BLASTING OF BROKEN MARBLE ZONES

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ABSTRACT
On receipt of marble blocks appear deformed zones with presence of cracks and other deformities and very small cracks with different azimuth in the rocky massif. The fastest and economical way to bring this zone are removed by applying the methods of blasting.
Before blasting, these tables - zones are limited by the block, making the cuts with diamond wire because explosive action may cause of surrounding quality marble blocks.
Keywords: *blasting, crashed zones, cracks, marble blocks zone, cuts*

1. INTRODUCTION

The energy generated by the explosion of some quantity of explosives, have broken and breaking kvaliti of marble stones rocks, cracks form and various deformations in the surrounding massif rocks. Around of blasting place and outlying areas the generate detonated wave, causing elastic deformation, concentrically arranged around the mining area.

These detonation shok waves passing through a rocky massif cause defirmation with small craks and other deformities of the particles from the ground and surrounding massif od the querry. Blasted series performed on surface in thwe quarry mine, cause different effects on the environment in terms of intensity of the shocks, air shocks and pieces of blasted rock mass.

2.0 GOALS FOR PERFORM BLASTING IN SPLIT-CRUSHED ZONES

In this paper describes some methods of blasting in the broken zones in the one quarry mine in Prilep . The method which describe is the use of drilling -blasting work with use of diamond wire and cutting machines for prepare cuts around the blocks which are prepare for blasting. This zones are crushed and have a lot of cracks, deformities and other geological negative characteristics.

In general extraction of marbles blocks from the white hard rock mass is done in some ways:
- Drilling vertical and horizontal drill holes and blasting charge, and
- Combined extraction with drilling, blasting and diamond wire sawing.
- Combinations with cutting machine and diamond wire.

In areas where the working floor are expected quality blocks and where deformities are present in marble range, it is necessary to remove these masses in a manner that ensures efficiency and safety in terms of quality marble surrounding massif. Usually these masses-tables are removed by blasting and this method is the subject of this paper.

Benches in the quarry mine are 6 - 8 m high. The height is conditioned by the structural-tectonic characteristics of the massif, and the technical characteristics of the machinery used during excavation. The height (1/2H) is also in favor of the dimensions of the final product - commercial blocks of 3,0 x 1,3 x 1,7 m in size.

2.1 Drilling

Depending of working trench, characteristics of marble zones which must to blasted and the face for frontal excavation have been done, horizontal and vertical holes are drilled. Vertical drill holes are drilled at a distance of 1,0 to 3,0cm depending on the characteristics of the block, diameter for drilling, the manner of initiation and method of blasting.

Drill holes are drilled in the footwall at a zero angle of drilling (horizontal). The first horizontal drill hole should be spaced in the middle between the first and second vertical frontal drill hole. This pattern is done in

order to eliminate possible overlapping of strikes of vertical and horizontal holes that may result in concentration of blasting material (explosive, detonating fuse and black powder) and excessive damage of the block. The drill holes – horizontal are shown in fig. 1.

