J. Int. Environmental Application & Science, Vol. 12(1): 42-48 (2017)

Concept Paper on Decline Ramp Opening in Deep Horizons XI^{th} to $XIII^{th}$, of the Mine Trepca in Stanterg

Muhamedin Hetemi*, Rafet Zeqiri

Public University of Mitrovica, Faculty of Geosciences, Mining Department in Mitrovica,KOSOVO

Received December 09, 2016; Accepted March 20, 2017

Abstract: The paper focuses on a study to find out the expenses and time duration of opening of deep horizonts XI^{th} - XII^{th} in Trepça mine with decline shaft (ramp) and is giving the result which can be recommended in practice and bring benefit to the mine.Although this subject was not treated so far, in practice of underground mines in Kosovo, by scientific thematic methods of opening optimization and comparison of this method especially in a case when is imposed the hoisting method in the mine since current method cannot be used further because of limits that hoist machine has. Depending of that, it will depend shorter time of investment return and favorable production, that can have decisively impact on the mine economy.In this paper were analysed and compared essential points, expenses parameters starting from needed labor force, expenses and time for opening main objects, the underground water drainage problems, needed analytical and statistical calculations.

Keywords: *mine, shaft, spiral ramp, optimization, analyses*

Introduction

On the previous paper published in JIEAS, it was analysed the shaft sinking in deep horizont by vertikal shaft. The construction of spiral declinefromhorizonXI^{th} – $XIII^{th}$, respectively works at spiral steep, would be done in strong limestone and in environments which secure safe working environment. The ramp for deepening the horizon related to three levels with has distance between them of 60 m, horizon XI^{th} (15.20m quota through the horizon XII^{th} (-45.20m quota), to the horizon $XIII^{th}$(-105.20 quotas) was led from the top-down and built the entire length and height set. What matters is the approach ramp near ore bodies in order to start as soon as possible production at the mine, which would shorten the duration of return investment. All these are shown in the figures such as: cross-section of the shaft and the ramp, the appearance and position of ramp service in the XI horizon to horizon XIII, position and place of the ramp. Also were calculated the length, angle of decline, and the azimuth direction, in various points around the track of the spiral ramp.

Geology of the resource

Trepça mine was established in 1927, but production started in 1930, as result of geology researches. It has Pb and Zn metal mainly, but also Ag, Au, Bi, Sn, Sb etc.Ore bodies have appearance in contact between breccias and limestones, with cross section surface of 100-5,000m2, with incline angle 30÷800. Mining field of Trepça has large deposits such as: Stanterg, Zijaça, Melenica, Maxhera, XhidomaandRashan, that were investigated and ore quality and quantity was identified as shown on table 1. The used method named in professional literature as Trepca Method. still remains the basic method of exploitation of minerals in Stanterg mine. Technological advancements of method by using hydraulic filling and preparatory spiral works, raised mine productivity.

The cost and value of the spiral corridore construction

Construction of ramps will be through internal limestone. A ramp length is 730m per horizon with transverse profile $S = 15m^2$ and we move out approximately $11{,}000m^3$ volume of infertile, ie if we add to this 20% increase in bulk density due to increased mining and volume measures, we should calculate that opening ramp, to remove sterile material we have somewhere roughly around $13{,}200m^3$. Given two horizons opening through, then we will have duplication of costs and material, therefore, the length of the ramp would be 1,460m, and about $26{,}400m^3$ sterile material to remove(Elevli B, 2002).

Corresponding: E-Mail:muhamedin.hetemi@umib.net; Tel:+38128535725

Trepça mine opening was done in four phases as described on previous papers, and was depending on terrain configuration, position of ore bodies, depth etc. (Figure 1).

