THE PURSUIT OF MONITORISING THROUGH TIME OF SOME CONSTRUCTIONS WITH THE STRUCTURE MADE OF CONCRETE AND MASONRY

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Abstract

The paper presents aspects of the following activity, through topographic methods, of the behavior in time of one constructions with structure made of concrete and masonry, namely: the administrativ building of the S.C. ARGOS S.R.L. from Cluj – Napoca standing on the Onisifor Ghibu street. In this case the cause that engendered the appearance of manifestations in the buildings was the existence of an underground gap below the construction or in near proximity. In this case, because the volume of the gap created throughout the realization of the collector Channel for the household waters was not big (diameter in light of 2,15m), the manifestations emerged during the execution of the channel ended with the finalizing of the works in the area of the administrative building of the S.C. ARGOS S.R.L and reestablishment of a new state of equilibrium of the terrain in the respective area.

Key words: monitorizing through time, pursuit, survey methods

The main purpose of the activity pursuit in time is that of preventing possible constructions accidents which lead to important material losses and sometimes even casualties of human life and to maintain a more larger period of work for the constructions founded in exploitations in safe conditions.

The activity of pursuing the behavior of constructions in time is an action settled through the Law no. 10/1995 regarding the quality in constructions (The Law no. 10/1995), respectively the Normative regarding the pursuit of behavior in time of the constructions P 130 – 1999 (HGR no. 766/1997), as well as throughout a series of normative documents and specific technical regulations. This activity it develops through the entire period of life of the constructions, it assumes the gathering and capitalization of information obtained through observation and measurements and has as purpose the tracking in time of the deficiencies emerged and the establishing of the retrieval measurements of these, therefore it can satisfy the stipulations regarding the maintaining of the resistance` s requests, stability and endurance of the constructions, as well as the other essential requests.

The pursuit of behavior through time of the constructions can be actual or special (Order MLPAT NO. 57/N/1999), in admission with the category of importance of the construction, the way of following and the methodology of effectuation of this being established by the designer or by the expert through the Technical Book of the construction.

The special pursuit is organized by the owner on the basis of a project of special pursuit elaborated by a firm that has expertise in the field or by the planner and it is executed by specialized personnel and specialists with complex and specialized means of measuring and observation.

The special pursuit is applied only in certain situations (Order MLPAT NO. 57/N/1999):

- in the case of the new constructions of a particular or exceptional importance;
- in the case of the constructions in exploitation with dangerous development, established through a technical expertise;
- at the owner` s request, at the Inspectorship of State in Constructions or of the organizations approved by this on specialized domains.

2. THEORETHICAL REASONS

A building submitted to the solicitation regime determined by external factors or by its functional conditions can suffer linear, angular and specific displacements and abnormalities, namely:

a. linear displacements and abnormalities:

- settlements/ landslips;

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- bulging;
- arrows of certain construction elements;
- dips;
- crevasses and crazes;
- horizontal displacements;

b. angular displacements and abnormalities:
- dips of the constructions determined by the rotation of the foundation elements in vertical plan;
- twists of the constructions determined by the rotation of the foundation elements in horizontal plan;

c. specific abnormalities:
- stretchings and shortcuts of certain construction elements under the effect of straining or compression – decompression of the respective elements.

2.1 The determination of the constructions settlements/landslips

The most precise method of the establishing of a constructions settlement/landslip is the method of the geometric grading. The method assumes the execution of certain repeated observations over some slidable marks (dabs of settlement) clamped into the elements of resistance of construction, which moves at the same time with this, communicating with some fix marks(control marks), placed outside the influence area of the building (*fig.1*) (Ghe. Nistor, 1993).

