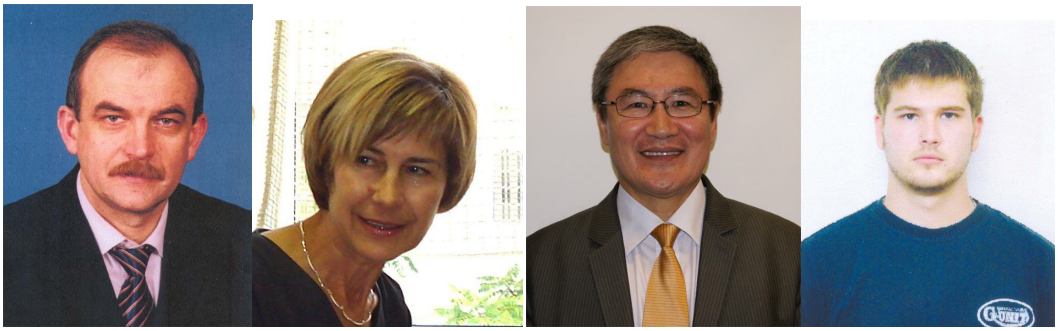
Remote methods researches of system “base – foundation – above ground building”



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ABSTRACT: The opportunity of use of remote nonconventional methods for an estimation of system « base - foundation - superstructure » is shown raised radiation taking place in a working area. Scheduled positions of fractured zones marked in the basis of a builded building of the cultural - tourist center in Zaporozhye on map and directly on locality, determined with use of biolocation effect, were identical. Results, which were received with use of biolocation methods, have confirmed with devices, geophysical researches and scientific experimental works on cementation detected of fractured zones.

1 INTRODUCTON

Atomic engineering development is accompanied by troubles of various complexity and danger. For an estimation of scales of troubles, workings out and realisations of operative measures on their localisations, workings out of technical actions for liquidation of consequences of troubles it is necessary to have the true information on a condition of building designs (Yu. Nemchinov et al. 2006).
The reliability of the prediction of stress-strain condition of the “base – foundation – above ground building” system is dependant on the different factors, which among the most important are the engineering-geological investigations extent and quality, and the reasonable selection of calculation models and technical studying of a condition of building designs. To receive the full information on building object in the conditions of raised radiation not always it is given possible, or it is connected with the big financial expenses.
In Ukraine we have experience of a remote estimation of the is intense-deformed condition of system “base – foundation – above ground building” with use of automated measuring-information system "Monitoring" is resulted. The system is based on inductive transformers. Information on physical magnitudes is being monitored and periodically collected and then processed and stored in computer.
The following parameters of «base – foundation - superstructure» system are monitored: direction and value of structure displacement; tilt angle; settlement; size of crack opening. The advantage of the automated system is that the period of system starting and monitoring can be programmed using

a mobile telephone, including in inaccessible places. Technical characteristics of sensors are as follows: metering accuracy is 0,001 mm; temperature range is $-30^0 \ldots +70^0$; weight is 0,22...0,6 kg; external dimensions: 25…76 mm diameter in diameter; length is 190…246 mm. The sensor case is damp- and dustproof.

The obtained data is transferred in the centre of processing of the information in the form of SMS messages. The computer program allows to count a direction, size of displacement of a design for a point of installation of the detecting device. Taking into account the results of monitoring, this allows to estimate the deflected mode of building structures (A.V.Shokarev, 2009).

Increase of metrological characteristics of a monitoring system with electromagnetic detecting devices is connected to the decision of a problem of reduction of influence on reliability of results of the supervisory control of external factors. To such factors it is possible to relate an ambient temperature; the external electromagnetic field formed at change of a radiating background, etc.

For reception of the information on system « the basis - the base - the superficial structure » taking place in a working area of raised radiation is offered to use also remote nonconventional methods.

Biolocation effect is used for the decision of similar tasks. Biolocation effect is the act of radiation acceptance by men and its indication as formation of ideomotor act causing turn of framework or fluctuation of pendulum, etc. The Phenomenon of the given effect has not satisfactory theoretical substantiation but there are many concepts of work of indicators of effect (a pendulum, a framework, a rod, etc.) (Sochevanov N.N. et al. 1984) The method based on use of biolocation effect is biolocation and it is applied for the decision of various tasks including search of deposits and geological mapping (Puccko L.G , 2002).