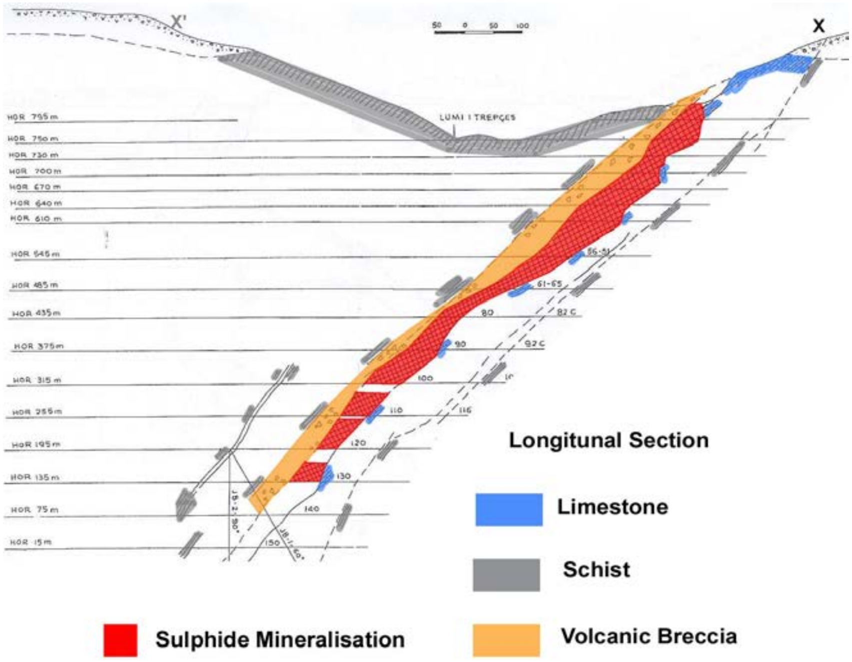

Figure1. The position of ore bodies in Trepça mine

Exploatation method used in Trepça mine is shown on Figure 2.

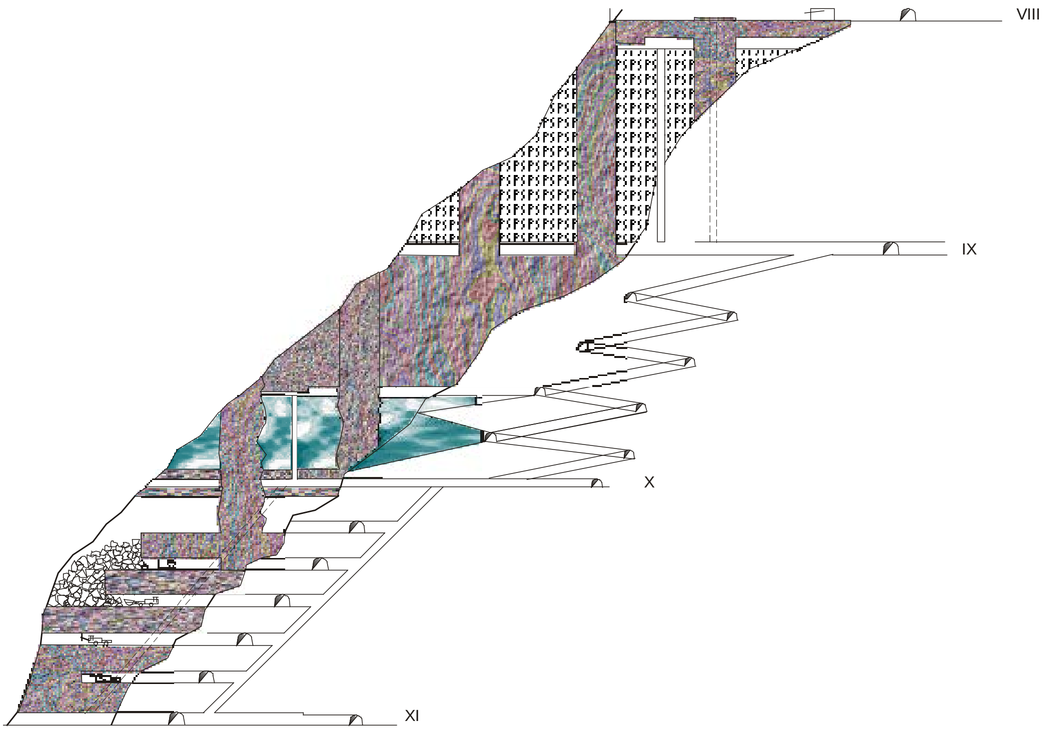

Figure2.Trepça mine method

In Figure 3 is shown servicing ramp position, through the floors of the horizon towards the XI-XII and just a detail, how to construct a spiral ramp in one level.

