

NEW EFFECTIVE AND ECOLOGICALLY FRIENDLY TECHNOLOGY FOR DEMOLITION OF BLAST DEMOLITION OF EXCISE DIMENSION ROCKY PIECES WITH CUMULATIVE ACTION CHARGES

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SUMMARY

As a result of the work performed under a US AID—Ecolinks sponsored project, developed was a new technical process for Blast demolition of excise dimension rocky pieces with cumulative action blast charges for the condition Skakavitsa Rock Quarry, State Bulgarian Railroad Company. At the previously used technology the fragmentation of the excise dimension rocky pieces was achieved through utilization of open charges with various weight placed above the rocks. The simultaneous detonation of several rocky pieces was accomplished through Detonation cords, which led to large expense of explosives, large quantity of flying rocks and substantive air blast. The developed new technology included:

1. Introduction of the newly developed charge construction for demolition of excise dimension rock pieces
2. Classification of the oversize rock in four types by the location of the primary flat surface for the purpose of achieving a more effective placement of the charge.
3. Development of a new scheme of charge initiation, according to rock's size and location;
4. Proposing a change in the blasting agent and its packaging.

The following targeted objectives were reached through the implementation of the new technology for secondary blasting operations:

- Reducing the quantity and cost of explosives for demolition of a 1m³ rock piece by over 50% ;
- Decreasing, by over 50%, the toxic gas emissions resulting from demolition of oversize rock;
- Eliminating flying rock and largely minimizing the air blast in the blasting field;
- Over 25% reduction in the costs of the secondary blasting operations

All this measures contribute to more ecologically friendly and effective demolition of excise dimension rocks.

The new technology was developed under contract with Ecolinks, initiative of the US Agency for International Development, conducting assistance for quarry Skakavitsa, the Bulgarian State Railroad Company. This technology could be successfully used for varied conditions in extraction of inert materials.

The goals and main objectives of the developed technology were:

1. Reduction the relative cost of explosives for demolition of 1m excise dimension rocky piece with over 50 % -- from 2-3 kg/m³ to 1-1,3 kg/m³;
2. Decrease of over 50 % the toxic gas emissions resulting form demolition of excise dimension rocky pieces;
3. Elimination of flyrocks and substantial reduction of the shock wave at demolition of excise rocky pieces in the blasting field;
4. Over 25 % reduction in the cost of secondary blasting operations.

These main objectives are achieved through the implementation of the following technological solutions, part of the new technology:

1. Classification of the resultant excise dimension rocks and their organization in four major groups, based on rock's volume. The excise dimension rocky pieces are compactly built

up of sand, small to medium grains, and on rare occasions coarse. Their weight is between 2,2 and 2,5t/m^{3m} and have Protodiakonov coefficient for firmness of 6 to 8.

The characterizing proportions of the excise dimensions rocky pieces are given in Table 1.

Table 1 The characterizing proportions of the excise dimensions rocky pieces

No	Length,m	Width,m	Height,m	Volume,m ³
1	1.5	1.2	1	1.5-1.8
2	1.5	1.2	1.2	1.9-2.2
3	1.5	1.5	1.2	2.2-2.7
4	2	1.5	1.2	3-3.6
5	2	1.5	1.5	3.8-4.5
6	2	2	1.5	5-6
7	2.5	2	2	8.8-10
8	3	2	2	10.5-12

2. Classification of the excise dimension rocky pieces by the location of the primary flat surface for the purpose of achieving more effective placement of the charge.

3. Introducing new charge construction for demolition of excise dimension rocky pieces. The charges are prepared with cumulative gaps at Skakavitsa quarry.

4. Achieving blasting of a group of excise dimension rocks based on their size and location through the use of a new process of charge initiation with a millisecond delay.
5. Deployment of more suitable from ecological and effective standpoint cartridge emulsion-type explosive with brand name Lazarit, chosen after extensive testing and examination at the Minenergo Ltd. testing center. Determined was that this explosive emits fewer toxic gases in the environment, fragments the excise dimension rock pieces more efficiently, and has a relatively low market price compared to other available explosives.
6. Use of stemming over blast charges aiming at reduction of toxic emissions and attaining of better rock fragmentation.

