



ANALYSIS OF THE IMPACT OF LANDSLIDE REHABILITATION IN THE EASTERN PART OF THE OPEN PIT JUŽNI REVIR ON THE ECONOMY OF THE MAJDANPEK COPPER MINE

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Abstract

The exploitation of copper ore at the Open Pit Južni Revir takes place in complex natural and technical conditions, and a special feature is that landslides occurred on the eastern slope of the mine. The occurrence of landslides in this part of the Open Pit threatened the continuity of the ore exploitation process in the mining system of excavation-processing, which is why it is necessary to reconstruct the eastern slope of the mine.

In the paper, the impact of the reconstruction of the optimal contour of the Open Pit Južni Revir, due to the need for landslide rehabilitation, on the net present value (NPV) was analyzed.

Keywords: landslide, rehabilitation, NPV.

1. INTRODUCTION

The Open Pit Južni Revir operates within the company Majdanpek Copper Mine, which is a part of the company Serbia Zijin Copper doo. The Majdanpek copper mine, in terms of production, technical and technological sense, is a complex mining system that has activities from the geological explorations of mineral resources, exploitation and processing of ore to a number of accompanying activities as the necessary support to core business [1].

One of the specifics that affects the complexity of open pit mining is that, due to mining activities, the stability of the eastern side of the mine was disturbed and landslides occurred, as a result of which the continuity of the process of ore exploitation in the mining system of excavation-processing is threatened.

There are two dominant influencing factors when planning exploitation at the Open Pit Južni Revir: (1) to ensure a stable slope of the east side of the open pit and (2) to exploit the ore body in such a way as to maximize the value realized from the open pit under existing conditions.

Based on the analysis of cash flows for the case of the optimal contour of the open pit and the case of the modified contour of the open pit, due to the rehabilitation of landslides, it can greatly contribute to making crucial decisions regarding the economics of exploitation in open pits [2,3,4].

2. METHODOLOGY

2.1 Geotechnical characteristics of the eastern slope of the open pit

Based on the results of previous geological research, as well as the terrain reconnaissance, an unstable part of the terrain in the eastern part of the Open Pit Južni Revir, which was affected by a landslide, was determined.

The unstable part of the terrain consists of a complex of medium and completely degraded slates and gneisses and medium and completely degraded andesites.

Figure 1 shows the landslide zone and Figure 2 shows a characteristic geotechnical section of the eastern slope of the Open Pit Južni Revir that shows the landslide.



Figure 1. The landslide zone

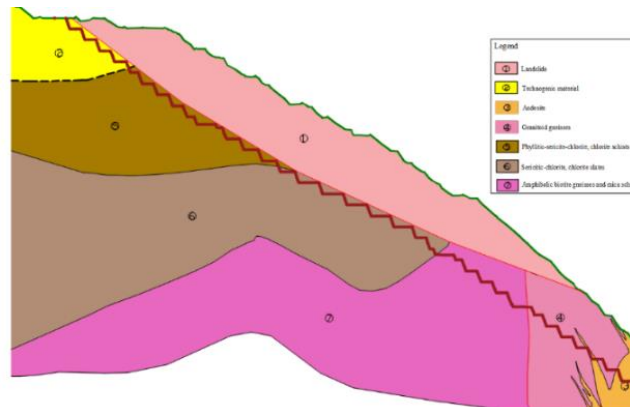


Figure 2. A characteristic geotechnical section on the eastern side of the Open Pit Južni revir [5]

2.2 Modeling of landslide solid in the eastern side of the open pit

Landslide solid is generated in the Geovia GemsTM software on the basis of defined vertical geotechnical profiles using the TIN (Triangle Irregular Network) method [5].

The landslide is large, with complex geometry and movement dynamics. The area of the landslide is 826,309 m².

Figure 3 shows the looks and position of the landslide solid in a 3D environment.

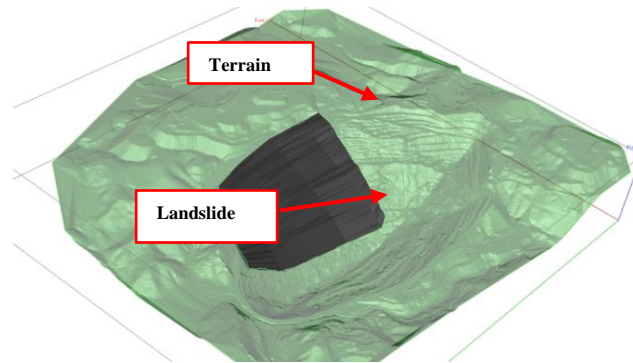


Figure 3. The position of the landslide solid

2.3 Ultimate open pit contour

The ultimate open pit contour was generate using the Geovia Whittle™ software. The optimization process is based on the block model of the deposit, created by the geostatistical modeling method.

2.4 Landslide rehabilitation in the eastern part of the open pit

Landslide rehabilitation involves modifying the optimal contour of the excavation, in order to remove all material from the unstable zone.

The reconstruction of the eastern part of the Open Pit Južni Revir was carried out on the basis of the adopted geometric elements of the open pit and the generated landslide solid.

Figure 4 presents a characteristic profile showing a deviation of the modified (final) contour from the optimal contour of the open pit.