Table 1. Ore reserves in Trepça Mine

No	Mine-Location	Ore Quantity (t)	Ore Quality (%)			Metal (t)		
			Pb	Zn	Ag (g/t)	Pb	Zn	Ag(kg)
1.	Stantërg	20,754,000	4.02	4.02	76.0	834,311	674,505	1,577,304
2.	Melenica	2,552,000	5.80	5.80	85.0	148,016	107,184	216,920
3.	Maxhera	600,000	3.80	3.80	72.0	22,800	18,000	43,200
4.	Mazhiq-Maja Madhe	1,500,000	3.30	3.30	60.0	49,500	42,000	90,000
5.	Gjidomë-Mazhiq	2,000,000	3.30	3.30	60.0	66,000	56,000	120,000
6.	Rashan-Tërstena	2,500,000	3.30	3.30	60.0	82,500	70,000	150,000
7.	Zijaca	5,175,000	2.83	2.83	16.0	146,453	112,815	82,800
8.	**Total**	**35,081,000**	**3.85**	**3.85**	**65.0**	**1,349,579**	**1,080,504**	**2,280,224**

Source: Trepça under UNMIK administration. (2005). *Summary description of the lead zinc silver resources and the Trepca mines in Kosovo*

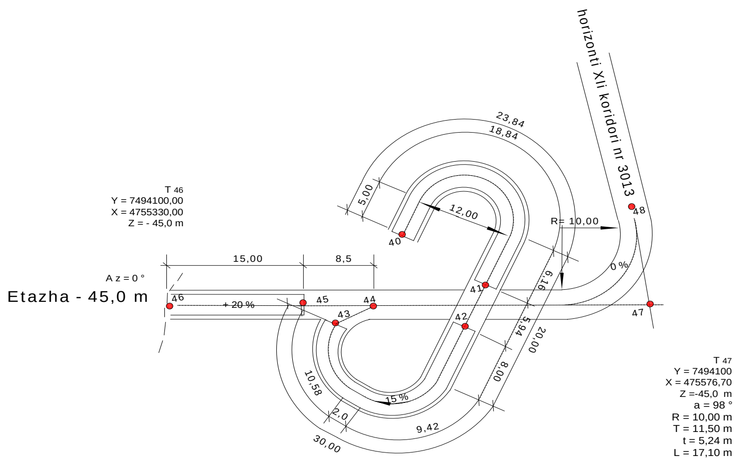

Figure 3. Schematic view of spiral ramp in one level (-45,0m)

Results of research and physico-mechanical attributes of rocks that surround the facility where should be built spiraling corridor and other associated facilities (spiral ramp) on the horizon XII and below, are given in Table 2.

Table2 -Rock charachteristics on level XI-XII

Type of rock	γs	γv	σsh	σt	f	C
Limestone	2.86	2.80	494.7	50.3	5.27	87.73
Schist	2.83	2.76	441.3	65.7	4.45	85.84
Brecca	3.00	2.90	608.7	64.3	6.08	109.59

Source: Stan Terg Mine. (2006). *Feasibility study. Trepca Mine.* Mitrovica, Kosovo

Based on the physico-mechanical research and rock properties results on which to build these facilities, it can be reached a conclusion that schist appear as a sort diverse as very strong, stable, silicate scale to those less stable as brecca, phyllite etc.