The charges are prepared at the field from the cartridge emulsion type explosive Lazarit and explosive type Amonit 6, as in the contact area between the charge and the rocky piece is formed cumulative gap through placing a V-shaped thin laminated iron sheet with size of 0,35 to 0,5mm.

Figure 1 below shows a prepared charge for Secondary Blasting operations.

Table 2 Blasting Parameters, types and modifications of the CHARGES WITH CUMULATIVE ACTION

Charge №	Modification	Charge mass, kg	Charge length, mm	No of explosive, cartridges	No of cartridge lines	No of blasting caps ЕДМР-25	Volume of oversize rock, m ³	Size of stemming, dm ³
1	I	2	240	5	1	1	до1	15
2	I	2,2	240	11	2	2	1,5-2,2	30
	II	4,4	460	22	2	2	2,5-4,5	60
3	I	3	240	15	2	2	2-3	40
	II	6	480	30	2	2	4-6	80
	III	9	480	45	2+1	2	6-9	150
4	I	4,8	240	24	3	2	3,6-4,8	70
	II	9,6	480	48	3	2-4	7,5-9,5	120
	III	10	480	50	3+1	2-4	8,5-10	150

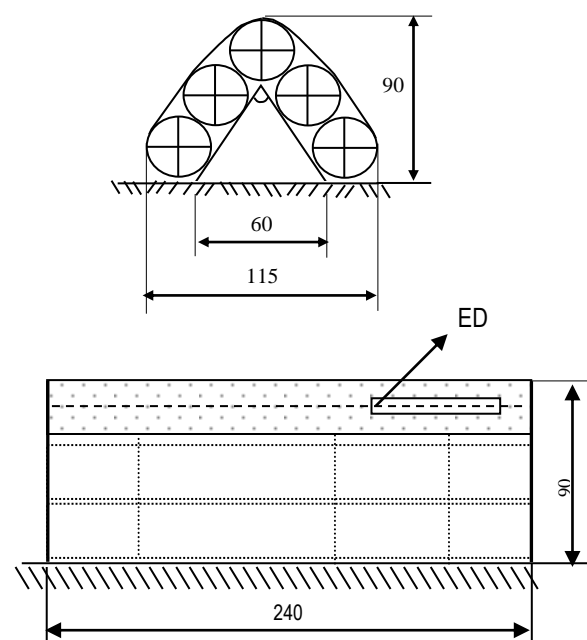


Figure 2.1. Charge type 1, Modification 1

The principal charge construction corresponding to the four groups of excise dimension rocky pieces are presented in the

Table 2 gives the charge parameters according to the size and location of the excise dimensions rocky pieces.

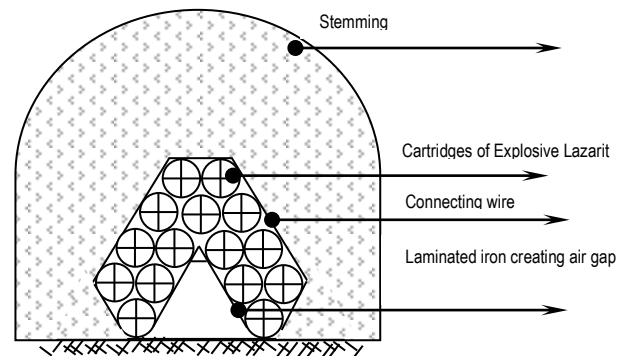


Figure 1. New charge construction for secondary blasting

documentation of the developed and approved technological process.

For fragmentation of the excise dimension rocky pieces at quarry Skakavitsa are applied four types charges prepared according to the size of the V-shaped profile, the number of the cartridges and the number of the lines of the explosive cartridges placed on the profile. The four types charge constructions corresponding to the four groups of rocky pieces described in Table 2 are shown in Figure 2.

Charge №1 is prepared of five 200 g- cartridge explosive evenly placed on the V-shaped laminated iron sheet, representing an equilateral triangle with length of the side 60 mm. This charge construction is designed for small rocky pieces (up to 1 m³) and demolition of peaks. The length of the charge is 240mm.

