INTERNATIONAL SCIENTIFIC CONFERENCE

CIBv 2010

12 – 13 November 2010, Braşov

ASPECTS REGARDING INVESTIGATION AND CONSOLIDATION OF SITE ARRANGEMENT OF RESIDENTIALN BUILDINGS

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Abstract: In this paper the authors presents the causes, forms of manifestation, methods of investigation and solution for consolidation of the site arrangement of residential buildings that was affected through degradation of existing retaining wall.

Key words: retaining wall, degradation state, cracks, the opening of cracks, horizontal displacements.

1. INTRODUCTION

The site which forms the object of the analysis is situated at the eastern limit of Râşnov town, on the national road (DN1) between Râşnov and Poiana Braşov, next to the properties 14 and 16 on the Cetății St.

The Northern side of the arrangement site is bordered by a retaining wall of natural stone masonry, with a role of maintaining the stability behind it, which is the support for the buildings-located at the numbers mentioned above.

The street follows the axis of Cetății Valley, whose water is channeled through a system of reinforced concrete collector of ovoid form, placed under the road.

The area is geologically included in the cretaceous orogenesis, of polimictic conglomerate nature, specific to the mountains in Poiana Braşov.

The slopes enclosing Cetății Valley have their bedrock the polimictic conglomerate Cenomanian, known as "the conglomerate in Bucegi" over which a layer of deluvial – proluvial alteration was couched.

The studied site consist in an artificial platform that passes over the rocky slope towards South, and on the Northern side is limited by the retaining wall located on a sandy and dusty diluvium, of a width of about (50-70) cm (fig. 1).

From a geomorphologic point of view the site belongs to a valley known as Cetății Valley that crosses over the Mountains of Poiana Braşov from the central to the Western area, being a right affluent of Bârsa.

Given these forming conditions, the river bed is dug in conglomerates, and on the slopes being couched a diluvium cover, mainly sandy.

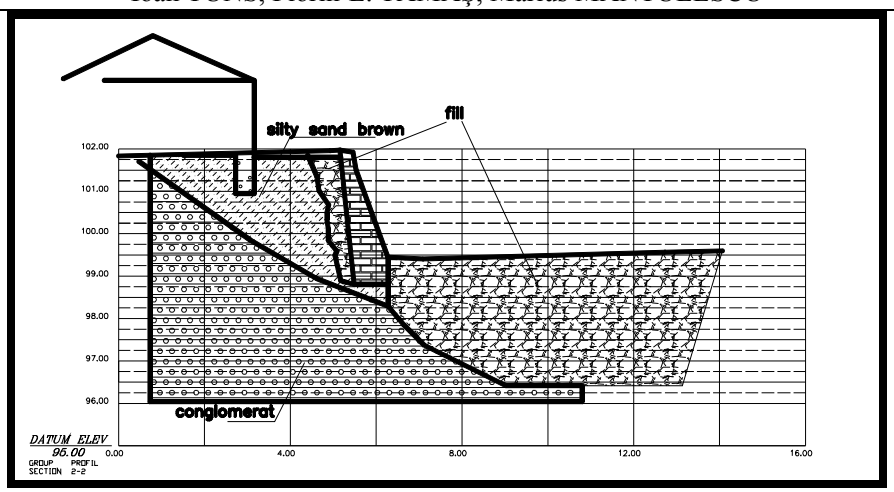


Fig. 1 Soil geotechnical profile

2. INVESTIGATION AND CONSOLIDATION OF SITE ARRANGEMENT

2.1 The causes of degradation state

The platform artificially created having the role of support layer for the buildings mentioned under the previous point is limited on the North side by a retaining wall made of stone masonry to ensure stability of the soil located behind it.

Sewage works carried out near and under the wall lead altered the strength and stability of a section of the wall and of the related soil.

The status of degradation was determined mainly by the digging works on the main domestic sewage collector, carried out near and under the implantation quota of the retaining wall and left open on relatively large length, for a certain period of time [1].

The state of degradation was favored also by the action of other disturbing factors such as [1]:

- The moisturizing of the earth under the retaining wall due to rupture during the digging works of a pipeline of the street water supply, located about 1.0 m from the basis of the wall.
- Removal from a balanced position of a section of the retaining wall, by registering linear and angular displacements as a result of annulling the effect of reactive pressure of the excavated soil from the front of the wall being in contact with it before the excavation works, the lack of soles, as well as the reduced embedment length of the wall in the soil;
- The break off of stones from the wall, sections with deep cracks, exfoliations of material structure due to the long corrosions of the environmental factors;
- Increase of aggressive factors due to vibrations caused by movement of road vehicles.

