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Professional paper

EXPERIMENTAL DETERMINATION OF BEST PERFORMING CUT IN LECE UNDERGROUND MINE

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Abstract: Development operation in underground mining require high performance drilling and blasting. In order to determine best performing cut in Lece mine series of experiments were conducted. It was noticed that sequencing of initiation has crucial impact on cut performance. Line cut had experienced filling of empty holes with blasted material that was indistinguishable from the main rock. Finally, best results were obtained by delayed initiation of charges in circular pattern. Such cut construction provided complete hole recovery instead of previous poor results.

Keywords: blasting; explosives; underground mining;

1 INTRODUCTION

Underground mining methods used in Lece mine require increased amount of development openings such as drifts and ramps. Due to inadequate application of underground mining methods and mine design almost half of ore quantity is excavated through development in some months. It is clear that effectiveness of development excavation has direct influence on the costs and production capacity.

It was disappointing that drilling and blasting is done by handheld drills with rods 1.6m long, while drillholes have diameter 39mm. Technical reports on blasting efficiency provided information that after blasting effective advance was 1.35m, while 0.25m of the blasthole was wasted. However, geodetic data informs about huge differences based on location of blasting. For example, on the location RT1-222SZP during period of 01.09.-30.09.2019. there has been 15 blasting and total advance was 13m, which is 0.86m per blast. On the location RZ-43-80L during the same period there was 30 blasts while total advance was 35.5m which gives 1.18m per blast. Al other locations inside of mine has similar effects. Figure 1 illustrates blasting pattern that has been used for

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development. It was determined that miners have modified this pattern according to their need and experiences, some of them use cylindrical and most use wedge type cut. In each case amin problem was bad cut performance and therefore experimental design of cut was performed.

Importance of the proper cut design are widely reported and explained in literature (AyalaCarcedo, 2017; Zhang, 2016; Xu, Li, Liu, & Zhang, 2019). Damage of surrounding rock mass due to improper blasting is one of the problems that needs to be taken care of since it may provide instabilities (Torbica & Lapčević, 2016; Torbica & Lapčević, 2015; Torbica & Lapčević, 2018) and higher quantity of materials to be handled. Previous works on blasting optimization in Lece mine were considering ring blasts and is available in (Duranović, et al., 2018).

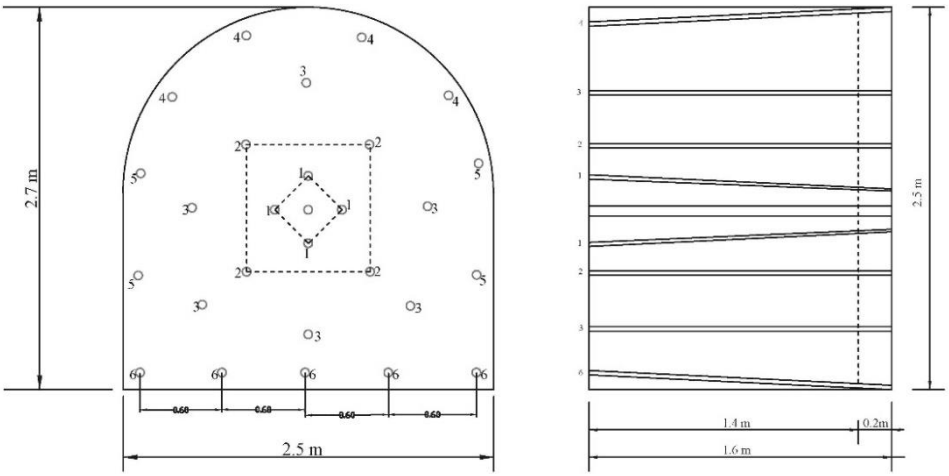

Figure 1 Blasting pattern used in Lece mine

2 RESEARCH TOWARDS CUT DETERMINATION

All experiments were conducted in orebody RT-1 where rock mass is consisted of clayey andesites and unknown geomechnical parameters at the time. As it is hard crystalline rock wedge cut is eliminated from consideradion and only cylindrical type was considered. Main mistake that has been identified is that charged hole in the cut are too far away from the empty one. Therefore, base distance for the begging is taken to be 5 hole diameters since this distance is widely reported in theory and practice.

Initially, line cut with 5 holes where every second hole is charged was test (Figure 2), three charges in total. All charges were initiated at same time. Figure 3 illustrates results of this experiments where empty holes were filled with blasted material.

