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LANDFILL STABILIZATION IN OPEN PIT MINE OF BOGATA, BRASOV COUNTY

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Abstract: The open mine of Bogata's aim is the exploitation of basalt resulting from the Quaternary volcanism of Racoş. The current surface of landfills is irregular, as a result of the movements of material that have occurred in recent years, due to the exceeding of the natural slope angle of the material. Based on the results of geotechnical investigtions we have proposed a reshape of the landfill. Analysis by finite element method has highlighted a dangerous accumulation of horizontal efforts on the western area. Therefore we considered necessary to add a support element consisting of a body of reinforced soil with geosynthetic materials

Key words: open mine, stability, slope, reshape, shearing resistance

1. INTRODUCTION

1.1 Current situation

The open mine of Bogata's aim is the exploitation of basalt resulting from the Quaternary volcanism of Racoş. Tailings resulting from excavations were stored inside the exploatation area. As a result of several factors some areas of the landfill have collapsed, requiring improvement works to ensure its stability. The current surface of landfills is irregular, as a result of the movements of material that have occurred in recent years, due to the exceeding of the natural slope angle of the material. Irregularities facilitate accumulations of stagnant water and their infiltration into landfill, which leads to a reduction in stability. Simultaneously, due to the dump body movements, cracks have occurred that accumulate rain water.

1.2 Geological and geomorphological data of the area

From a geomorphological point of view the area belongs the southern border of the Transylvanian Plateau, in Persani Mountains. The main characteristic of the depression is that the transition from mountain to plain Olt is made through mountainous hills which, together with the terraces, is represent a piedmont area which looks like an amphitheater.

The geological composition of the Persani Mountains comprises both crystalline rocks belonging to the series of Fagaras, Mesozoic sediments (conglomerate of Bucegi, Sinaia strata) and an eruptive complex with a basaltic character in marginal areas. Removal of Pliocene sedimentary layer- due to the submerged erosion led to the formation of three concentric structural areas and their particular developments.