Charge № 2 is constructed of 2 lines 200g cartridge explosive placed evenly on the V-shaped profile as in charge № 1. This charge is designed for rocky pieces with volume 2-4 m³. There are two modifications based on the length of the charge -- 240 and 480 mm applied for 2,4 и 4,4 kg sized rocks respectively.

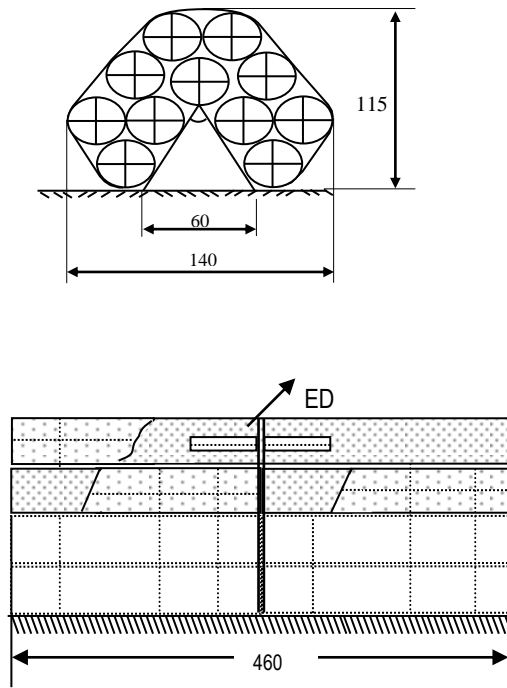


Figure 2.2.. Charge type 2, Modification II

Charge № 3 is composed of two lines explosives with the charge of the cartridge 200g placed on the sides of the triangle of the V-shaped laminated iron with length of the sides 90 mm. This charge type is used with excise dimension rocky pieces with volume from 2 to 9 m³. Developed are three modification of this charge type for lengths of 240, 480 and 480 and respective mass of 3 to 9 kg.

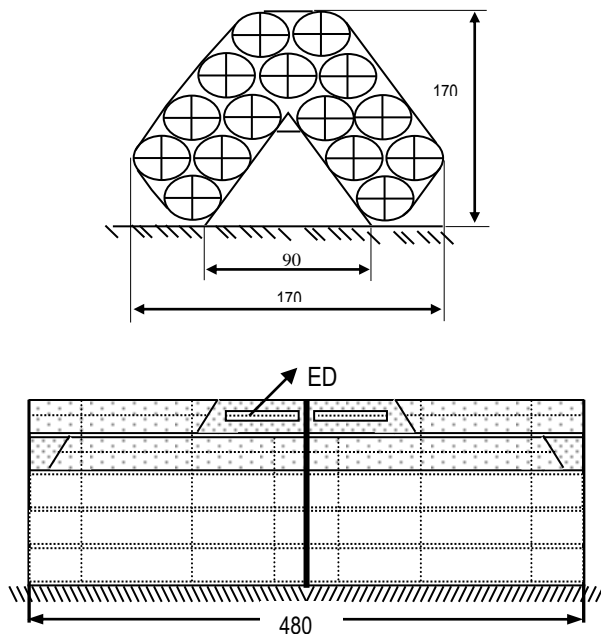


Figure 2.3. Charge type 3, Modification II

Charge № 4 represents three lines of cartridge explosive arranged on the V-shaped laminated iron profile. Developed are three modifications with the length of the charge as follows: 240 mm - 4,8 kg; 480 mm - 9,6 kg; 480 mm - 10kg. The charge is used for the fragmentation and partial demolition of relatively large sized rocky pieces in the range of 4 - 10m³.