Technology and techniques of excavation in spiral corridore construction

The cross section profile of the ramp-to-horizon XI - XII, was chossen for basic equipment which is the same as available at the mine. Ramp excavation techniques will be described briefly:

Driving with a slope scale 1: 8 is affordable for the equipment.Drilling the stope / forehead of the ramp should be excecuted by two hydraulic hammers Jumbo Boomer H127. For loading and transport can be used LHD loader, spoon with volume of 2.5m^3. LHD loader will be completed with diesel truck transport if the distance reaches 300m.Ramp is set to pass through the inner limestone rocks due to the

approach of ore body and the possibility to easyextract ore and reduce expenses. Research drilling in length of 15-20m can be made by Boomer, using additional poles(McMullin, 1994).
Working forehead in cross-section area should be 14:50m^{2}respectively adding 5%, is 15.0m^2.

Spiral ramp designed models
For more adequate presentation of works were used different software, but in general was used 3D Studiomax and Auto Cad. In figure 5 is shown cross-section of the ramp with presented position and the position of the servicing ramp (A) through the levels of the horizon XI to the horizon XII. (Hetemi, Contribution to the optimal modelling of mine field opening from level XI to level XIII in Stanterg mine, 2013). Also was given the length, angle of decline, and the azimuth direction, as well as levels,shown on Figure 4.

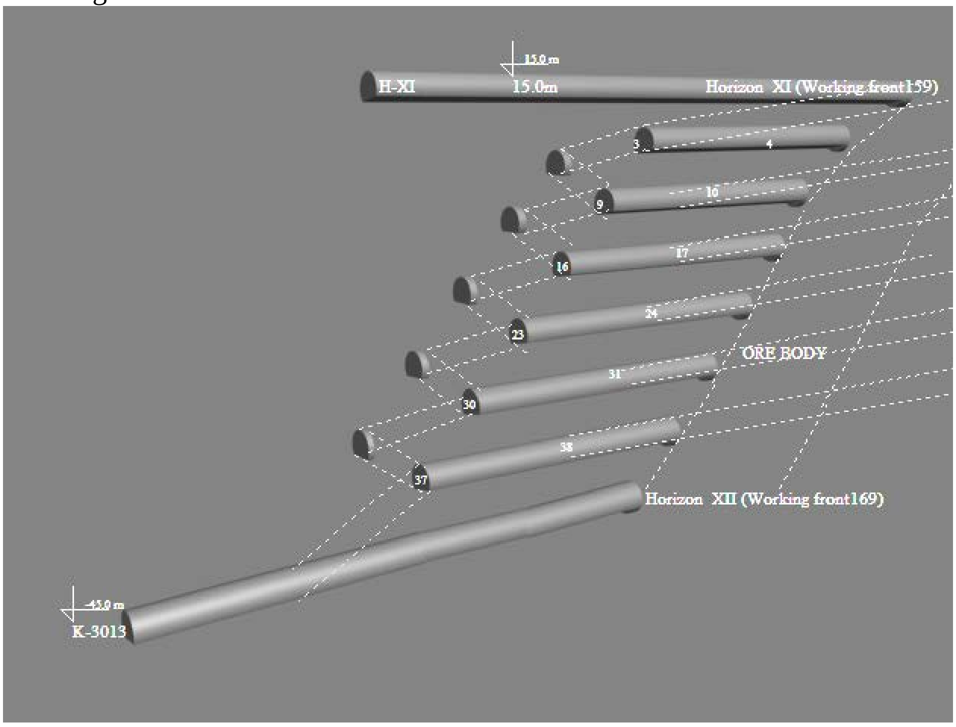

Figure 4. Spiral ramp construction between level XI-XII

Operational expenses
Drilling and Blasting expenses
For the drilling of corridore, with Boomer machine, 46 boreholes will be made, 25 in one shift,and the length of it is 3m.Therfore the expensesfordrilling and blasting are calculated as following on table 3.