The purpose of the present work is to show an opportunity of use of remote nonconventional methods for an estimation of system « the basis - the base - a superficial structure » to raised radiation taking place in a working area.

2 BRIEF CHARACTERISTIC OF INVESTIGATION SITE AND TECHNIQUE OF WORKS PERFORMANCE AND TECHNIQUE OF WORKS PERFORMANCE

The investigation site is located in the central part of Zaporozhye on the left coast of Dnepr valley; this is excavation in rocky massif in length up to 100m and width up to 30m. The site from the north is limited by Tbilisi Street and from the south borders with the artificial lake located on a place of former building quarry with the water table close to a water level in Dnepr. Difference of marks between a water level in lake and a mark of bottom of excavation makes ~14m. It is planned to construct a cultural - tourist complex on the given site.

The complex engineering - geophysical researches of fracturing estimation of the given rocky massif were executed in February … March 2007 by Zaporozhye branch NIISK. The primary goal of work was the estimation of fracturing estimation of rocky massif and elements of an engineering - geological structure of site taking into ac

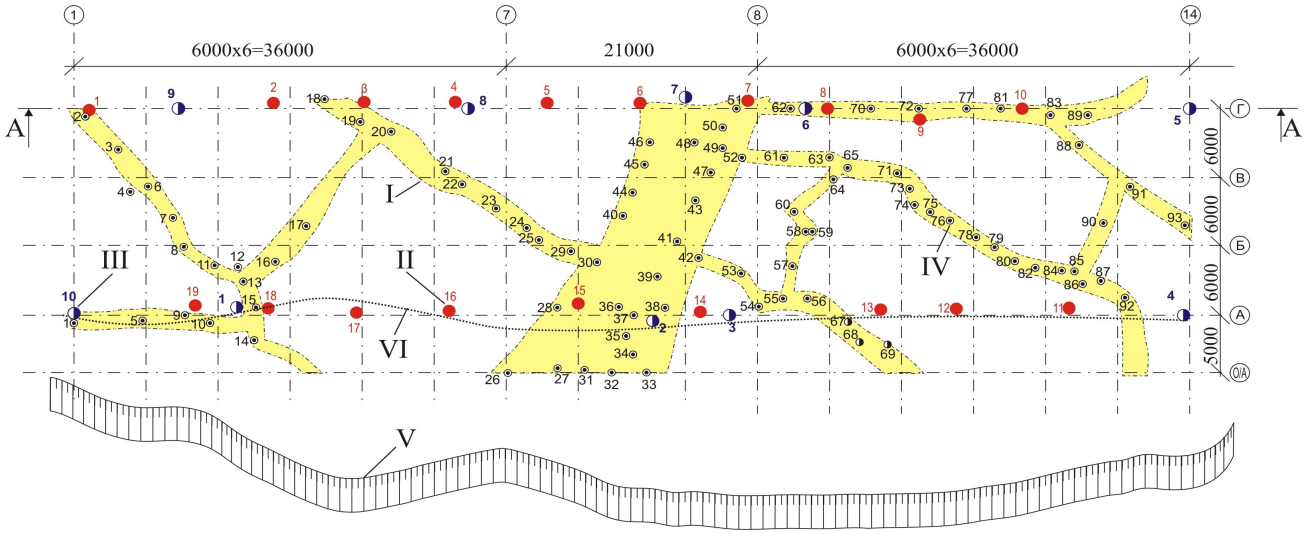

Figure 1. The circuit of an arrangement of cracked zones, points of sounding and cementing boreholes on platform of construction of the cultural - tourist complex in Zaporozhye: I- cracked zones determined with the help of remote and direct biolocation methods; II-points of electric sounding; III-points of magnetic- resonant sounding; IV-cementing boreholes; V-ledge of quarry; VI-border of zone with increased fracturing of rocky massif which formed at development of quarry.

count probable natural and technogenic components.

The complex of works including three stages has been executed for the decision of tasks.

The first stage included performance of engineering - geophysical researches of fracturing estimation of rocky massif (The report about engineering, 2007) (Fig. 1): remote biolocation researches on map (a topographical basis); direct biolocation researches on locality; electroprospecting works on locality by method of vertical sounding (VES); works on locality with use of method of passive magnetic- resonant location of subsoil (PMRLS);

The second stage included experimental researches of cracked zones: development of the project of cementation of the top part of zone with increased fracturing of rocky massif (The work design, 2007); performance of cementing works on tested site; cementation of rocky massif; quality assurance of performance of cementation by direct biolocation method; additional cementation of rocky massif by results of quality assurance of the executed cementation.

