DEFINING THE SLIDING PLANE AND DEFORMATION OF THE TERRAIN

MSc. Risto Popovski, Prof. Dr. Zoran Panov, MSc. Radmila Karanakova Stefanovska
Faculty of natural and technical sciences, University of Goce Delcev, Republic of Macedonia

ABSTRACT
During the preparation of this paper there were made terrain measurements on place with different geostructure characteristics. For the measuring here is used advanced equipment for movement on the placed points with methods and analyses who are widely used all over the world. In that way information's are collected for movement of the terrain and are processed, they are of big use for resolving a very complicated problems in mining, construction and appearance of natural landslides. Geodetic measurements are made, map terraining and a special notice while experimental researches is dedicated to geodetical measurement and measurement in geoelectric.

1. GEODETIC MEASUREMENTS OF INVESTIGATING AREA

For monitoring the terrain and making geodetic base with measuring points were made following geodetic activities:

- Making topographic maps of terrain
- Setting the measuring points (9) on the terrain;
- Design and construction of a polygonal web, from which to observe the terrain and mark the main points;
- Measurement of deformation occurring during the time period of two years.

The measurement is based on polygonal points from where one gets a topographic map which forms the basis for any analysis. For analyzes were made:

- Digital maps of the explored area
- Longitudinal and cross sections

1.1. Used equipment for geodetical measurement

WILD LEICA TC 1600 is a total station, the instrument which is used for prepare for digital topographic map and measure of the deformation and dislocation of the set benchmarks in the terrain during the period when we took and other measurements.

The company WILD has high quality whom they satisfy the high criteriums which they have proven on the market for geodetical instruments and equipment for geodetical purpices. One of those instruments is the WILD LEICA TC 1600 (Fig.1), even if it belongs to an older generation for our time it has amazing characteristics.

Fig. 1 WILD LEICA TC 1600

1.1.1 Methods for measuring angles in trigonometric network

For measuring on the moving terrain are used and applied different methods to measure angles in trigonometric network. Every method has its own pros and cons but most importantly is the method which is used for measurement, so the systematic errors can be eliminated. Some of the most used method's that are used for measuring angles in trigonometric networks are:

 Gyrus method,
 Schreiber's method,
 Sector method,
 French method and
 Method of closing the horizont

1.2. Geophysical researches

Geophysical researches are one of the most important disciplines for measuring and analyses for different characteristics of the underground geological formations. The identification of geological formations, location and quantity of groundwater, capacity of aquifers are often targeted by geophysical researches. With the right choice of geophysical method the researches is greatly increased researches on the designated area. In that way the number of research drill hole which is comparing and proving the geophysical clues and with that the number of investments is greatly plummeting. Thru analyses and researches of the sliding plane of rock massive is used geophysical method thru which is given a specifical electrical resistance

2. GEOELECTRICAL EXPLORATIONS

On the ground, measurement was made on the locations where deformation and sliding on the ground has occurred. The instrument TERAMETER SAS 1000 was used for measuring specific electrical resistance (Fig. 2).

Fig. 2 TERAMETER SAS 1000

2D-electrical tomography was applied representing surface geoelectrical method that explores the electrical resistivity of the geological environment. It is usually one of the methods of apparent electrical resistance. 2D surveys produce more accurate models of one-dimensional research, because there are taken into account vertical and horizontal changes in electrical resistance. On Fig.3 are showing the ways for connecting of electrodes in use: Wenner, Schlumberger array of electrodes, dielectrodes and dipole. You may have noticed that Wenner configuration is a special case where the four electrodes are placed at equal distance a. For Shlumberger array the ratio l / L will vary during normal measurement.