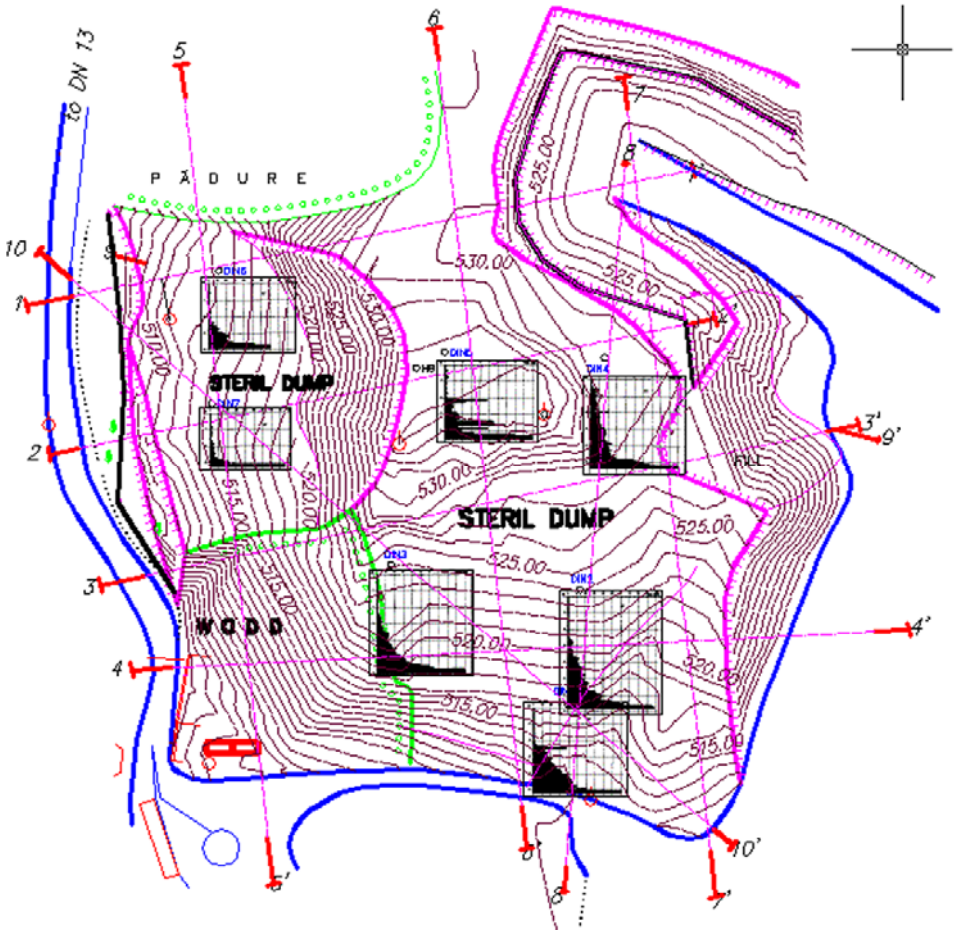

Fig. 1 Topographic map of the site with dinamic penetrations diagrams

The result of magmatic activity is the formation of basalt columns, over which there has developed an alterration eluvial layer. Columnar basalt layer is generally cvasiorizontal, but in the marginal area on the site, has an inclination of about 16 °. Surveys have not been able to determine which portions of the landfill material is in place, motionless, and which is the result of the excavation operations, its nature being the same

2. GEOTECHNICAL INVESTIGATIONS

2.1 Performed woks volume:

To identify the current pattern of the surface a surveying in stereo projection '70 was made. This was superimposed on older surveys, from 2005 and 2008 respectively, in order to determine the layer deposited in the tailings pile

To determine the thickness of the tailings, 7 dynamic penetration test coupled with geotechnical drilling were executed. Surveys were carried out on depths up to 10.0 meters (located on the site plan).

Dynamic penetrations tests were made with the DM 30 SA instalation and were accompanied on the same hole by auger drilling, with continuously disturbed sampling (DIN1 - DIN7).

Two open pits were also made up to a depth of 1.50 meters from which undisturbed samples (monolithic blocks) were collected for testing in the laboratory.

2.2 Soil stratification

Surveys have found a layering quite heterogeneous in size.

On the surface there are clayey deposits of sterile material, and at the base, parental rock respetctivley basalt.

Perhaps in some areas the bedrock has remained covered with sterile, but the distinction between the local material and the one brought there is very difficult to make, its nature being identical.

As a result, in the calculations for reshaping the landfill, we took into account the worst possibility, namely that all material over the basalt consists of transported tailings.

2.3 Hydrological, hydrogeological data (groundwater level and its character)

The area is drained by the Bogata river that passes nearby.

Surveys have not found groundwater. The waters in the area are not aggressive. The permeability coefficient of the land surface (up to 3 meters) is 10-5 cm / sec.

Due to the its uncompacted nature, the soil offers more easy ways for water to move, so humidity is very high.

2.4 Laboratory results

On the disturbed samples granulometric and plasticity analysis were made. From the undisturbed samples, colected only from the depth of 1.50 m were made in direct shear tests in UU conditions. The results were considered residual values and were used as such in the calculations.

3. MASSIF MODELING

3.1 Conceptual modeling

Two old topographic surveys from 2005 and 2008 were obtained from the beneficiary, but not completely overlapping the studied area. Surveying was conducted in a Stereo '70 coordinate system, taking as a reference level points of detail existing also in the old plans.

The overlap obtained with the old plan has partially outlined the body of the landfill. Where the original data was missing we used the results of dynamic penetrations; those surface profiles are shown in dotted lines - "terrain surface in 2005 (supposed)".

As a result, two virtual surface plots were created using the Land Developement platform corresponding to the situation in 2005 and 2010. Sections of the dump body allowed simultaneous viewing of the two surfaces facilitating the calculation of stability.