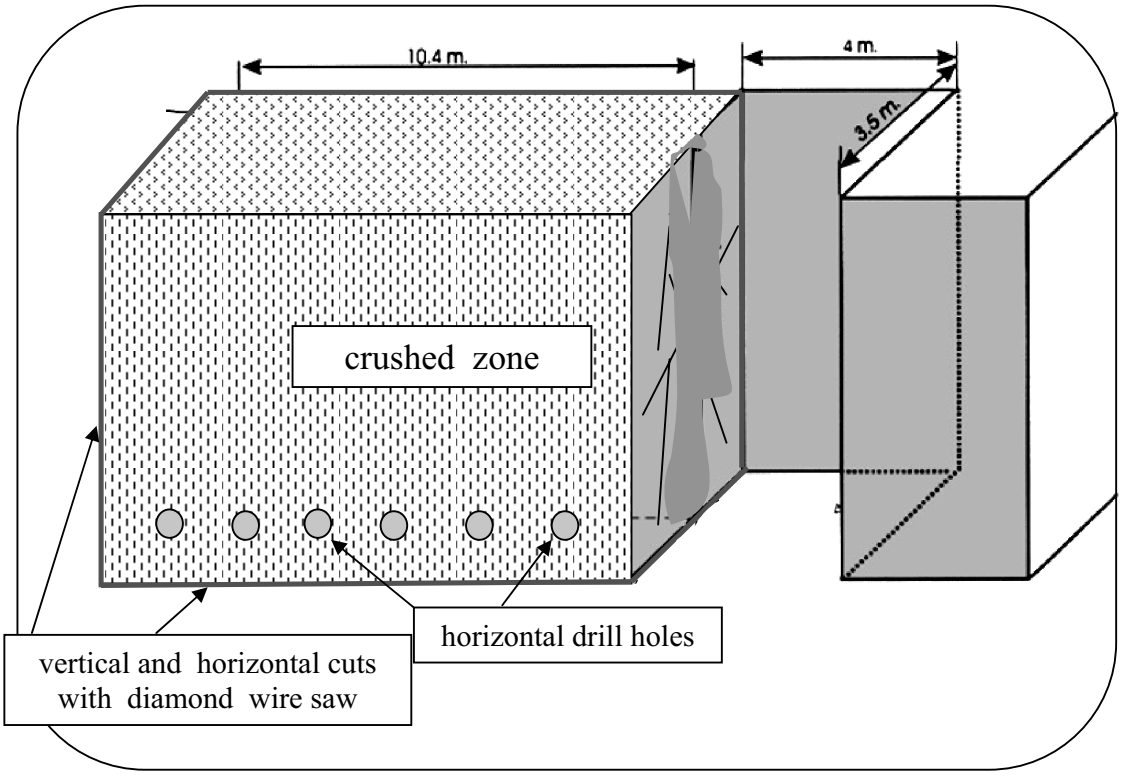

Fig. 1. Horizontal drill holes with location of crushed zones

2.2 Blasting

Blasting operation or technical broken of the hard rock mass requires the use of such blasting material that will provide minimum damages of the around quality rock mass.

At the same time it should split – blast (rib - contour splitting) along the length of the vertical and horizontal cuts.

In that regard, explosives used are as follows:

- Powder ammonium nitrate explosive (Amonex-4, Detonit) with cartridge diameter of 32 or 60 mm
- Detonation fuse class C – 12, Detonating cap No. 8, Nonel detonators and connectors.

By applying the system to initiate **Nonel** significantly reduce detonating pressure and seismic effects on the surrounding rocky massif. With its application might initiate a series of millisecond intervals different and individually for each drill hole or in groups of two or more.

Thus reducing the effect of simultaneously large amounts of explosives.

In order for the removal of broken marble tables and substandard masses from active working area - floor derived from a growing number of mining by applying Nonel system and initiate appropriate type of explosives.

2.2.1 Blasting of trial series

This blasting is with 6 horizontal drill holes height of 1 meter of horizontal surface with a length of 3 meters. They are arranged in a row and the distance between them was 2,0 m.

The diameter of the drilling is ф90mm. Presentation of blast series is given in Figure 2. Blasting explosives used is Amonex-4, labeled 60/1000, with a diameter of 60 mm cartridge and a cartridge weight of 1000g. The amount of explosive is given in Table 1.

Tab. 1

Number of drill holes	Length of drill holes, L_b (m)	Amount of explosive , Q_b (kg)
1	3,o	2,8
2	3,o	3,8
3	3,o	3,8
4	3,o	3,7
5	3,o	3,7
6	3,o	3,7

The specific consumption of explosive amounts: q = Q / V = 21,5 / 352 = 0,06 kg/m^3
The construction of charging explosive, position of nonel detonator and connectors are given in Figure 2. Scheme of connection initiation sequence is also shown in the fig 2.
Initiating of nonel sistem is with Det. Cap. No. 8 and fuse.

The initiation was a terminal initiating the activation of two drill holes using various nonel connectors including: connector SL - zero (0ms), 2 - SL17, 2 - SL25 and one (1) SL42.