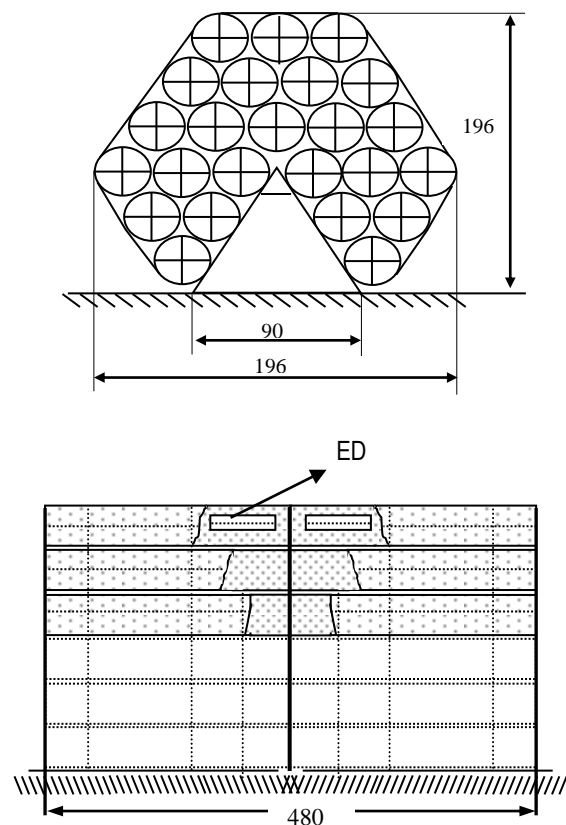


Figure 2.4. Charge type 4, Modification II

The preparation of the charges is conducted on the blasting field by two technologies:

- Technology 1. The charge is assembled from wrapped cartridges of explosive – five or seven, depending on the type of the charge to be used. The cartridges are strapped up with recycled wires of electric detonators. The advantages of this technology include: ensuring absolute compactness of the charge, rapid assembly of the charge at place of application, and its suitability for steep, vertical terrains. Disadvantage of the technology is the relatively large extensive preliminary preparation.
- Technology 2. The charge is constructed above the excise rocky piece as the stemming is applied simultaneously. Advantages of this technology are the firm securing of the charge to the object to be detonated and the fewer preliminary preparations. The technology, however, requires extra attention and skill for the preparation of the charge. Another disadvantage is that this technology is not applicable at steep and vertical terrains.

Figure 3 presents scheme for situating of the prepared cumulative charge on rocky piece with applied stemming.

The implementation of the newly developed technology for Blast demolition of excise dimension rocky pieces with cumulative action blast charges achieved the main objectives of more effective and ecologically friendly secondary blasting operation at quarry Skakavitsa.

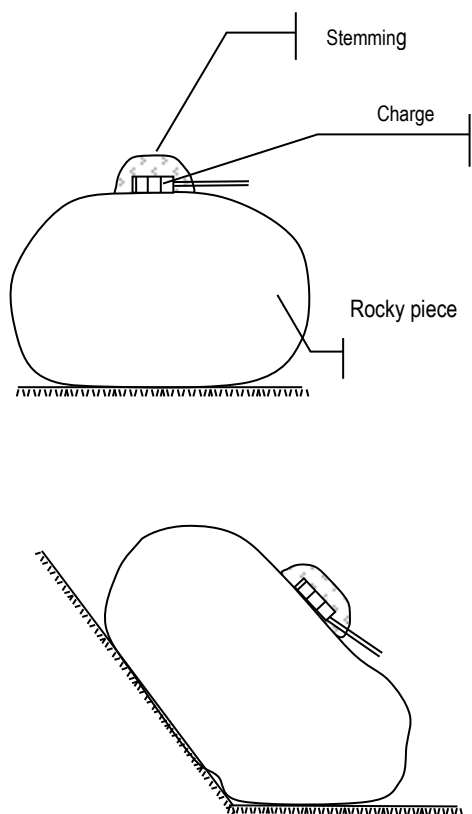


Figure 3. Placement of charges over rocky pieces

The developed and implemented at quarry Skakavitsa new technology for demolition of excess dimension rocky pieces, utilizing charges with cumulative action lead to the following conclusions:

1. The developed technology is practical, feasible and allows the preparation of the cumulative charges at the location of their usage.
2. The new technology achieves:
 - Reducing the quantity and cost of explosives for demolition of a 1m³ rock piece by over 50% ;
 - Decreasing, by over 50%, the toxic gas emissions resulting from demolition of oversize rock;
 - Substantially reducing the flyrock in the blasting field ;
 - Significantly minimizing the air blast and sound at secondary blasting operations;
 - Simultaneous demolition of many rocky pieces with the application of the electrical scheme of millisecond delay.

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