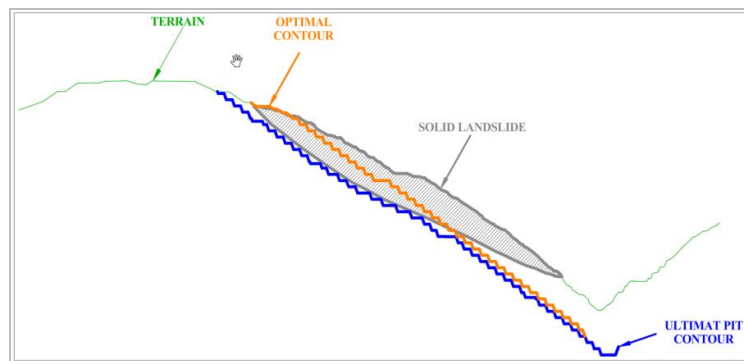


Figure 4. Modified contour and optimal contour in the eastern side of the Open Pit Južni Revir

3. RESULTS AND DISCUSSION

The dynamics of ore and waste exploitation at the Open Pit Južni Revir is shown in Figure 5.

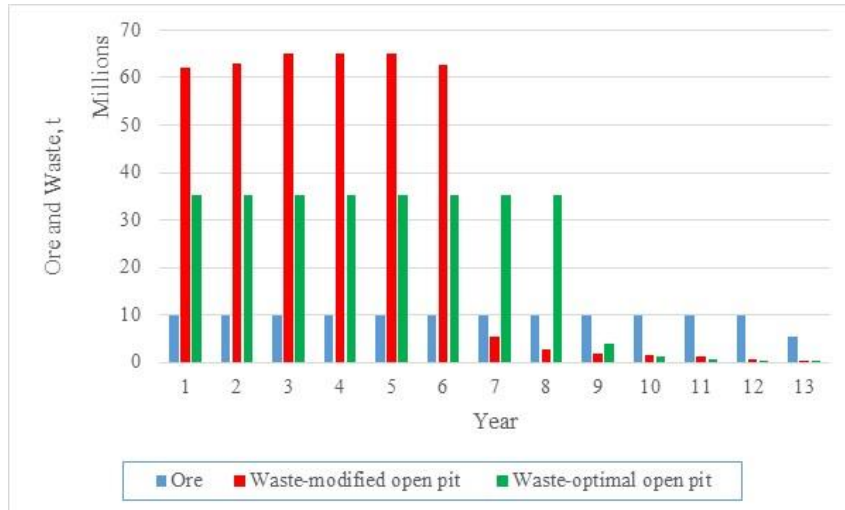


Figure 5. Dynamics of exploitation of ore and waste at the Open Pit Južni Revir

Figure 6 shows the cash flows for the optimal contour and the modified contour of the Open Pit Južni Revir.

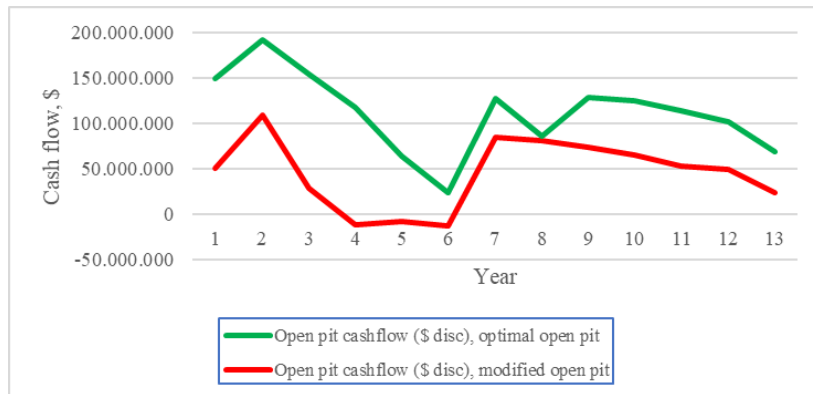


Figure 6. Cash flow for the optimal contour and the modified contour of the Open Pit Južni Revir

On the basis of presented results, the following can be concluded:

- 1) The life of ore exploitation at the Open Pit Južni Revir is 13 years.
- 2) The total amount of waste in the optimal open pit contour is 286,629,364 t, and in the modified open pit contour is 396,891,145 t.



- 3) From the first to the sixth year, waste quantities are higher by approximately 30 million tons/year in the modified mine contour.
- 4) The discounted cash flow in years 4, 5 and 6 has a negative value for the modified optimal contour of the open pit.
- 5) Over the entire life of the open pit, the discounted cash flow for the modified contour is lower compared to the optimal contour.
- 6) The NPV for the optimal contour of the open pit is \$896,643,015.
- 7) The NPV for the modified optimal contour of the open pit is \$585,932,261.

4. CONCLUSION

The occurrence of a landslide in the eastern part of the Open Pit Juzni Revir threatens the safety of workers and mining equipment during mining operations. Due to the real threat of interruption of the exploitation process, it is necessary to rehabilitate the landslide.

Rehabilitation of the landslide implies modification of the optimal contour in the eastern part of the open pit.

Within the modified optimal contour of the open pit, the amount of waste that will be excavated is greater than in the optimal contour by 110,261,781 t. As a result, the Open Pit Južni Revir will achieve a lower NPV by \$310,710,754.

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