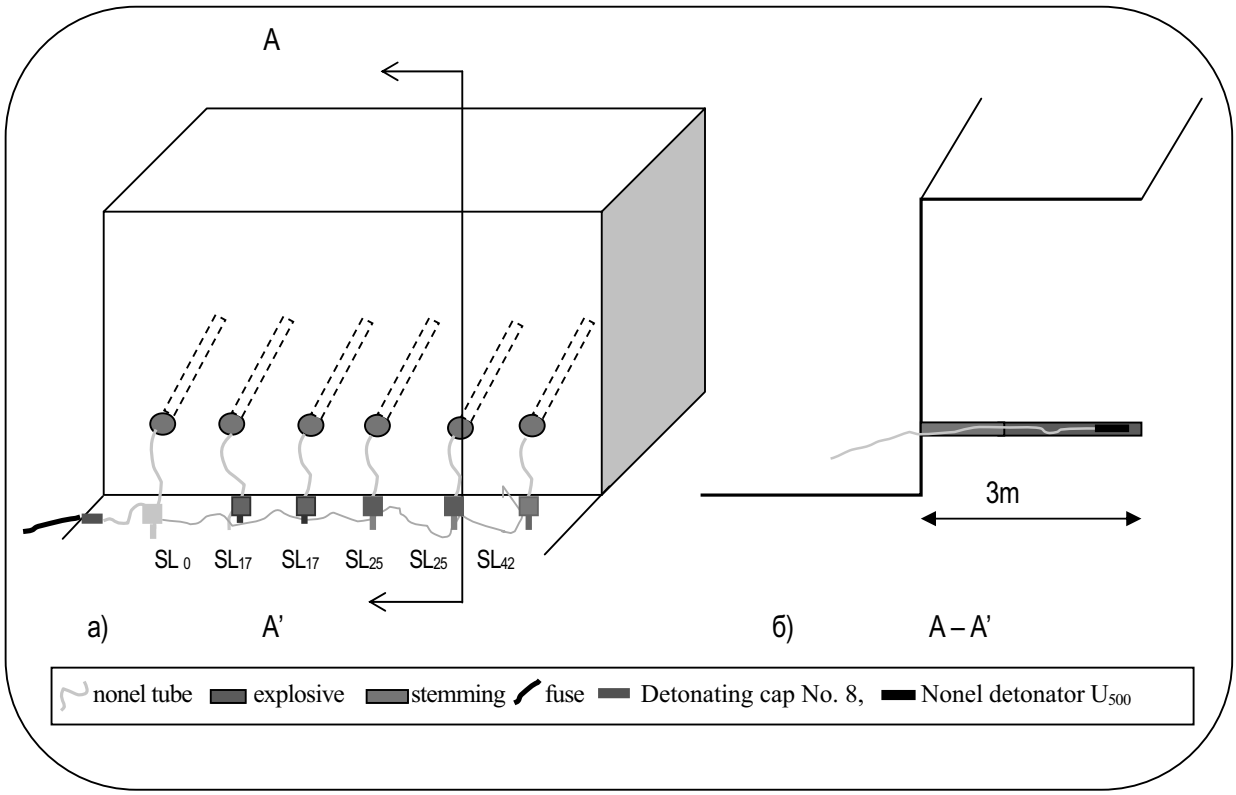

Fig. 2 Scheme of connection initiation sequence

2.3 Analysis of the obtained results and effects

Taking into account the results derived from mining and analysis of the effects can be given the following conclusions:

Drilling can be performed using the combined horizontal and vertical drill holes with proper layout and geometry for proper layout of explosive charge. This will reduce the % of getting large blocks unsuitable for loading, increase the capacity of the machines for loading and transport stress in their work, better granulation of mined material for further use or transport.

Blasting should be done by applying the appropriate explosives according to the diameter drilling (ф60 or ф70). Use the type of explosives (AMONEKS - 4) which corresponds to the working environment and has no effect on changing the physical - mechanical characteristics of marble massive. This explosive are with small density (1,0 g/cm ^{3}) and the detonation velosity is relatively low about 3200m/s with good gas volume production or release more than 1004 l/kg. Using the inappropriate types of explosives causing increased consumption, insecurity and worker health and safety, greater impact on the surrounding mass and uncertain application in transport, handling and initiation.

Initiation of NONEL. In terms of initiation according to the values obtained from measuring points can be concluded that the application of NONEL - initiating systems completely or greatly reduce seismic effects and sound effects for the environment and also reduced the speed oscillations of the particles in massive range which is extremely important for this quarry mine and get quality marble plate and blocks.

3.0 CONCLUSION

In this paper was analyzed and displayed only one major operation in carrying out technological processes used for obtaining the marble blocks.

Technologies and methods for blasting for economical and high effective production of the final product into quarry with surface exploitations is very important.

It is very important during projecting of mine for exploitation of dimension stone to determine parameters of drilling, blasting, machines and technologies which may be used for final definition which technology is going to be used.

During the process of deciding which technology is going to be used, there is appropriate usage of some experimental blasting series for defining the proper method of doing a drilling – blasting work. The choice of technology and methodology for stone blocks and reduce their costs and optimizing them has always posed a major problem.

4.0 REFERENCES

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