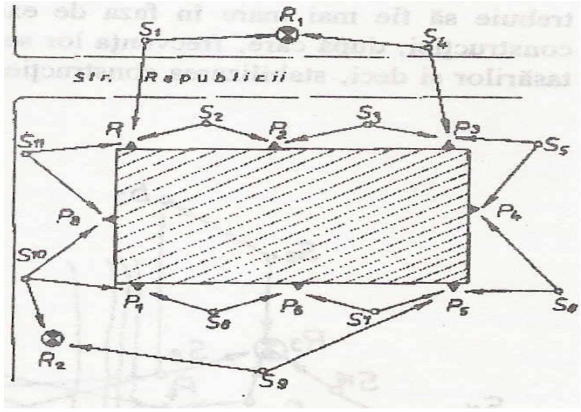

Figure 1

The control marks R_1, R_2, are placed in such a way that their level can` t be modified in time through: the influence of construction, the variation of the level of phreatic water and the subterranean waters, vibrations, the circulation of automobile. The control marks are collocated so that they can cover equally the area surrounding the construction. Their placement is made keeping in count:
- the geotechnical and hydrological conditions;
- the necessity of assuring the proper conditions for the effectuation of the readings;
- the systematization of the ground surrounding the building, etc.

The dabs of settlement $P_1 \div P_{8,}$ embed in the resistance elements of the construction, at its corners, in the proximity of the joints of settlement and at the characteristic points of the construction. Given their location, the dabs of settlement are reproducing accurately the vertical movements of the construction and they make it possible to be measured.

At taking the measurements are used contouring preciseness instruments and special stages of invar. The execution of the observation comprises in the implementation of a geometrical contouring from the middle of ordinal I and II, in favorable atmospheric conditions, executed in a direct and inverted sense, or with two plans of sighting. The non closure of the contouring has to fit in tolerance $T = \pm 0{,}5mm \cdot \sqrt{n}$, where n represents the number of stations.

The accurate geometrical contouring will be executed in each stage, as possible, on the same ranges and in similar technical conditions. The frequency of the stages of measurements is established in accordance to how active is the phenomenon of settlement/landslip; once the phenomenon is established the distance between the measurements will grow.

The estimation of the vertical movements of the dabs of settlement can be made through one the procedures:
- based on the level differences between the following points;
- based on the quotes of the settlement dabs.

The absolute or total settlement of each dab(T_i) is calculated as difference between the quote of the cycle of current observations (H^i_i) and the quote of the cycle of initial observations (H^0_i).

$$T_i = H^i_i - H^0_i \qquad (1)$$

The medium settlement of the whole construction is calculated with the equation:

$$T_m = \frac{T_1 A_1 + T_2 A_2 + ...T_n A_n}{A_1 + A_2 + ...A_n} \qquad (2)$$

where:

T_1, T_2, T_n - are the absolute settlements of the dabs of settlements;

A_1, A_2, A_n - represents the surfaces of the soles foundations relevant to the elements of resistance on which are fixed the settlement dabs.

The medium settlement can be calculated as well as the arithmetic sum of all of the settlements of the control marks.

2. 2 THE DETERMINATION OF DIPS OF CONSTRUCTION

The procedure that assures the biggest precision in the determination of the constructions` dips is based on the angular measurements using very precise instruments (1^{cc}) for the measurements of the angles.

The method consists in the placement at a distance equal to two – three times the hight of the construction, on the direction of the wall, of two clamps from which will be measured the horizontal angles formed by a point situated at the superior leaf of the wall and at a stable point placed outside the influence area of the construction (*fig. 2*) (M. Ortelecan, M. Palamariu, T. Jurac,1999).

