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GEOMECHANICAL TESTING ON THE LANDSLIDE AT THE ČUKARU PEKI FLOTATION TAILING DUMP[***]

Abstract

During formation of the flotation tailing dump Čukaru Peki, a landslide was activated above the mentioned location, which led to a standstill and endangerment of works. In order to obtain the geotechnical bases for designing the measures for its rehabilitation, the landslide tests were performed. Geomechanical works included the field research and testing, laboratory geomechanical testing and cabinet work.

Keywords: *geotechnical research, landslide, landslide remediation*

1 INTRODUCTION

Serbia Zijin Mining Doo Bor, as an Investor, ordered from the Mining and Metallurgy Institutre Bor to perform the geomechanical tests on the landslide, which was activated at the location of flotation tailing dump Čukaru Peki, in order to obtain the geotechnical bases for designing the measures for its rehabilitation. Geomechanical works included the field research and testing, laboratory geomechanical testing and cabinet work.

Works on the terrain preparation for dam construction and formation the flotation tailing dump Čukaru Peki, are performed according to the Main Mining Project for preparation the mineral raw materials and landfills for mining waste and pyrite concentrate from the Čukaru Peki deposit - Upper Zone, Mining and Metallurgy Institute Bor, 2020. In a part of terrain where preparation for construction the flotation tailing dumpis planned, the landslide was activated (Figure 1.1).

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Figure 1.1 *View of the landslide from the above (December 2020)*

2 TYPES AND SCOPE OF PERFORMED RESEARCH AND TESTING

2.1 Field research

Within the field research of the subject location, in the period of second half of December 2020, the following was performed:

- Terrain mapping;
- Sampling for laboratory tests;
- Shear "In Situ".

The terrain mapping was performed in order to better understand the real - real situation in the subject area, i.e. the active exodynamic process and results of its action in the field (Figure 2.1).

Figure 2.1 *Crack in terrain in the immediate vicinity of landslide (December 2020)*

Selection of samples for the laboratory geomechanical tests was performed during the engineering geological mapping of terrain. The total of 14 samples were taken.

Direct shear in the field was performed in order to determine the shear parameters along the sliding plane, i.e. mechanism of disturbed stability. It was performed in two places, according to a contact of the clay Quaternary cover with the Miocene substrate, according to the discontinuity for which it is assumed that the material slipped, Figure 2.2.

Figure 2.2 *Appearance of a build-in shear equipment in the field*

2.2 Laboratory geomechanical tests

In order to define the physical – mechanical and deformation parameters, the laboratory geomechanical tests were performed on the rock and soil samples.

The results obtained by testing the samples were used as the input parameters for analysis the stress states of material as well as the total displacements during sliding. The analysis was done using SLIDE v6.0.

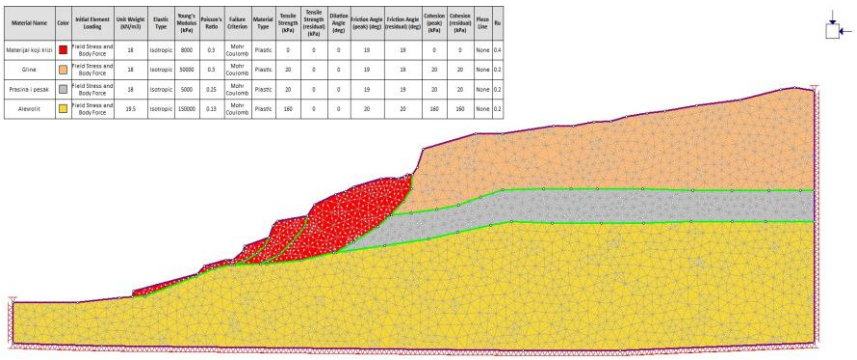

Figure 2.3 *Analyzed materials with their characteristics*

Figure 2.4 shows the sliding tendency of material with total displacements, expressed in meters.