2.2 The forms of manifestation of the degradation state

The independent, grouped or simultaneous actions of the disturbing factors mentioned at paragraph 2.1 have generated the degradation state shown in section 2.3, whose forms of manifestation are presented below.

The lack of passive resistance of the earth located downstream of the retaining wall [3], [4] as a result of the digging carried out near and under the foundation quota, on long sections (fig. 2), led to linear and angular shifts of the wall, highlighted by cracks whose opening reaches to 10 cm.

The opening of cracks formed in the area is accentuated in the area of the compression joint on the wall height, but cross also the support area of the protection bulwark achieved subsequently (fig. 3 and 4).

Fig. 2 The digging carried out on long sections near and under the foundation quota of the retaining wall

Fig. 3 The large opening of the compression joint

Fig. 4 Cracks in the protection bulwark area

The linear and angular movements of the portion of the wall bounded by serious cracks have generated their separation from the wall and trigger of land portions expanding to the existing buildings (fig. 5).

Fig. 5 Crashing of portions of land behind the retaining wall

The forms of manifestation of the presented degradation highlight the retaining and stability capacity of the retaining wall affected as a result of the sewerage works [3].

To restore the newly created situation, emergency measures are required aimed at restoring the strength and stability condition of the retaining wall affected following the sewerage works.

2.3 Effort states and strains of the bulk ground

In order to restore the capacity for strength and stability of damaged retaining wall and of the bulk ground behind it, following the state of degradation spotted, thereby endangering the strength and stability condition of buildings bearing the numbers 14 and 16, the analysis of efforts state and horizontal strains in bulk grounds was carried out. For the computation of the ground the software GeoStudio by module SIGMA/W. [2] was used.

Land shaping, figure 6, was carried using 4 types of materials:

a. basic rock – conglomerate, with dimensional stability properties of a solid;

b. the front and the back filling of the wall, considered as a linear elastic material with the deformation modulus E = 5000 kPa;

c. diluvium sand dust, with E = 10000 kPa;

d. the retaining wall, considered by disparate elements by the average cohesion value c = 100 kPa.

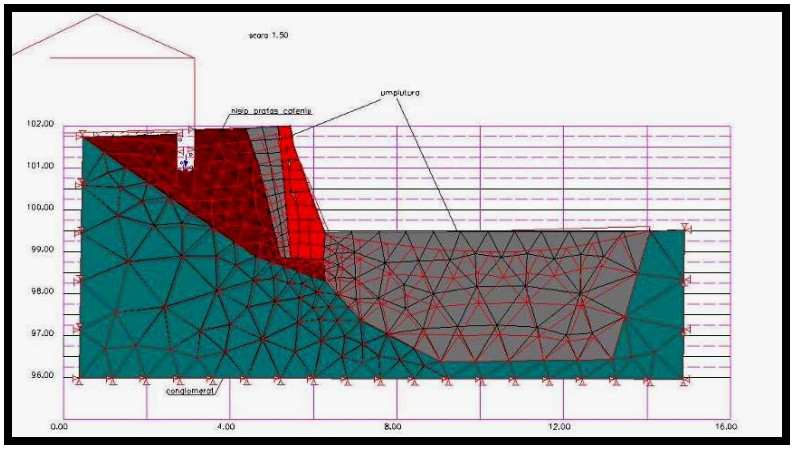


Fig. 6 Meshing the bulk ground

The analysis of effort state and horizontal displacement was carried out in three stages:

1. Initial stage of incident occurrence;

2. Execution stage of the excavation in view of performing the new wall next to the existing one;

3. The stage of removing the retaining points after ground excavation of the existing wall.

The three stages of analysis have resulted from technological point of view, such as:

- During the initial stage the evaluation of the foundation level degree of the buildings was carried out – buildings nearby, in order to identify the optimal solution for rehabilitation;

- The second stage aimed at assessing the opportunity to adopt the solution of rehabilitation required by the beneficiary, by carrying out the new retaining wall in front of the existing one;

- Third stage was aimed at assessing the site degree of stability during the critical stage of work, with the excavation of ground from the old wall and removal of retaining points.

For the computation it was considered that the overload of the foundation sole of the building is 300 kPa, and earth displacements are limited on the profile.