The different configurations of the electrodes provide advantages and drawbacks compared with one another in terms of logistics and resolution.On the terrain was made profiling with probing on the locations where deformations and sliding occurred. Results are analyzed with the software IPI2win which allows presentation of the results in 2D electrical tomography. The profiles are made according to the needs and conditions of the ground

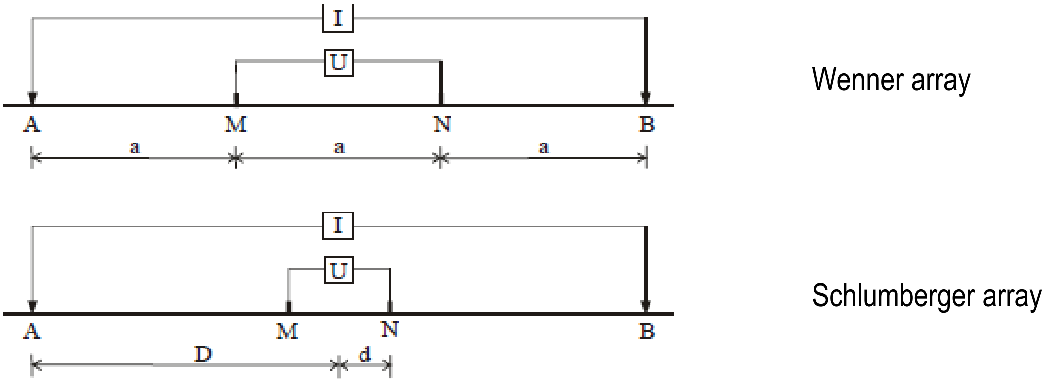

Fig. 3 Electrode arrays (A and B are current, M and N are potential electrodes)

3. RESULTS OF MEASUREMENTS

Geoelectrical measurements

On Fig. 4 is given a place of set geoelectrical profiles for measuring the apparent specific electrical resistance and trigonometric points for monitoring the deformation of the terrain and move it

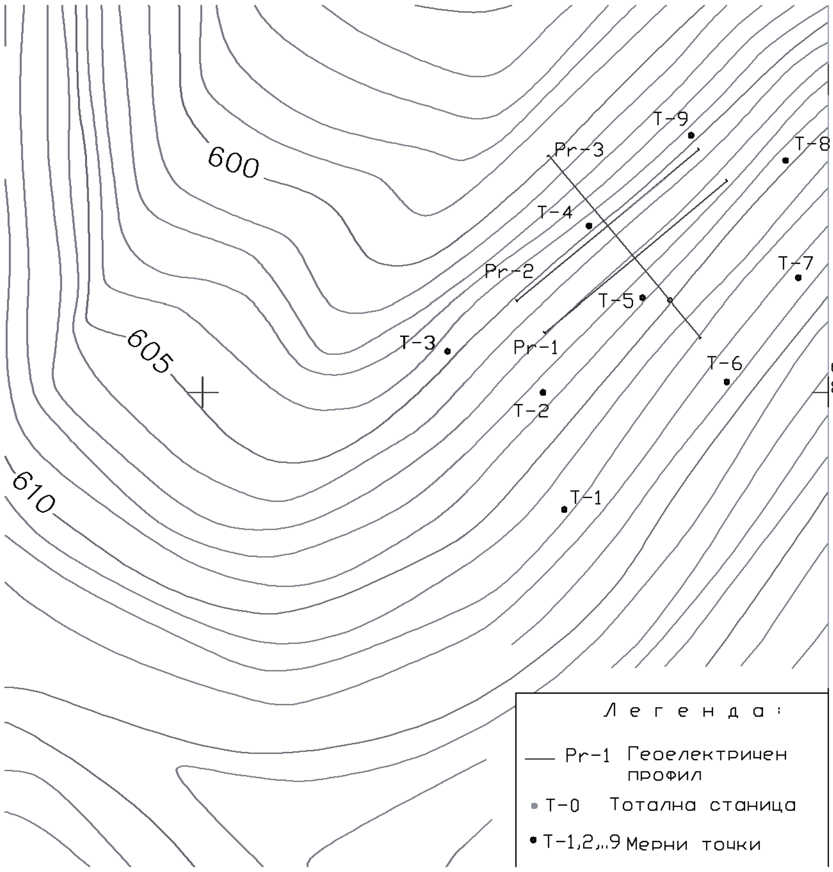

Figure 4

The profiles PR1 and PR2 represent us geo-electrical measurements of electrical resistance and modeled layers from the area. From here, you can see and guess where there could be a sliding plane which would reach the ground sliding. Model of the specific electrical resistance on the profiles PR-1 and PR-2 is given on the fig. 5. The layers are separated according the calculated resistance.