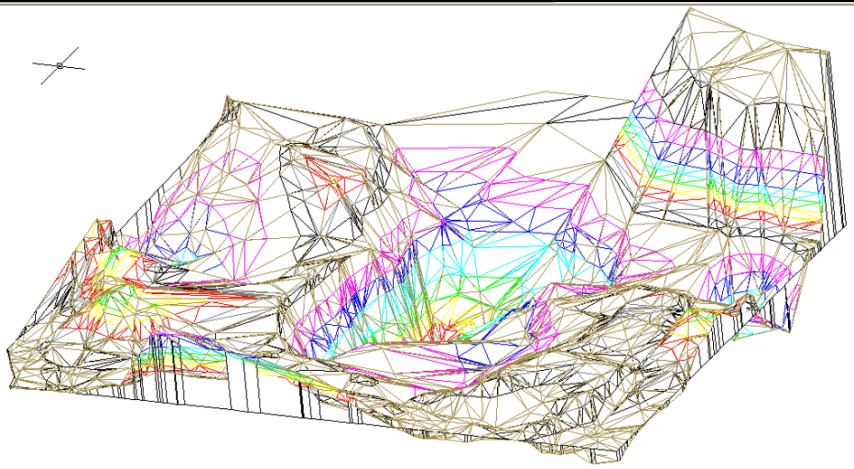

Fig. 2 Landfill's body in 3D

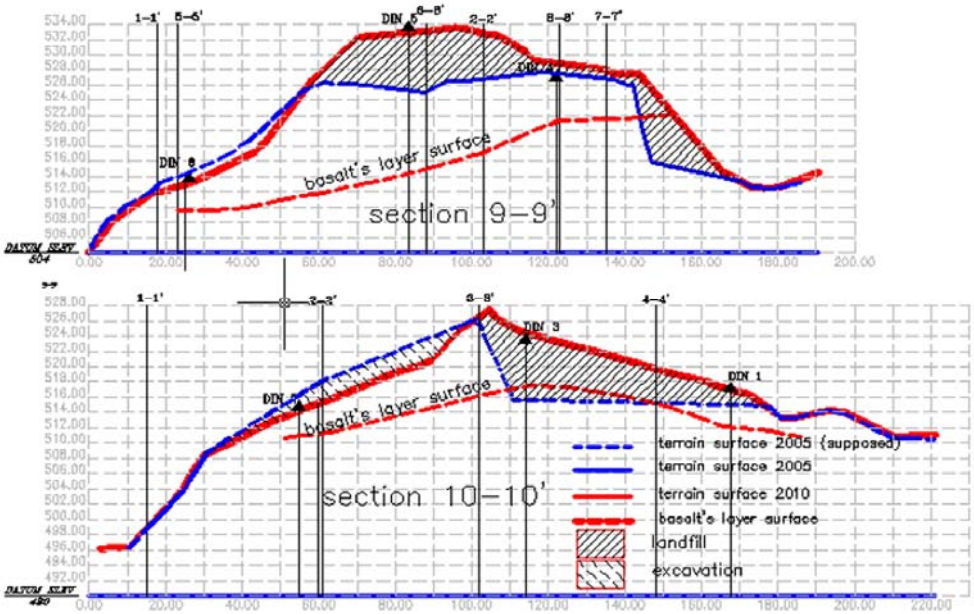

Fig. 3 Geotechnical sections

3.2 FEM analysis

To analyze the efforts that will result in the dump body we used to finite element analysis using the GeoStudio platform module SIGMAW.

Two types of material were defined: the deposits of sandy clay and basalt foundation. It was chosen the most unfavorable situation, one in which there is no natural eluvial layer on the basalt foundation. Basalt's position is regarded as certain as the results of dynamic penetrations and direct observations on the walls.

Material surface characteristics, considered in a simplified way as linear-elastic, were taken from laboratory results; the basalt was considered non-deformable.

Analysis results concluded that on the western area hazardous efforts will accumulate that may exceed the horizontal shear strength of the filling material. The analysis was not performed for a quantitative effect; for the moment we do not have complete data and we also consider that in

general it can not be used in geological and geotechnical studies except to study in principle different variants.