By analyzing the state of efforts and horizontal strains of the ground considering the three work stages it resulted that:

• In the initial stage 1 the unitary horizontal efforts considerably increase in the area next to the neighboring building foundation, figure 7 without this, however, being affected, and the maximum horizontal displacement of the bulk land reaches 3.2 mm (fig. 8).

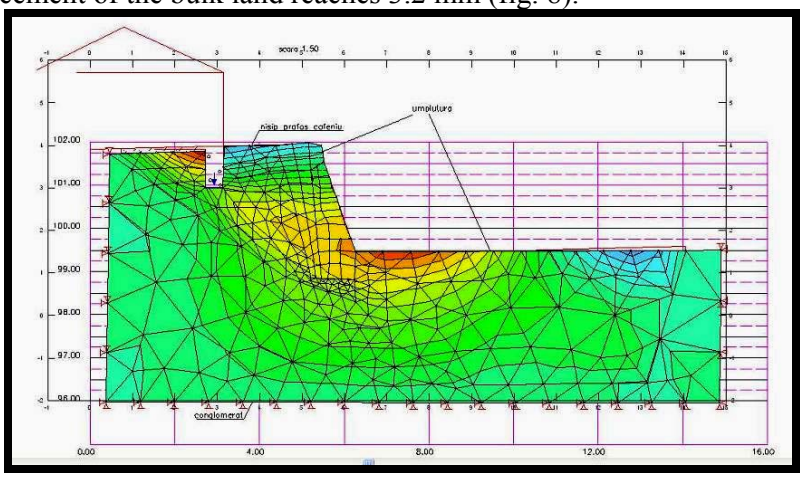


Fig. 7 Distribution of horizontal efforts in the ground next to the neighboring building at the initial stage

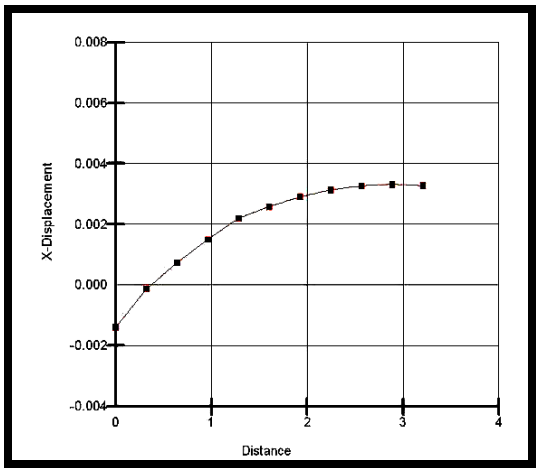


Fig. 8 The chart of horizontal displacements of the ground of the inner side of the wall

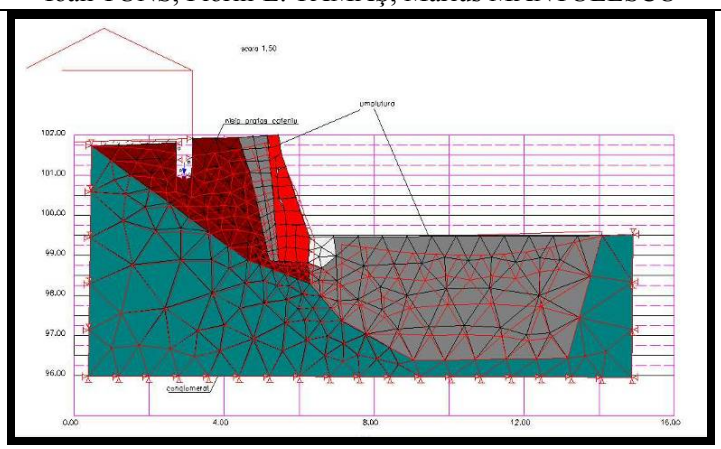


Fig. 9 Distribution of horizontal efforts in the ground next to the neighboring building at the initial stage

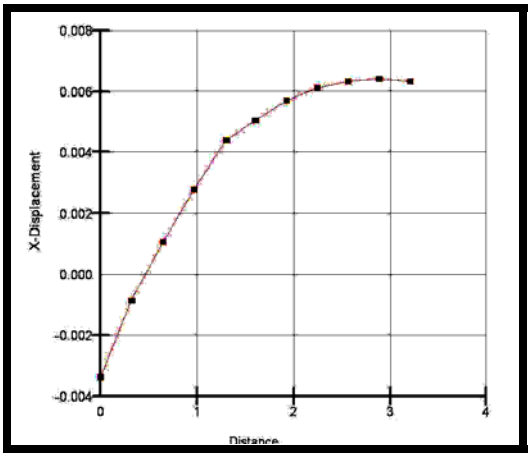


Fig. 10 The chart of horizontal displacement of the joint network points on the inner side of the wall

• In the second stage it was ascertained the accumulation of horizontal efforts at the basis of the wall, where the maximum horizontal displacement is recorded, namely 6.4 mm (fig. 9 and 10);

• In stage 3 it was noticed that the effort state does not change significantly in the building foundation area (fig. 11) and the maximum horizontal displacements of the basis of the wall increased to 10.2 mm (fig. 12) but they do not constitute a dangerous burden for adjacent buildings.