The third stage included quality assurance of cementation of cracked zones by carrying out of seismic prospecting works (The conclusion about results of rocky massif, 2007).

3 ENGINEERING - GEOPHYSICAL RESEARCHES BY FRACTURING ESTIMATION OF THE ROCKY MASSIF

3.1 *Remote biolocation researches*

Remote biolocation researches were carried out in the building of Zaporozhye branch NIISK to the address Zaporozhye, Novostroyek 4 Street, located on distance 8km from the platform of researches. The topographical survey of site in scale 1:250 was as the basis for performance of work. The purpose of works was revealing of cracked zones on topographical survey and drawing of their scheduled arrangement on survey. The pendulum of drop-shaped form executed from rock crystal and suspended on a string in length 13 … 14sm was as the indicator of effect.

The technique of work with a pendulum consists in the following. The operator having taken in hands a pendulum brings it to a place of research on map. A method of inquiry receives all necessary information

"Is it cracked zone?" - The pendulum answers: "No", vibration for example counter-clockwise.

"Is it cracked zone?" - The pendulum answers: "Yes", vibration for example clockwise.

Realization of this technique has allowed to reveal all existing cracked zones, to define their width and length, and to put these zones on a topographical basis (Fig. 1). Revealed cracked zones was located under a corner to a slope; zone of increased fracturing which formed at development of quarry with use of explosion energy of deep charges of explosive was located in parallel to ledge.

The operator spent 3 hours on remote biolocation researches.

3.2 *Direct biolocation researches*

Direct biolocation researches were carried out by the same operator directly on a platform of researches by the traditional technique (Sochevanov N.N. et al. 1984). The framework of the Γ-shaped form was the indicator of effect. The revealed contours of cracked zones were rendered by paint on a surface of massif. The operator spent 4 hours on revealing of cracked zones. Contours of cracked zones and their scheduled positions which determined by direct and remote biolocation methods were completely identical (Fig. 1).

3.3 *Engineering - geophysical researches*

The complex of engineering - geophysical works has been executed for the decision of tasks (The report about engineering, 2007) including:

- Electroprospecting works by method of vertical electric sounding (VES);
- Works by method of passive magnetic- resonant location of subsoil (PMRLS);

Electric sounding was carried out with use of the complete set of the electroprospecting equipment of low frequency ELF – 3. Thus the apparent resistance was measured on earth surface at gradual increase of researches depth due to consecutive increase in length of power line up to 50m. Works were carried out by symmetric Schlumberge installation at maximal spacing of power line above 50m and a receive line 1,0m. The general number of VES points were 19 (Fig. 1), at a step 7 … 16m and depth of researches up to 15m. The relative error of individual measurement on VES point did not exceed +\- 5 %.

The received results of electroprospecting works were interpreted in two stages.

The analysis of VES curves was made at the first stage of interpretation, qualitative, specific electric resistance (SER) was defined in characteristic points. Basically SER of layers depends on uniformity, a degree of fracturing, mineralogical structure of hollows filling and other parameters. Presence of humidified filling in fracturing granitoids results in decrease of SER of soil and absence of filling - to higher values of SER. The second stage of interpretation, quantitative, was character-

ized by data acquisition about capacity of layers and their specific electric resistance. The software package of interpretation of VES curves was applied to realization of the second stage in an interactive mode with the image of interpretive curves on the screen. The received data of capacities of layers and their specific electric resistance were used for construction of geoelectric profiles (Fig. 2).

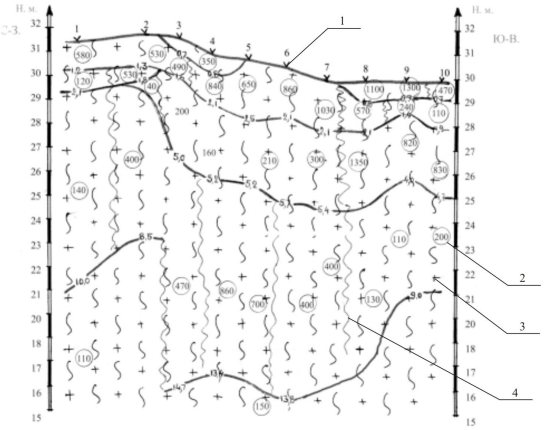

Figure 2. The Geoelectric profile on line A-A: 1 – VES point and its number; 2 - SER value of layer in ohm, m; 3 - depth of geoelectric border in meters; 4 - stratum disagreement of geoelectric borders.