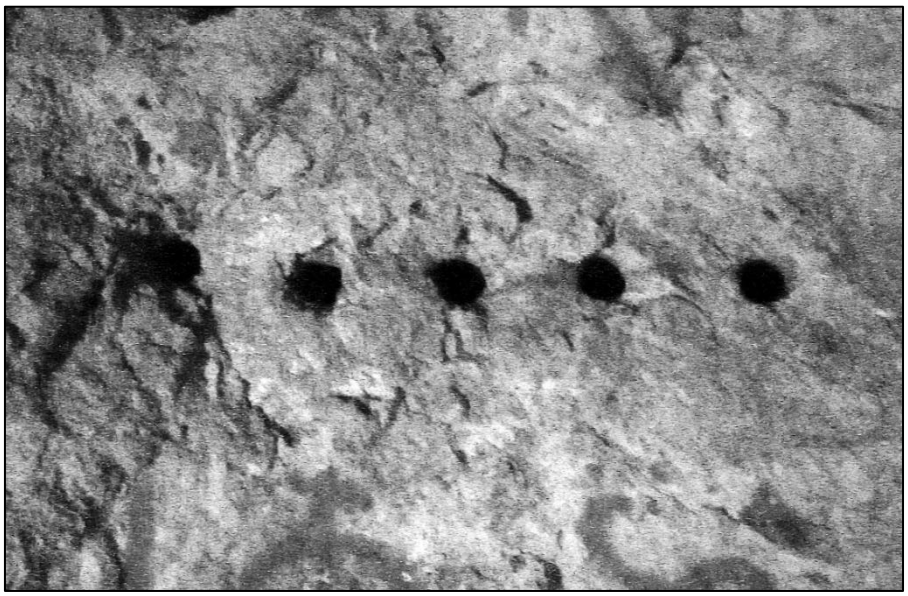

Figure 2 Line cut drilling pattern

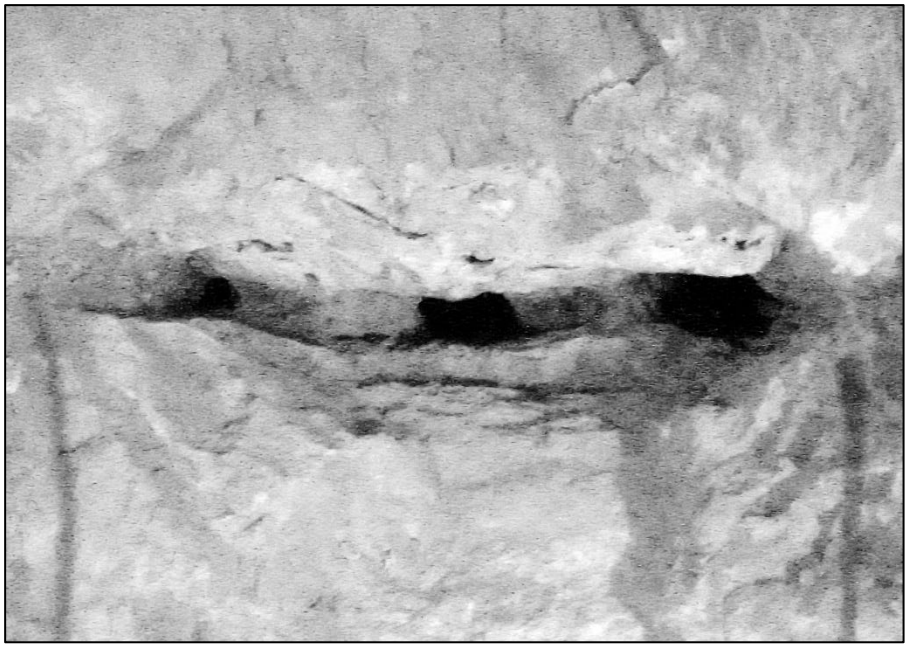

Figure 3 Line cut after blasting

Since it is case with clayey andesite, blasted material was compacted into empty holes that it was very hard to distinguish it from the main rock or remove.

Then, two cuts illustrated in Figure 4 were applied with the same distance between holes. With the first cut where 4 holes are charged with central one empty, all holes were initiated at same time, and with the second one on central hole was charged. Results are same as in the first experiment.

It was clear that main problem is the removal of the blasted material from the cut and it implied further experiment where explosive charges were initiated in circular pattern with delay between them, Figure 5 and 6. The first experiment provided excellent results where empty space was created along complete length of the drilled holes of 1.6m, Figure 7.

In order to confirm the results whole face was blasted using countour blasting technique as illustrated in Figure 8. At the face after blasting there is no evidence of boreholes, advance was complete of 1.6m, while walls are smooth without damage.

