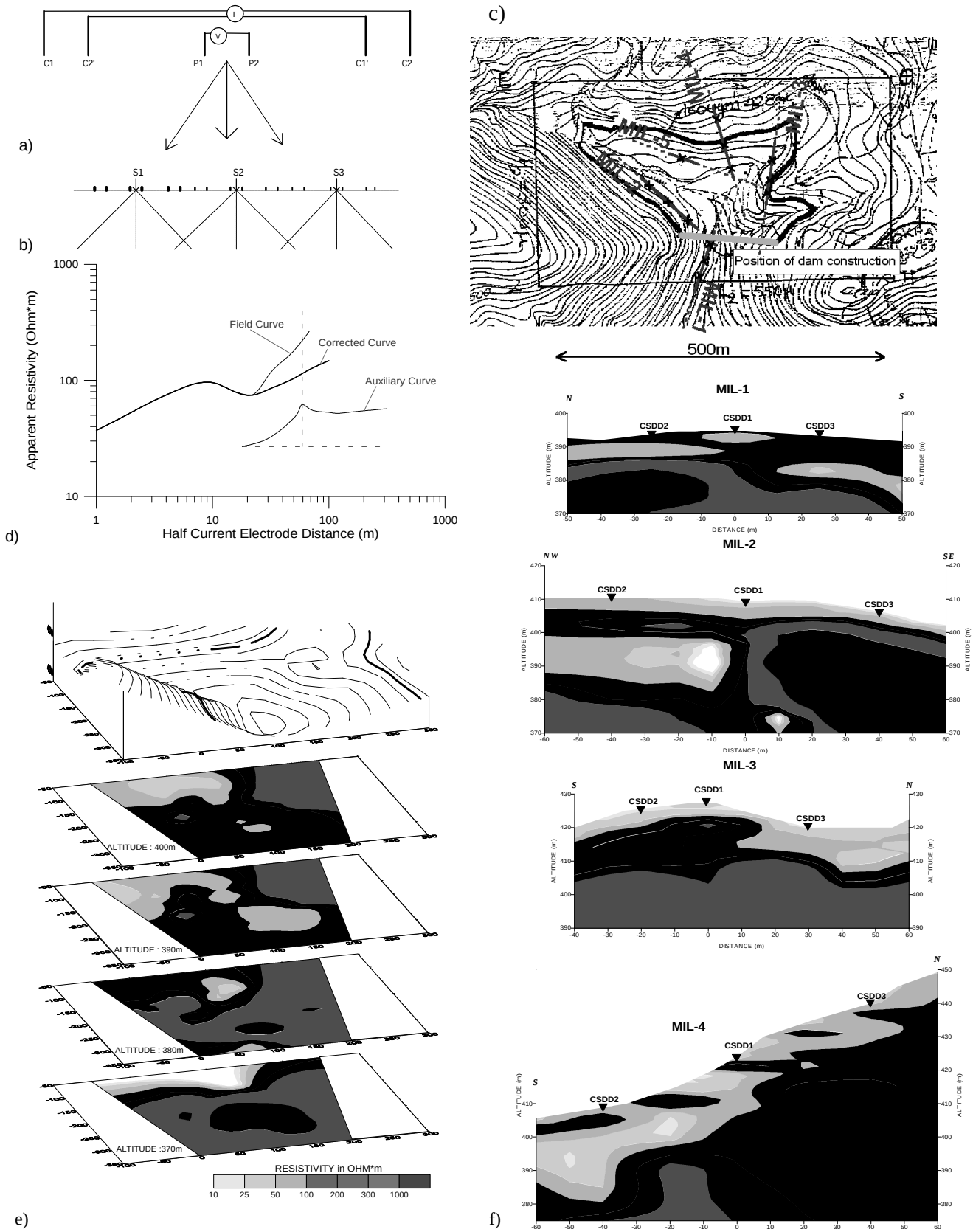

Fig. 1. a) Combined Schlumberger & Dipole-Dipole" array (CSDD), b) In line CSDD soundings, c) Topographic map where the future artificial lake is outlined, the resistivity profiles are presented with gray lines and the dashes continue to show profiles direction. A heavy light gray line gives the position of dam construction. d) Presentation of the graphical procedure resulting the correction of the curve and positioning of the lateral interface The Schlumberger curve was made with the respecting values of $CSDD1_{MIL-4}$, The presence of inhomogeneity is proved since it is present and in the section after the 2d interpretation. e) 3D presentation of the topographic relief and the results of resistivity interpretation with slices of the underground with constant altitude. f) Resistivity sections after 2-D interpretation of the apparent resistivity section made by three CSDD in line resistivity soundings. In the area between the centers of "MIL-2" and "MIL-1" profiles there is limestone which is in the vicinity of the future dam. The greater thickness of the conductive surface material in "MIL-3" and "MIL-4" sections are due to the erosion activity that is evident in the topographic map. (the same results are presented in the previous 3d picture).

b) The depth and shape of bedrock (pure schist) relief is presented in 2d and 3d ways **c)** The thickness of soil and weathered or eroded - fractured schist - flint is evaluated (the greater thickness of loose material in “MIL-3” and “MIL-4” sections is due to the erosion activity which is evident in the topographic map). **d)** The erosion is the main reason for the many lateral inhomogeneities in the sections without excluding the possibility of fault presence. These inhomogeneities have been detected by field data as well since they create electrode effects in the apparent resistivity curves (the curves corrected by a graphical method [Apostolopoulos, 1993] give the position of the inhomogeneity and the values used for the interpretation).

The above valuable information by the geophysical survey contribute a lot in the previous mentioned surveys and help in the positioning of geotechnical test boreholes and upgradient and downgradient groundwater monitoring wells. The number of borings is reduced after the geophysical study.

References

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