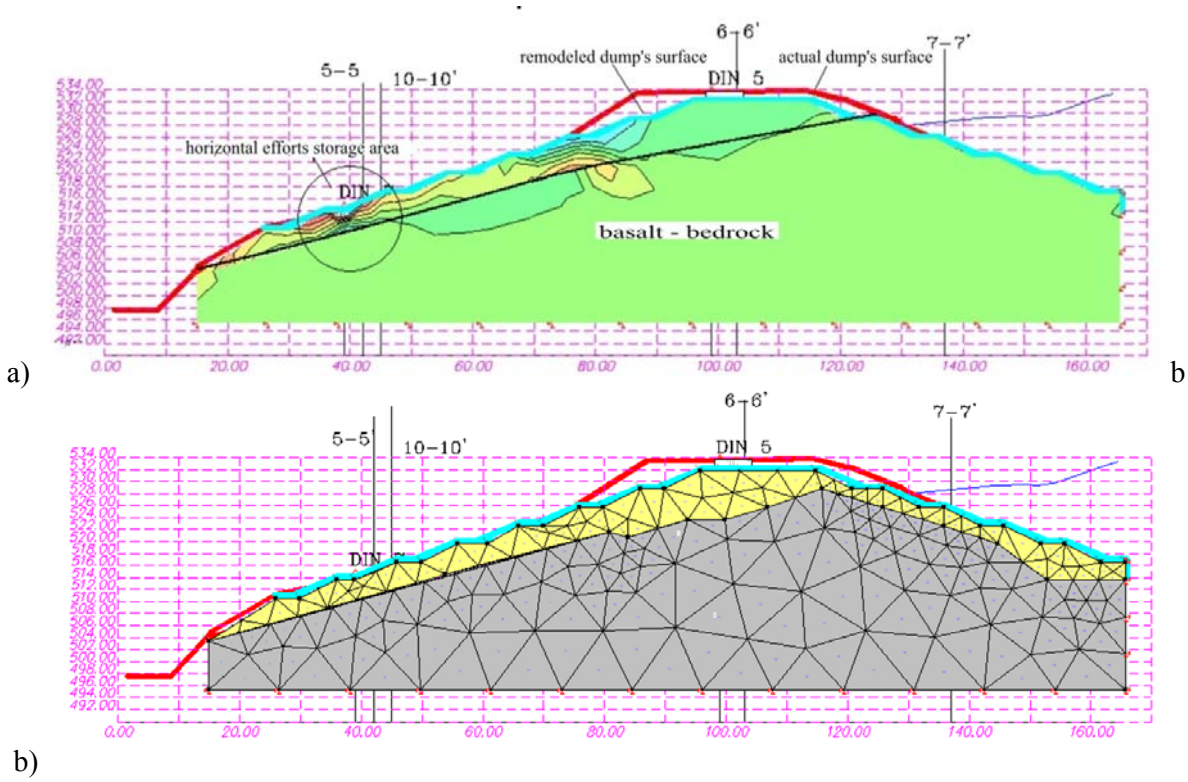

Fig. 4 Horizontal efforts (a) and massif discretization (b)

4. PROPOSED SOLUTIONS

Based on these results proposed a reorientation of the heap in which the steps will have a height of 4 m, an angle of 23 ° slope and width of the stairs will be 3.5 meters.

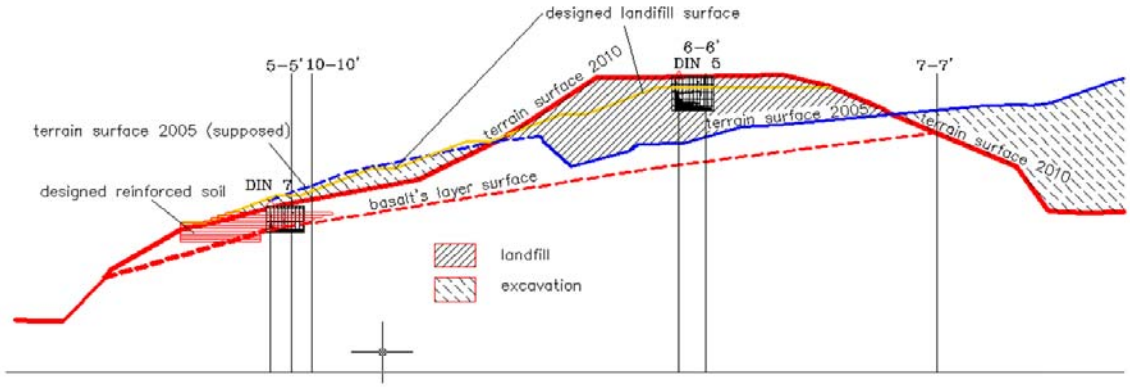

Fig. 5 Geotechnical section 2-2' with designed slope

It was adopted the maximum height slope of 4 meters, proposed by [4]. Safety factor adopted according to the definitive slope is 3 [1].