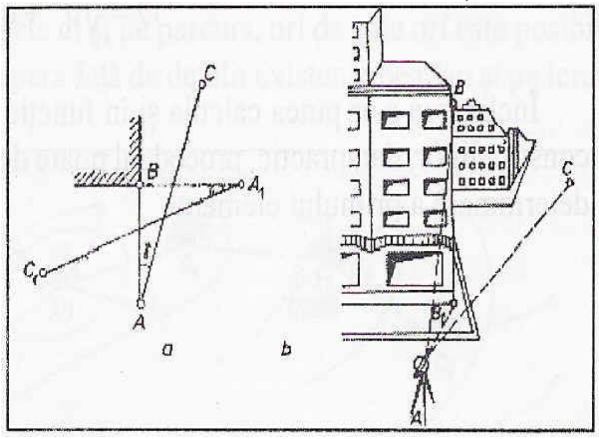

Figure 2

The size of the angular dip of the wall is determined as a difference between the horizontal angles measured in two consecutive stages.

$$\gamma=\gamma'' - \gamma' \qquad (3)$$

The linear size of the dip is calculated with the equation:

$$l = \frac{\gamma^{cc}}{\rho^{cc}} \cdot D \qquad (4)$$

γ^{cc} - angular dip, expressed in centesimal seconds;
ρ^{cc} - represents the factor of transformation
D - the horizontal distance between the clamp which situates with the transit and the point situated on the superior leaf of the wall.

3. PRACTICAL ASPECTS

Next will be presented the methodical and the results of the pursuiting in time of one building with the structure made of masonry affected by the same cause: the existence of an underground excavation under the building or in the proximity of this one.

3.1The pursuit of monitorising of the administrativ building

The administrativ building of the S.C.Argos SRL from Cluj – Napoca is situated on the Onisifor Ghibu street. The current building is composed from two associate bodies, each of them having separate foundation.

In front of the building, along the Onisifor Ghibu street, at an horizontal distance of approximately 6m but placed at a depth of 11m, was built the collector Channel right levee Little Somes, section Mihai Viteazu market – Mărăşti (*fig. 3*).

As expected, the disturbance of the state of natural equilibrium existent – caused by the execution of the works at the collector channel, has determined the appearance of certain manifestations in the state of stability

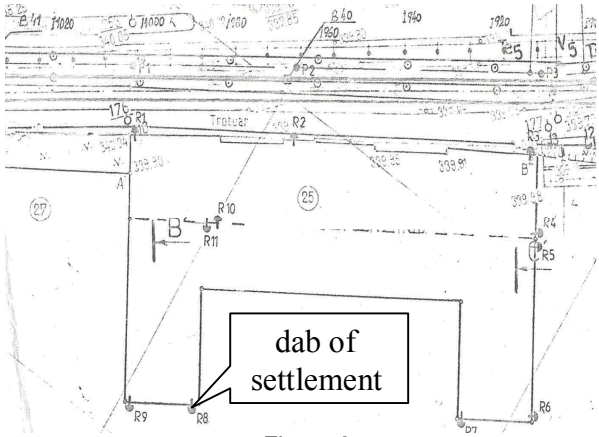

Figure 3

of the constructions in the proximity of the collector channel. Therefore, in the administrative building appeared bracks, in vertical plan, in the associate area of the two bodies of the building.

For the pursuit of the behavior in time, through topographic methods, was elaborated a following plan and it was realized the network of following. As control marks were used the aggregation settlement VI. The settlement marks were clamped in the elements of resistance of the building, in the old body: R1 – on the N corner, R2 on the NE side, R3 – on the E corner, R4 – on the S corner and R10 inside on the SW side, as well as in the new body – the marks: R5 – on the E corner, R6 - on the S corner, R7 and R8 on the SW side, R9 – on the W corner and R11 inside on the NE side (C. Arsene, I. Morar).On this following network were made observations through the method of the geometrical levelling from the middle. It was used the precision levelling NI 002 Zeiss with a compensator of a fly type, with a double position, of whose constructive position is of 0,2mm/double km of levelling fillet of invar. After the execution of the first measurement(the basic measurement, initial), the next steps have happened at a distance of time of approximately one month.

