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Geotechnics

Dušan Tašić[*], Dragan Ignjatović[*], Lidija Djurdjevac Ignjatović[*], Vanja Djurdjevac[*]

GEOTECHNICAL INVESTIGATIONS FOR DEFINING THE BUILDING CONDITIONS OF THE NEW QUARRY CRUSHER PLANT IN BOR[**]

Abstract

Geotechnical investigations were conducted at the construction site of the new crushing plant at the open pit "Kriveljski kamen" in Bor. The construction of parts of this plant is planned on an unstable slope. The aim was to define the lithological-geotechnical material and terrain structure as a basis for determining the optimal conditions of construction, excavation methods, funding and undertaking the reclamation measures in the area intended for accommodation of facilities.

Keywords: *geotechnical investigations, crushing plant, unstable slope, construction conditions*

1 INTRODUCTION

As part of an increase in the production capacity of stone aggregate at the open pit "Kriveljski kamen", it is necessary to renew the limestone preparation plant. Geomechanical investigations were performed at the place planned for location of the new crushing plant. The location of facilities planned for construction is on the southern edge of the open which is located approximately 4 km as the crow flies northwest of Bor. Micro-locally, the position is on a steep slope, right next to the already existing crushing plant. Field observations, exploratory drilling, core mapping and geomechanical sampling of rocks and soil on the slope were performed. After that, a geotechnical model of terrain was designed, in order to observe the object-engaged soil interaction.

2 REVIEW OF INVESTIGATIONS

In accordance with the investigation program, the following geomechanical investigation works were performed:

- Engineering geological mapping of the terrain;
- Exploratory drilling - the achieved depth for all boreholes were from 10.8 to 31 m, i.e. the total of 104.9 m of drilling;
- Geotechnical mapping of cores (Figure 1);
- Laboratory geomechanical tests on two soil samples and thirteen samples of rock material.

[*] *Mining and Metallurgy Institute Bor, Zeleni bulevar 35, 19210 Bor, Serbia*

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Figure 1 *Marking core for geotechnical mapping*

3 INVESTIGATION RESULTS

Based on all obtained data, the characteristic geotechnical cross - sections of terrain was constructed, within which the calculated values of important geomechanical parameters were presented. The calculated values of physical and mechanical parameters of rock material were obtained on the basis of results of the laboratory tests and statistical processing of the obtained results, field classification of cracked rock masses RMR [1], as well as using the software package RocData [2].

At the investigated location, based on the lithological and geotechnical composition, the eight geotechnical units were separated (as it is shown in Figure 2):

1 Technogenic material-embankment,
2 Sandstone debris,
3 Broken limestone,
4 Massive limestone,
5 Broken sandstone,
6 Compact sandstone,
7 Broken andesitis,
8 Compact andesits.

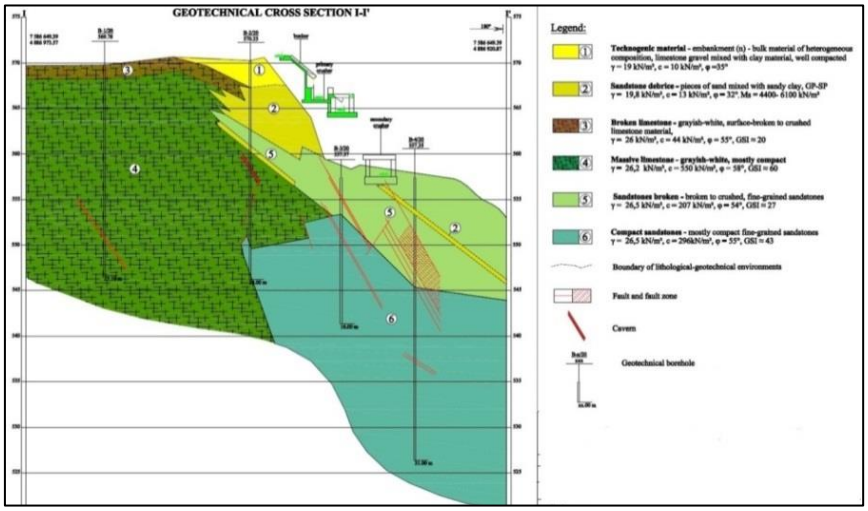

Figure 2 *Geotechnical cross sections of terrain with disposition of objects*

4 GEOTECHNICAL CONDITIONS OF FOUNDATION AND ANALYSIS OF THE SLOPE STABILITY

GEO5-Spread Footing version 5.2019.80 of the company "FINE civil engineering software" was used for calculation the bearing capacity of soil, which was done according to Eurocod 7 (2004).

The primary crusher facility with accompanying equipment will be founded on two foundation slabs. It is planned to fund the so-called "Massive gravitational foundation." The foundation will be laid shallow on terrain surface. The results of conducted calculation are shown in Figure 3.