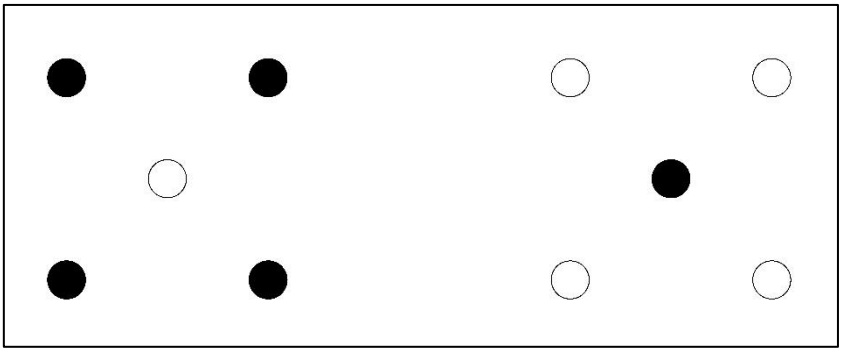

Figure 4 Tested cut patterns during research

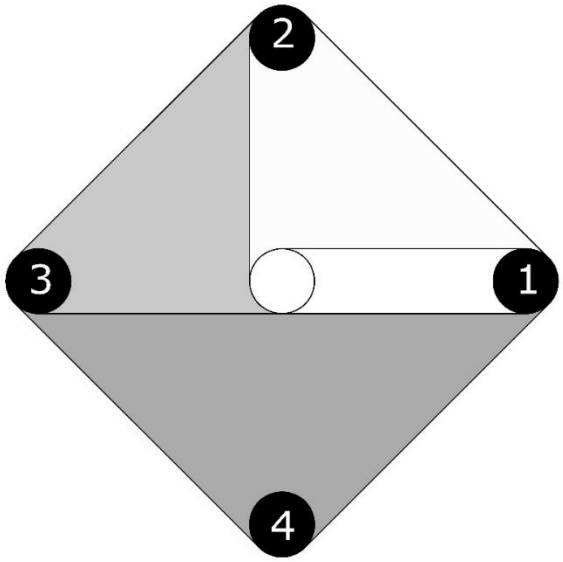

Figure 5 Cylindrical cut with delayed initiation of charges

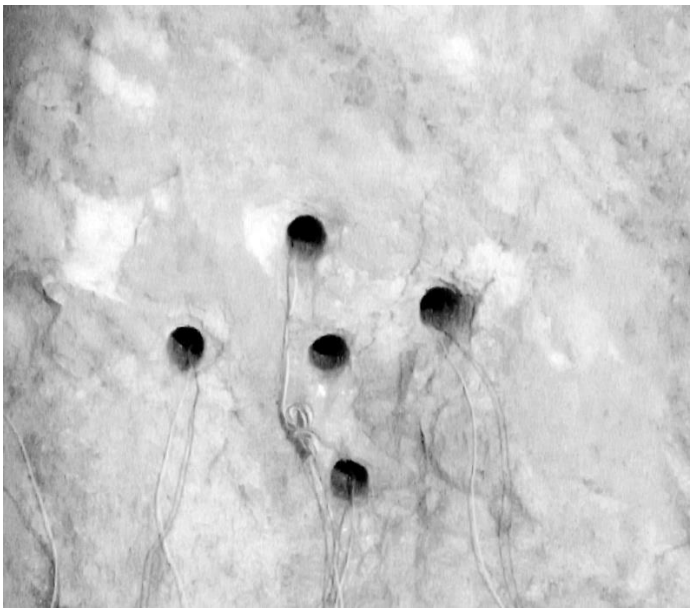

Figure 6 Drilled and charged cut prepared for blasting

Figure 7 Results ontained after blasting

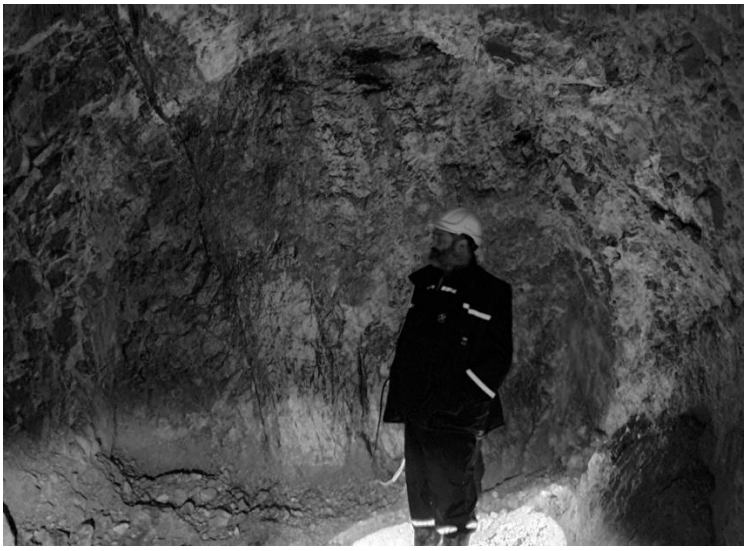

Figure 8 Drift excavated using cylindrical cut with circular initiation and contour blast

3 CONCLUSION

Inappropriate blasting and technological discipline may lead into bad development operations and increased costs of such work. In order to eliminate such practice experimental work has been conducted and best performing cut has been defined.
Main problem that has been faced is that explosive charges were too far away from the empty hole in the cut. By reducing the distance to widely reported 5 diameters several experiments were conducted. During this work extraordinary behavior was experienced since in several experiments with the line cut empty hole were filled with blasted material that was in such state of compaction that it was hard to distinguish it from the host rock. Several other experiments experienced same behavior due to the, most probably, higher content of clay in the rock mass.
Finally, best results were obtained by putting the delay between explosive charges in the cut pattern and initiating them in circular sequence. This cut turned out to be only one that provides complete recovery of the hole length and is being used since in the development operation in Lece mine.

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