Because the vertical movements were caused by the appearance of the underground gap arised after de realization of the collector channel, we deal with a diving phenomenon. The parameters followed were:

- the diving on the period Δs

$$\Delta s_i = H^i_i - H^{i-1}_i \text{ [mm]} \qquad (4)$$

- the absolute and total diving S

$$S_i = H^i_i - H^0_i \text{ [mm]} \qquad (5)$$

- the diving speed v

$$v = \frac{\Delta s_i}{n} \text{ [mm/month]} \quad (6)$$

where n represents the elapsed time period between two consecutive measurements, expressed in months. The registered values for the remembered parameters in the case of the 11 dabs of settlement, are presented in Table 1.

Table1

The observation stage	The first periodic measurement (at 29 days from primary measurement)			The second periodic measurement (at 49 days from primary measurement)			The third periodic measurement (at 79 days from primary measurement)		
Determined parameters / Label dabs of settlement	Δs [mm]	S [mm]	v [mm/month]	Δs [mm]	S [mm]	v [mm/month]	Δs [mm]	S [mm]	v [mm/month]
R1	-0,9	-0,9	-0,9	+0,6	-0,3	+0,6	+1,0	+0,7	+1,0
R2	-1,0	-0,9	-1,0	+0,6	-0,4	+0,6	+0,7	+0,3	+0,7
R3	-0,9	-0,9	-0,9	+0,4	-0,5	+0,4	+0,3	-0,2	+0,3
R4	-0,9	-0,9	-0,9	+0,7	-0,2	+0,7	+0,7	+0,5	+0,7
R5	-0,3	-0,3	-0,3	+0,2	-0,1	+0,2	+0,2	+0,1	+0,2
R6	-0,1	-0,1	-0,1	+0,1	+0,0	+0,1	+0,0	+0,0	+0,0
R7	-0,3	-0,3	-0,3	+0,2	-0,1	+0,2	+0,1	+0,0	+0,1
R8	-0,4	-0,4	-0,4	+0,3	-0,1	+0,3	+0,3	+0,2	+0,3
R9	-0,3	-0,3	-0,3	+0,3	+0,0	+0,3	+0,1	+0,1	+0,1
R10	-1,5	-1,5	-1,5	+0,6	-0,9	+0,6	+0,6	-0,3	+0,6
R11	-0,8	-0,8	-0,8	+0,6	-0,2	+0,6	+0,2	+0,0	+0,2

Analyzing the dates from the table it is observed that, although at the first periodical measurement the values of the three parameters were relatively big in the case of the dabs of settlement clamped in the old wing of the building, after the channel was built and in the surrounding rocks it was reinstalled a state of equilibrium, the followed parameters have come back to normal, the movement phenomenon being attenuated till it vanishes.

CONCLUSIONS

The activity of the monitorising of the behavior through time of constructions receive a special importance in the actual conditions when the majority of constructions from our country have a minimum age of 19 years. In the same time, the pursuit of the behavior through time of constructions represents a source of informations for the projecting activity, regarding the type of behavior in real conditions of the intended constructions and the interaction of elements with the environment. Throughout the dates and the given informations, the following activity in time offers the posibility to compare the results obtained through modelation and experimentation with those from the exploatation. Even if it is about the actual pursuit, but especially in the case of the special pursuit, this activity must be approached with professionalism and the projects of special pursuiting to ensure the identification the causes that are producing the effects appeared in the followed constructions and in the same time to propose measures that can limitate to minimum these effects. When it is needed (in the case of the special pursuit) the pursuit through topographic methods, in needs to be realized with instruments that can ensure the necessary precision in these kind of labours, to apply the proper method to each case individually and the period between two stages of measurements to be according to the aplitude of the phenomenon of settlement/ diving or of the dip of construction.

In the same time, the beneficiary is obligated to apply the exact dimensions proposed for preventing possible accidents and to ensure a exploitation of constructions in safety conditions.

In the first presented case it was observed that through the pursuiting of behavior in time by topographic methods it was determined of the fugitive nature of the phenomenon of settlement/diving caused by the execution of the collector channel, not being necessary anymore measures for the stabilization of the construction.

REFERENCES

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