Deep sounding on technology of PMRLS similarly to standard logging of boreholes allows to study geological profile in vertical measurement with the help of a measuring complex that allows to make direct definitions of structure and the contents of substance (Susin O.A., Novik N.N., Shokarev A.S. (2003). Results of such soundings are represented as schedules of mass fractions of the given substance in mass unit of all soil. The resonant frequency of investigated substance and conformity of intensity of a measured signal in accepted units to the contents of substance is defined for this purpose on artificial models. The calibration tests are executed for big amounts of substances and experimental dependences of signal strength on the given frequency from the contents of researched substance were received.

Deep sounding were carried out on a platform of researches for studying capacity and conditions of fractured zones in profile, studying of density change of granites on depth in natural location. It was 10 sounding up to depth 50m. The points of sounding settled down close to sutural line of fracture in its trailing wing for undercutting of fractured zones in profile and studying of their conditions of location. The part of soundings was executed in not fracturing blocks for studying density of granites outside of fractured zones. The arrangement of points of sounding is shown on Fig. 1. Results of soundings are presented on schedules of change of density of granites on depth (Fig. 3). Measurements of granite density were carried out with step 10sm along a vertical axis at sounding. Thus, according to used of PMRLS technology, each executed indication characterizes average density of granite in volume of the cylinder in diameter 10sm and height 6sm, i.e., if emptiness had been met more than this size, indication would be zero.

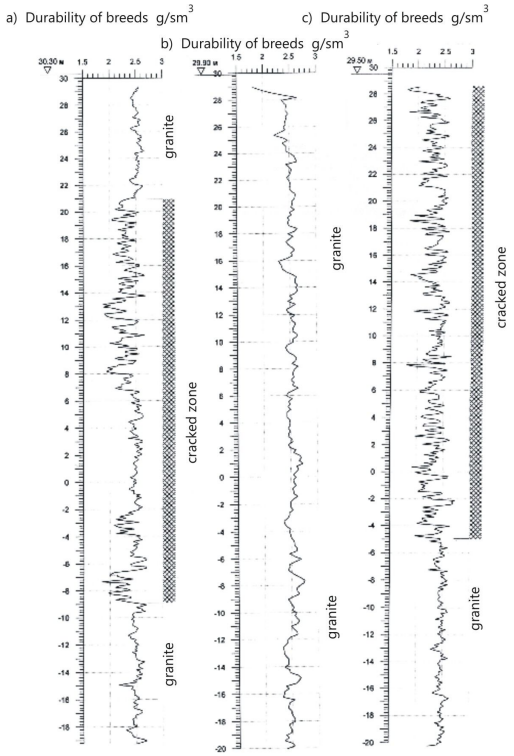

Figure 3. Change of soil density on depth with the data fixed by method of passive magnetic- resonant location of subsoil (PMRLS): a) - point 2; b) point 4; c) - point 6.

The granites density changes within 2,22-2,76g/sm3 at average values of 2,49-2,53g/sm3 according to data of soundings outside of cracked zones. Constant and unweathered granites have density of 2,58-2,61g/sm3. Their density reduces to 2,2g/sm3 at weathering. Their density increases as a result of secondary mineralization and increase dark-coloured minerals in structure of granite (migmatites). Therefore the presented limits of change of soils density on PMRLS data in rather monolithic blocks of building site are natural and characterize on the one hand degree of weathering of massif and on the other hand – its initial mineralogical heterogeneity.

The granites density changes within 1,80-2,74g/sm3, at average values of 2,28-2,34g/sm3 in fractured zones. The change of granites density

looks as a sawtooth curve with often changes of the minimal and maximal values of density in fractured zones on schedules of soundings. The position of fractured zones on schedules is shown by additional shading for presentation.

Executed instrument geophysical researches have proved the correctness of drawing of fractured zones on map with use of remote biolocation methods. The specific electric resistance of granite is less (110 … 200 Ohm, m) in VES points located directly in fractured zones, for example №№ 1,8 … 10, than in points №№ 4, 5 (700 … 800 Ohm, m) where fractured zones have not been fixed (Fig. 2).