Transport expenses
One of the steps of underground mining operations is transport and ore extraction to the surface. However, due to technological developments in new transport equipment such as trucks that have highlighted the advantage regarding transport to the mine. Transport through the ramp is a good alternative for bringing mineral to the shaft. Many mines have applied such a method of ore transportation. Two thirds of Australian mines have adopted transport ramp. This situation prompted us to make a comparison of transport through skip or ramp for various mining operations.
There are some general criterias such as:

➤investment and development in mining transportation equipment

➤ore transport costs

➤The value of the transport project as a whole.

In order to compare the alternatives to transport by shaft or ramp, each variant is analyzed on the basis of relevant criteria. A technical-economic comparison is made between two possibilities presented by trucks and skipit.

Table 3.Expenses per 1m` drilling-blasting by Boomer

Drilling expenses	345,565 €
Bleasting expenses	139,000 €
Total	484,565 €

For trucks loading there should be opened corridors as planned, in each 25m distance was designed a chamber where the car was handling and loading the truck.
For analyses time interval of driving and in –out loading-unloading was calculated to be 10min.
Each day advance in ramp is 3m then we could conclude that every day transport distances increase up to a distance of 1,460m. When we add shuttle then it is best to have a total estimated:

$$L_{V-A} = \frac{S}{l} = \frac{1430}{3} = 477$$

Based on this the truck makes a trip of 684,000 m.
The characteristics of the truck have movement in line transporting a total of 930m which means that the time taken for calculating the furthest point.Once taken for analysis that will work with both trucks then we have:The truck can carry our 12t or 5m^3 for volume up to 37m^3, which are calculated as 7,5 or 8 shifts and is accepted as approximate 8 trucks for removing minnedmaterial.The speed is 0-10 m/s was accepted the average of 5 m/s then the gain calculation of 3min needed for reaching distance of 930m.

Workforce expenses

For the calculation of labor costs Gantt schedule will rely on the design of works to be arranged by regime of works for better work organization during the opening of the mine. The workforce must be well organized in four brigades system to work in three shifts during 300 days in a year.First shift is scheduled after workers perform drilling by BommerSecond shift will do the support of facilities by anchoring and if needed concrete support the remaining parts of 3m and fill holes drilled by prior and undermine change.Third shift is to secure the corridor to undermine and make loading of ore transport respectively, and do corridore support and if time allows to begin the process of drilling.It is anticipated that within three shifts make advancement of corridor for 3m.Corridors are planned to be build in total of 1460 m and built stacks provided by the same group within the time when dealing with support or additional time may be provided in some cases there is no need for support.
Time set to open all these corridors is calculated as follows:

$$T_{\min e} = \frac{L_{total}}{A} = \frac{1{,}460}{3} = 476 \ \ workingdays$$

$$P_{\min e} = \frac{T_{\min e}}{B} = \frac{476}{300} = 1.5 \ \ years$$

Timetable to open mine:

$$T_{\min e} = \frac{L_{total}}{A} = \frac{1430}{3} = 470 \ \ workingdays$$

or 1 year and 4 months,and are shown on table 4.

Table 4. Ramp openning expenses

Drilling – blasing expenses	484,565 €
Ore loading expenses	527,075 €
Transport expenses	325,300 €
Air ventilation expenses	50,040 €
Workforce	1,028,840 €
Total	2,415,820 €

The advance in opening the ramp in horizons XII and XIII, is described below on Table 5.Work will continue with preparation for excavation. Two months time before the start of production in the first stope. The total time from iniciation decision to start of the ore production in the XII horizon is 28 months.Alternative enforcement of power diesel trucks is interesting and there is reason to investigate the case of the corrections system deepening ramp. Capital investment for diesel trucking system will be slightly more expensive than electric trucks (Brazil, et al., 2008). The ventilation system in Stantërg mine should improve within mine capacity. Assessment of diesel energy trucks opposite electric trucks will not be elaborate further on this project but will be processed if the mine management decides in favor of ramp alternative.