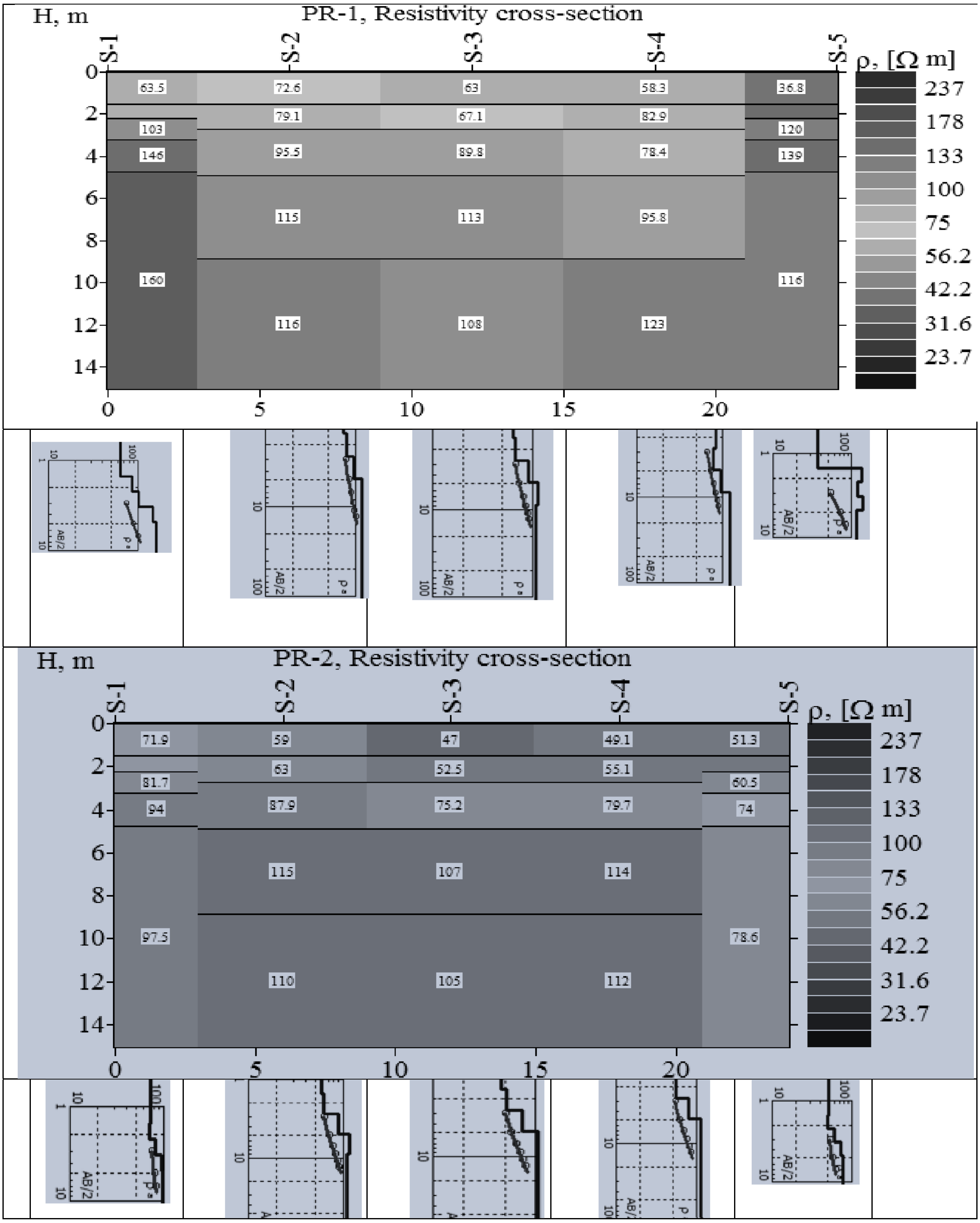

Figure 5 Models of specific electrical resistance on profiles PR-1 and PR-2

Geodetic measurements

There were made three geodetic records on the placed trigonometric network. In the table 1 are given coordinates of the benchmarks. J just want to mention that during the next two measurements some of the benchmark points were missing. So, the curiosity of the people could not be prevented, so from the last measurement are missing six benchmarks. Finally, from the results can still be seen, although missing some points there were slight displacement of some benchmarks.

Table 1

Coordinates				Moving		
	X-0	Y-0	H-0	DX	DY	DH
T-0	7604364,760	4622920,760	610.57	0	0	0
T-1	7604457,802	4622831,193	611,91	0	0	0
T-2	7604454,371	4622849,961	608,56	0	0	0
T-3	7604439,100	4622856,560	604,53	0	0	0
T-4	7604461,769	4622876,608	604,67	0	0	0
T-5	7604470,309	4622865,072	608,93	0	0	0
T-6	7604483,801	4622851,667	613,81	0	0	0
T-7	7604495,250	4622868,290	613,77	0	0	0
T-8	7604493,213	4622887,090	609,85	0	0	0
T-9	7604478,115	4622891,110	604,82	0	0	0

Table 2

coordinates				moving (m)		
	X-1	Y-1	H-1	DX-1	DY-1	DH-1
T-0	7604364,760	4622920,760	610.57	0	0	0
T-1	7604457,802	4622831,192	611,91	0	0,001	0
T-2	7604454,379	4622849,972	608,56	-0,008	-0,011	0
T-3	7604439,113	4622856,581	604,539	-0,013	-0,021	-0,009
T-4	7604461,784	4622876,634	604,682	-0,015	-0,026	-0,012
T-5	0	0	0	-0,007	-0,005	-0,003
T-6	7604483,801	4622851,667	613,81	0	0	0
T-7	7604495,251	4622868,29	613,77	-0,001	0	0
T-8	0	0	0	0	0	0