If density of granite changes within1,8 … 2,74g/sm3 (points PMRLS №№ 1, 2, 6, 7, 10) in cracked zones, density of granite changes within 2,22 … 2,76g/sm3 (points PMRLS №№ 4, 5, 8, 9) in uncracked zones (Fig. 3)

4 EXPERIMENTAL RESEARCHES OF FRACTURED ZONES

The project of cementation of rocky massif was developed on the basis of the executed researches (The work design (2007). The given project provided fastening of rocky massif by reinforced cementation of granites in fractured zones. Cemented boreholes were located directly in fractured zones (Fig. 1).

Works of rocky massif fastening were made by Open Company "ZB Hydrospecstroy" from July, 25 till September, 5 in 2007, from bottom of excavation.

The work of excavation preparation was before cementation of fractured zones which providing crop of loessial soils, removal of top part of bark of granite weathering (a disperse zone), the device of lean concrete. Thickness of lean concrete makes 0,2 … 1,5m. It is connected to significant capacity of crushed stone soils in the base of the projected center. Tampons for cementation of boreholes were established directly in concrete preparation.

Works of rocky massif fastening were carried out in the following sequence:

A. Preparatory works.
- Breakdown and binding of cemented boreholes (Fig. 1);
- Installation of the process equipment and distributing of pipelines;

B. Bored works.
- Boring of boreholes ∅ 105mm in depth 8…11m;
- Boring was carried out with blow of boreholes for removal of sludge with the subsequent washing by water;

C. Hydraulic sampling.
- serviceability and tightness of cemented system was checked by forcing of water in boreholes after installation of a tampon in borehole;
- Hydraulic sampling was made at pressure 0.3MPa;
- Specific water absorption of rocky soils was determined by results of sampling;

D. Cementation of boreholes.
- The forcing of cement mortal was made by mortar pump with adjustable drive;
- Cementation of boreholes was carried out by cement mortal with application of portland slag cement of 400 mark;
- Preparation of mortal was carried out in working unit by mixing cement with water before reception of homogeneous weight, the mortal were mixed before receipt in borehole;
- Cementation of boreholes was made with the following scale of change of the contents of cement in the water-cement relation: 4; 1,33; 0,8; 0,57;
- The decrease of the mortal charge to 5l/minutes at pressure 0,3MPa was accepted for refusal of mortal absorption.

Tested cementation was preceded to cementation of massif. The tested site settled down in axes « 1 … 3 » lines "A...G" (Fig. 1). The absorption of cement mortal was insignificant (60l, 20l) at the maximal charge in 10l/minutes at cementation of boreholes №№ 4, 12, located outside of fractured zones. The absorption has made 320 … 546l at the maximal charge 24l in one minute at boring of boreholes №№ 6, 7, 15 in fractured zones.

The further cementation of massif was made under the project (The work design, 2007). Absorption of mortal in boreholes was 1000 … 200l at pressure 0,5 … 3,0 atmospheres.

93 cemented boreholes were bored in the base of the cultural - tourist center at fastening of rocky massif (Fig.4).

Figure 4. Drilling of cement chinks

5 QUALITY ASSURANCE OF CEMENTATION OF FRACTURED ZONES

Quality assurance of the executed cementation of the rocky massif was carried out by its seismic translucence. 24 - Channel computerized digital seismic station “Laccolite 24 M-2” was used as registered equipment. Researches were carried out on two structures. The length of arrangement has made 46 meters; a step is 2 meters between geophones.

The analysis of the given geophysical measurements has shown that the base of builded cultural - tourist complex is quasi-homogeneous after cemented works i.e. zones of fracturing are absent (The conclusion about results of rocky massif, 2007).

6 CONCLUSION

1. The executed complex of research works including remote (on map) and direct (on district) biolocation researches and also electroprospecting works by method of vertical electric sounding, works by method of passive magnetic-resonant location of subsoil, cementation of fractured zones has confirmed an opportunity of use of remote non-standard methods for an estimation of a technical condition of system "base - foundation - superstructure" raised radiation taking place in a working area.

2. Remote biolocation method demands the further development, first of all its theoretical substantiation, and also development of requirements to operators who makes the given kind of researches.

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