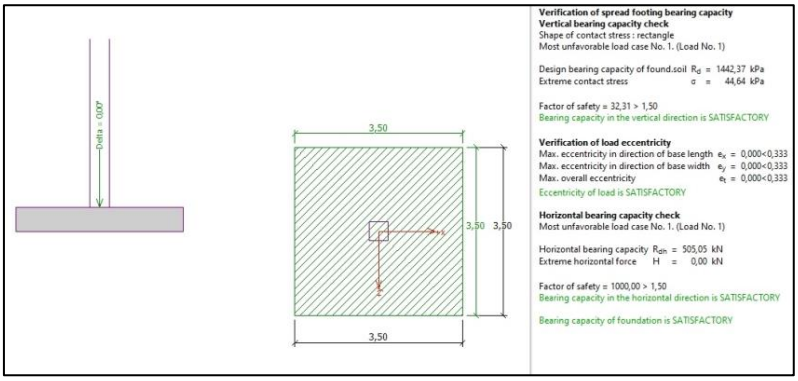

Figure 3 *Foundation bearing capacity calculation*

Funding on AB foundation board — *L x B = 3.5 x 3.5 m*
Fund depth — $D_f = 1$ *m*
Bearing capacity of soil — $q_a = 1442$ *kN/m*^{2}

For the purpose of designing all constructive solutions of facilities of the new crushing plant, an analysis of the current slope stability was performed where the stability problems were observed (Figure 4). Also, a stability analysis was performed to determine the area on slope of the cross section with the safety factor Fs less than 1.2 (Figure 5). The stability calculation was done with the *Rocscience* program *Slide v6.0*. With the Slide program, the stability calculation is performed in the conditions of boundary equilibrium. The calculation was done according to the *Janbu* method.

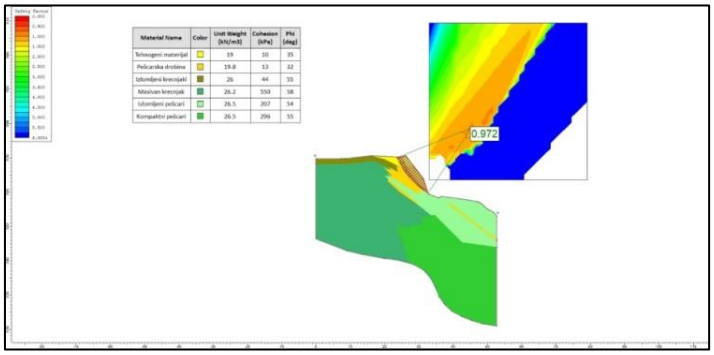

Figure 4 *Analysis the stability in current state of slope - Janbu method*

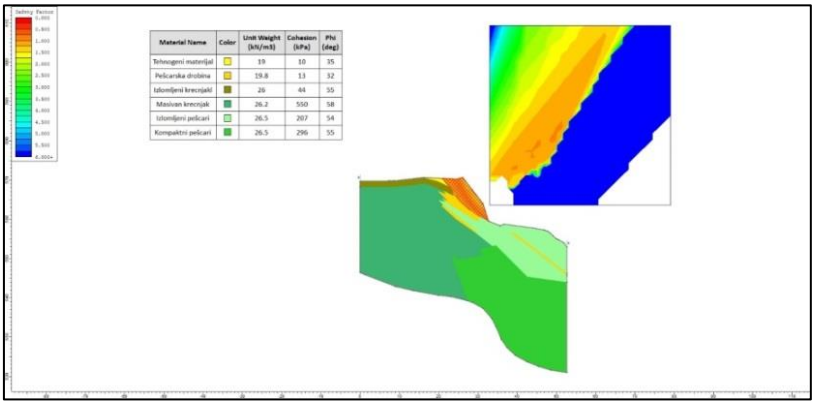

Figure 5 *Specify the area in which Fs < 1.2 - Jambu method*

Based on the conducted analysis of slope stability provided for accommodation the facilities and equipment (bunker, primary crusher), it can be seen that the subject slope is not stable in the current conditions (obtained values of Fs are 0.98 and 0.97). During the construction of facilities, the reclamation measures must be performed, in order to bring the slope into a stable condition. In this case, the designer decided to apply the anchoring of retaining wall by fixing the anchors to the rock mass, which the analysis showed to be stable.

CONCLUSION

For the need to build a new crusher plant in Bor, a certain amount of geotechnical exploration work was performed. There was a problem related to the engineering-geological conditions of the field, which was reflected in the fact that construction was planned on an unstable steep slope. Based on the investigation results, a geotechnical terrain model was formed, which defined the geotechnical conditions of construction and provided data to the designers for adequate positioning of reclamation measures in the field.

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