Table 5. The activities in horizon opening by spiral ramp

The activities in the ramp	Timetable
Technology assessment and planning details to the point of decision	3 months
Start with planning and preparation on the horizon XI. Ventilation, sterile material removal, transport of equipment to the depth, workshop etc.	6 months
The ramp digging down to the horizon XII in length of 500m and 20m^2 of profile. Connection to the shaft end penetrated by ventilation	3 months
The excavation of the reservoir, ramp type, installation of overflow pump.	1 month
Direction (main corridor) horizon XII - XIII by ventilation shaft is estimated at about 350m.	2 months
Continuation of stack on the ventilation shaft in horizon XI	1 month
The descent of the truck on the horizon XI and mounting on the shaft workshop. Installation directory (conductor) in ramp from horizon to horizon XII to XIII.	2 months
The excavation of the ramp next to the horizon XII and XIII in length of 500m with 20m^2 profile. Connection with the ventilation shaft	3 months
Ramp excavation toward catchment and installation of submersible pump.	1 month
Connection stack of ventilation shaft and horizon XII.	1 month
Reservoir and pumping station on the horizon XIII, permanent pumping installations.	3 months
Ventilation stack for horizon XII connection	1 month
Total	**27 months**

NOTES: Provisional regulation of ventilation in the XII and XIII horizon. The development of mining work can start on this horizon.

Conclusion

Solving method of opening the mining field in an underground horizon should be based on the specific details of each mine separately. However, a preliminary study and evaluation at the request of giving can become an initial selection which method or option should be studied in details. Estimated cost and duration of the work schedule at the opening of capital facilities as well in our case that ramp has created. Opening mining field by spiral ramp in deep horizons has several advantages:

Advantages:
Cheaper cost of opening
Activation time interval much shorter production,
Machinery is easier for maintenance

Disadvantages:
Mining facilities are smaller dimensions
Ventilation is in unfavorable parameters,
Greater workforce
Engines are limited productivity.
The security- protection at work is less
It should be noted that the choice of opening the mining field with a ramp toward the shaft can be affected by many other factors including equipment, use of the future opening facilities and the impact on the overall production of the mine, the requirements for additional ventilation, specific conditions in stopes, etc.

Technical analysis are drawn to two different economic and time parameters were analyzed:
Opening ramp costs ....2,415,820 €
Opening periods ramp .... 2.5 years
Return on investment ....6.2 years

From this we can conclude that the option of opening the ramp has cost almost twice less than the version with the shaft sinking, as was described in Hetemi and Zeqiri (2016) paper, therefore theduration of opening is shorter. By comparing the investment return we can conclude that the start of production by ramp opening option is more favorable towards the deepening of the shaft variant(Walters D. M., 2009).

References

Brazil M, Grossman, P. A., Lee, D. H., Rubinstein, J. H., Thomas, D. A., & Wormald, N. C. (2008). Decline design in underground mines using constrained path optimization. *Mining Technology, 112*(3), 164-170.

Elevli B, D. A. (2002). Underground haulage selection: Shaft or ramp for small scale underground mine. The Journal of the South African Institute of Mining and Metallurgy, 102, 255-260.

Hetemi, M. (2013, February). Contribution to the optimal modelling of mine field opening from level XI to level XIII in Stanterg mine. 1-129. Mitrovica, Kosovo, Kosovo.

Hetemi, M., & Zeqiri, R. (2016). Concept paper on shaft sinking of the mine Trepca in Stanterg new horizons XIth to XIIIth. JIEAS, 11(1), 65-71.

McMullin, D. R. (1994). Shaft sinking and ramp excavation, which method for what conditions. Society for Mining, Metallurgy and Exploration, (pp. 94-151). Colorado.

Stan Terg Mine. (2006). Feasibility study. Trepca Mine. Mitrovica, Kosovo.

Walters, D. M. (2009). Ventilation for sinking vertical, sub vertical and decline shafts. Shaft Sinking and Mining Contractors Conference. The Southern African Institute of Mining and Metallurgy.

Trepça under UNMIK administration. (2005). Summary description of the lead zinc silver resources and the Trepca mines in Kosovo.