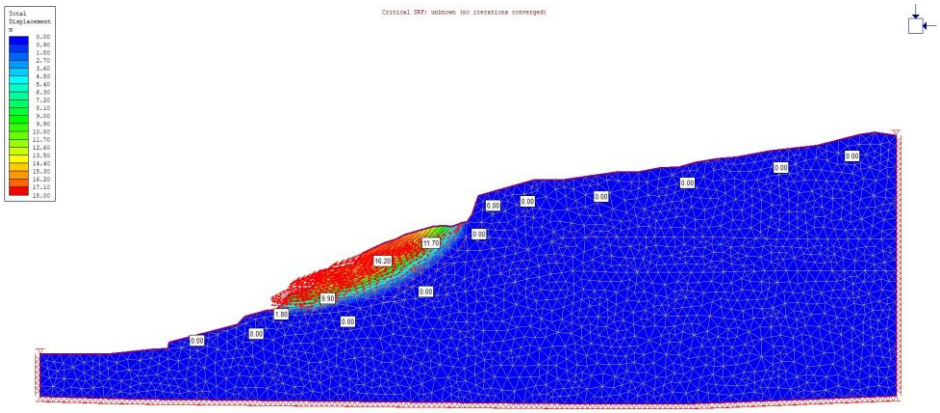

Figure 2.4 *Total displacements of sliding material, in meters*

Figure 2.5 shows the maximum shear deformations of sliding material.

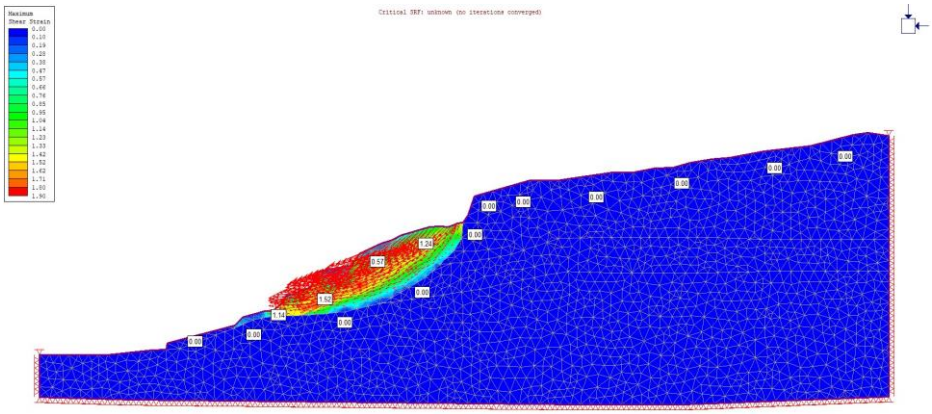

Figure 2.5 *Maximum shear deformations of sliding material*

3 RESEARCH RESULTS

Surface clayey cover is the subject to swelling, with a change in physical-mechanical and structural properties. The resulting masses, in the presence of water that accumulates above them, tend to move under the action of gravity, upon contact with a decomposed or fresh base rock. For that reason, the intensive, cyclic sliding processes take place on the right bank slopes, intended for the dam for

mation, which are supported and accelerated by anthropogenic action, i.e. by removal of masses at the foot of slopes during excavation. Thus, by cutting the slope, the landslide in question was activated. The sliding affected an area of approximately 60 x 45 m. The frontal scar of landslide at the top of slope is noticeable, with an average jump of 3 m. It is assumed that the thickness of driven material in the upper part is up to 12 m and that it decreases towards the lower part of slope. In addition to landslides at the site in question, the landslides and cracks in terrain were observed in awider vicinity of t landslide.

In any case, the following factors contribute to the sliding process of microlocation and immediate environment:

- anthropogenic action, i.e. excavations in unstable or conditionally stable terrain;
- geological composition of the terrain - alternating batches of highly plastic clay with more sandy interbeds through which groundwater circulates, as well as a high level of groundwater (recorded in the exploration works in 2019);
- tendency of clays that build the terrain to swell and compress, as a result of which cracks of dm dimensions are formed, through which water from precipitation flows directly into the terrain.

CONCLUSION

Based on all the above, the following can be concluded:

- At the location of the right bank of dam of the flotation tailing dump Čukaru Peki, the occurrence of landslides was registered and geomechanical research was performed in order to understand the causes and mechanism of instability, engineering geological conditions in the field, and to implement the preventive and interventional remediation measures. For that purpose, a certain scope of geomechanical works was performed with accompanying field and laboratory tests.
- The investigated terrain was built in natural conditions from: clay Quaternary cover, within which the clay and sand-dust lots and siltstones in the floor alternate. Part of the clay deposits has undergone gravitational transport (sliding) and represents the colluvium (landslide body).
- The geomechanical parameters of the selected engineering geological environments have been determined, which will be used for the development of the Landslide Rehabilitation Project.
- It is recommended that the rehabilitation of landslide in question would be performed by removal the clay cover (layers 1 and 2) in the area covered by the landslide and its immediate surroundings, in order to fund the dam on the basic rock mass.
- During the execution of earthworks, it is obligatory to engage professional geological supervision by a geological engineer and a civil engineer - geotechnician. During the work realization, with the approval of geotechnical supervision, the project can be adjusted to the actual geotechnical conditions.

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