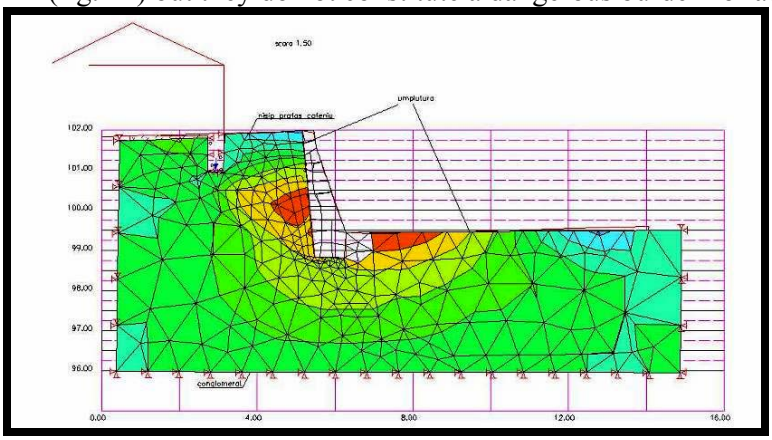


Fig. 11 Chart of unitary horizontal efforts in work stage 3

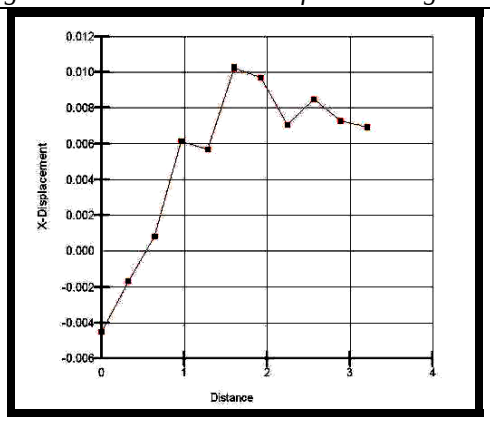


Fig. 12 The chart of unitary horizontal efforts in work stage 3

2.4 Consolidation of site arrangement

After investigations effected regarding the causes, forms of manifestation, state of efforts and strains in bulk ground, presented in § 2.1; 2.2; 2.3 the follow stages of work was proposed:

- Assurance stability of retaining wall and bulk ground behind through the achievement of the strong support by means metal profile UNP120 disposed in vertical position at max. 2.0 m, this unloaded at ground by two inclined supports;
- Blocking horizontal displacement of the wall base through filling with concrete (C 6/7.5) of digging;
- The achievement of completion with ground in behind wall, in layers of 15-20 cm;
- Stopping circulation up to restore situation.
- Changing the affected side wall, by achievement of new zone of reinforcement concrete.

The form, geometrical dimensions and reinforcing are presented in fig. 13 and 14.