T-9	7604478,137	4622891,134	604,823	-0,022	-0,024	-0,003

Table 3

Coordinates				Moving (m)		
	X-1	Y-1	H-1	DX-1	DY-1	DH-1
T-0	7604364,760	4622920,760	610.57	0	0	0
T-1	7604457,802	4622831,192	611,910	0,000	0,001	0,000
T-2	0,000	0,000	0,000	0,000	0	0,000
T-3	0,000	0,000	0,000	0,000	0	0,000
T-4	7604461,790	4622876,644	604,688	-0,021	-0,036	-0,018
T-5	0,000	0,000	0,000	0,000	0	-0,003
T-6	7604483,801	4622851,667	613,810	0,000	0	0,000
T-7	7604495,251	4622868,290	613,770	-0,001	0	0,000
T-8	0,000	0,000	0,000	0,000	0	0,000
T-9	7604478,143	4622891,136	604,830	-0,028	-0,026	-0,010

CONCLUSION

One of the main problems in mining, building, road construction and other geotechnical works which are connected with the rock masses, is their stability. From the obtained data of geo-electrical sounding can be concluded that from the specific electrical resistance of the rock masses can determine sliding plane of the landslide. The places which are of capital importance (mines, dams, hydropower and other geotechnical structures), which threatened the stability of the ground it is recommended continuous monitoring of multiple parameters. We recommend placing a measuring instrument for continuous monitoring of deformations (displacement), pore pressure, complete voltage condition on the ground, specific electrical resistance, etc. If there is more information about the condition of rocks there will be more reliable models for the calculation of stability and determination of the safety factor.

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