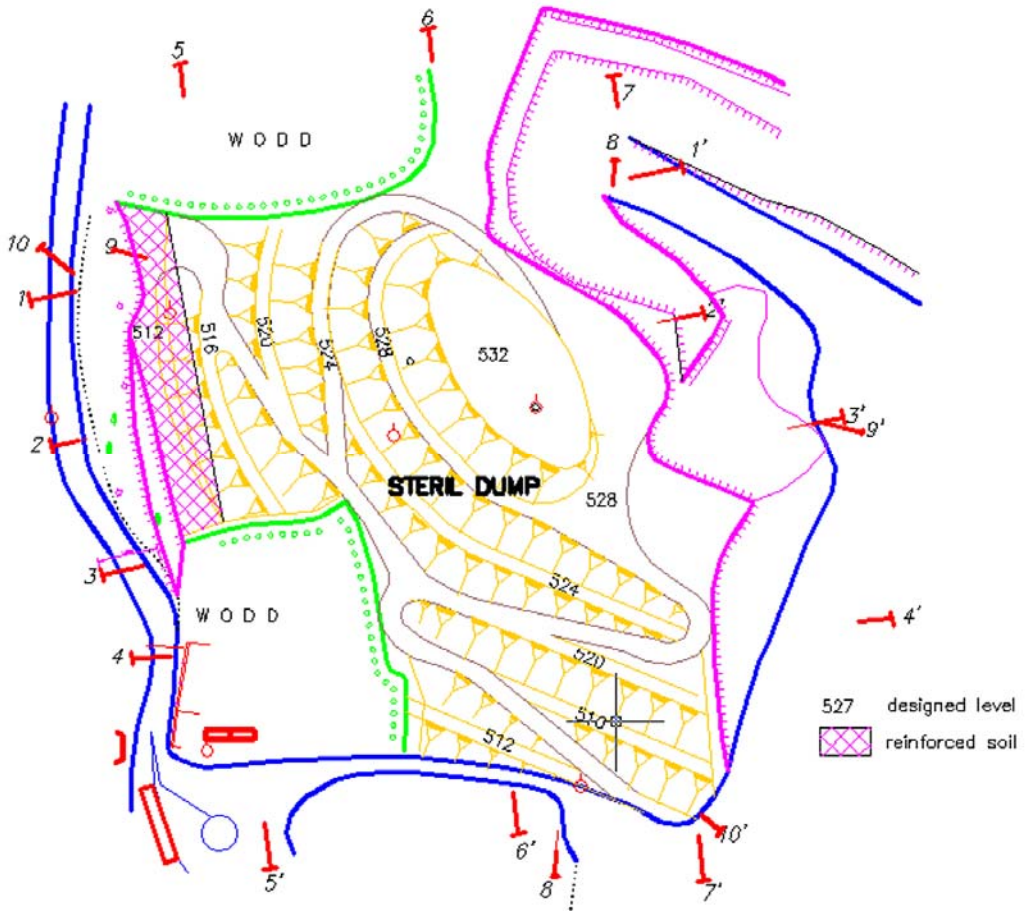

Fig. 6 Designed reshape of the landfill

Based on these results proposed a reshape of the landfill in which the slopes will have 4 meters height of 4 m, the angle of 23 ° and width of the bench will be 3.5 meters wide.

Analysis by finite element method has highlighted a dangerous accumulation of horizontal efforts by western area, which exceeds the shear strength of the material. Therefore we considered necessary to add a support element consisting of a body of earth reinforced with geosynthetic materials. Earth to be used in body reinforcement will be improved by the addition of granular material.

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