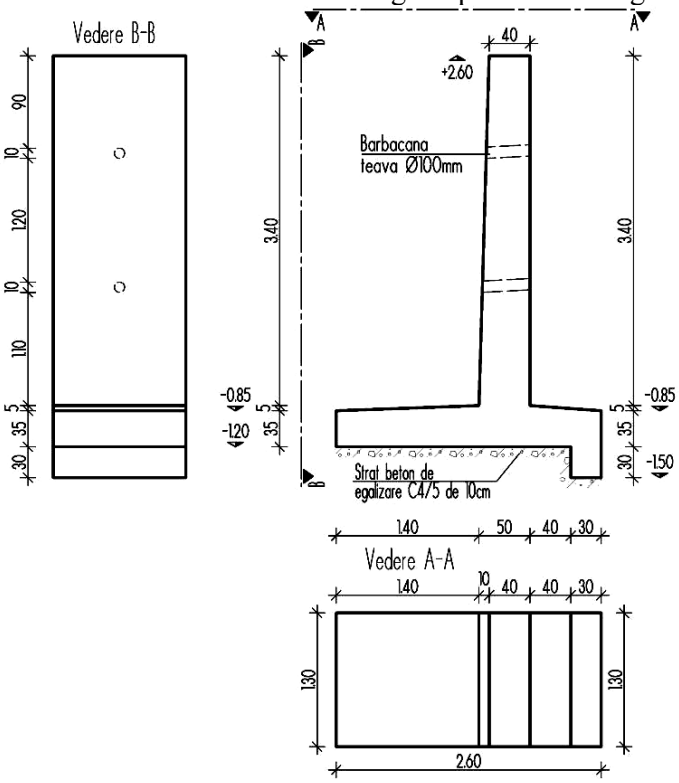
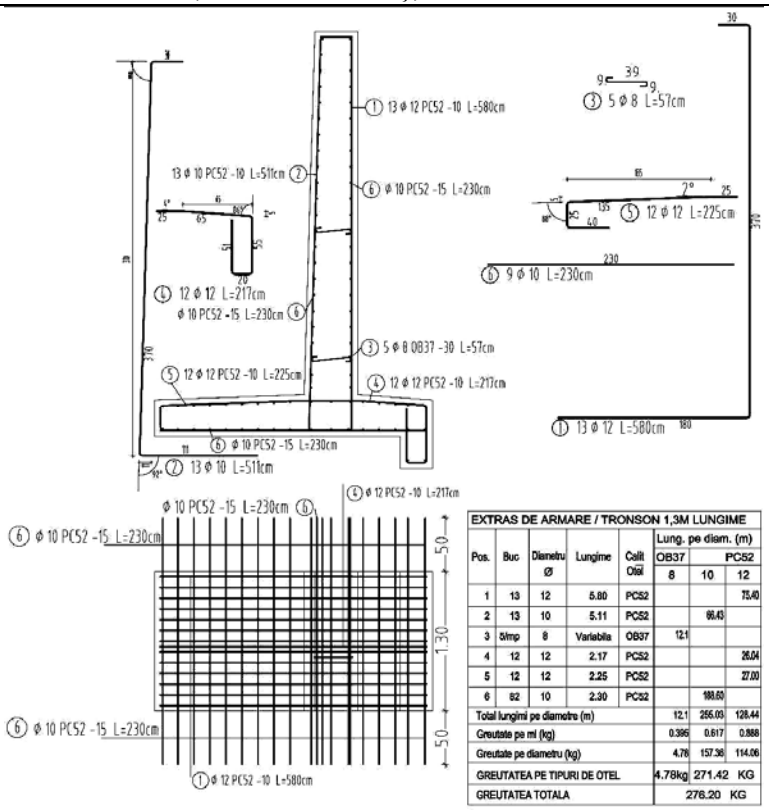


Fig. 13 Formwork plan for a 1.30 m section length of new designed retaining wall



EXTRAS DE ARMARE / TRONSON 1,3M LUNGIME

Pos.	Buc	Diametru Ø	Lungime	Calit Otel	Lung. pe diam. (m) OB37 8	PC52 10	PC52 12
1	13	12	5.80	PC52			75.40
2	13	10	5.11	PC52		66.43	
3	5/mp	8	Variabila	OB37	12.1		
4	12	12	2.17	PC52			26.04
5	12	12	2.25	PC52			27.00
6	82	10	2.30	PC52		188.60	
Total lungimi pe diametre (m)					12.1	255.03	128.44
Greutate pe ml (kg)					0.395	0.617	0.888
Greutate pe diametru (kg)					4.78	157.36	114.06
GREUTATEA PE TIPURI DE OTEL					4.78kg	271.42	KG
GREUTATEA TOTALA						276.20	KG

Fig. 14 Reinforcing plan for a 1.30 m section length of new designed retaining wall

3. CONCLUSIONS

The analysis of state of efforts and horizontal displacements of the ground in the two work stages enabled the adoption of the site rehabilitation solution by:

• Blocking the movements of the wall base by casting of a stuffing concrete (C6/7.5) in the trenches made at its basis, while ensuring a support for the wall parament;

• Replacing the affected section with a new design, made of reinforced concrete and reinforcing the soil on the site by compaction and/or added injection material.

The proposed rehabilitation solution ensures the restoration of strength capacity and stability of the damaged site without affecting the safe operation of existing buildings [3], [5].

The results obtained from the analysis of efforts state and strains were used for designing of the new retaining wall.

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Received September 20, 2010